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**AN EXPLORATION OF
THE PRE-DEVELOPMENT PHASE OF
NEW PRODUCT DEVELOPMENT
IN NEW ZEALAND MANUFACTURING SMALL
AND MEDIUM ENTERPRISES**

**A thesis presented in partial fulfilment of the requirements
for the degree of Master of Engineering in Product Development
at Massey University, Auckland, New Zealand.**

**WARREN ARTHUR BAIER
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Abstract

Developing successful new products in New Zealand Small and Medium Enterprises (SMEs) is difficult due to several factors. These include greater expectations, new technology, reduced product lifecycles, high project failure rates, and the pressures from competition. This presents a significant challenge for a product development team as it leaves companies searching for opportunities to gain an advantage in the market place.

The low level of research performed in relation to SMEs over the past number of years, especially in the field of New Product Development (NPD), has resulted in an increase in interest by practitioners and academics.

This research was aimed at exploring the pre-development phase currently employed by SMEs within the New Zealand manufacturing industry. The purpose was to gauge the understanding and importance of this early stage in NPD amongst practitioners from these SMEs, as the literature highlighted this as an area of weakness requiring empirical research. Specifically, the objectives set for this research investigation were to survey manufacturing SMEs in New Zealand, compare the findings with past and current research on a national and international level, and make conclusions in relation to:

- The nature and complexity of the pre-development activities performed by New Zealand manufacturing SMEs.
- The difficulties and/or limitations New Zealand manufacturing SMEs encounter whilst implementing the pre-development activities.
- The importance of and attitude towards the pre-development phase with regards to the overall NPD process and the company's product development efforts.

The study consisted of a questionnaire survey, run during June and July 2007 with twenty-two SMEs representing the light engineering/manufacturing, electronics, and food industry sectors. The questionnaire survey was followed up with one-on-one interviews with some of the participating companies allowing for both quantitative and qualitative data to be obtained.

The research investigation found that the difficulties in carrying out the five pre-development activities studied were common, compounded by the lack of skills in-house to do so. Of the five pre-development activities studied, the preliminary technical analysis was found to be given the most attention by the companies with regard to overall project time, with lesser emphasis placed on the other four activities. Many of the companies developed 'new to the world' products or entered new markets with existing products where they primarily took part in the business-to-business market. Good relationships existed between the manufacturing SMEs and their suppliers, distributors and customers.

Management were found to have a high level of involvement in product planning, as they tend to be involved in key decision making in NPD in SMEs. Many of the companies had difficulty when it came to identifying opportunities and customer needs, with the addition of numerous barriers limiting the implementation of NPD. The greatest difficulties arose during the practical implementation of tools and techniques due to several challenges, such as limited budgets, lack of time and resources as well as incompatibility within the existing company culture.

Clearly, the pre-development phase is the basis for the remainder of the NPD process with essential development decisions being made here. This phase is therefore crucial in determining the likely outcome of NPD projects. The research findings suggested that greater consideration and effort should be placed on the pre-development phase, even more so with the cost increasing exponentially when mistakes are made later in development. The study highlighted the need to improve the tools and techniques available for use during the pre-development phase, as companies are aware of its importance but find it the most difficult to undertake. High new product failure rates; over-expenditure of project time; lack of awareness, commitment, and formality; and the high level of difficulty experienced by the New Zealand SMEs studied, suggests there is a need for the implementation of better tools and techniques during the pre-development phase to aid successful NPD in New Zealand manufacturing SMEs.

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Publications

A research paper, co-authored by Dr. Aruna Shekar, based on this research study was submitted and accepted into the Industrial Engineering and Engineering Management (IEEM) 2008 Conference held in Singapore during the month of December, 2008. The paper will be presented at the Conference as well as being publicised in the Conference proceedings. A copy of this research paper is included in Appendix I.

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Definitions

Pre-development Phase, Front End (FE), Pre-phase 0, Pre-project Activities: “The messy ‘getting started’ period of product development. Preceding the more formal product development process, it generally consists of three tasks: strategic planning, concept generation, and, especially, pre-technical evaluation. These activities are often chaotic, unpredictable, and unstructured. In comparison, the subsequent new product development process is typically structured, predictable, and formal, with prescribed sets of activities, questions to be answered, and decisions to be made” (Belliveau et al., 2002, p.444).

New Product Development (NPD), Product Development (PD): “The overall process of strategy, organization, concept generation, product and marketing plan creation and evaluation, and commercialization of a new product. Also frequently referred to just as ‘product development’” (Belliveau et al., 2002, p. 450).

Small and Medium size Enterprise (SME): There is no official definition of an SME in New Zealand. However, according to Organization for Economic Co-operation and Development (*The OECD small and medium enterprise outlook*, 2000) they are considered to:

- Involve personal ownership and management
- Have few or no specialist managerial staff
- Be no part of a large business enterprise

In addition to the above, Cameron and Massey (1999) and the Ministry of Economic Development (2007) define a SME as an enterprise employing between zero and 99 employees whereas of February 2006, SMEs made up 99.4 percent of New Zealand enterprises (*SMEs in New Zealand: structure and dynamics*, 2007).

New Zealand Manufacturing Industry: Companies within the New Zealand manufacturing and production industry have been defined by Statistics New Zealand (2007) as: those producing “goods from raw materials or assembles products from components. It supplies the domestic and international markets and some specialist niche markets”.

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Chapter 1: Introduction

1.1. Introduction

Products and services are crucial to the success of almost all enterprises (Cooper & Kleinschmidt, 1987; Patrick, 1997). The need for new products is driven by change in technology, increase in competition, changing customer needs and decreasing product lifecycles (Rosenau, Griffin, Castellion, & Anschuetz, 1996). On the other hand, the activity of NPD is still considered to be “one of the riskiest yet most important management challenges” (Cooper & Kleinschmidt, 1987, p. 182; Diegel, 2004; Khurana & Rosenthal, 1998; Kim & Wilemon, 2002; Koen et al., 2001) as the ability to meet customer expectations is often considered to be the most essential of all business activities (Barclay, Dann, & Holroyd, 2000; Kerr, 1994).

An increase in difficulties and uncertainties associated with NPD are becoming more and more frequent due to the resulting pressure placed on developing more new products, especially at a greater rate than in the past. To succeed, companies are finding that they need to develop new or improved products consistently and at a faster rate. However, most companies tend to experience difficulties early on in the development process, with most projects failing just after they began due to the high failure rates that have become extremely common in NPD today (Barclay et al., 2000; Cooper, 1988; Zhang & Doll, 2001).

There has been a rapid increase in the use of NPD tools, techniques, and processes since the early nineties by companies relying on their innovativeness (Davidson, Clamen, & Karol, 1999) or those companies searching for competitive advantages, often in the form of a shorter NPD process (Zhang & Doll, 2001). Past research regarding NPD found that the most successful companies, mainly from the United States of America and the United Kingdom, were those that used a recognised, formal, and clearly defined development process (Diegel, 2004; Gawith et al., 2007; Kahn, Barczak, & Moss, 2006), however, there is still the concern of the large amount of time wasted as it is not uncommon for one third of a company’s total development efforts to consist of unnecessary changes in the project (Herstatt, 2000). The best opportunity, at minimal effort, for improving the NPD process as well as providing the greatest potential for a product or service to succeed is said to be through

improving the performance of the activities undertaken during the pre-development phase (Herstatt, 2000; Khurana & Rosenthal, 1998).

The pre-development phase begins with idea screening and ends when the idea has been accepted to progress through the remainder of the development process (Herstatt, 2000). This period of a project can often consume large quantities of time long before development has begun (Smith & Reinertsen, 1998) with the project team generally oblivious to this happening. The performance and the decisions made during the pre-development phase play a significant role in determining the overall outcome of a project (Cooper & Kleinschmidt, 1987; Kim & Wilemon, 2002; Smith & Reinertsen, 1998). The majority of companies, however, do not follow or use most product development processes and if they do vital stages tend to be left out or they focus on the development and commercialisation stages due to the vast amount of management tools and techniques available for guidance (Boeddrich, 2004; Ho, 2001; Kerr, 1994; Koen et al., 2001).

New Zealand has an established reputation for being an innovative country and a higher percentage of SMEs than most countries (Gawith et al., 2007; *SMEs in New Zealand: structure and dynamics*, 2007). SMEs form the majority of companies in OECD (Organization for Economic Cooperation and Development) economies however there is no definition used globally to describe a SME (*The OECD small and medium enterprise outlook*, 2000) although they are often defined using an employee number measure (Devlin, 1984; *The OECD small and medium enterprise outlook*, 2000). SMEs generally lack the experience, knowledge, and managerial skills often associated with larger companies and are often referred to as being the source of most new jobs, generate a substantial share of GDP, are locally based, have a greater dependence on their external environment, make a crucial contribution to innovative activity and technological changes, often influenced by what happens in their local community and resemble similar characteristics to that of the owner (Allocca & Kessler, 2006; Karlsson & Olsson, 1998; *The OECD small and medium enterprise outlook*, 2000).

Despite the extensive body of knowledge and wide acceptance of the NPD, generally associated with large companies, there still remains a lack of research and knowledge

regarding the pre-development phase both nationally and internationally, therefore creating an area of weakness.

1.2. Research Objectives and Questions

The literature highlighted the pre-development phase of New Zealand businesses as an area of weakness therefore requiring empirical research. The aim of the research was to gauge the understanding and importance of this early stage amongst practitioners in New Zealand manufacturing SMEs.

It was set out to survey New Zealand SMEs currently involved in the manufacturing industry to gather information on their NPD pre-development activities, compare the findings with past and current national and international research (where appropriate), make conclusions with regards to the research questions, and make relevant recommendations for improving the pre-development efforts of these SMEs.

The research investigation was driven by the following three research questions which were based on the literature and were used to pursue the aims and objectives for the research study:

- Q₁: What is the nature and complexity of the pre-development activities performed by New Zealand manufacturing SMEs?**

- Q₂: What are the difficulties and/or limitations New Zealand manufacturing SMEs have during the implementation of the pre-development activities?**

- Q₃: What is the importance of and attitude towards the pre-development phase with regards to the overall NPD process and the enterprise's product development efforts?**

1.3. Research Limitations

This research investigation had certain limitations as found with most research based studies. These limitations have been listed below:

- The research focuses on the pre-development phase of the NPD process within New Zealand manufacturing SMEs from both the North and South Islands allowing for a nationwide representation of the industry sector. Therefore it will not study how the products are developed, produced or commercialised, instead it investigates the understanding, importance, and execution of the activities that make up the pre-development phase.
- Constraints, such as time and costs, prevented the author's ability to establish a relationship with the participating enterprises as well as limiting the options for conducting the research.
- The data collected was mainly used in summary form as the responses received were often the opinion of an individual rather than the from the company's perspective. Thus the results may not completely represent the findings that may have been achieved as a result of a larger response rate and/or if the questionnaire was completed from the company's point of view.
- There was the possibility of exaggerated answers being provided by participants. Research by Kruger and Dunning (1999) titled "Unskilled and Unaware of It: How Difficulties in Recognizing One's Own Incompetence Lead to Inflated Self-Assessments" found that "the incompetent will tend to grossly overestimate their skills and abilities" (p. 1122). Additionally, some respondents may have been aware of and/or knowledgeable about NPD and the key topics relating to this research which may have given them a greater understanding on the subject being investigated and therefore having the opportunity to exaggerate their answers. Whether exaggerated answers were or were not given is unknown where trying to identify such answers fell outside the scope of this research.

1.4. Expected Outcomes

The following list of expected outcomes was considered to be applicable to this research study based on the review of literature and knowledge gained as a result of experience in the New Zealand manufacturing industry:

- Low levels of project planning and the use of NPD tools and techniques.
- Condensed and informal product development processes missing many vital stages.
- Moderately low performance of the NPD activities especially during the early stages of development.
- Low levels of knowledge, awareness, guidance, and attention given to pre-development activities by SMEs.
- Minimal resources; such as staff, time, and finances; devoted to pre-development activities.
- Varying levels of communication between departments are likely to exist with relatively high levels of interaction and communication associated with the smaller sized companies (possibly all New Zealand SMEs).

1.5. Thesis Structure

- **Chapter 1** introduces the research project.
- **Chapter 2** discusses and reports on the literature studied on new product development, the pre-development phase, and SMEs in New Zealand and overseas with regards to the research topic.
- In **Chapter 3** an explanation of the methodology and techniques used in the research investigation conducted for this thesis are given.
- **Chapter 4** analyses and discusses the results from the questionnaire survey and interview sessions. Comparisons with past research (from New Zealand as well as internationally) and literature are made where applicable.
- **Chapter 5** makes conclusions of the research and provides recommendations for New Zealand SMEs in the manufacturing industry.

Chapter 2: Literature Review

2.1. Review of New Product Development

Management, integration, speed and flexibility have become a must and the focus of attention for those companies involved in the development of new products or services for what has now turned into a dynamic and competitive marketplace (Millson, Raj, & Wilemon, 1992; Takeuchi & Nonaka, 1986; Veryzer & Mozota, 2005). The economic success for most companies depends on their ability to identify customer requirements and to quickly produce products at a low cost that meet these requirements to maintain a competitive edge (Filson & Lewis, 2000; Ulrich & Eppinger, 1995).

Achieving this requires significant input from a multidisciplinary team consisting of individuals from each functional area (such as engineering, research and development, marketing, production, and management) of a company (Ulrich & Eppinger, 1995). The NPD process, however, provides a form of controlling and managing NPD where in recent times there have been signs of rapid increase in the use of NPD tools, techniques and processes (Davidson et al., 1999; Kerr, 1994; Mossing, 2008; Ulrich & Eppinger, 1995).

2.1.1. New Product Development Defined

The development and commercialisation of products has been successfully achieved on a global-scale for decades with and without the use of a product development process (Campbell, 1999; Cooper & Kleinschmidt, 1987; Patrick, 1997). However, the development of successful products is difficult with the level of difficulty increasing when consistent performance is required between projects (Barclay et al., 2000). Using a formal approach for controlling and managing this daunting challenge of NPD often results in an increase in the likelihood of the product being a success as well as vital competitive advantage (Barclay et al., 2000; Campbell, 1999).

The processes used in industry often differ to that described in literature, however, the definition of NPD and the process involved given by the Product Development and Management Association (PDMA) is as follows:

New Product Development (NPD): “The overall process of strategy, organization, concept generation, product and marketing plan creation and

evaluation, and commercialization of a new product. Also frequently referred to just as ‘product development’” (Belliveau et al., 2002, p. 450).

New Product Development Process (NPD Process): “A disciplined and defined set of tasks and steps that describe the normal means by which a company repetitively converts embryonic ideas into salable products or services” (Belliveau et al., 2002, p. 450).

2.1.2. The Process of New Product Development

The earliest process models used for undertaking NPD were generally technology-driven, where during the 1960’s this was questioned and changed to have a greater focus placed on the customer (Abd Rahaman & Muhamad, 2004). Around the same period Booz-Allen and Hamilton conducted what is now regarded as the first investigation into product development, resulting in what is said to be the first product development process model which was based on formally documented process models used by the successful participating companies (as cited in Campbell, 1999; as cited in Kerr, 1994).

The NPD process consists of a sequence of phases, steps, activities, and reviews whereby “many of these steps and activities are intellectual and organizational rather than physical” (Rainey, 2005; Ulrich & Eppinger, 1995, p. 14). The process begins at the idea stage, moves through a number of steps, and ends at the commercialisation stage often requiring each department for varying durations throughout the project, offering both qualitative and quantitative techniques for this structured approach to NPD (Cooper, 1988; Ho, 2001; Millson et al., 1992; Ulrich & Eppinger, 1995). As progress is made, information changes as it is interpreted and used in different ways by each of the departments involved during the development process (Maylor, 2002; Zhang & Doll, 2001).

The general idea behind the NPD process stays the same whereas the models may and generally do change, although the traditional and most commonly used NPD process models are said to be inefficient, slow paced, and at times ineffective (Rainey, 2005). Alternatively, organising NPD into a process that can run concurrently rather than sequentially can lead to preventing rework as well as reduced project times and costs

with teams sharing knowledge and information, in effect, creating a shared knowledge base (Maylor, 2002; Zhang & Doll, 2001). Generally, relationships amongst departments are often complicated and as a result often affect the project outcome (Maylor, 2002). Communication between departments is a must as it allows for the transfer of project and product information as well as being crucial to increasing the opportunity for the launch of a successful product (Griffin & Hauser, 1992; Ho, 2001).

The generic product development process, as shown by the example in Figure 2-1, can be broken into three main stages (Koen et al., 2001):

- The 'Pre-development phase' (sometimes referred to as: 'Fuzzy Front End', 'Front End', 'Pre-phase 0', and 'Pre-project Activities').
- The 'Product Development' stage.
- Commercialisation stage.

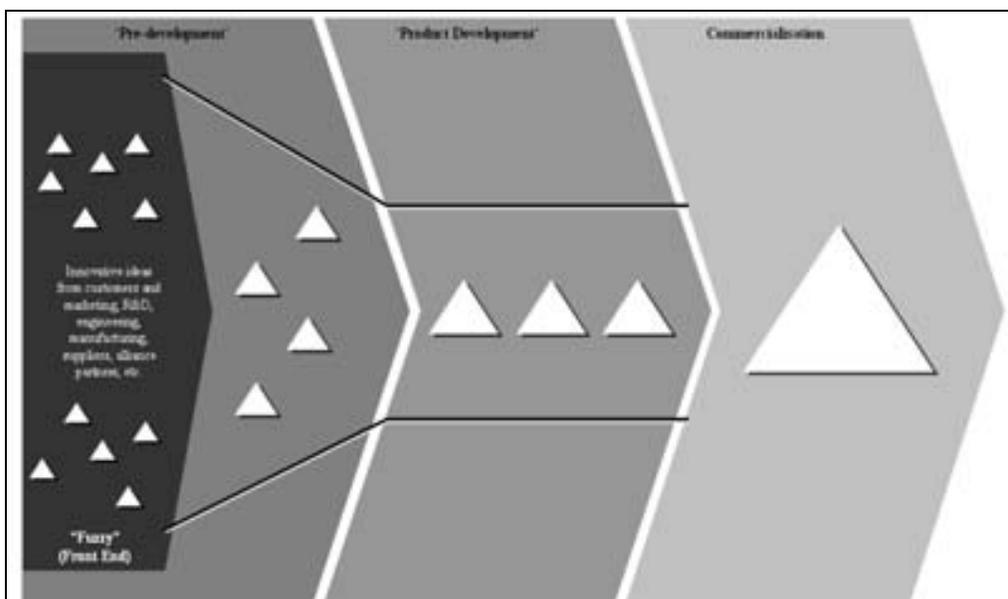


FIGURE 2-1: Example of a generic product development process (Belliveau et al., 2002).

As time has progressed there have been numerous changes in the approaches taken for implementing NPD. Some companies make use of a structured and formal NPD process where others are completely oblivious to the process which they employ (Ulrich & Eppinger, 1995). Whereas Diegel (2004) commented on it being of greater importance for those involved in NPD to be reasonably knowledgeable on the subject, allowing for the ability to choose and implement only the stages, activities, methods,

tools, and techniques that apply to each individual project. Companies have been changing from the functional and sequential approaches to NPD to inter-disciplinary approaches, offering formal stages and gates for progressing through the development process, as how well the process is implemented potentially determines the project outcome with the greatest benefits obtainable during the pre-development phase (Campbell, 1999; Cooper, 1994; Cooper & Kleinschmidt, 1987).

2.1.3. The Pre-Development Phase of NPD

Companies have been left with no alternative choice than to search for new ways of improving the efficiency and shortening the time it takes to develop new products (Filson & Lewis, 2000; Zhang & Doll, 2001). Timing is crucial, being first to release a new product or service into a market before competitors and at the right time greatly increases the competitive advantage as well as the business opportunities that result (Allocca & Kessler, 2006; Campbell, 1999). However, most NPD projects fail as a result of misinterpreting the pre-development phase (Cooper, 1994; Zhang & Doll, 2001).

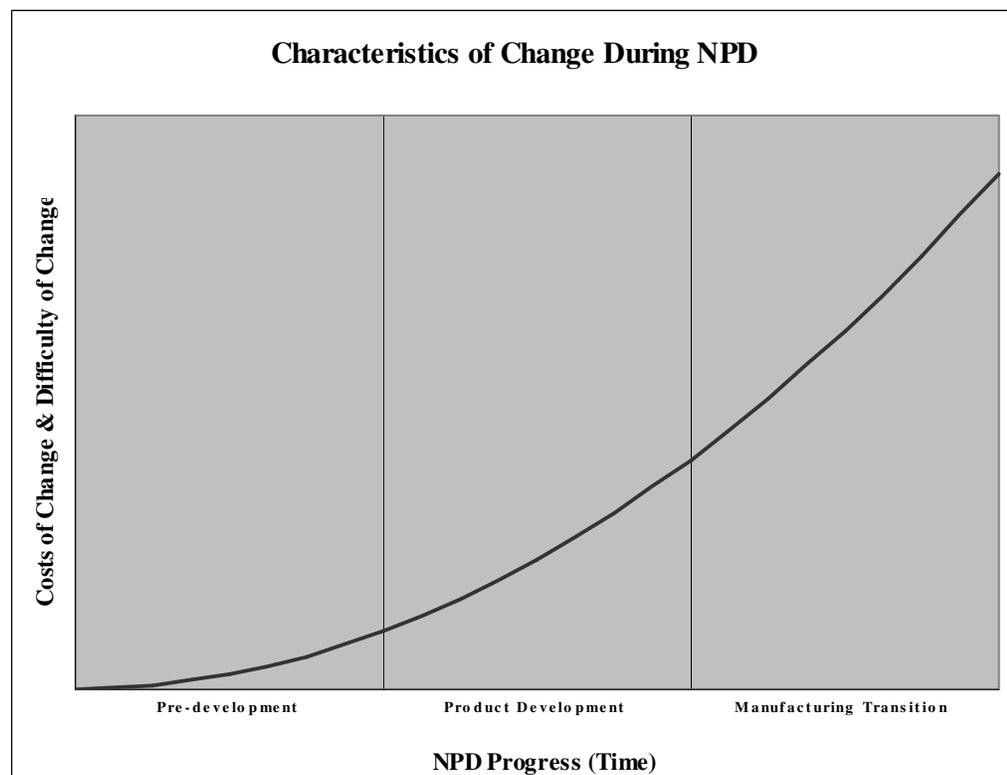


FIGURE 2-2: Characteristics of change during NPD (Herstatt, 2000; Rainey, 2005; Smith & Reinertsen, 1998).

The probability of a product succeeding in the marketplace can be greatly improved through identifying opportunities, understanding customer wants and needs, and translating these into product specifications during the pre-development phase (Belliveau, Griffin, & Somermeyer, 2004; Koen et al., 2001). Product changes tend to be made very late in the NPD process, often because of the constant process revision that is required which in turn can result in causing enormous disruptions and possible delays to the project (Maylor, 2002). In addition, the cost and difficulty of making changes increases at an exponential rate as a project progresses (see Figure 2-2), where changes made later in a project have greater potential to consume larger quantities of project time (Herstatt, 2000; Rainey, 2005; Smith & Reinertsen, 1998). Consequently the opportunity for improvement during the initial phase of the NPD process is enormous, largely due to the unpredictable nature, the low costs, and the opportunity for making changes to a project with minimal effect (Koen et al., 2001; Smith & Reinertsen, 1998).

Practitioners and academics are both well aware of the importance of the pre-development phase with regard to the success or failure of a product or service (Koen et al., 2001; van Aken, 2004). Difficulty exists during this early stage of development due to uncertainty as well as the activities so often being left out as a result of ignorance, limited resources, and the lack of tools and techniques for properly conducting and managing the stage (Boeddrich, 2004; Ho, 2001; Kerr, 1994; Koen et al., 2001). In fact, research was found stating failure rates of well over 90 percent with the greatest risks being prominent during the pre-development phase (Cooper & Kleinschmidt, 1987; Diegel, 2004; Khurana & Rosenthal, 1998; Kim & Wilemon, 2002; Koen et al., 2001). However, Khurana and Rosenthal (1998) also suggest that the front end of NPD offers the best opportunity for companies to improve the effectiveness of their NPD process.

2.1.3.1. The Front End of NPD Defined

The pre-development phase is the first of three stages containing the groups of activities that makeup the NPD process. Unlike the predictable nature and immense amounts of research, literature, techniques, and tools that exist to aid in managing the activities of the later stages of the NPD process, there has been little research

undertaken on the pre-development phase. (Boeddrich, 2004; Kim & Wilemon, 2002; Koen et al., 2001).

The pre-development phase generally consists of the following five activities: idea screening, preliminary market assessment, preliminary technical analysis, detailed market research, and business/financial analysis. Belliveau et al. (2002) have defined the pre-development phase of NPD as:

“The messy ‘getting started’ period of product development. Preceding the more formal product development process, it generally consists of three tasks: strategic planning, concept generation, and, especially, pre-technical evaluation. These activities are often chaotic, unpredictable, and unstructured.

In comparison, the subsequent new product development process is typically structured, predictable, and formal, with prescribed sets of activities, questions to be answered, and decisions to be made” (Belliveau et al., 2002, p. 444).

2.1.3.2. Pre-development Activities

At this early stage of product development is a set of activities that are undertaken prior to the formal process of product development, once an idea has been accepted for further development (Herstatt, 2000; Reinertsen, 1994). The activities require input from different departments within a company throughout the course of the NPD process, including the pre-development phase. Each of these departments have different knowledge levels and information with regards to undertaking NPD which can greatly improve project success when undertaken as a team (Zhang & Doll, 2001).

This early period of NPD is where decisions regarding the project are made and actions taken which are crucial in determining both the level of the investment and commitment made to a project, often affecting the overall outcome, but it still remains the most poorly undertaken stage out of all three NPD stages (Kim & Wilemon, 2002; Smith & Reinertsen, 1998). Proper completion of the NPD activities, especially the pre-development activities, can lead to benefiting the company in areas such as early market entry, greater competitive advantage, increasing the likelihood of product success, shorter development times, and better control over the NPD process (Kerr, 1994).

Table 2-1 contains descriptions of the five pre-development activities as well as listing the tools and techniques suggested by academics and those used by industry for the pre-development phase.

Activity	Description	Tools and Techniques
Initial screening of the idea	Where the initial go/no go decision is made with regards to the project, product and project funding. This is generally based on the screening of the ideas using different tools and techniques.	Scoring methods (criteria and weighting), group decisions, informally by an individual.
Preliminary market assessment	An initial assessment of the market place.	Analysis of the market place (competitors, market shows, market size, consumers, customers and product positioning).
Preliminary technical analysis	An initial analysis of the technical portions of the project.	This is often research based, although sometimes observation is used in some cases. Regulations, patents, company capability, drawings, and specifications are examples of what is being looked into.
Detailed market research	Detailed analysis of the market that the product is aimed at. The analysis must involve a reasonable sample, formal design and collection method.	Concept testing, conjoint analysis and a detailed study of competitors.
Business/financial analysis	Analysis of the business/financial sections of the project. This is done in most cases to check project feasibility and often leads to a go/no go decision for whether the project moves into the next stage of NPD.	Costs and sales forecasts, discounted cash flows, return-on-investment, payback period, and profit.

TABLE 2-1: Activities included in the pre-development phase (Cooper & Kleinschmidt, 1986; Ho, 2001; Kerr, 1994; Khurana & Rosenthal, 1998).

2.1.3.3. The Importance of the Pre-development Phase

Poor management of the pre-development phase, as with the remainder of the NPD process, can have significant consequences for a NPD project (Kim & Wilemon, 2002). Many business, product, and project related decisions are made during the early stage of NPD with regard to the company (Cooper, 1994; Kim & Wilemon, 2002). Incorrectly or not undertaking the set of activities that make up the pre-development phase could lead to difficulties over the duration of the project,

including: project delays, market and technology uncertainties, financial uncertainty and difficulty, and resource related issues (Kim & Wilemon, 2002). Changes made during the later stages of NPD tend to result in greater time consumption and costs although, research has found that many companies fail at achieving this (Kim & Wilemon, 2002; Maylor, 2002).

Given the information and understanding of the pre-development phase being chaotic, unpredictable, and unstructured both researchers and practitioners of NPD are beginning to recognise the weakness that exists during this early stage of NPD (Belliveau et al., 2002; Kim & Wilemon, 2002; Koen et al., 2001). Cooper (1994) found that initial screening of the idea, preliminary market assessment, preliminary technical analysis, detailed market research, and business/financial analysis were crucial to the success of NPD. These activities should be undertaken without question although this does not always occur in most cases. However, the activities are gaining increased recognition with regards to their importance to the success of NPD (Cooper, 1994). Successful completion of these five activities can drastically change the outcome of a project, as for one it will reduce the project time as inadequately defined projects entering the stages which follow the pre-development phase often encounter changing project definitions (Cooper, 1994).

Research by Cooper and Kleinschmidt (1987) found that the recognition of user requirements and technological opportunities, as well as wise business decisions and skilled NPD management, has shown signs for improving the likelihood of success. Academics and practitioners emphasise the need for more time, effort, and resources to be given to the early activities, since these activities are crucial for generating a clearly defined product definition as well as determining the outcome of the project (Cooper, 1994; Kim & Wilemon, 2002). The lack of management during these activities is so often identified as one of the main reasons leading to the difficulties commonly associated with this early period of NPD, with research revealing that having a clarified product concept and product definition early on in a project is surprisingly difficult and is where most companies fall short (Kim & Wilemon, 2002).

2.1.4. Difficulties Implementing NPD

Most literature was found to focus on the difficulties and barriers preventing enterprises from undertaking NPD and emphasising the importance of a formal and structured NPD process, rather than what is required to minimise or remove the difficulties, barriers, and risk so widely associated with NPD and the pre-development phase as well as how to undergo NPD constructively (Cooper, 1994; Ho, 2001). The causes of these difficulties so often experienced in NPD have been narrowed down to poor communication and lack of team work within project teams (Zhang & Doll, 2001).

Many researchers have reported differing levels of NPD failure. This includes research by Booz-Allen and Hamilton (as cited in Diegel, 2004) and Cooper and Kleinschmidt (1987) quoting failure rates of one in seven projects succeed commercially and two thirds succeed commercially respectively. However, a more realistic figure for products failing once commercialised have been estimated to be well over 90 percent (Patrick, 1997).

The majority of companies tend to fail at successfully performing NPD largely due to experiencing difficulties such as the lack of internal support and resources, misinterpreting customer requirements, poor project planning, limited resources, poor product definition, poor communication, market and technology uncertainty, and lacking competitive drive (as cited in Diegel, 2004; Edgett, Shipley, & Forbes, 1992). When technology and factories are in the drivers seat there is significant internal competition for any given customer, which is not good for the company nor the customer, in fact the difficulty is that the industry continues to need brilliant engineers, but they should not be inventing because of technology alone, they should be inventing with the end-user in mind (T. Giordano, personal communication, June 16, 2007).

Griffin and Hauser (1992) state, “that each function resides in its own “thoughtworld” – engineers (R&D) speak a technical language of product features and specifications and respond to an engineering culture of problem solving while marketers speak in their own language, hopefully that of the customer, and operate in a customer-oriented

culture” (p. 362). This difference between the departments discussed above is similar with regards to all departments involved in NPD where achieving a successful level of communication in such an environment is regarded as being extremely difficult (Griffin & Hauser, 1992). Communication amongst team members, staff in general, project teams, suppliers, distributors and customers is often referred to as the vital link needed for NPD success (Cooper & Kleinschmidt, 1987). The success of a product generally relies on the combined effort of team members and therefore the likelihood of success is greatly increased when communication levels are high, especially in project teams, allowing for the sharing of information in relation to the product being developed.

Proficiently undertaking numerous NPD projects at once requires skills, as it is known that doing so greatly constrains project outputs as difficulties often arise relating to poor communication and limited company resources (Filson & Lewis, 2000). Additionally, there is no guarantee that making use of a NPD process will lead to product success (Belliveau et al., 2004).

Past research has found that staff need to be involved early on in the product development process, requiring careful integration with staff from other departments, where it has been proven time and time again that when the departments cooperate effectively, new products have a better chance for success (Hise, O'Neal, Parsuraman, & McNeal, 1990). Griffin and Hauser (1992) stated that if project success was to be achieved, a NPD process is needed to provide direction for the development of a product and to encourage inter-disciplinary participation through which communication and information transfer is a must.

2.2. Review of Small and Medium Enterprises

SMEs form the majority of companies in OECD (Organization for Economic Cooperation and Development) economies (*The OECD small and medium enterprise outlook*, 2000) and are often the source for new job creation, generating a substantial share of GDP, have a greater dependence on their external environment, and are often influenced by what goes on in their local community (Karlsson & Olsson, 1998; *The OECD small and medium enterprise outlook*, 2000). However, the competitive nature of industry encourages growth in productivity which builds on the rise and fall of smaller and younger enterprises which are more vulnerable and prone to failing, less than half survive after five years in business, resulting in a large turnover of SMEs (Cameron & Massey, 1999; *The OECD small and medium enterprise outlook*, 2000).

2.2.1. Small and Medium Enterprises Defined

There have been numerous attempts at determining characteristics of both small and large companies as a means for allowing company size to be differentiated (Devlin, 1984) yet, there is still no universal definition for SMEs (*The OECD small and medium enterprise outlook*, 2000). The measure of company size varies world-wide where number of employees, sales figures, and industrial classification are examples of some of the measures used.

Category	New Zealand		Australia	Europe	UK	USA
	No. of Employees	Enterprises %	No. of Employees	No. of Employees	No. of Employees	No. of Employees
Micro	0 to 5	86.9	0 to 5	0 to 10	0 to 9	0 to 9
Small	6 to 49	11.8	6 to 19	11 to 50	10 to 49	10 to 99
Medium	50 to 99	0.7	20 to 200	51 to 250	50 to 249	100 to 499
Large	100+	0.6	200+	250+	250+	500+

TABLE 2-2: International definitions of enterprises in terms of number of employees (adapted from Cameron & Massey, 1999; adapted from Gawith et al., 2007; adapted from *SMEs in New Zealand: structure and dynamics*, 2007).

The economic differences of each nation makes the use of a common worldwide definition for company size impossible (*The OECD small and medium enterprise outlook*, 2000). Although, it is not uncommon to find that most countries base the definition of company size on an employment measure and therefore it is the most

common and widely used measure (Devlin, 1984; *The OECD small and medium enterprise outlook*, 2000). Table 2-2 contains the definitions for company size for New Zealand, Australia, Europe, United Kingdom, and the United States of America according to the most commonly used employment measure. In addition, a breakdown of micro, small, medium and large enterprises as a percentage is also given for New Zealand.

Quantitative measures, such as number of employees, are frequently used for defining enterprise size, and are generally used due to their convenience (Curran & Blackburn, 2001). Non-statistical criteria are used in some cases where Allocca and Kessler (2006) outline some of these characteristics as: having less experience, greater flexibility, differing functional structures, and informal planning. Similar criteria or enterprise characteristics often associated with SMEs have been well described in the Bolton Report of 1971 (Devlin, 1984):

“First, in economic terms, a small firm is one that has a relatively small share of its market. Secondly an essential characteristic of a small firm is that it is managed by its owners or part-owners in a personalised way and not through the medium of a formalised management structure. Thirdly, it is also independent in the sense that it does not form part of a larger enterprise and that the owner-managers should be free from outside control in taking their principle decisions” (as cited in Devlin, 1984, p. 4).

The current research will focus on SMEs therefore it is necessary to define them in some way. Thus, for the purpose of this research it was chosen to use the employment measure that is so widely used allowing for comparisons with existing research to be made.

2.2.2. Small and Medium Enterprises

Even with the vast number of SMEs, most NPD research focuses on large enterprises with little information regarding whether the research findings can be applied to SMEs. There has been global interest in SMEs since the 1970's, with economic and technological changes increasing the awareness and attention (*The OECD small and medium enterprise outlook*, 2000; *SMEs in New Zealand: structure and dynamics*,

2007). Governments have introduced different forms of support and programmes specifically for SMEs, after realising the important roles SMEs have with larger companies and the economy (*The OECD small and medium enterprise outlook*, 2000; *SMEs in New Zealand: structure and dynamics*, 2007).

The contributions and key roles SMEs make towards the economy, such as employment, exports, social integration, gross domestic product, specialist suppliers to larger companies, sources of innovation, and providing competition for existing companies, is extremely important (Devlin, 1984; *The OECD small and medium enterprise outlook*, 2000). Governments are beginning to establish services, grants, and programmes specifically for supporting these smaller companies' requirements (*The OECD small and medium enterprise outlook*, 2000; *SMEs in New Zealand: structure and dynamics*, 2007).

The high failure rate, especially during the first three years of starting out, of SMEs is often said to be the result of experiencing some or all of the following difficulties (Devlin, 1984; Ho, 2001; *SMEs in New Zealand: structure and dynamics*, 2007):

- Find it difficult to gain market share.
- Often rely on one person to make the decisions, the owner-manager.
- Often affected by decisions made by Government and happenings in their local community.
- Lack of financial support, often because of the high risk involved.
- Lack of support and advice, SMEs rely on external sources.
- Not always a fast learner.

2.2.3. New Product Development in SMEs

The importance of SMEs to the economy and their inability to compete with large enterprises is acknowledged by most governments (Cameron & Massey, 1999). Many countries, for example Australia, Japan, New Zealand, Finland, the United Kingdom, and North America, have some form of government departments setup for supporting, advising, and aiding SMEs. Larger companies have a greater grasp on the economy and commercial activities and as a result governments quite often provide greater support which, in some cases, is readily available to companies (Devlin, 1984).

Many research investigations take company size as the key to being innovative (Ettlie & Rubenstein, 1987). The “early stages of growth are marked by uncertainty both in technology and marketing” in SMEs where this poor growth rate, partially caused by their inability to expand their range of products after the first product or product range, leaves them with the choice of specialising in their start-up products, or worse, the company failing as a result (*The OECD small and medium enterprise outlook*, 2000, p. 18). However, the formality, structure, and planning of NPD carried out by SMEs and large enterprises differ (Gawith et al., 2007) where major innovations over the years have come from companies of all sizes (Allocca & Kessler, 2006).

Ettlie and Rubenstein (1987) made a point that the size of a company may impact on their level of innovation or else the number of employees in a company could be a result of their innovativeness which has been supported by Allocca and Kessler (2006) and Gawith et al. (2007). SMEs tend to focus on a small range of products aimed at the local or national market as these companies happen to be the backbone to most communities (*Small and Medium Businesses in New Zealand*, 2004). With this said these smaller companies often encounter difficulties in NPD such as the lack of finance, informal and unstructured development processes, and poor management skills, although having the benefit of being able to react faster to opportunities as well as finding it easier than larger companies at taking risks (Allocca & Kessler, 2006; Gawith et al., 2007; Karlsson & Olsson, 1998; *Small and Medium Businesses in New Zealand*, 2004).

NPD in SMEs is mainly undertaken through the use of an informal and unstructured process generally missing many crucial steps. The poor reputation associated with SMEs and NPD, management, marketing and the overall approach taken is largely the result of these smaller companies having less NPD knowledge and experience, absence of proper management, limited resources, limited access to skilled staff and finances, little market presence and competitive advantage, and weak product planning (Allocca & Kessler, 2006; as cited in Kerr, 1994). If a process is made use of, it is generally implemented focusing on simplicity often only making use of the less complicated and easily understood NPD activities (Allocca & Kessler, 2006; Gawith et al., 2007; Ho, 2001; Kerr, 1994). Whereby, even with highly skilled staff,

the informal process still contributed to poor planning and communication (Rainey, 2005).

With the points made above in regards to NPD in SMEs, it is clear that these assist in creating an incomplete NPD system which is likely to restrict the overall performance and end result of NPD undertaken by SMEs. However, evidence of successful SMEs does exist and for that reason successful NPD by SMEs cannot and should not be ruled out as they too are able to gain from the use of NPD and the tools and techniques available for the activities involved (Gawith et al., 2007).

2.3. SMEs, NPD, and the Pre-development Phase in New Zealand

The literature illustrates New Zealand as having an economy primarily consisting of SMEs (Devlin, 1984; Gawith et al., 2007; *Small and Medium Businesses in New Zealand*, 2004). New Zealand is relatively small when compared on a global scale with regards to population. The geographic location of the country impacts on global sales and opportunities with many companies looking to overcome the isolation by looking overseas for development opportunities (Ho, 2001). A large portion of the New Zealand economy relies on import and export product. Companies participating in such activities are often considered to be vitally important to the country's economy as they tend to be the main providers of the country's goods, services, and employment and having similar characteristics, including success and failure, to that found in other countries (Cameron & Massey, 1999; Devlin, 1984; *Small and Medium Businesses in New Zealand*, 2004; *SMEs in New Zealand: structure and dynamics*, 2007).

SMEs tend to dominate the New Zealand business environment, similarly to the dominance experienced elsewhere, with ambitions of long term survival and being loyal to customers (Souder, Buisson, & Garrett, 1997). The lack of research still exists in relation to SMEs, NPD, and the pre-development phase in New Zealand with slightly higher levels of research performed overseas. It was found that little research has been undertaken in relation to NPD in New Zealand. Limited resources, such as small budgets and skilled staff as well as the lack of awareness for the need of NPD over the years is likely to be the most significant contributing factor to the low levels of new product commercialisation, the high levels of new product failure, and the current quality, performance, and usage levels by New Zealand companies (Ho, 2001; *Small and Medium Businesses in New Zealand*, 2004).

The Ministry of Economic Development is responsible for providing assistance and advice on SME issues in New Zealand to the Government (Department of Labour, 2005; *The OECD small and medium enterprise outlook*, 2000) whereby the New Zealand Government aims at assisting businesses in being innovative as well as developing and taking on new technologies. However, this is achieved through means other than focusing on individual companies and direct financial assistance, rather

their aim is to provide assistance and support to SMEs through community services (*The OECD small and medium enterprise outlook*, 2000).

As discussed in section 2.2.1, there is no official definition for SMEs in New Zealand, however these small companies are often independently owned and managed often including the role of decision maker, quite often have difficulty accessing and/or sourcing finance largely due to their high risk nature, thus the majority of finance is covered by the owner, few or no professional staff, and are not a subset of a larger corporation or business group (Devlin, 1984; *Small and Medium Businesses in New Zealand*, 2004).

Categorising companies by employee numbers has been successfully used for both national and international research as outlined by Cameron and Massey (1999). Research undertaken by the Ministry of Economic Development (New Zealand) found that as of February 2006, 86.9 percent of New Zealand enterprises were found to be micro in size (zero to five employees), 11.8 percent were of the small category (six to 49 employees), and 0.7 percent were categorised as being medium in size (50 to 99 employees). As a result of the above figures, New Zealand enterprises employing between zero and 99 employees, SMEs, makes up 99.4 percent of all New Zealand companies confirming New Zealand is a country primarily consisting of SMEs (Devlin, 1984; Gawith et al., 2007; *SMEs in New Zealand: structure and dynamics*, 2007).

Ho (1999) suggested that dramatic changes to the economic environment within New Zealand resulted in significant improvements to general company practice. Still, it is very likely, however, that the lack of NPD experience and knowledge, perhaps preventing the carrying out of necessary activities through the use of proven tools and techniques, may still be affecting the practice of product development in New Zealand. The lack of skilled staff generally means that SME owners perform the majority of roles in the business such as, manager, accountant, engineer, and production worker (Ho, 2001) thus taking full responsibility for most business activities. Involvement of the SME owner-manager in NPD is generally seen as a benefit to the company in terms of carrying out such activities (Ho, 2001) which is backed up by Kerr (1994) suggesting “that the individual culture within the economy

is conducive to creation endeavours and stimulates new product ideas” (p. 37). However, the individuals involved often present poor skills, knowledge, experience, and capability both in business and in NPD activities, where the addition of the limited resources and company culture holding companies back from expanding their already small product range as well as further developing the business and their involvement in the discipline of NPD (Ho, 2001; *Small and Medium Businesses in New Zealand*, 2004). New Zealand SMEs tend to outsource work, including NPD, requiring a high level of communication between companies is crucial to the outcome of the project (Gawith et al., 2007).

In the past several countries have come to the aid of their larger companies, somewhat neglecting the SMEs,, helping them to compete on the international stage as it was, at the time, these larger companies were seen as the main provider of employment, innovation, and economic growth although it was later found that SMEs play a crucial role in the economy through growth, employment, and innovation along with large companies (*SMEs in New Zealand: structure and dynamics*, 2007).

Internationally manufacturing and engineering are the largest industries with past and current economic situations, including New Zealand, influencing the overall performance and usage of NPD. Kerr commented on the low occurrence of NPD in the past is due to “little incentive for the Product Boards to differentiate their products and little pressure from consumers for more sophisticated products” (p. 38). Generally speaking, the NPD processes used by New Zealand SMEs appear to vary widely where the processes implemented are often informal and lack structure where Ho (2001) found that the higher the importance placed on NPD by a company would also result in a higher percentage of NPD activity usage. Kahn, Barczak, and Moss (2006; as cited in Gawith et al., 2007) suggested that implementing a formal NPD process can potentially slow the entire process, reduce innovation, and interfere with communication.

In the past New Zealand industries were found to lack competitiveness although over the years, notably recently, the situation has improved considerably with major improvements in the field of NPD with many New Zealand companies now finding themselves participating in industry at an international level (Souder et al., 1997).

2.4. Restatement of Research Questions

Overall, the literature has shown that the actual practice of NPD, including the pre-development phase, in all New Zealand enterprises and industries is weak with past studies giving evidence to the fact that there may be an obvious need for more to be done with regards to educating New Zealand companies in relation to implementing NPD accurately and effectively.

For this reason it was decided to undergo research to explore the pre-development phase of NPD in New Zealand manufacturing SMEs through investigating **the nature and complexity of the pre-development activities, the difficulties and/or limitations experienced whilst implementing NPD and the pre-development phase, and the level of importance placed and the attitudes towards the pre-development phase and NPD with reference to the literature and industry experience.**

Chapter 3: Research Methodology

3.1. Introduction

The literature review, Chapter 2, highlighted a number of key issues generally associated with NPD and the pre-development phase. These issues were generally related to the process, tools and techniques, management attitudes, and the barriers preventing the use of pre-development activities. Furthermore, the literature clearly portrayed the overall level of importance and effect the pre-development phase has on product development.

The basis of this research was derived from past studies by Campbell (1999), Gawith et al. (2007), Ho (2001), Kahn et al. (2006), Kerr (1994), and the author to fit in with the aims and objectives of the research investigation. This planned research was intended to gauge the understanding and importance of the pre-development phase amongst product development practitioners from the electronics, light engineering/manufacturing, and food sectors of the New Zealand manufacturing industry through the use of a questionnaire survey carried out with a sample of 336 companies and interview-style sessions performed with randomly selected questionnaire respondents enabling both quantitative and qualitative data to be obtainable.

3.2. The Sample

3.2.1. Sample Selection

The method of random selection was chosen over other sampling methods, such as cluster and purposive, because of the resources and information available to the author at the time of undertaking the research. The New Zealand Yellow Pages, New Zealand business directories, and online databases were the main sources used to obtain background information on enterprises. The sample was based on a subjective analysis whereby the author identified and selected those companies that were both likely to be involved in the manufacturing industry and be classified as a SME according to the New Zealand definition (employ less than 100 staff) as discussed in Chapter 2.

A total of 336 manufacturing SMEs representing the light engineering/manufacturing, food, and electronics industry sectors were randomly chosen from around New Zealand to be used as the sample for this research investigation. This was considered a realistic figure to obtain a respectable response to the research, where a larger sample would increase statistical reliability, reducing both the variability and the error tolerance of the data (Institute of Technology and Engineering, 2004).

3.2.2. Validity of Sample

The sample obtained for this research investigation was considered to be sufficient for providing a fair representation of manufacturing SMEs from the New Zealand industry. Chetty (1996) found that past studies in New Zealand using the mail survey method have had low response rates and adds that “the case study method overcomes the problem of conducting research in a country, such as New Zealand, where the small sample base means that there might not be enough firms to justify using statistical generalisation”(p. 74).

To justify the research method used it was decided that both qualitative and quantitative data would be collected and used in the analysis through use of the questionnaire survey and one-on-one interview data collection techniques. These and/or similar methods and techniques for data collection and analysis were observed

to have been used in past research by Kerr (1994), Campbell (1999), Ho (2001), and Gawith et al. (2007) to great effect.

3.3. Ethical Issues

Research being performed in relation to humans or which could potentially affect others, including groups and communities, must comply with the Code of Ethical Conduct for Research (Massey University Human Ethics Committee, 2006). The nature of the current research being performed only required a low risk application to be filed with the Massey University Human Ethics Committee. A ‘low risk’ research project is defined by the Massey University Human Ethics Committee (2006) as “one in which the nature of harm is minimal and no more than is normally encountered in daily life”. In addition, a record of the research project is kept on the Low Risk Database which is included in the Massey University Human Ethics Committee Annual Report.

Participants were given the right to refuse to participate and informed that any materials/recordings produced during the research would be kept for five years and then be destroyed. Further ethical principles that were observed and practiced over the research period are shown in Table 3-1.

Ethical Principles	Method of Observation
Respect for persons/participants	Recognising and being accepting to personal dignity, beliefs, privacy and autonomy of individuals.
	Giving participants the right to withdraw from the research at any time.
Minimisation/reducing the risk of harm	Preventing exposing the participants to unnecessary harm.
	Recognising and minimising the possibility of harm to those involved through all means possible.
	Being aware of the possible risks of harm to groups/communities/institutions when publishing results.
Informed and voluntary consent	Participation was voluntary. All information regarding what such participation involved was provided to all prospective participants. All original documents were kept as a hardcopy along with participants’ consents.
Respect for privacy and confidentiality	The privacy and confidentiality of all parties involved was respected throughout the duration of the research.

TABLE 3-1: Ethical principles observed throughout the duration of the research project (adapted from Massey University Human Ethics Committee, 2006).

The risks involved in this research investigation were assessed and managed accordingly. The rights of the enterprises and individuals involved in this research investigation were considered, respected, and taken seriously at all times during the research project where every effort made to implement and comply with the Code of Ethical Conduct for Research, Teaching and Evaluations Involving Human Participants.

3.4. The Questionnaire Survey

The research investigation was intended to gain a representative overview of the pre-development phase of the New Zealand manufacturing industry. Based on such constraints as time and cost of travelling the country meeting with each participating company on a one-to-one basis, it was decided that a mail questionnaire survey would be the most appropriate method for gathering the required data and the one used in this research.

A trial run of the questionnaire was performed with a small group taken from the sample prior to conducting the full questionnaire over a six week period during June and July 2007. The responses and feedback received from the trial run were used to develop the questionnaire further focusing on quality, layout and clarity to ensure that it would meet the objectives set out at the beginning of this research investigation.

All participating enterprises that provided contact details and had agreed to being contacted after the data had been analysed were sent a summary of the results in recognition of their participation.

3.4.1. Development of the Questionnaire Survey

An effort was made to determine the most appropriate means of collecting data through the use of the mail questionnaire method. The basis of this questionnaire and this research was derived from past studies undertaken by Campbell (1999), Gawith et al. (2007), Ho (2001), Kahn et al. (2006), and Kerr (1994) as well as including the ideas of the author to meet the aims and purposes of this study. Focus was placed on making the questionnaire easily understandable and unthreatening to SMEs. It needed to be concise, easy to read and answer, clearly presented, unfamiliar terms explained, and be respondent friendly. All this was taken into consideration whilst preparing and compiling the questionnaire and the accompanying documents introducing and outlining the research.

The questionnaire had been developed allowing for sufficient data to be obtained which could then be analysed and used to answer the research questions. The questionnaire was broken down into five sections based on key areas highlighted in

the literature. As the questions progressed, a more in-depth focus developed with questions focusing on internal NPD, the pre-development phase and activities, technical and marketing functions, and the barriers or difficulties observed during the company's NPD accomplishments.

The questionnaire consisted of a mixture of 35 'tick box' multiple-choice, multi-point scale, structured and unstructured short answer direct questions. The general layout of the questionnaire was as follows, where copies of both the trial-run and the final questionnaire can be found in Appendix II and Appendix III respectively:

- Section A:** The seven questions in this section were designed to enable a basic understanding of the companies' background and demographics. Some of the results to this section are for categorising data from the sections which follow.
- Section B:** Section B consisted of six questions designed to explore the **internal product development** efforts in the participating companies. Portions of the NPD process were looked into and were used to lead into the pre-development portion of the research study.
- Section C:** Seven questions were used to focus on the **Front-end/Pre-development phase**. It looked at areas such as the importance, time spent, and the effectiveness of the pre-development activities.
- Section D:** The seven questions in this section were designed to further explore the pre-development activities with regards to the engineering/R&D and marketing functions of the enterprises.
- Section E:** Section E utilised eight questions to explore **the outcomes of the NPD efforts and what barriers exist that prevent implementing such activities**.

The three documents accompanying the questionnaire included a covering letter, an information sheet, and the consent form (also included in Appendix II and Appendix III). Each of the accompanying documents is briefly described below.

Covering Letter: The covering letter was used as a valuable basis for introducing the author and the research investigation.

Information Sheet: The information sheet provided further details regarding the research project. It outlined the research procedure, the method of data collection, how the data would be used, confidentiality and participant's rights, and a list of contact details for the people responsible for the research.

Consent Form: A consent form was attached to the questionnaire and was required to be filled out and returned with the questionnaire survey. This was done as a means of proving that the participant has agreed to reading the information sheet, had understood the details of the study, any questions answered, and that they understood their rights.

3.4.2. Trial Run and Running of the Questionnaire Survey

It was decided early on in the project that a trial run of the questionnaire survey would be undertaken prior to the full questionnaire survey. This was done as a means for testing the overall layout, flow, and the instructions included as part of the questionnaire (as discussed in 3.4.1) and accompanying documents prior to the mailing of the questionnaire to the entire sample.

Fifteen companies within close proximity of the author were approached, informed about the project, and asked if they would consider taking part in the research study. Twelve of the fifteen companies showed interest when first contacted. Copies of the questionnaire and the accompanying documents were sent to the small group willing to take part in the trial run. Of the twelve questionnaires sent out only five were completed and returned during allotted time. This however was sufficient, providing feedback with regards to improvements that could be made.

Some minor changes were made to the layout and re-ordering some of the questions improving the readability and improved overall flow. Once the necessary changes had been made to the questionnaire and the accompanying documents it was

concluded that the documents were clearly presented, easy to read with simple wording (terminology defined), as short as possible requiring little time to complete, and structured in such a way to entice participation.

In total 321 copies of the questionnaire survey were sent out for completion over a fixed duration of four weeks during June and July 2007. A reminder letter was sent out after three weeks to those companies who had not yet responded, and responses were accepted up to six weeks after the initial mailing out of the questionnaire. Overall, a total of 22 usable responses were received from the randomly selected sample of New Zealand manufacturing SMEs.

3.4.3. Interview Sessions

A face-to-face, semi-formal, questionnaire-based interview structure was chosen as the best approach for gaining further details, exploration, and clarification on some of the key points brought out by the questionnaire survey. Each interview lasted approximately half an hour and was conducted by the author following the interview guide included in Appendix IV. During the interview sessions participants were encouraged to speak freely about the discussion topics where the general response from the interviewees to the interview questionnaire technique was very positive.

3.5. Data Analysis and Tools

Quantitative and qualitative was obtained from both the questionnaire and the interview sessions allowing for a greater and unbiased representation of the sample. The qualitative data was collated and sorted into categories or alternatively used as supporting quotes. There were no significance tests completed for this research investigation as the response rate was seen as being too low to allow for un-biased and usable results to be achieved.

The data analysis and the generation of tables and figures were performed using Microsoft Excel 2003 software package. Screen captures of the spreadsheets used as part of the analysis process are included in Appendix V. Statistical data, such as averages and frequencies, were calculated where appropriate and focus placed on data sets that were of large interest to the research investigation.

Chapter 4: Research Findings

4.1. Introduction

This chapter presents the research findings based on the responses from both the questionnaire survey and the interview sessions. The results have been discussed descriptively as a result of the low number of responses preventing the undertaking of detailed statistical analyses. All sections of the questionnaire are discussed and explored with the main focus being on the most significant findings in relation to the research objectives with reference to the literature.

4.2. General Information

4.2.1. Enterprise Size and Years Operating

New Zealand is known as a nation predominantly made up of SMEs (Devlin, 1984; Gawith et al., 2007). As of February 2006, 99.4 percent of New Zealand enterprises were SMEs (*SMEs in New Zealand: structure and dynamics*, 2007).

Each participating company was placed into one of three categories (micro, small and medium) based on the New Zealand definition given by Cameron and Massey (1999) for SMES as discussed in Chapter 2. The breakdown of the participating companies is shown in Figure 4-1. **The majority of responses of this research investigation were received from micro (eight) and small (ten) enterprises where only four were classified as medium sized enterprises.**

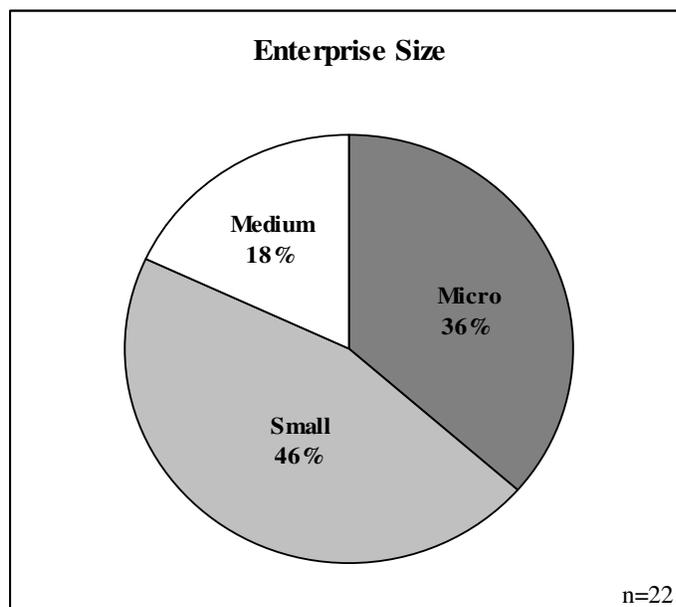


FIGURE 4-1: Participating enterprises categorised by number of employees.

4.2.2. Years in Business

The period of which 19 of the participating SMEs have been in business varied widely, as shown in Figure 4-2. **The average number of years operating as a business was calculated to be 22 years and a median of 24 years.**

Eleven of the 18 respondents have been operating as a business for over ten years. Research has found that less than a half of small start-up enterprises entering

into business manage to remain in business for more than five years with only a couple managing to develop into larger companies (*The OECD small and medium enterprise outlook*, 2000).

Cameron et al. (1999) state that the first three years are the most vulnerable for smaller companies in comparison to their larger counterparts as the likelihood of failure is at its greatest during this period. A significant decrease in number of enterprises remaining in business appears to exist between zero and 20 years for the current research (see Figure 4-2). Most notable is the decrease in number of SMEs between the categories of less than five years, six to ten years, and 11 to 20 years. These observations compliment the statement made by Cameron et al. (1999) and are likely to be associated with the difficulties so often experienced by SMEs during the starting up of a business.

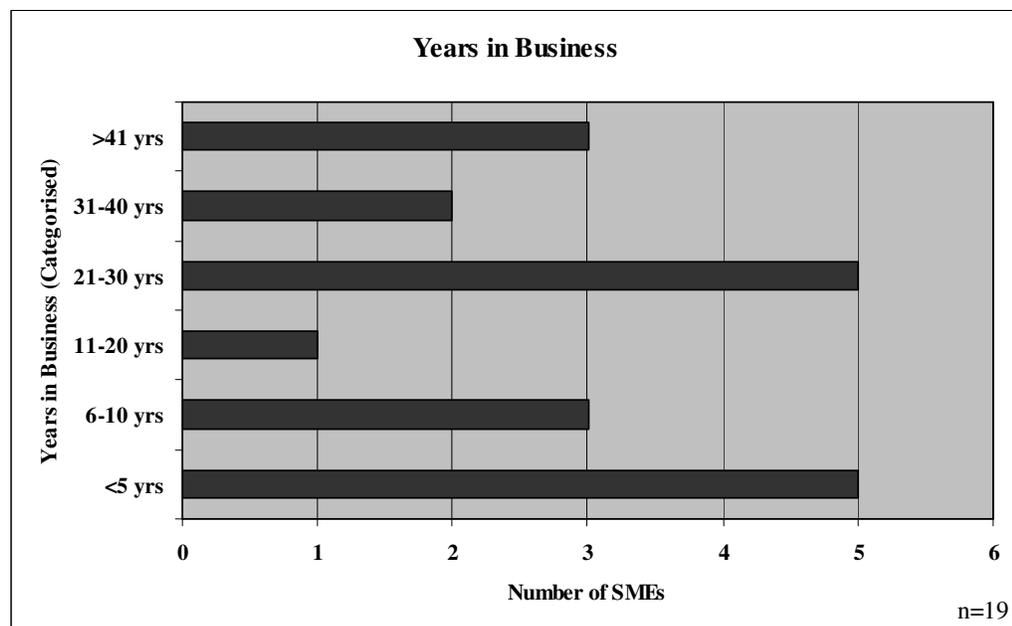


FIGURE 4-2: Number of SMEs versus years in business.

The growth, in terms of company size, of New Zealand SMEs has been somewhat limited over the years with more than half remaining the same size where research by the Ministry of Economic Development, New Zealand (*SMEs in New Zealand: structure and dynamics*, 2007) found that, as of February 2006, the average size of New Zealand SMEs had vaguely decreased. Larger companies generally have more resources available to them which in turn can be a major influence on the

development and production of new products. With this said, it is also possible that larger companies may be over-structured, have little control, or generate few ideas because of the lack of management control.

The low growth rate observed in the research findings and supported by past research should not be seen as a burden to the companies or to the country as their smallness could benefit the overall structure, organisation, culture, and performance of the business and thus support the key role SMEs play in New Zealand's economy (Devlin, 1984; Ho, 2001; Stuart & McCulloch, 1980).

4.2.3. Industry Sector

Responses were received from enterprises representing the food, electronics and light engineering/manufacturing sectors of the New Zealand manufacturing industry. For the purpose of this research the categorisation of industry sectors were based on the definitions used by Statistics New Zealand (2007) as shown in Table 4-1.

Industry Sector	Definition
Light Engineering/ Manufacturing	Enterprises that meet the definition of the New Zealand manufacturing industry performing light engineering or manufacturing activities (for example: tool design and manufacture, product design, and engineering services).
Electronics	Those companies that meet the definition of the New Zealand manufacturing industry with regards to the production or assembly of electronic items.
Food	Enterprises that meet the definition of the New Zealand manufacturing industry with regards to the production or assembly (packaging) of food items.

TABLE 4-1: Definitions of industry sectors represented (adopted from Statistics New Zealand, 2007).

Table 4-2 details the number of enterprises and years operating based on company size and the industry sector served. **The results found that 73 percent of the respondents were from the 'Light Engineering/Manufacturing'** likely due to the engineering and manufacturing trades being so dominant within New Zealand.

Interestingly, the same trend found by Kerr (1994) during his research investigation on the product development practices of small manufacturing companies in New Zealand can also be observed in the results shown in Table 4-2 for the light engineering/manufacturing industry sector. As the number of employees increases so

do the mean years operating. The same cannot be said for electronics and food industry sectors due to the low level of responses from these groups.

Industry Sector	Size	No. of Enterprises	Mean Years Operating
Light Engineering/ Manufacturing	Micro	4	10
	Small	8	33
	Medium	4	36
Electronics	Micro	3	6
	Small	1	5
	Medium	-	-
Food	Micro	-	-
	Small	1	6
	Medium	1	4

TABLE 4-2: Breakdown of enterprise size, mean years operating and industry sector.

4.2.4. Market Served

All 22 participants responded to the question regarding which market they serve. Generally New Zealand manufacturing SMEs are mainly involved in primarily business-to-business markets. This suggests that there should be a high level of interaction amongst businesses.

As shown in Table 4-3, **exactly one-half of the participating companies were involved in primarily serving business-to-business markets. Twenty-seven percent were involved in primarily consumer markets and the remaining 23 percent serve both consumer and business-to-business markets.**

Market Served	Frequency	Percentage
Primarily consumer markets	6	27%
Primarily business-to business markets	11	50%
Both consumer and business-to-business markets	5	23%
Total	22	100%

TABLE 4-3: Market served by the participating SMEs.

4.2.5. Annual Sales

Annual sales figures were obtained from all 22 participating enterprises and are categorised in Table 4-4. **Annual sales of less than 25 million New Zealand dollars**

were common in **95 percent of the SME participants**. There was only one participating company with annual sales between **25 million New Zealand and 100 million New Zealand dollars**. These findings agree with a statement made by Oram (2005) with regards to small innovative manufacturing and service companies in New Zealand having annual sales of less than 50 million New Zealand dollars.

Response	Frequency	Percentage
< NZ\$25 Million	21	95%
NZ\$25 M to < NZ\$100 M	1	5%
NZ\$100 M to < NZ\$500 M	0	0%
NZ\$500 M to < NZ\$1 Billion	0	0%
NZ\$1 Billion or more	0	0%
Total	22	100%

TABLE 4-4: Annual sales generated by New Zealand manufacturing SMEs.

The annual sales figures for New Zealand SMEs may be low when compared with international figures, however, these enterprises provide a significant contribution in areas such as exports, gross domestic product, and employment thus reiterating the importance and role of SMEs in today's economy (Devlin, 1984; *The OECD small and medium enterprise outlook*, 2000).

4.2.6. Staff Background

Participants were asked to mark on each of the three scales provided, the percentage of staff having a background in technology and/or engineering, marketing and/or sales, and any other background. **On average, 49 percent of employees have a technical and/or engineering background where only 16 percent have a marketing and/or sales background. The remaining 35 percent consisted of staff having a different background than that of marketing, engineering, technology, and sales.**

The data was broken down by employee background versus company size and is shown in Figure 4-3. It is evident that **micro enterprises have almost double the percentage of employees with a technical and/or engineering background than that of small and medium enterprises**. The small and medium enterprises tend to

have a higher percentage of employees with backgrounds other than marketing, sales, engineering, or technical.

This occurrence is possibly due to micro enterprises requiring the minimum staff for running the company especially if most of the business activities, such as accounts and production, are outsourced whereas the larger enterprises begin to integrate additional staff, such as factory and production workers. In addition, large enterprises have an advantage over SMEs when acquiring qualified staff as well as the consequences of the low level of formality in the performance of NPD in New Zealand.

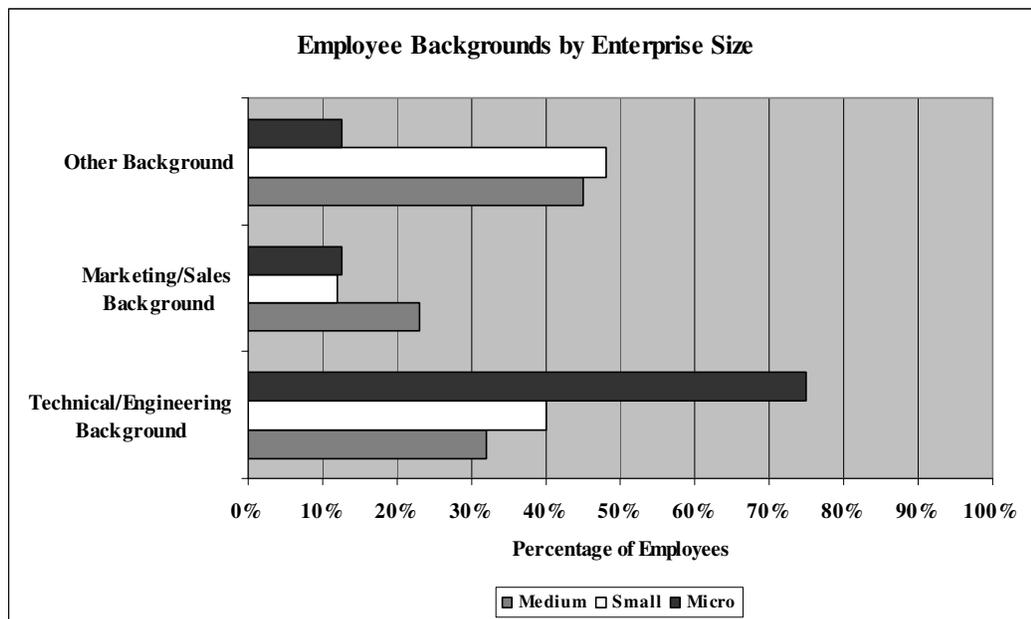


FIGURE 4-3: Employee backgrounds according to enterprise size.

4.2.7. Relationship with Distributors, Suppliers and Customers

The relationship between the participating SMEs and their distributor(s), supplier(s), and/or customer(s) was found to be very good for all three. A rating of approximately four on a scale of one to five was calculated from the responses given. Souder et al. (Souder et al., 1997) found that New Zealand companies focused on “long term survival, customer loyalty, growth through dedication to excellence, and a devotion to learning” (p. 467) as well as being “proficient at creating influential relationships with their customers and building intimate supplier-customer “clusters”” (p. 470).

The same can be said for the participating companies of this current study which can be supported by statements made during the interview sessions:

<i>“We have a great relationship with distributors”</i>
<i>“...due to internal and customer communication”</i>
<i>“...good help from key suppliers and good quick results from consultants if required”</i>
<i>“Excellent supplier and consumer relationship”</i>
<i>“Taking proactive action with customers. We have developed knowledge of the market and their needs”</i>

4.2.8. Core Benefits of Product Range

Approximately one quarter of the 19 respondents who answered this question develop and produce products with core benefits based on technology. With most participating companies representing the light engineering/manufacturing industry sector it was interesting to find that 37 percent design and develop products that do not have core benefits based on technology.

Core Benefits	Frequency	Percentage
Based on technology	5	26%
Sometimes based on technology	7	37%
Not based on technology	7	37%
Total	19	100%

TABLE 4-5: Core benefits of main product range based on.

Further analysis found that 85 percent of the respondents derive the core benefits of their main product range from technical innovation and user benefits, 11 percent from technical innovations alone, and four percent from user benefits. Both sets of results suggest that most companies base the core benefits of their main product range on technology as would be expected from companies participating in the manufacturing industry. This is also backed up by the findings in section 4.2.6 (Staff Background)

where it was found that on average 49 percent of staff have technical and/or engineering backgrounds.

4.3. New Product Development

4.3.1. Product Planning Responsibility

The respondents were asked to select from the four options provided, the one that best represents the product planning responsibilities in their company. The results are shown in Figure 4-4, where **just over half, 55 percent, of the enterprises who answered this question use a group comprising a mix of different departments, an inter-disciplinary team, that are responsible for product planning.** The remaining 45 percent can be broken down as **25 percent use the entire company, 15 percent an individual does the product planning and 5 percent for one department performing the task.**

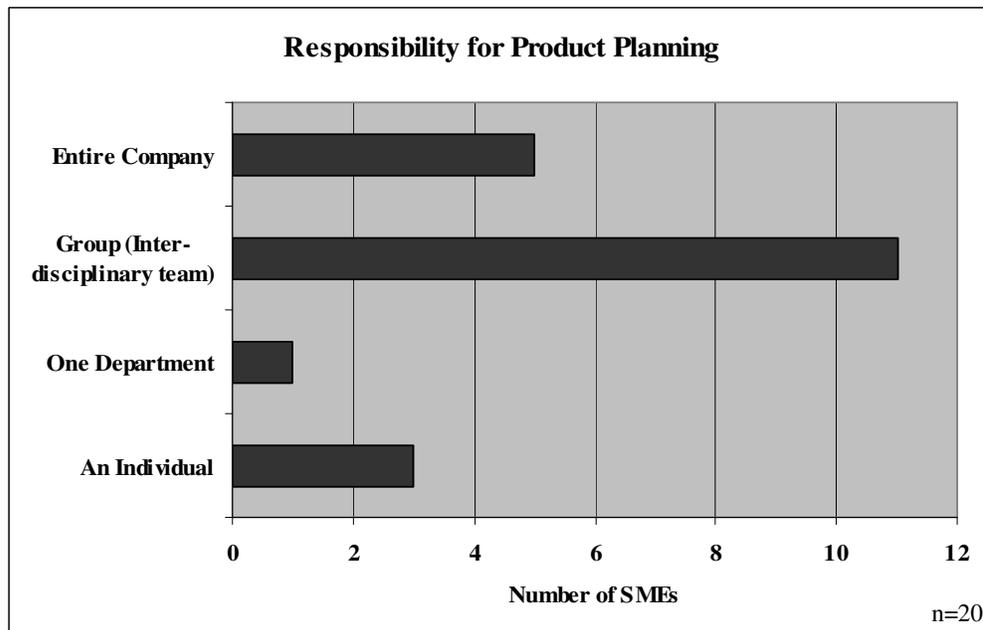


FIGURE 4-4: Responsibility for product planning

These results are interesting in that New Zealand manufacturing SMEs undertake product planning as an inter-disciplinary team. Jenkins et al., (Jenkins, 1997) put forward that there has been an increase in popularity with regards to teamwork as enterprises have come to recognise that NPD requires cooperation from an inter-disciplinary team to aid its success. Not implementing some or all of the pre-development activities sufficiently often means that the decisions made during product planning are based on insufficient information resulting in a disorganised project.

4.3.2. Initiation of Product Development

Table 4-6 shows the tabulated data for the departments initiating NPD. **The two dominant departments from this research study were management and marketing.** The dominance of these two departments is not considered to be out of the ordinary for New Zealand as there is generally a high level of involvement from management/owners within SMEs as well as there being evidence that New Zealand SMEs tend to have a close connection with their customers.

Department	Size	Frequency	Overall	Percentage
R&D	Micro	0		
	Small	1	1	3%
	Medium	0		
Product Development	Micro	0		
	Small	2	2	6%
	Medium	0		
Engineering	Micro	1		
	Small	1	3	9%
	Medium	1		
Management	Micro	4		
	Small	9	14	40%
	Medium	1		
Marketing	Micro	3		
	Small	4	11	31%
	Medium	4		
Other	Micro	4		
	Small	0	4	11%
	Medium	0		

TABLE 4-6: Departments initiating NPD by enterprise size.

The low level for initiation of product development by the Research and Development, Product Development, and Engineering departments was found to be related to being restricted by company size and the limited resources available. Generally speaking, the low number of employees in most SMEs, especially by New Zealand standards, does not always allow for such departments to exist.

The combined results, Table 4-7, of the departments initiating NPD and the formality of the development process demonstrates that the initiation of NPD is done informally most of the time.

Department	Size	Frequency
R&D	Formal	1
	Informal	0
Product Development	Formal	1
	Informal	1
Engineering	Formal	0
	Informal	3
Management	Formal	2
	Informal	12
Marketing	Formal	3
	Informal	8
Other	Formal	2
	Informal	2

TABLE 4-7: Formality of NPD process by department initiating NPD.

4.3.3. Product Development Processes

Participants were asked to briefly describe, sketch a basic diagram, or attach a copy of the product development process currently implemented by the company, where if the question was left unanswered it was assumed that a documented development process did not exist.

The descriptions and diagrams received from the respondents, collated in Appendix VI, allowed data to be generated in relation to the participating enterprises using none, one, or a mixture of NPD processes to guide their NPD efforts. Table 4-8 summarises these findings.

Type of Process	Frequency	Percentage
None	6	27%
List	8	36%
Flow Chart	7	32%
Stage Gate	1	5%
Total	22	100%

TABLE 4-8: NPD process models used by current research investigation participants.

Clearly, just over one-quarter of the participants do not have a NPD process in place for their development efforts. Fifteen SMEs provided examples or descriptions of basic sequential linear processes similar to that of the 13 stage model presented by Cooper and Kleinschmidt (1986) and the eight stage model presented by Kotler (as cited in Larsson & Martinkauppi, 2004). There was one response received from a company implementing a NPD process based on the Stage-Gate process presented by Cooper et al. (1993).

From the 16 responses to this question it was noticeable that the majority of the processes had stages missing. In general, the processes consisted of only the activities that appeared to be of some relevance to the company in question. This is consistent with the studies undertaken by Kerr (1994) and Campbell (1999) research whereby manufacturing companies in New Zealand involved in product development were missing many vital stages from their NPD process.

When questioned on NPD and NPD processes, the interview sessions participants' comments were as follows:

“Most companies don’t grasp the entire concepts of NPD and all the steps this process involves (if done correctly). Or they do not see the benefit in doing so.”

“I would say most companies are probably not completely aware of the potential benefits of using such activities for NPD”

“New Zealand is very small, so launch costs for a new product are not overly high and excluding corporate advertising budget, it is not expensive to launch ten products and have three fail, 2 succeed really well and the rest be average. Time is of the essence, so it is often better to get something out there [the marketplace] and refine it later if necessary rather than analyse for two years prior to launch.”

“Knowledge of the market by company personnel is high; this allows more confidence in product launches and an ability to skip steps if necessary.”

4.3.4. Formality of Product Development Process

According to literature there are benefits for those utilising a formal NPD process, however, it is also possible for the tools and techniques involved and company culture to intervene with the NPD endeavours (Barclay et al., 2000; Campbell, 1999). Implementing some form of a NPD process is not sufficient to ensure the successful outcome of a project as the factors such as the attitudes of all individuals involved can greatly impact on different portions of the project (Campbell, 1999). For example, the lack of formality in NPD, especially during the early activities, can potentially disturb the management of NPD within an enterprise.

The interview sessions brought out various views for both using and not using a formally documented NPD process in the participants own words.

“We have a structured process”

“We aren’t disciplined enough when applying our development process - we don’t stick to it, this causes delays and errors”

“We are continually improving our NPD process”

“Have a structured process but need to sort out a better one”

“Most definitely would benefit [from the use of formally documented process], just as long as it is flexible.”

“Sometimes too restrictive, we use ours as a guideline but don’t do every step or task in every project.”

“We have a difficulty in keeping to it. At times it is easier just to ignore it.”

“A documented process is a must have – biggest reason I believe is so that you can measure your companies NPD. If you can’t measure you can’t improve.”

“We have one. It is meant to be used as part of our quality procedures although it is often forgotten about or pushed to one side. A documented process doesn’t seem to fit what we currently do.”

The questionnaire participants were asked to choose from the list of four descriptions of NPD process formalities, the one that most closely resembles their enterprise's NPD process. All 22 companies responded to this question with **78 percent of these participating companies had either no standard approach to Product Development (14 percent) or no formally documented process but follow a clearly understood path of tasks (64 percent). The remaining 22 percent made use of a formally documented process with 4 of these enterprises incorporating an inter-disciplinary team.**

In comparison, Gawith et al. (2007) found that 60 percent of New Zealand SMEs used an informal development process and approximately 28 percent used a formal process, Ho (2001) found that 42 percent use a formal process and 58 percent use an informal process, Campbell's (1999) research concluded that just over half utilised a formal product development process, Kerr (1994) found that 52 percent of New Zealand manufacturing companies made use of a formal product development process and 48 percent did not, and Page (1993) found that just over half of the companies followed a structured and well defined process.

The difference in results between the current study and that by Gawith et al. (2007), Ho (2001), Campbell (1999), Kerr (1994), and Page (1993) discussed above is most likely due to the populations used in each study, change in the economy, and by the way the research investigations were undertaken. With this said, there appears to be an evident trend showing New Zealand companies moving away from the idea of using formal NPD.

4.3.5. Communication within Teams

When asked if the communication within the project team was excellent it was found that 13 of 19 participating companies agreed. **Five strongly agreed to the question and interestingly only two companies disagreed.** One respondent made a comment next to the question that poor communication between departments existed.

Findings from research by Kahn et al., (2006) quite simply suggested that formal NPD processes "may not improve communication and decision making, and in fact, may

slow the process and reduce innovation” (as cited in Gawith et al., 2007, p. 3) where it has also been noted that NPD projects are more likely to succeed if there is communication amongst the departments involved. In addition, during an email conversation regarding NPD teams on June 24, 2007 Tom Giordano went on to say:

I believe that most companies have engineers and marketing folks that are like oil and water. The engineers view marketing folks as fancy suits who spend most of their time having dinners with customers. They are story tellers. The marketing folks view the engineers as nerds who go off and do what they want and have no common sense. The magic of a successful company (I believe) is to come up with a process by which both these teams respect each other and work together well.

The communication and interaction between departments encourages project details and information to be passed between the departments allowing for common knowledge base to be formed as found by Souder et al. (1997). For example, if production were made aware of the product details early on in the design phase, they could make suggestions on such things as to which material would be best suited to the product allowing for this to be taken into consideration during the development phase.

4.3.6. New Products and New Product Features

Participants were provided with three options and the opportunity to make their own suggestions on how new products and new product features come about within the company. The three options provided were:

- New ideas and/or technology developed internally,
- Through suppliers, customers or research in market gaps, and
- “Me too” products.

The most checked answer, chosen by all but one participant, was ‘suppliers, customers, or research in market gaps’. Following this, the next most checked option, checked by thirteen companies, was new products or new product features come about through internally developed ideas or technology. In addition, there were six responses received from enterprises creating new products or new product features by following or copying their competitors and one response was received from the

food sector specifying the use of nutritional research as the main source for their new products or new product features.

4.3.7. Market and Technical Related Criteria

Part of the research involved investigating the importance of the market and technical criteria in relation to a product range(s). **The results, shown in Table 4-9, illustrates the importance of market related criteria for 94 percent of the respondents was considered to be between neutrally important and very important.**

When the same question was asked with regards to the importance of the technical related criteria, it was found that **only 89 percent of the 19 respondents considered it to be between neutrally important and very important.** After having a closer look, there is however, almost double the number of responses rating the market related criteria as very important in comparison to the technical related criteria as being very important.

Response	Market Related Criteria		Technical Related Criteria	
	Frequency	Percentage	Frequency	Percentage
Not Important	1	5%	2	11%
Neutral	9	47%	12	63%
Very Important	9	47%	5	26%
Total	19	100%	19	100%

TABLE 4-9: Importance of market related criteria.

During one of our email conversations on June 16, 2007, Tom Giordano made a rather interesting point:

“I am an engineer at heart and I really want to believe that a well designed technical product will sell. And that it’s the best way to run a company. Build a good product and they [customers] will come. In fact, that is basically how Philips Medical Systems does their product innovation. But I still do believe that a market driven development organisation is far more successful as a business than a technology driven one”.

4.3.8. Product Development Advice

One would expect SMEs, especially the newer ones, to make maximum use of the advice available to them, particularly acknowledging their limitations when it comes to resources and knowledge. Participants were asked to indicate what their main sources of advice were when it came to NPD where the results are included in Table 4-10.

Source for Advice	Frequency	Percentage
Bank Manager	0	0%
Accountant	0	0%
Lawyer	3	16%
Trade Associations	0	0%
Local Councils	0	0%
Business Development Boards	0	0%
Private Consultants	5	26%
Universities	1	5%
Local Large Company(s)	0	0%
Local Small Company(s)	1	5%
Outside Individual	0	0%
Research Institute	2	11%
Customers	5	26%
Suppliers	1	5%
Internet	1	5%

TABLE 4-10: Sources of NPD advice.

It was found that **New Zealand manufacturing SMEs do not appear to make adequate use of external sources of advice available. In fact, the comparison of the current studies findings and those found by Kerr (1994) suggest that the current participants are less extensive users of such sources.**

The low level of assistance from both large and small local companies suggests interaction and support amongst such businesses would be minimal. **Private consultants and customers were the largest sources for product development advice with five responses being received for each. Lawyers and research institutes followed closely with three and two responses respectively.** Interestingly universities, local councils, and business development boards were very rarely or never used by the participating enterprises.

These findings reflect those obtained by Kerr (1994) suggesting there has been very little change when seeking NPD advice. The low usage levels of advice sources available to New Zealand manufacturing SMEs suggests that there is a tendency of not getting advice when required, have difficulties accessing advice, do not perform NPD enough to require the advice, or are not aware of the support and sources available. It appears that the ‘kiwi ingenuity’ and the ‘can do’ or ‘number eight wire’ mentality has a place within New Zealand companies.

A portion of the interview session was used to further investigate this topic. In particular it was asked if the company would consider making use of resources specifically designed for New Zealand SMEs. Key responses received included:

“We will use the resource.”

“Probably not unless there is something radically new”

“We may although we don’t currently have anyone in a product development position.”

“Depends on the information provided”

“Depends on the cost and how useful it actually is to our business. It would be good if it was something we could use on our own”

There appears to be some support for the idea of providing a resource or resources on NPD and the pre-development phase designed specifically for SMEs preferably for self-paced usage. However, the shortage of resources within SMEs requires them to search externally for advice and assistance (Ho, 1999).

4.3.9. Balance between Engineering/R&D and Marketing

Twelve of the 21 responses received regarding the balance between engineering/R&D and marketing, in terms of which one dominates, suggesting an equal balance exists between these departments within the company. Eight responses were received for almost all engineering/R&D with little input from

marketing and one response for almost all marketing with little input from engineering/R&D.

Table 4.11 shows the responses broken down by industry sector. Disregarding the low response level, it is still evident that light engineering/marketing came across as having equal dominance between the marketing and engineering/R&D functions with a slight tendency of engineering/R&D being of greater dominance. The marketing department was the more dominant function in the food sector whereas the opposite, engineering/R&D being more dominant, was found to be true for the electronic sector. However, “the majority of companies who have both engineering/R&D and marketing departments are often found to have difficulties with communication and interaction between the two departments” (Giordano, personal communication, June 24, 2007).

Balance Between Engineering/R&D and Marketing	Frequency				Percentage
	Light Engineering/Manufacturing	Electronics	Food	Total	
Almost all engineering/R&D with little input from marketing	5	3	-	8	38%
50% Engineering/R&D and 50% marketing	10	1	1	12	57%
Almost all marketing with little input from engineering/R&D	-	-	1	1	5%
Total	15	4	2	21	100%

TABLE 4-11: Balance between dominant departments and industry sector.

The findings above are interesting in that they tend to disagree with the answers given for both the questions on staff backgrounds and the departments initiating NPD, sections 4.2.6 (Staff Backgrounds) and 4.3.4 (Initiation of NPD) respectively. The reason for this is not certain, it is however possible that the participants may have either misunderstood the questions being asked or may have provided an answer representing what was considered to be the best answer for that question.

4.3.10. Products Commercialised Over Past Five Years

On average the participating SMEs commercialise around seven products over a period of five years with an average development time of 16 months per product.

Arguably the development time of a product is dependent on factors such as the nature and specifications of the product, the development team, the knowledge base of the company, and the resources available.

The results for the mean and median number of products commercialised over a period of one and five years are broken down by company size and are shown in Table 4-12. These findings and those from section 4.3.6 (NPD Program Objectives and Success), suggest that the NPD efforts made by New Zealand manufacturing SMEs are working in their favour.

Enterprise Size	5 Years		1 Years	
	Mean	Median	Mean	Median
Micro	8.0	6.0	1.6	1.2
Small	4.8	5.0	1.0	1.0
Medium	8.3	9.0	1.7	1.8
Overall	7.0	6.7	1.4	1.3

TABLE 4-12: Number of products commercialised.

Interestingly, as an average, micro and medium sized enterprises manage to commercialise almost double that of small enterprises during a five year period, however the medians for the five year period suggest that the medium sized enterprises out pace both micro and small enterprises. It is likely that micro and small enterprises, employing between zero and 49 staff, do not have the ability due to constraints as a result of their size thus limiting the quantity of ideas they can turn into products.

4.3.11. NPD Program Objectives and Success

Participants were questioned on whether their current NPD program meets the performance objectives originally set out and whether this same program can be considered as an overall success.

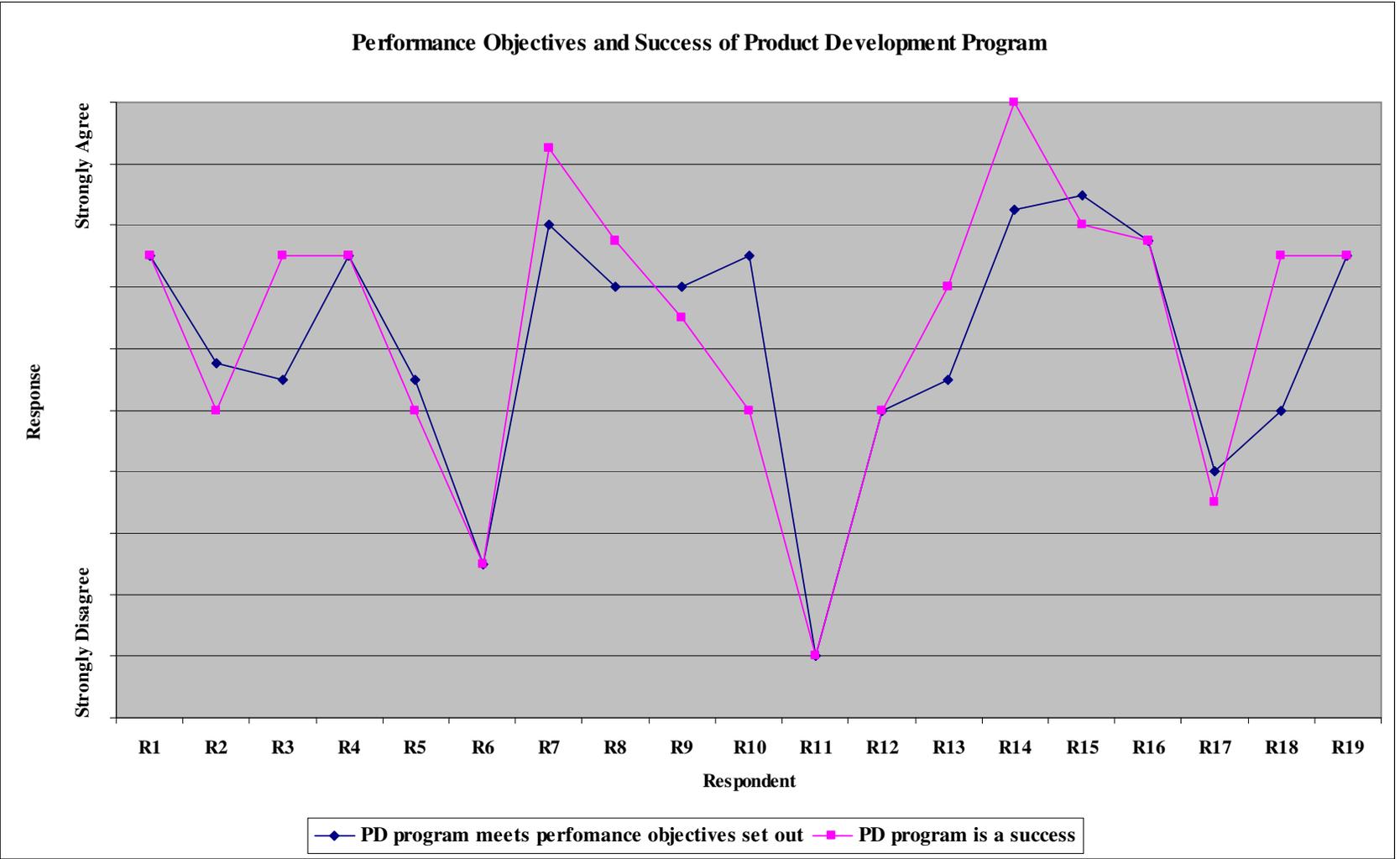


FIGURE 4-5: Performance objectives and success of product development program.

The average response from 17 SMEs suggested they agree to the products developed during the last five years have been commercially successful. Campbell (1999) found that “the vast majority of respondents regarded product development as either very or vitally important to the overall success of their company” (p. 70). Interestingly, when the data is plotted together, as shown in Figure 4-5, the two data sets appear to follow the same trend quite simply suggesting that the companies are generally meeting the performance objectives set out with the couple of odd exceptions. Some of the respondents fall above and some fall below their expectations for their product development programme.

4.4. Pre-development

4.4.1. Relevance of Pre-development Activities

Participants were questioned on what they considered the relevance of pre-development activities to NPD in SMEs. A five-point scale, ranging from no importance to vitally important, was used for each of the five pre-development activities.

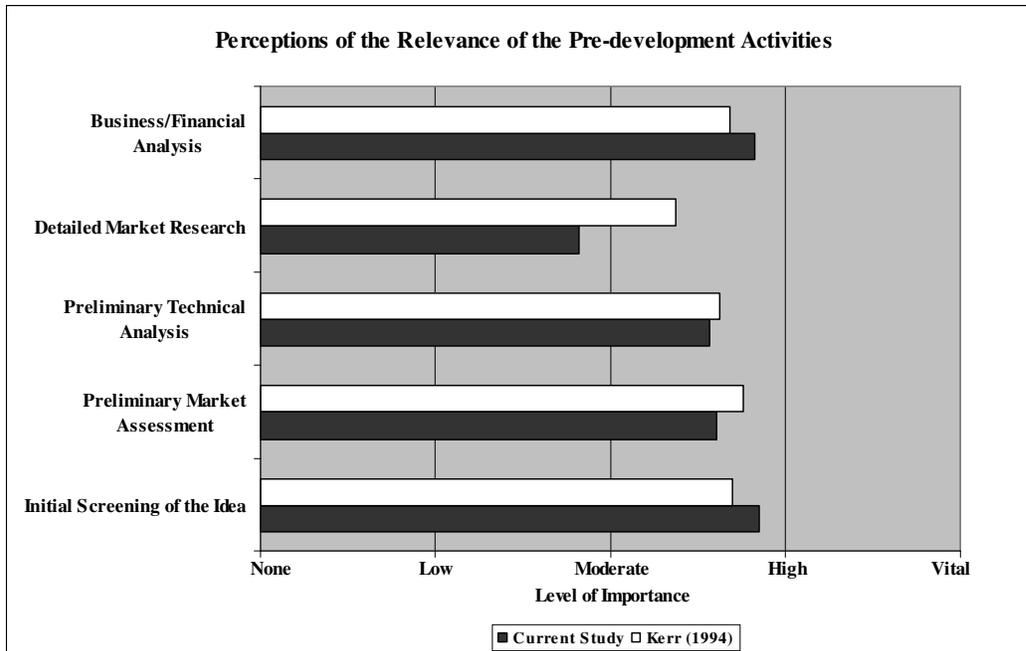


FIGURE 4-6: Comparison of perceived relevance of the pre-development activities.

Overall, the pre-development activities were considered to be fairly important. **The average level of importance for four out of the five pre-development activities was approximately midway between moderately important and highly important (see Figure 4-6).** The activities which were considered to be of most relevance were the ‘initial screening’ of product ideas and ‘business and financial analysis’ where the least relevant of the activities was performing ‘detailed market research’.

The activity of detailed market research had an average level of importance just below moderately important. This is most likely due to the companies developing products for a market segment they are already familiar with, hence having the

advantage of having the information on hand. This was found to be common with the participating SMEs as it was brought up repeatedly during the interview sessions.

The comparison of the data from the current study and Kerr's (1994) study (see Figure 4-6) found that the results tend to follow a similar trend. **The largest and most noticeable difference between the two studies was in the perceived importance of detailed market research, which was found to be less than that found by Kerr (1994).**

The result of research undertaken during the eighties and nineties by Barclay et al. (2000) suggests that **the importance of product development has been greatly recognised with an increase in its usage. However, the comparison of this current study and the research by Kerr (1994) discussed above suggests that there has been very little change in the perceived relevance of the five pre-development activities questioned over the past thirteen years.**

4.4.2. Time Spent on the Pre-development Phase

Further research was performed looking into the percentage of project time spent on the pre-development activities by those companies participating. The results suggest that, on average, the participating SMEs expend:

- 10.5% on the initial screening of the idea
- 8.6% on the preliminary market assessment
- **23.1% on the preliminary technical analysis**
- 8.5% on the detailed market research
- 10.1% on the business/financial analysis

Clearly the activity of preliminary technical analysis had the highest consumption of project time. This may be due to the research population being made up of companies from the manufacturing industry or alternatively New Zealand companies tend to focus on this activity due to the simplicity in performing the tasks involved. The activity of undergoing detailed market research made use of the least overall percentage of project time whereby this same activity was also rated by the participants as being of least relevance as discussed in Section 4.4.1.

Based on the above results, the pre-development activities undertaken by New Zealand manufacturing SMEs were calculated to take up, on average, 60 percent of the project time available. **It can be said that the pre-development phase consumes a large quantity of project time within New Zealand manufacturing SMEs**, in fact, approximately 14 percent longer than that found by Smith and Reinertsen (1998) (see Figure 4-7). However, there is a discrepancy when these findings when compared with those found by Souder et al. (1997) where New Zealand and American companies were found to spend 71 percent and 42 percent of overall project time respectively on the commercialisation stage of NPD.

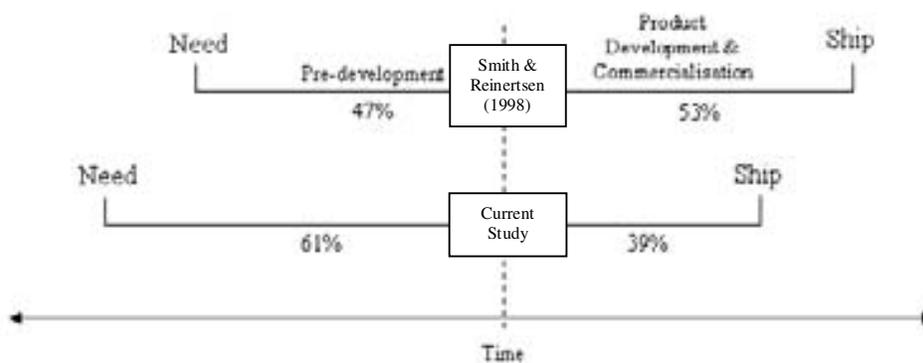


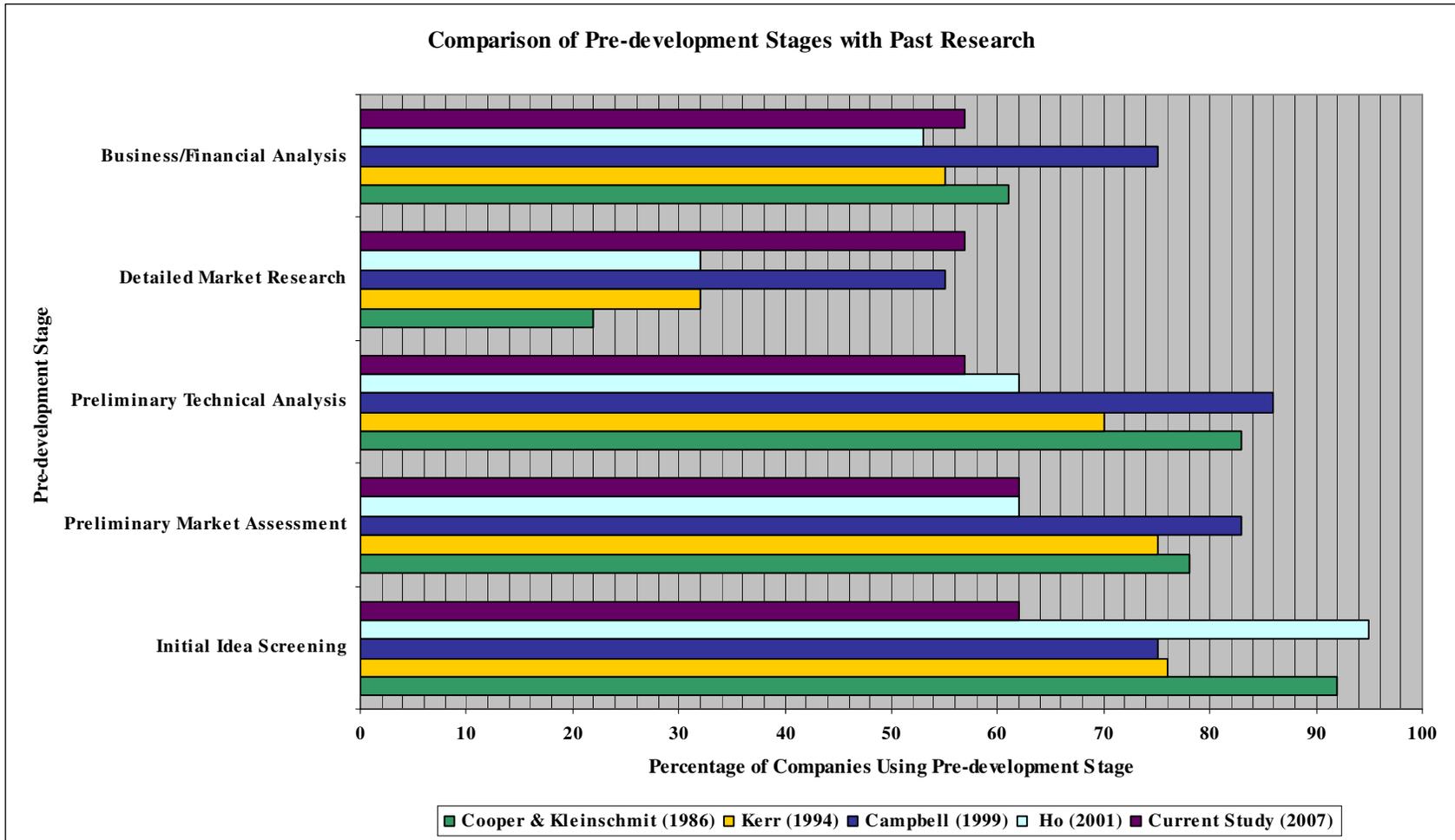
FIGURE 4-7: Comparison of average pre-development times (adapted from Smith & Reinertsen, 1998).

4.4.3. Use of the Pre-development Activities

The use of the pre-development activities were investigated focusing on making comparisons with past local and international research by Cooper and Kleinschmidt (1986), Kerr (1994), Campbell (1999), and Ho (2001). The results were plotted and are shown in Figure 4-8.

Responses were received from all the participants of the current study where it was found that all 22 companies made use of one or more of the pre-development activities as shown in Figure 4-8. **However, a more in-depth analysis of the data confirmed that 41 percent of the participating enterprises exclude some or all of the pre-development activities largely due to time and resource constraints, lack of skilled staff, and limited knowledge to carry out the activities properly.**

FIGURE 4-8: Comparison of the pre-development activities with past research.



The pre-development activities generally have a lower usage rate than that of the same activities as found by past research **even with most companies recognising the importance of including all the pre-development activities as part of their NPD efforts**. Local research by Kerr (1994) and Campbell (1999) found that the activities more intangible in nature, such as market assessments and business/financial analysis, were made use of less by New Zealand companies where in Australia, SMEs were once again found to have higher usage and performance levels in technology related activities (Huang, Soutar, & Brown, 2002). Therefore, it should come as no surprise when the same was found to be true for the current study participants. This outcome could be related to New Zealand often being referred to as having a hands-on mentality, focusing on the physical activities rather than the mental activities.

4.4.4. Product Development Uncertainty

“Innovation in NPD ranges in complexity from the updating of an existing product to the successful commercial exploitation of a radically new idea” (Larsen & Lewis, 2007, p. 142). Technology and market uncertainty can often be found near the front end of product development in essence restricting the successful completion of the NPD process.

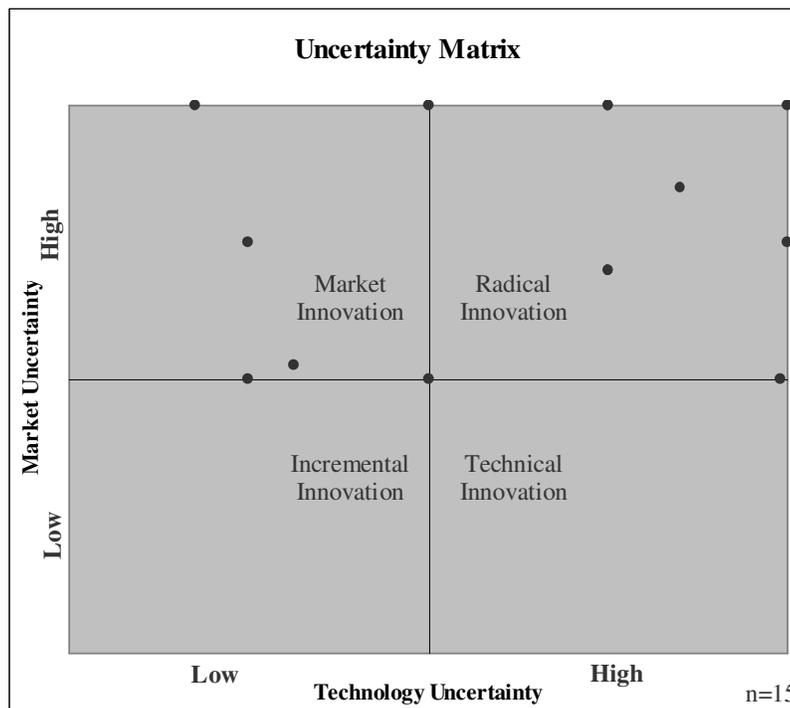


FIGURE 4-9: Market and technology uncertainty for New Zealand manufacturing SMEs.

An uncertainty matrix was plotted (see Figure 4-9) based on the literature and uncertainty matrix by Lynn and Akgun (1998) and the responses to the questions regarding the newness of technology to the company and whether the target market or customers differ between projects.

Lynn and Akgun (1998) suggest that if identifying and translating customer needs into product specifications is challenging, then the newness of the market and technology to the company would be considered as high. As the results show in Figure 4-9, the participating SMEs tend to have high market uncertainty and an even spread of high and low technology uncertainty. This would suggest that these companies focus on developing products that are ‘new to the world’ and entering new markets with existing products, where on the odd occasion they might be involved in undertaking projects involving customised products and/or small improvements of existing products or product range.

4.4.5. Degree of Difficulty

The degree of difficulty in identifying customer needs, translating customer needs into product specifications, and identifying opportunities was investigated in relation to the pre-development efforts of the participating SMEs. The results, shown in Table 4-13, verifies the difficulties that manufacturing SMEs encounter when identifying opportunities as well as identifying and translating customer needs.

Response	Identifying Customer Needs	Translation of Customer Needs	Opportunity Identification
	Frequency	Frequency	Frequency
Low	4	6	1
Medium	10	9	5
High	7	5	14
Total	21	20	20

TABLE 4-13: The degree of difficulty associated with opportunities and customer needs.

Nineteen out of 20 participants and 17 out of 21 participants were found to be having difficulty with identifying opportunities and identifying customer needs respectively. This level of difficulty encountered during the idea generation sub-stage

may likely be a key factor as to why so many New Zealand manufacturing SMEs poorly utilise the pre-development activities.

Opportunity identification was considered the most difficult of the three tasks. Seventy percent of the participants agreed they experienced a high degree of difficulty when identifying opportunities. The degree of difficulty associated with identifying and translating customer needs into product specifications was considered to be of medium difficulty by the majority of the respondents on a three point scale.

4.4.6. Generation of New Product Ideas

A small portion of this research investigation involved exploring the methods used for generating new product ideas. This was achieved by questioning participants on how their new product ideas were generated in accordance with the PDMA definition of idea generation:

“All of those activities and processes that lead to creating broad sets of solutions to consumer problems” (Belliveau, Griffin, & Somermeyer, 2002)

Three answers were provided, where it was asked that the participants selected all the answers that applied:

- Ideas are actively generated by formally planned techniques.
- Ideas are actively generated by informal activities.
- Ideas come about without prompting from a wide variety of people.

Thirteen of the 22 participants actively generate new product ideas through informal activities, ten suggested that new product ideas come about without prompting from a wide variety of people, and seven generate new product ideas by using formally planned methods such as brainstorming and customer observations.

Giordano (2007) suggests that the industry still requires reputable engineers; however they should not be developing products because of technology alone, the engineers should be developing products with the consumer in mind. Additionally, key

statements made during the interview sessions with regards to the time companies spend on the activities early on in the development process included:

“We just don’t have enough time to fully analyse the ideas we generate”

“Our meetings for developing concepts are mainly spent generating ideas instead”

“We often come up with a great mix of ideas that will and won’t work – but we waste too much time doing so”

Two further questions aimed at gaining an insight into the use of inter-disciplinary teams during idea generation and screening were asked, where the results have been tabulated in Table 4-14. Literature suggests that there has recently been an increase in the use of inter-disciplinary teams within companies over the past couple of years especially since the recognition of NPD as an inter-disciplinary activity (Jenkins, 1997).

Response	Generated by an Inter-disciplinary Team		Selected by an Inter-disciplinary Team	
	Frequency	Percentage	Frequency	Percentage
Strongly Disagree	0	0%	0	0%
Disagree	0	0%	4	33%
Neutral	4	36%	3	25%
Agree	5	45%	3	25%
Strongly Agree	2	18%	2	17%
Total	11	100%	12	100%

Table 4-14.: Generation and screening of ideas through the use of an inter-disciplinary team.

Seven of the eleven responding participants agree, to some extent, to using an inter-disciplinary team during idea generation. Whereas, only five out of twelve respondents said they use an inter-disciplinary team during the screening of ideas. It is not uncommon for the owner/manager of an SME having a large influence on the outcome of a project through his/her involvement during the NPD period of the project (Devlin, 1984; Ho, 2001).

4.4.7. Pre-development Techniques

Participants were asked to identify from a list the techniques included in their company's pre-development phase. The data shown in Figure 4-10 illustrates the percentage of participating SMEs performing each technique.

The results suggest that the majority of the techniques listed get used by slightly less than half of the respondents. **There was generally greater focus placed on the easily repeatable techniques that have a method or process which is easily followed, especially those included in the preliminary technical analysis.** The use of customer oriented tools was only performed by six of the participating SMEs whereby Soulder et al. (1997) found that New Zealand managers tend to make use of trade shows and product demonstrations to gain new product ideas as well as attempting to attract new customers.

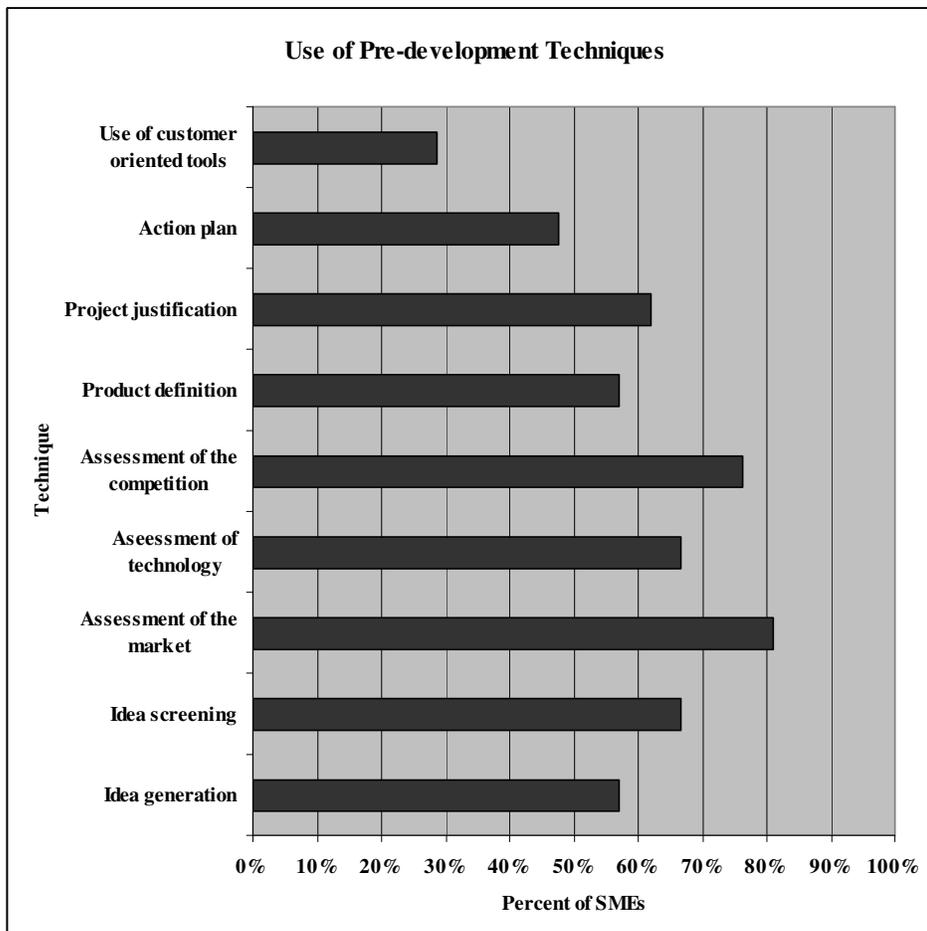


Figure 4-10: Use of pre-development techniques.

The findings here reflect that found by Kerr (1994) where it was stated: “the individual techniques used within the Product Development process were non-complex, particularly for the more intangible disciplines such as market research and financial assessments” (p. 78). A statement made by one participant during the interview sessions that really stood out and summarised this question best:

“...need more market research, focus groups, detailed target market analysis”

Participants were later asked during the interview sessions to expand on the specific techniques and/or tools used during the pre-development activities. The responses received included:

- Direct contact with customers, suppliers and distributors
- Basic use of scoring/rating style methods for screening ideas
- An individual generally evaluates the ideas although sometimes it is done as a group
- Market analysis commonly focusing on competitor information, shares, and market size
- Patent search
- Drawings and specifications. Sometimes used during the NPD process as a discussion starter
- Cost and sales forecasting. Mainly return-on-investment and pay back period
- Capability analysis and project viability

4.4.8. Effectiveness of Pre-development Phase

Participants were asked to rate the effectiveness of the pre-development phase within their company on the five-point scale provided. It was found that **most of the responses, 45 percent, agreed that the effectiveness of their pre-development phase was excellent** as shown in Table 4-15.

Response	Frequency	Percentage
Poor	4	18%
Good	8	36%
Excellent	10	45%
Total	22	100%

TABLE 4-15: The effectiveness of pre-development phase.

It appears that the large number of participants not having a formal NPD process along with the difficulties and limitations associated with performing the pre-development activities are possibly the perception of an individual rather than the actual effectiveness of the SMEs.

4.4.9. Barriers Preventing the Use of NPD Tools/Techniques

Participants were asked to identify what prevents their company from making use of and/or adopting further NPD tools and techniques that are now available. Focus was placed on the barriers associated with the NPD process to provide a broader picture of the issues faced with before, during, and after the pre-development phase. Table 4-16 presents a list of difficulties that are sometimes experienced by companies during NPD along with the corresponding responses obtained from this research.

Insufficient budget was found to be the most common barrier preventing New Zealand manufacturing SMEs from adopting or using the NPD tools and techniques available. Also evident was that **eight of the 22 SMEs state that there just is not enough time** to make proper use of the tools and techniques and **five consider it to be too difficult from a resource, culture, and/or process point of view.**

Barrier	Frequency	Percentage
Insufficient budget	10	45%
The cost does not seem to be justified by the benefit	2	9%
Too difficult to implement from a technical perspective	0	0%
Too difficult to implement from a resource, culture, and/or process	5	23%
Requires too much training	3	14%
Lack of awareness	3	14%
Lack of understanding	3	14%
Lack of time	8	36%
Not knowing how or when to get information	1	5%
Bad experience with product development or similar tools/techniques	0	0%
Other	3	14%

TABLE 4-16: Barriers preventing the use of NPD tools and techniques.

Additional difficulties, categorised in Table 4-16 as ‘Other’, suggested by three of the participants was the **lack of qualified/knowledgeable staff in the field of NPD,**

managers/owners only interested in the bottom line, and the lack of appreciation of the benefits of the various tools and techniques available.

These findings were consistent with both literature and the research carried out by Kerr (1994) and Ho (2001) where the main barriers experienced whilst undertaking NPD included financial restrictions, time constraints, lack of resources, and the shortage of skilled staff.

Participants were asked if they could provide their thoughts on why they would consider their overall NPD efforts to be a success or failure, the comments received included:

“Government support is minimal” (Referring to start-up SMEs)

“Few banks support SMEs”

“Great relationship with distributors”

“Our company culture”

“Require more market research, focus groups, and detailed market analysis”

“We are not disciplined enough when applying our development process i.e. we don’t stick to it, this causes delays and errors”

“Internal and customer communication”

“Need to sort out a better process and have a better filter for bright ideas”

“Good communication, not too many people involved on the decision making process, good systems that allow projects to flow, good help from key suppliers and good quick results from consultants if required”

“We don’t plan to change anything in the future”

“Excellent supplier and consumer relationship”

“Put more resources into R&D and keep upgrading R&D staff skills”

4.5. Summary of Research Findings

Overall, the questionnaire and interview sessions provided valuable insights into the nature of the pre-development activities in New Zealand manufacturing SMEs. It can be said that the manufacturing SMEs were well aware of NPD but were unsure of some of the tools involved, but they did not appear to be overly concerned about it. Additionally, the participants, more so the companies interviewed, had mixed views on the pre-development phase. However, there was still evidence of strong interest in NPD and the overall success of the projects undertaken. Below is a brief summary of the key findings from the research investigation.

The majority of responses were received from micro and small enterprises, although responses from micro, small and medium enterprises were received representing the light engineering/manufacturing, electronics, and food industry sectors. On average, almost half of the employees had a technical and/or engineering background with only 16 percent having a marketing and/or sales background. It was thought that the smaller manufacturing enterprises may have outsourced the marketing and sales components of the business, especially during the business start-up period. All but one enterprise had annual sales of less than 25 million New Zealand dollars which was backed up by a statement made by Oram (2005).

Roughly, 80 percent of the participating companies had been operating as a business at the time of the research with **most found to be involved in business-to-business markets and mainly focusing on ‘new to the world’ products and entering new markets with existing products.** The SMEs were found to have a **good relationship with their suppliers, distributors, and customers.** **Management played the most important role when it came to product planning in New Zealand manufacturing SMEs, as they generally tend to be involved in key decision making stages during NPD.**

Approximately one third of the participating SMEs were found to have no NPD process in place with 78 percent using an informal approach to NPD. If a formal approach to NPD was undertaken, stages and activities that could be physically undertaken and relevant to the project were included in the process. Just under

half of the participants agreed that the effectiveness of their pre-development phase was excellent whereby the pre-development activities were considered to be relatively important with a similar level of importance since Kerr's (1994) study. **Of the five pre-development activities studied, the preliminary technical analysis was found to be the focus, with lesser emphasis placed on the other activities.**

A comparison with past research showed New Zealand manufacturing SMEs appear to be moving away from the formal approach to NPD, instead placing emphasis on communication and team dynamics. **Most respondents suggested good communication exists between departments** with 55 percent having interdisciplinary teams responsible for product planning. Just over half of the participating companies have an equal balance when it comes to engineering/R&D and marketing, although management and marketing have dominance in initiating NPD.

Many of the companies were found to have difficulties with identifying opportunities and customer needs with the addition of numerous barriers limiting the implementation of NPD. **The greatest difficulties came from practical implementation of tools and techniques due to several challenges such as limited budgets, time, resources and company culture**, where the use of the available sources of advice within New Zealand were found to be inadequately used. It was considered that this may all be related to the fact that **many of the SMEs studied do not see the need for formal NPD, are not aware or lack the knowledge of what NPD is, and are not overly concerned about it.**

Chapter 5: Conclusions and Recommendations

5.1. Conclusions and Recommendations

The following conclusions and recommendations were made as a result of this research study which explored the pre-development phase of NPD in New Zealand manufacturing SMEs. The answers below are presented in relation to the findings obtained and the discussions made in earlier chapters with recommendations being made thereafter.

Q₁: What is the nature and complexity of the pre-development activities performed by New Zealand manufacturing SMEs?

The NPD process used by New Zealand manufacturing SMEs was considered to be informal and unstructured in nature, although it had the added quality of being flexible. Overall, 17 companies had no formal NPD process in place for product development, while those companies implementing a formal NPD process focused mainly on the activities that made use of easily repeatable tools and techniques.

It was found that over half the participating companies generated new product ideas informally where the products produced were market and radical innovations generally aimed at the business-to-business markets. As SMEs tend to be locally based, close interaction and level of commitment with neighbouring companies, customers and the local community is crucial to the success of their business. Evidence of this was found in the research with the participating SMEs **having good relationships with their suppliers, distributors and customers.**

Management and marketing departments were found to play the most important roles in New Zealand manufacturing SMEs although greater awareness of the pre-development phase and NPD would be beneficial for all staff involved. Notably, **management tends to be highly involved in key decision making phases, such as product planning, during the NPD process.** Communication between departments was paramount to the undertaking of NPD, with approximately half the SMEs knowingly making definite use of inter-disciplinary teams during product planning, idea generation, and idea selection.

Efforts made during the pre-development phase by New Zealand manufacturing SMEs included the use of some tools and techniques throughout the duration of the pre-development phase, intentionally and unintentionally, to varying degrees. A large portion of the participating SMEs agreed that the effectiveness of their pre-development activities were excellent and that performing the five activities were an important part of their NPD efforts. However, further analysis of the findings suggested that **the pre-development phase was poorly executed with activities being poorly implemented, or even worse, ignored.** An example of this was shown in the research investigation with most companies only making use of one method, such as a basic scoring method for screening ideas, rather than the other tools as found in the literature. This leads to misinformation progressing through to the remaining two stages of the NPD process.

It appears that the companies studied are leaving the formal approach to NPD and rather focusing on team functionality and loyalty to their suppliers, distributors and customers. Many of the manufacturing SMEs do not see the need for formal NPD, are unaware of it, or they are not overly concerned about formally implementing NPD. The formal process of NPD tends to be better suited to the larger companies. The complexity of formal NPD may be a problem for SMEs in New Zealand. With low staff numbers and limited resources being common, it appears that the flexible, informal approach to NPD these SMEs implement fits in with their company culture and the day-to-day business activities undertaken by such companies within New Zealand.

Q₂: What are the difficulties and/or limitations New Zealand manufacturing SMEs have during the implementation of the pre-development activities?

The participating SMEs generally developed and introduced several new products into the market place annually with the majority apparently meeting the initial objectives set out by the manager, project team or company. Based on the discussion above on the first research question concerning the nature and complexity of the pre-development phase in New Zealand manufacturing SMEs, it could be said that these companies are in a considerably comfortable position. Many appear to be reasonably

successful at what they do, therefore playing a vital part in the New Zealand economy. However, **many do experience difficulties throughout the development process, impacting on their ability to develop a product to a point where it can be successfully commercialised.**

Overall, it was found that New Zealand manufacturing SMEs **mainly experience difficulties in identifying opportunities and customer needs.** Additionally, **the main barriers preventing these small companies from expanding their development efforts were reported to be insufficient budgets, limited resources, lack of time and incompatibility with company culture.** These difficulties often escalate later on in the development process as a result of the low level or lack of performance during the pre-development phase, resulting in inadequate use of the sources for advice available, increasing product failure rates and limiting company growth.

Q₃: What is the importance of and attitude towards the pre-development phase with regards to the overall NPD process and the enterprise's product development efforts?

New Zealand manufacturing SMEs were found to focus on the physical activities and that less importance was placed on the pre-development activities today than that placed on similar activities almost two decades ago. **Of the five pre-development activities studied, the preliminary technical analysis was found to be the focus of the participating companies, with relatively lesser emphasis on the four remaining activities.**

The activity of preliminary technical analysis was found to consume, on average, almost one quarter of the overall project time, whereas all the pre-development activities combined consumed around 60 percent of project time. Furthermore, around half of the participating companies considered the effectiveness of their pre-development phase to be excellent and many agreed that the activities involved during this early stage of NPD were moderately important. A level of importance is attached to the pre-development activities, although many do not see the need for formal NPD

or they are not overly concerned about it. The attitude towards the pre-development phase of NPD in New Zealand manufacturing SMEs is therefore poor.

This research investigation has provided an insight into the pre-development phase of NPD within New Zealand manufacturing SMEs. The influential nature of the pre-development activities in determining project outcomes was shown with supporting evidence showing why successfully implementing these activities can lead to product success. The approach taken to NPD and the pre-development phase currently employed by the participating companies work well, however there is still room for major improvements. It appears to be that the pre-development phase, as well as NPD, within New Zealand manufacturing SMEs, is still at an early stage of entering the New Zealand environment, with many of these small companies unaware of the NPD process or they do not have the necessary level of resources. The introduction of a SME specific support program aimed at allowing self-paced learning is likely to increase both the performance of the pre-development phase and the level of NPD applied within New Zealand.

In conclusion, it can be said that the pre-development phase is the basis for the remainder of the NPD process with essential development directions being provided. However, implementation rates are low possibly influenced by the fact that the country's economy and industry is still undergoing development itself. Overall, the SMEs have strong levels of leadership and involvement from management, close relationships with key stakeholders, portrayed an informal and unstructured yet flexible approach to NPD and general business activities whilst focusing on developing products for niche markets. High new product failure rates; over-expenditure of project time; lack of awareness, commitment, and formality; and the high level of difficulty experienced by New Zealand manufacturing SMEs suggests there exists a need for the implementation of better tools and techniques during the pre-development phase. There is probably also a need to get the message regarding the importance of the pre-development phase and NPD out into industry to aid in successful NPD. Similarly, perhaps there is also a need for a more complete pre-development phase incorporating all pre-development activities with greater attention and resources made available within the New Zealand manufacturing industry. This could include adopting the formal rigour at the 'gates' during the development process allowing go-no go decisions to be made as in the Stage-Gate process

presented by Cooper and Kleinschmidt (1986) as well as partnering with universities or other complimentary businesses. This is likely to increase the awareness and attention companies place on NPD in New Zealand as well as increasing the number of the country's SMEs competing at an international level.

5.2. Future Research

Based on the findings, the conclusions, and the recommendations from this research investigation the following areas are suggested for further study:

- The wider impact and financial value of the pre-development activities on the entire product development process.
- Reasons and thinking behind how SMEs determine which pre-development and/or product development activities to implement based on the information they have.
- Difference in NPD approaches amongst market-driven and technology-driven enterprises.
- Techniques to balance the technology and marketing approach and communication.
- How to improve innovation in spite of budgets and time constraints, by leveraging their strengths in communicating with suppliers/distributors and management involvement.
- Study the influence and role of the managing director(s) or CEO(s) in the decision making of NPD in SMEs and compare internationally.

Bibliography

- Abd Rahaman, M. N., & Muhamad, M. R. (2004). The winning new product strategy: market or technology driven?, *International Engineering Management Conference 2004* (pp. 1052-1055): IEEE.
- Allocca, M. A., & Kessler, E. H. (2006). Innovation speed in small and medium-sized enterprises. *Creativity and Innovation Management*, 15(3), 279-295.
- Atuahene-Gima, K. (1995). An exploratory analysis of the impact of market orientation on new product performance: a contingency approach. *Journal of Product Innovation Management*, 12(Sept), 275-293.
- Barclay, I., Dann, Z., & Holroyd, P. (2000). *New product development: a practical workbook for improving performance*. Oxford: Butterworth-Heinemann.
- Behrendt, S., Jasch, C., Constanca Peneda, M., & Van Weenen, H. (1997). *Life cycle design: a manual for small and medium-sized enterprises*. New York: Springer-Verlag Telos.
- Belliveau, P., Griffin, A., & Somermeyer, S. M. (2002). *The PDMA toolbook for new product development*. New York: John Wiley & Sons, Inc.
- Belliveau, P., Griffin, A., & Somermeyer, S. M. (2004). *The PDMA toolbook 2 for new product development*. Hoboken, N.J.: John Wiley & Sons, Inc.
- Boeddrich, H.-J. (2004). Ideas in the workplace: a new approach towards organizing the fuzzy front end of the innovation process. *Creativity and Innovation Management*, 13(4), 274-285.
- Cameron, A. F., & Massey, C. (1999). *Small and medium-sized enterprises: a New Zealand perspective*. Auckland, New Zealand: Longman.
- Campbell, H. (1999). *Knowledge creation in New Zealand manufacturing*. Unpublished master's thesis, Massey University, New Zealand.
- Chetty, S. (1996). The case study method for research in small-and-medium-sized firms. *International Small Business Journal*, 15(1), 73-85.
- Ciccantelli, S., & Magidson, J. (1993). From experience: Consumer idealized design: involving consumers in the product development process. *Journal of Product Innovation Management*, 10, 341-347.
- Cooper, R. G. (1988). Predevelopment activities determine new product success. *Industrial Marketing Management*, 17(3), 237-247.

-
- Cooper, R. G. (1994). New products: the factors that drive success. *International Marketing Review*, 11(1), 60-76.
- Cooper, R. G. (2008). Perspective: the stage-gate idea-to-launch process-update, what's new, and NexGen systems. *Journal of Product Innovation Management*, 25(3), 213-232.
- Cooper, R. G., & Kleinschmidt, E. J. (1986). An investigation into the new product process: steps, deficiencies, and impact. *Journal of Product Innovation Management*, 3(2), 71-85.
- Cooper, R. G., & Kleinschmidt, E. J. (1987). New products: what separates winners from losers? *Journal of Product Innovation Management*, 4(3), 169-184.
- Cooper, R. G., & Kleinschmidt, E. J. (1993). Stage gate systems for new product success. *Marketing Management*, 1(4), 20-29.
- Curran, J., & Blackburn, R. A. (2001). *Researching the small enterprise*. London: Sage Publications.
- Davidson, J. M., Clamen, A., & Karol, R. A. (1999). Learning from the best new product developers. *Research Technology Management*, 42(4), 12-18.
- Department of Labour. (2005). *Decent work - Ministry of Economic Development*. Retrieved 10 October, 2008, from <http://www.dol.govt.nz/services/decentwork/activities/agencies/med.asp>
- Devlin, M. H. (1984). *The small business sector in New Zealand: an introductory perspective*. Wellington, N.Z.: Development Finance Corporation of New Zealand.
- Diegel, O. (2004). *Design breakdown structures: a tool for innovative targeted problem solving in collaborative product development teams*. Unpublished doctoral dissertation, Massey University, New Zealand.
- Edgett, S., Shipley, D., & Forbes, G. (1992). Japanese and British companies compared: contributing factors to success and failure in NPD. *Journal of Product Innovation Management*, 9(1), 3-10.
- Ettlie, J. E., & Rubenstein, A. H. (1987). Firm size and product innovation. *Journal of Product Innovation Management*, 4(2), 89-108.
- Filson, A., & Lewis, A. (2000). Cultural issues in implementing changes to new product development process in a small to medium sized enterprise (SME). *Journal of Engineering Design*, 11(2), 149-157.

-
- Gawith, J., Grigg, N., Shekar, A., & Anderson, A. (2007). Examining the product development process in New Zealand SMEs. *EIASM Conference, Portugal*.
- Griffin, A., & Hauser, J. R. (1992). Patterns of communication among marketing, engineering and manufacturing - a comparison between two new product teams. *Management Science*, 38(3), 360-373.
- Herstatt, C. (2000). A casual model of the impact of the "Fuzzy Front End" on the success of new product development. Hamburg: University of Hamburg.
- Hise, R. T., O'Neal, L., Parsuraman, A., & McNeal, J. U. (1990). Marketing/R&D interaction in new product development: implications for new product success rates. *Journal of Product Innovation Management*, 7(2), 142-155.
- Ho, A. C. M. (2001). *The impact of the Technology New Zealand scheme on small-and-medium enterprises in New Zealand*. Unpublished master's thesis, Massey University, New Zealand.
- Huang, X., Soutar, G. N., & Brown, A. (2002). New product development processes in small and medium-sized enterprises: some Australian evidence. *Journal of Small Business Management*, 40(1), 27-42.
- Inkson, K., Henshall, B., Marsh, N., & Ellis, G. (1986). *Theory K: the key to excellence in New Zealand management*. Auckland, New Zealand: David Bateman.
- Institute of Technology and Engineering. (2004). 183.201 Product innovation process I - study guide. New Zealand: Massey University, New Zealand.
- Jenkins, M. (1997). *The customer centred strategy*. Great Britain: Pitman Publishing.
- Kahn, K. B., Barczak, G., & Moss, R. (2006). Dialogue on best practices in new product development - PERSPECTIVE: establishing an NPD best practices framework. *The Journal of Product Innovation Management*, 23(2), 106-116.
- Karlsson, C., & Olsson, O. (1998). Product innovation in small and large enterprises. *Small Business Economics*, 10(1), 31-46.
- Karol, R., & Nelson, B. (2007). *New product development for dummies*. Hoboken, N.J. : Chichester: John Wiley & Sons, Inc.
- Kerr, G. B. (1994). *A study of the product development practices of small manufacturing companies in New Zealand*. Unpublished master's thesis, Massey University, New Zealand.

-
- Khurana, A., & Rosenthal, S. R. (1998). Towards holistic "Front Ends" in new product development. *Journal of Product Innovation Management*, 15(1), 57-74.
- Kim, J., & Wilemon, D. (2002). Focusing the fuzzy front-end in new product development. *R&D Management*, 32(4), 269-279.
- Koen, P., Ajamian, G., Burkart, R., Clamen, A., Davidson, J., D'Amore, R., et al. (2001). Providing clarity and a common language to the "Fuzzy Front End". *Research Technology Management*, 44(2), 46-55.
- Kruger, J., & Dunning, D. (1999). Unskilled and unaware of it: how difficulties in recognizing one's own incompetence lead to inflated self-assessments. *Journal of Personality and Social Psychology*, 77(6), 1121-1134.
- Larsen, P., & Lewis, A. (2007). How award-winning SMEs manage the barriers to innovation. *Creativity and Innovation Management*, 16(2), 142-151.
- Larsson, J., & Martinkauppi, M. (2004). Customer centric product development, *Case studies of Saab and Sony Ericsson*. Lulea, Sweden: Lulea University of Technology.
- Lynn, G. S., & Akgun, A. E. (1998). Innovation strategies under uncertainty: a contingency approach for new product development. *Engineering Management Journal*, 10(3), 11-17.
- Massey University Human Ethics Committee. (2006). *Human Ethics*. Retrieved May 10, 2007, from <http://humanethics.massey.ac.nz/>
- Maylor, H. (2002). *Project management* (3rd ed.). Harlow: Financial Times Prentice Hall.
- McDonough, E. F., & Barczak, G. (1992). The effects of cognitive problem-solving orientation and technological familiarity on faster new product development. *Journal of Product Innovation Management*, 9(1), 44-52.
- Millson, M. R., Raj, S. P., & Wilemon, D. (1992). A survey of major approaches for accelerating new product development. *Journal of Product Innovation Management*, 9(1), 53-69.
- Mossing, E. (2008). Product Development Path - Development of a supportive method focusing on design rationale: Lulea University of Technology.
- The OECD small and medium enterprise outlook*. (2000). Paris, France: Organization for Economic Co-operation and Development.

-
- Oram, R. (2005, 18 March). Manufacturing: a new model for the global economy. *Financial Times of London*.
- Oram, R. (2007). *Reinventing paradise*. Auckland, New Zealand: Penguin Group.
- Page, A. L. (1993). Assessing new product development practices and performance: establishing crucial norms. *Journal of Product Innovation Management*, 10(4), 273-290.
- Patrick, J. (1997). *How to develop successful new products*. Lincolnwood, Illinois: NTC/Contemporary Publishing Company.
- Pavia, T. M. (1991). The early stages of new product development in entrepreneurial high tech firms. *Journal of Product Innovation Management*, 8(1), 18-31.
- Rainey, D. L. (2005). *Product innovation: leading change through integrated product development*. New York: Cambridge University Press.
- Reinertsen, D. G. (1994). Streamlining the fuzzy front-end. *World Class Design to Manufacture*, 1(5), 4-8.
- Rosenau, M. D., Griffin, A., Castellion, G. A., & Anschuetz, N. F. (1996). *The PDMA handbook of new product development*. New York: John Wiley & Sons, Inc.
- Small and Medium Businesses in New Zealand*. (2004). Wellington: Small Business Advisory Group.
- SMEs in New Zealand: structure and dynamics*. (2007). Wellington, New Zealand: Ministry of Economic Development.
- Smith, P. G., & Reinertsen, D. G. (1998). *Developing products in half the time*. New York: Van Nostrand Reinhold,.
- Souder, W. E., Buisson, D., & Garrett, T. (1997). Success through customer-driven new product development: a comparison of U.S. and New Zealand small entrepreneurial high technology firms. *Journal of Product Innovation Management*, 14(6), 459-472.
- Statistics New Zealand. (2007). *Manufacturing and production*. Retrieved April 16, 2008, from <http://www.stats.govt.nz/economy/industry/manufacturing-and-production.htm>
- Stuart, G. F., & McCulloch, D. G. (1980). *Technology and innovation in the New Zealand manufacturing industry: a discussion paper*. Lower Hutt, N.Z.: Physics and Engineering Laboratory, DSIR.
- Takeuchi, H., & Nonaka, I. (1986). The new new product development game. *Harvard Business Review*, 66(1), 137-146.

-
- Ulrich, K. T., & Eppinger, S. D. (1995). *Product design and development*. Singapore: McGraw-Hill Book Co.
- van Aken, J. E. (2004). Organising and managing the fuzzy front end of new product development. Technische Universiteit Eindhoven, The Netherlands: Department of Technology Management.
- Verganti, R. (1997). Leveraging on systematic learning to manage the early phases of product innovation projects. *R&D Management*, 27(4), 377-392.
- Veryzer, R. W., & Mozota, B. B. d. (2005). The impact of user-oriented design on new product development: an examination of fundamental relationships. *Journal of Product Innovation Management*, 22(2), 128-143.
- Zhang, Q., & Doll, W. J. (2001). The fuzzy front end and success of new product development: a casual model. *European Journal of Innovation Management*, 4(2), 95-112.

Appendices

Appendix I

An Exploration of the Pre-development Phase in New Zealand Small-to-medium Enterprises

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Abstract - Developing successful products is difficult, with few companies being highly successful more than half the time. This presents a significant challenge for a product development team. This research was aimed at exploring the pre-development phase currently employed by small and medium enterprises (SMEs) from the New Zealand manufacturing industry. The purpose was to gauge the understanding and importance of this early stage in product development amongst practitioners from these SMEs, as the literature highlighted this as an area of weakness requiring empirical research. This study involved twenty-two SMEs using a questionnaire survey followed by personal interviews with some of the participants. The study found that the pre-development phase of New Zealand SMEs lacked awareness, commitment, and formality. Difficulties were also associated with carrying out the activities, worsened by the lack of skills in-house to do so.

Keywords - Small-to-medium enterprise, pre-development activities, new product development.

I. Introduction

Products and services are crucial to the success of almost all enterprises [1, 2]. The need for new products is driven by change in technology, increase in competition, changing customer needs, and decreasing product lifecycles [3]. The activity of New Product Development (NPD) is often referred to as the riskiest yet most important challenge [1] for enterprises as the ability to meet customer requirements is often seen as the most essential of all business activities [4].

High failure rates in NPD are very common with most projects failing at the beginning of the development process [5, 6]. Literature cites that the most significant improvements and an increase in the likelihood of product or service success can be achieved through enhancements in the performance of the pre-development activities [7-9].

As New Zealand has an established reputation for innovation as well as a higher than normal proportion of SMEs, most enterprises employ less than 100 employees [10-12], this research set out to investigate the following for New Zealand SMEs:

- 1) The nature and complexity of pre-development activities within the companies.
- 2) The importance and difficulty associated with undertaking the pre-development activities within the companies.

II. LITERATURE REVIEW

There has been a rapid increase in the use of NPD tools, techniques, and processes since the early nineties by companies whose business is based on their innovativeness [13] and by those companies seeking to gain a competitive advantage [6]. The economic success of manufacturing firms depends on their ability to identify the needs of customers and to quickly create products at a low cost to meet these needs. "Achieving these goals is not solely a marketing problem, nor is it solely a design problem or a manufacturing problem, it is a product development problem involving all of these functions" [14].

A. Product Development Process

There have been many variations of the product development process since it was first outlined in the sixties, with the addition of an ever increasing supply of literature and academic research containing references to process models, methods, tools, and techniques which have been developed for guiding, planning, and managing NPD efforts [15]. The innovation process can be divided into three areas: the front end (several other terms are used such as: 'pre-development phase' [16], 'pre-project activities' [17], 'pre-phase 0' [8], or 'discovery' stage [18]), the new product development process, and commercialisation. Attention is increasingly being focused on the vague and indistinct pre-development activities that precede the formal and structured process of the second and third stages of the innovation process in order to increase the value, success probability, and number of high-profit concepts entering product development and commercialisation. A lack of methodical, systematic and structured procedures at the beginning of the innovation process has a substantial detrimental effect on the innovation management of an enterprise.

Enterprises tend to focus more on the activities following the pre-development phase, in which tangible resources are consumed and a large number of different management instruments are available. The pre-development phase or front end is "the messy 'getting started' period of product development" [18], when the product concept is still very unclear. "It generally consists of three tasks: strategic planning, concept generation, and, especially, pre-technical evaluation. These activities are

often chaotic, unpredictable, and unstructured. In comparison, the subsequent new product development process is typically structured, predictable, and formal, with prescribed sets of activities, questions to be answered, and decisions to be made" [18].

Decisions and commitments are made regarding time, finance, and the nature of the product during this initial stage, literally determining the overall outcome of the project before development has even begun [19]. Thus, the pre-development phase is an essential stage in the NPD process as it is often where large amounts of vital project time are consumed, is an area of weakness receiving little management and research attention in SMEs, and is where changes can generally be made at a minimal cost [19, 20].

B. Small and Medium Enterprises

SMEs form the majority of companies in OECD (Organization for Economic Cooperation and Development) economies [21] often being the source of most new jobs, generating a substantial share of GDP, have a greater dependence on their external environment, and are often influenced by the activities in their local community [21, 22].

There is no universal definition used to describe SMEs. "Internationally, firm size is measured in a variety of ways including by numbers of employees, sales figures, and industrial classifications. However, the diverse structures of different economies makes adherence to a single statistical definition unworkable" [21]. The SME categorisation for New Zealand, as defined by Cameron et al. [12] and the New Zealand Ministry of Economic Development [11], suggests that New Zealand SMEs are those companies employing between 0 and 99 staff which is 99.4% of all New Zealand enterprises [11]. Table 1 provides the SME categorisations found in New Zealand, Australia, Europe, the United Kingdom, and the United States of America.

III. RESEARCH METHODOLOGY

The basis of this research was derived from several past studies [4, 10, 23-25]. This study involved a questionnaire survey, carried out over a four-week period, along with interview-style sessions with randomly selected questionnaire respondents enabling both

qualitative and quantitative data to be obtained. SMEs were randomly selected from different sources such as New Zealand business directories and online databases. Due to the sample including SMEs from both the North and South Islands of New Zealand and the need to get a representative overview of the pre-development phase from the New Zealand manufacturing industry, a mail questionnaire survey was thought to be the most appropriate method for gathering the required data, and the one undertaken in this research. This was followed up with face-to-face interviews with product developers from some of the participating companies.

The key areas focused on by the questionnaire survey, based on the literature review, were: enterprise background, internal product development, pre-development phase, and the barriers impeding project outcomes. A trial run of the questionnaire survey was performed with six SMEs from Auckland and Northland regions of New Zealand prior to performing the research with the randomly selected sample. Direct feedback was obtained from trial-run participants where it was found that the questionnaire survey and the accompanying documents were more than adequate for reaching the objectives of this research investigation.

IV. RESULTS

A. Background

New Zealand is known as a nation predominantly made up of SMEs, 99.4% [10-12] spread across all industry sectors [26]. The 22 participating companies were categorised as: 10 small enterprises, 8 micro enterprises, and 4 medium enterprises according to the classification used in New Zealand to define SMEs.

The average percentage of employees having a technical and/or engineering background was 49% and those with a sales and/or marketing background was 16%. These results have been broken down by company size and are shown in Fig. 1. The results portray micro sized manufacturing enterprises consisting, on average, of staff with a technical and/or engineering background. As the company size increases the proportion of staff with a technical and/or engineering background decreases although there is a significant increase in staff having a different background to those being questioned.

TABLE I
INTERNATIONAL DEFINITIONS OF MICRO, SMALL, MEDIUM AND LARGE FIRMS IN TERMS OF NUMBER OF EMPLOYEES

Category	New Zealand		Australia	Europe	U.K	U.S.A
	No. of Employees	*Enterprises %	No. of Employees	No. of Employees	No. of Employees	No. of Employees
Micro	0 to 5	86.9	0 to 5	0 to 10	0 to 9	0 to 9
Small	6 to 49	11.8	6 to 19	11 to 50	10 to 49	10 to 99
Medium	50 to 99	0.7	20 to 200	51 to 250	50 to 249	100 to 499
Large	100+	0.6	200+	250+	250+	500+

*A breakdown of enterprise percent for each category is also provided for New Zealand.

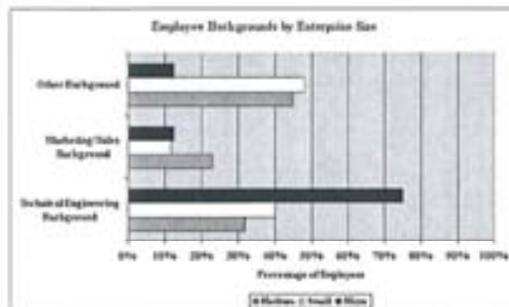


Fig. 1. Employee background according to enterprise size.

Eleven of the companies were involved in primarily serving business-to-business markets, six were involved in primarily consumer markets and five companies were involved in serving both consumer and business-to-business markets.

Annual sales of less than 25 million New Zealand dollars were common in 95% of the participating SMEs which is reflected in a statement made by Oram [27] with regards to small innovative manufacturing and service companies having annual sales of less than 50 million New Zealand dollars. Although these annual sales figures are considerably lower in comparison to that of other countries, the contribution these SMEs make in areas such as exports, gross domestic product, and employment in New Zealand is significant to the country's economy.

B. New Product Development

The research found that 78% of the participating enterprises had either no standard approach to product development or no formally documented process, but follow a clearly understood path of tasks. The remaining 22% utilised a formally documented process where four of the companies incorporated an inter-disciplinary team. Literature suggests that companies can benefit from the use of a formal product development process, increasing the likelihood of a successful market launch [23, 28]. Booz-Allen and Hamilton [29] found, as a result of their research, that the most successful companies made use of a recognised development process used in a systematic way with set stages being completed in a structured way.

Recent research by Kahn et al. [25] found that "formalised processes may not improve communication and decision making, and in fact, may slow the process and reduce innovation" which was reflected in the findings of this current research. Statements made by some of the interviewees supported these findings:

"We aren't disciplined enough when applying our development process - we don't stick to it, this causes delays and errors."

"Sometimes too restrictive, we use ours as a guideline but don't do every step or task in every project."

"We have difficulty in keeping to it. At times it is easier just to ignore it."

Clearly, the use of a formal NPD process for the development of new products is by no means enough to ensure success but it is apparent that the lack of a formal process, or more precisely, the pre-development phase, generally has a negative effect on the innovation management of an enterprise [30] as well as the outcome of the project.

The NPD process models used by the participating SMEs are summarised in Table II. Only a basic description of the process used by the company was asked for as the research focused on the pre-development phase. The data showed that just over one quarter of the participants do not have a NPD model in place for their development efforts. Fifteen SMEs provided examples or descriptions of processes similar to that of the 13-stage model presented by Cooper and Kleinschmidt [31]. However, when these results were analysed further with the responses from the interview sessions it was evident that the majority of the processes had portions missing.

Table III provides the tabulated results for the departments which initiated NPD. The two dominant departments from this research were found to be Management and Marketing having 40% percent and 31% of the responses respectively. The dominance of these two departments in SMEs was found to be a common practice according to the literature with owner/managers becoming too involved in projects.

C. Pre-development Phase

The pre-development activities were investigated based on past research by Cooper and Kleinschmidt [31], Kerr[4], Campbell [23], and Ho [24]. On average, all the participating SMEs from the current study completed the five pre-development activities. However, almost half of these companies appeared to be omitting all or some of the activities during their NPD endeavours. The findings were a reflection of Campbell's study [23] and were further supported by these responses made by some of the interview participants:

"Most companies don't grasp the entire concept of NPD and the steps this process involves (if done correctly). Or they don't see the benefit in doing so."

TABLE II
NPD PROCESS MODELS USED

Type of Process	Frequency	Percentage
None	6	27%
List	8	36%
Flow Chart	7	32%
Stage Gate	1	5%
Total	22	100%

TABLE III
DEPARTMENTS INITIATING NEW PRODUCT DEVELOPMENT

Department	Size	Frequency	Overall	Percentage
R&D	Micro	0	1	3%
	Small	1		
	Medium	0		
Product Development	Micro	0	2	6%
	Small	2		
	Medium	0		
Engineering	Micro	1	3	9%
	Small	1		
	Medium	1		
Management	Micro	4	14	40%
	Small	9		
	Medium	1		
Marketing	Micro	3	11	31%
	Small	4		
	Medium	4		
Other	Micro	4	4	11%
	Small	0		
	Medium	0		

"Knowledge of the market by the company personnel is high this allows more confidence in product launches and an ability to skip steps if necessary."

"New Zealand is very small, so launch costs for a new product are not overly high and excluding corporate advertising budget, it is not expensive to launch ten products and have three fail, two succeed really well, and the rest be average."

Participants were asked to mark what they considered the importance of the initial screening, preliminary market assessment, preliminary technical analysis, detailed market research, and business/financial analysis activities on the five point scale provided. The results are presented and compared with Kerr's [4] research in Fig.2.

Overall, the level of importance for each activity suggests that the majority of participants in the current study see the pre-development phase as being relatively important. The activities that were considered to be of most relevance by New Zealand manufacturing SMEs were initial screening and business/financial analysis with the least relevant being detailed market research. Research by Barclay et al. [28] found that the importance of product development has been greatly recognized with an increase in its usage however, the comparison between the current research and that done by Kerr [4] suggests that there has been very little change in the perceived relevance of the five pre-development activities questioned.

The responding SMEs were asked to best describe the techniques used during their pre-development activities. The common responses received included; individual and sometimes group evaluation of ideas; product drawings and specifications; market and competitor analysis; costs and sales forecasting; and direct contact with customers, suppliers, and distributors. The general attitude of New Zealand companies appears to be that of concentrating on establishing potential sales volumes for the product prior to project decisions and commitments being made.

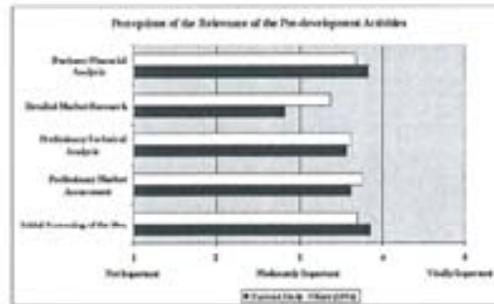


Fig. 2. Relevance of the pre-development activities.

The results to the overall project time spent on the pre-development activities found that the initial idea screening used up 11% of project time, 9% for the preliminary market assessment and a further 9% on detailed market research, 23% on the preliminary technical analysis, and 10% on the business/financial analysis. The combined average of time spent on these activities by the participants was 62%, approximately 14% higher than the average duration for the companies examined by Smith and Reinersent [19].

The participants were asked to rate the effectiveness of the pre-development phase within their company. Just less than half, 45%, agreed that the effectiveness of their pre-development phase was excellent. Although this may be true, the large number of participants without a formal NPD process and the difficulties and limitations they associated with performing these activities suggests otherwise.

The collated responses in Table IV portray the degree of difficulty the SMEs have when identifying opportunities as well as identifying and translating customer needs into ideas, giving reason to skip these early activities as they are considered to be too difficult. Qualitative responses from the interview sessions depict the views of the SMEs with regards to the NPD process:

"[We] require more market research, focus groups, and detailed market analysis".

"Have a structured process but need to sort out a better one".

"We need a better filter for bright ideas".

TABLE IV
DEGREE OF DIFFICULTY WITH CRITICAL TASKS

Response	Identifying Customer Needs	Translation of Customer Needs	Opportunity Identification
	Frequency	Frequency	Frequency
Low	4	6	1
Medium	10	9	5
High	7	5	14
Total	21	20	20

"We are continually improving our NPD process".

V. CONCLUSIONS

The pre-development phase is the basis for the remainder of the NPD process with essential development directions being given. High new product failure rates; over expenditure of project time; lack of formality, awareness, and commitment; and the high level of difficulty experienced by the New Zealand manufacturing SMEs suggest there exists a need for better tools and techniques for the pre-development phase to aid successful NPD. The study draws attention to improving the opportunity analysis sub-stage, as it was perceived to be important but most difficult for companies to undertake. The above are just a few of the reasons why more effort and consideration should be placed on the pre-development phase, even more so with the cost increasing when mistakes are made later in development.

REFERENCES

- [1] R. G. Cooper and E. J. Kleinschmidt, "New Products: What Separates Winners from Losers?," *Journal of Product Innovation Management*, vol. 4, pp. 169-184, 1987.
- [2] J. Patrick, *How to Develop Successful New Products*. Lincolnwood, Illinois: NTC/Contemporary Publishing Company, 1997.
- [3] M. D. Rosenau, A. Griffin, G. A. Castellion, and N. F. Amschaez, *The PDMA Handbook of New Product Development*. New York: John Wiley & Sons, Inc., 1996.
- [4] G. B. Kerr, *A study of the product development practices of small manufacturing companies in New Zealand: a thesis presented in partial fulfilment of the requirements for the degree of Master of Technology in Product Development at Massey University*, 1994.
- [5] R. G. Cooper, "Predevelopment Activities Determine New Product Success," *Industrial Marketing Management*, vol. 17, pp. 237-247, 1988.
- [6] Q. Zhang and W. J. Doll, "The fuzzy front end and success of new product development: a casual model," *European Journal of Innovation Management*, vol. 4, pp. 95-112, 2001.
- [7] C. Herstatt, "A Casual Model of the Impact of the 'Fuzzy Front End' on the Success of New Product Development," University of Hamburg, 2000.
- [8] A. Khurana and S. R. Rosenthal, "Towards Holistic 'Front Ends' In New Product Development," *Journal of Product Innovation Management*, vol. 15, pp. 57-74, 1998.
- [9] J. Kim and D. Wilemon, "Focusing the Fuzzy Front-end in New Product Development," *R&D Management*, vol. 32, pp. 269-279, 2002.
- [10] J. Gurwith, N. Grigg, A. Shekar, and A. Anderson, "Examining the Product Development Process in New Zealand SMEs," *EIASM Conference*, vol. Portugal, 2007.
- [11] *SMEs in New Zealand: Structure and Dynamics*: Ministry of Economic Development, 2007.
- [12] A. F. Cameron and C. Massey, *Small and medium-sized enterprises: a New Zealand perspective*. Auckland, N.Z.: Longman, 1999.
- [13] J. M. Davidson, A. Clamen, and R. A. Karol, "Learning from the Best New Product Developers," *Research Technology Management*, vol. 42, pp. 12-18, 1999.
- [14] K. T. Ulrich and S. D. Eppinger, *Product Design and Development*. Singapore: McGraw-Hill Book Co., 1995.
- [15] E. Mossing, "Product Development Path - Development of a supportive method focusing on design rationale," Lulea University of Technology, 2008.
- [16] R. G. Cooper, "New Products: The Factors that Drive Success," *International Marketing Review*, vol. 11, pp. 60-76, 1994.
- [17] R. Verganti, "Leveraging on systematic learning to manage the early phases of product innovation projects," *R&D Management*, vol. 27, pp. 377-392, 1997.
- [18] P. Belliveau, A. Griffin, and S. Somermeyer, *The PDMA Toolbook for New Product Development*. New York: John Wiley & Sons, Inc., 2002.
- [19] P. G. Smith and D. G. Reinersent, *Developing products in half the time*. New York: Van Nostrand Reinhold, 1998.
- [20] P. Koen, G. Ajamian, R. Burkart, A. Clamen, J. Davidson, R. D'Amore, C. Elkins, K. Herald, M. Incorvia, A. Johnson, R. Karl, R. Seibert, A. Slavejkov, and K. Wagner, "Providing Clarity and a Common Language to the 'Fuzzy Front End'," *Research Technology Management*, vol. [G E T], 2001.
- [21] *The OECD small and medium enterprise outlook*. Paris, France: Organization for Economic Co-operation and Development, 2000.
- [22] C. Karlsson and O. Olsson, "Product Innovation in Small and Large Enterprises," *Small Business Economics*, vol. 10, pp. 31-46, 1998.
- [23] H. Campbell, M.Tech, *Knowledge creation in New Zealand manufacturing: a thesis presented in partial fulfilment of the requirements for the degree of Master of Technology in Product Development at Massey University / Hamish Campbell*, 1999.
- [24] A. C. M. Ho, *The impact of the Technology New Zealand scheme on small-and-medium enterprises in New Zealand: a thesis presented in partial fulfilment of the requirements for the degree of Masters of Technology in Product Development at Massey University*, 2001.
- [25] K. B. Kahn, G. Barczak, and R. Moss, "Dialogue on Best Practices in New Product Development - PERSPECTIVE: Establishing an NPD Best Practices Framework," *Journal of Product Innovation Management*, vol. 23, pp. 106-116, 2006.
- [26] M. H. Devlin, *The small business sector in New Zealand: an introductory perspective*. Wellington, N.Z.: Development Finance Corporation of New Zealand, 1984.
- [27] R. Oram, "Manufacturing: A new model for the global economy," in *Financial Times of London*, 2005.
- [28] I. Barclay, Z. Dann, and P. Holroyd, *New product development: a practical workbook for improving performance*. Oxford: Butterworth-Heinemann, 2000.
- [29] Booz-Allen and Hamilton, "Management of New Products." NY: Booz-Allen and Hamilton, Inc., 1968.
- [30] H.-J. Boeddrich, "Ideas in the Workplace: A New Approach Towards Organizing the Fuzzy Front End of the Innovation Process," *Creativity and Innovation Management*, vol. 13, pp. 274-285, 2004.
- [31] R. G. Cooper and E. J. Kleinschmidt, "An Investigation into the New Product Process: Steps, Deficiencies, and Impact," *Journal of Product Innovation Management*, vol. 3, pp. 71-85, 1986.

Appendix II



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15 May 2007

Pre-development Activities in the Small-to-Medium Enterprise Sector

To whom it may concern,

I am writing to you to ask for your assistance in research I am conducting into how **Small-to-Medium Enterprises (SMEs) approach the pre-development phase of product development**. This research forms the basis of my thesis and will enable me to complete my Masters degree. This study is therefore private research and has not been initiated by, nor does it involve, Government or any other agency or board.

The research project aims at investigating the pre-development activities of New Zealand SMEs. This area is **one which is not so widely known** therefore, I am interested to gauge the understanding and the importance of this early stage in NPD within New Zealand. The results of the research will be analysed and tools and/or suggestions will be made as a means of aiding New Zealand SMEs.

If you agree to take part in the research, could you please complete the accompanying consent form and questionnaire and then return those using the self addressed envelope provided. In addition to the consent form and questionnaire, an information sheet is enclosed which provides an overview of the research project and the participants rights.

All companies that agree to participate have the option of choosing if they would like to receive a brief summary and comments on the overall results (This option is provided as the contact details of the company are optional). This will **provide comparisons with industry norms and suggestions that may help SMEs improve their product development process**.

Thank you for your attention and I hope that you will take the time to complete and return the questionnaire. If you require any further information, do not hesitate to call me. I welcome any information or comment from the business sector.

Yours faithfully

A handwritten signature in blue ink, appearing to read 'Warren Baier'.

Warren Baier
Product Development Masters Student

Pre-development Activities Success in the Small-to-Medium Enterprise Sector

PARTICIPANT CONSENT FORM

This consent form will be held for a period of five (5) years

I have read the Information Sheet and have had the details of the study explained to me. My questions have been answered to my satisfaction, and I understand that I may ask further questions at any time.

I agree to participate in this study under the conditions set out in the Information Sheet.

If you would like to receive a brief summary of the results as discussed in the covering letter, please provide an address below.

** Denotes a required field.*

Signature*: Date*:

Full Name*:

Company Name:

Telephone:

Postal Address:
.....
.....

Yes/No (Please circle one), please contact us as we would like to help by providing feedback on this pilot study questionnaire via:

- Email, please provide:
- Telephone, please provide:
- In person, the participant named above will be contacted to make arrangements.

Alternatively, you are welcome to contact the researcher or the supervisors (see information sheet for details)

Please return the completed documents *WITHIN 21 DAYS* of receiving them.

Pre-development Activities Success in the Small-to-Medium Enterprise Sector

INFORMATION SHEET

Product Development is the initiating, developing, testing, and introducing to the market new or improved products or services (Rosenau et al., 1996). The **failure rate of new or improved products or services is estimated at well over 90 percent**, all seemingly good products and services, but torpedoed by the unforgiving consumer (Patrick, 1997). However, it is known that the **most significant improvements of products or services can be achieved through enhancements in the performance of the front end activities** which in turn results in the success rate increasing exponentially.

The research is aimed at **comparing the Front End Activities of the Product Development processes of Customer-Driven and Technology-Driven Small-to-Medium Enterprises (SMEs) in New Zealand**. Focus will be placed on the techniques and methods currently utilised within New Zealand industries, where the analysis of the findings will be used to determine if a relationship(s) exists between product/service success and failure. As a result the research will attempt to develop some techniques and/or suggestions for helping New Zealand and world-wide enterprises to utilise their Product Development resources to their fullest potential.

Procedures:

The research will be carried out in two parts. Part one will involve a pilot study to gain a better understanding of the research area. Part two will involve a brief questionnaire survey to a broader range of companies that are involved in product development.

Data Collection:

Data Collection for Pilot Study Companies (Part One)

The pilot study is intended to use the questionnaire to provide feedback for final developments/changes for the second phase of the research project, the main questionnaire. The questionnaire process is expected to take approximately **10 minutes to complete**. Where additional time may be required if the participant accepts to provide feedback.

Data Collection for the Questionnaire Survey Companies (Part Two)

The second phase of research, **the questionnaire**, will utilise a broader range of companies. The focus will be on companies in the product development, manufacturing, and production industries. Questionnaire surveys will involve numerical 'tick-the-box', mark on a scale, and short answer format. The questionnaire should take roughly **10 minutes to complete**.

Use of Data:

The collected information will mostly be analysed quantitatively, though some qualitative analysis will be undertaken, and conclusions for improvements in pre-development activities for New Zealand SMEs will be drawn.

Confidentiality:

The interviews for the pilot studies and the questionnaire surveys **will be conducted under the strictest confidentiality**. Companies can provide the researcher with information on the understanding that it will be confidential to the people responsible for the research project listed in the section "People Responsible for Research" below.

Company names and other information, which could enable identification of the companies concerned, will not be published. It will not be possible to identify your company in the thesis or in any reports that emerge from the research.

Upon the completion of the project, **all key information will be retained in electronic form for a period of six months.** The consent form will be held for a period of five years. After these periods the information will be destroyed.

Rights of Participants:

You are under no obligation to accept this invitation. If you decide to participate, you have the right to:

- Decline to answer any particular question;
- Withdraw from the study (specify timeframe);
- Ask any questions about the study at any time during participation;
- Provide information on the understanding that your name will not be used unless you give permission to the researcher;
- Be given access to a summary of the project findings when it is concluded.

People Responsible for Research:

Researcher

Warren Arthur Baier
Product Development Masters Student (Master of Engineering)
Ph. 021 250 7778
Email: warren.baier@gmail.com

Supervisor

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Email: A.Shekar@massey.ac.nz

Supervisor

Professor Olaf Diegel
Faculty of Design & Creative Technologies - Auckland University of Technology
Ph. +64 9 921 9485
Email: Olaf.Diegel@aut.ac.nz

If you have any further questions please do not hesitate to contact the researcher or the supervisors.

This project has been evaluated by peer review and judged to be low risk. Consequently, it has not been reviewed by one of the University's Human Ethics Committees. The researcher(s) named above are responsible for the ethical conduct of this research.

If you have any concerns about the conduct of this research that you wish to raise with someone other than the researcher(s), please contact Professor Sylvia Rumball, Assistant to the Vice-Chancellor (Ethics & Equity), telephone 06 350 5249, email humanethics@massey.ac.nz.

Pre-development Activities Success in the Small-to-Medium Enterprise Sector

Questionnaire Survey – Pilot Study

Introduction:

This survey has been designed to gain an insight into your company's product development activities, technological capability and innovation.

Some questions may not apply to your company. In these cases simply:

- a. Leave blank if requires a check mark or a mark on a scale or,
- b. Simply respond N/A.

Please be assured that all answers and comments made in this survey will be treated in strictest confidence.

Product Development: The overall process of strategy, organization, concept generation, product and marketing plan creation and evaluation, and commercialization of a new product.

Pre-development/Front End: Precedes the more formal product development process, it generally consists of three tasks: strategic planning, concept generation, and, especially, pre-technical evaluation. These activities are often chaotic, unpredictable, and unstructured.

Confidentiality:

The interviews for the pilot studies and the questionnaire surveys **will be conducted under the strictest confidentiality**. Companies can provide the researcher with information on the understanding that it will be confidential to the people responsible for the research project.

Company names and other information, which could enable identification of the companies concerned, will not be published. It will not be possible to identify your company in the thesis or in any reports that emerge from the research.

Upon the completion of the project, **all key information will be retained in electronic form for a period of six months**. The consent form will be held for a period of five years. After these periods the information will be destroyed.

Please return the completed documents **WITHIN 21 DAYS** of receiving them.

PILOT STUDY NOTE: PLEASE feel free to add comments/feedback if applicable.

Section A: Background

1. Please identify the type of **market served** by the company:

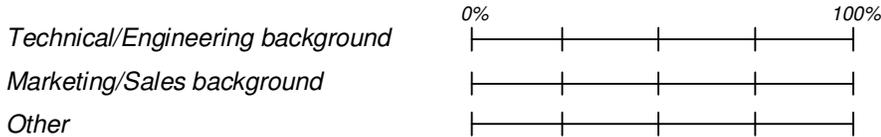
- Primarily Consumer Markets
- Primarily Business-to-Business Markets
- Both Consumer and Business-to-Business Markets
- Other, please specify: _____

2. Please describe the industry competing in (e.g. food, electronics, etc.): _____

3. Approximately, what is the **size of the company** in terms of number of employees?

- 0 – 5 Staff
- 6 – 49 Staff
- 50 – 99 Staff
- 100+ Staff

4. What **percentage of the company staff** has a:



5. Please indicate the company's **annual sales**:

- < NZ\$25 Million (M)
- NZ\$25 M to < NZ\$100 M
- NZ\$100 M to < NZ\$500 M
- NZ\$500 M to < NZ\$1 Billion (B)
- NZ\$1 B or more

6. How would you describe the **company's relationship with** the following? (Check all that is relevant)



Section B: Internal Product Development

1. Please tick the box that **most closely describes the company's Product Development process**:

- No standard approach** to new product development.
- While **no formally documented process** is followed, we **follow a clearly understood path of tasks** to be completed in product development.
- We **have a formally documented process** where one function completes a set of tasks, then passes the results on to the next function, which completes another set of tasks.
- We **have a formally documented process** where a **cross-functional team** completes a set of tasks; management reviews the results and gives the go-ahead for the team to complete the next set of cross-functional tasks.

2. Which department is usually **initiating the Product Development**? (Check all that is relevant)

- R&D
- Product Development
- Engineering
- Management
- Marketing
- Other, please specify: _____

3. Briefly **describe** the company's **Product Development process** (Flowcharts, etc. are welcome (Space is provided below)).

Space to draw flowchart, etc. (Can leave blank).

4. New products/product features come about through (Check all that is relevant):

- New ideas/technology developed within the company (Internal)
- Suppliers, customers or through research in market gaps
- "Me too" products (Copy of competitor(s) product)
- Other, please specify: _____

5. Product planning is the responsibility of (check one):

- An individual
- One department
- Group comprising a mix of different departments
- Entire company

Section C: The Front End

1. How are your new products ideas generated?

- Actively generated by formally planned activities** (such as brainstorming, competitor analysis, customer observation, etc.).
- Actively generated by informal activities.**
- Come **without prompting from a wide variety of people.**

2. A **breakdown of the pre-development activities often performed** during the development process is listed below. Please consider the last couple of products introduced to the market by the company and **indicate if the company used the activities listed**. Also **indicate how relevant you believe the use of the various activities is** to Small-to-Medium Enterprise development efforts:

	Not Important	Moderately Important	Vitaly Important
<input type="checkbox"/> Initial Screening of the Idea (The initial decision where it was first decided to allocate funds to the proposed new product idea)	----- ----- ----- -----		
<input type="checkbox"/> Preliminary market assessment (An initial market assessment)	----- ----- ----- -----		
<input type="checkbox"/> Preliminary technical analysis (An initial appraisal of the technical merits of the project)	----- ----- ----- -----		
<input type="checkbox"/> Detailed market research (Involving a reasonable sample, formal design, and collection method)	----- ----- ----- -----		
<input type="checkbox"/> Business/Financial Analysis (Leading to go/no-go decision)	----- ----- ----- -----		

3. Which of the following tools/techniques are **included in the initial stage of the company's Product Development process?** (Check all that is relevant)

- Idea generation (i.e. Brainstorming, etc.) (Please answer question 3a.)
- Idea screening (Please answer question 3b.)
- Assessment of the market
- Assessment of technology
- Assessment of the competition
- Product definition
- Project justification
- Action plan (Project Planning, etc.)
- Use of customer orientated tools (i.e. QFD, VoC, Focus groups, sales-representative data, etc.)

3a. The ideas were **generated by an interdisciplinary team?**

Strongly Disagree	Strongly Agree
----- ----- ----- -----	

3b. The ideas were **selected by an interdisciplinary team?**

Strongly Disagree	Strongly Agree
----- ----- ----- -----	

4. Please rate the **effectiveness of the Front End activities** within the company:

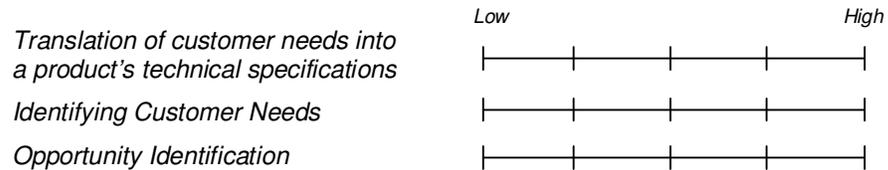
Poor	Good	Excellent
----- ----- ----- -----		

5. For the company's product development activities, what is the **balance between Engineering/R&D, and Marketing** in terms of which function dominates (Please select one):

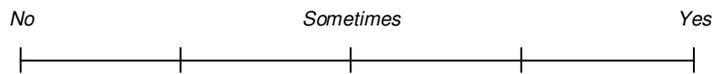
- Almost all Engineering/R&D with little, if any, input from Marketing
- 50% Engineering/R&D input and 50% Marketing input
- Almost all Marketing with little, if any, input from Engineering/R&D

Section D: Technology/Market

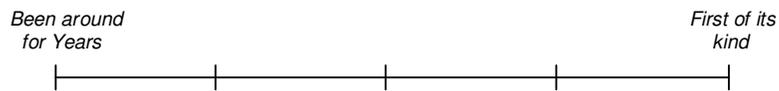
1. Within the company, what is the degree of difficulty in the following areas:



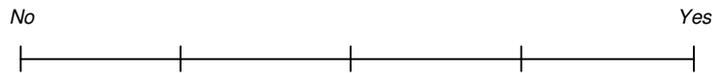
2. Does the target market or customers differ between projects?



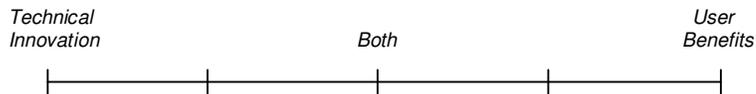
3. How new is the technology (of the product) to the company?



4. Are the **core benefits of the company's main product range based on technology**?

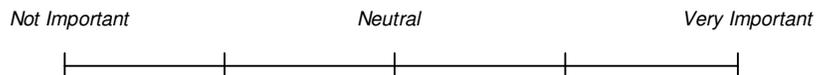


5. Are the **core benefits of the company's main product range derived from**?

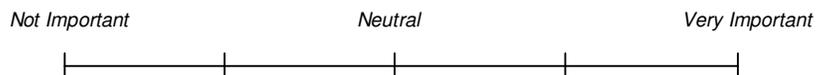


6. How important are your products':

a. **Market related criteria?**



b. **Technical criteria?**



Section E: Outcomes

1. Approximately how many **new products have been commercialised** by the company over the **past 5 years**? _____

2. How much do you agree that the following statements describe your company?

a. Our product development program meets the performance objectives set out for it

Strongly Disagree Strongly Agree

b. Overall, our product development program is a success

Strongly Disagree Strongly Agree

c. The communication within the project team is excellent:

Strongly Disagree Strongly Agree

d. Products developed during the last 5 years have been commercially successful:

Strongly Disagree Strongly Agree

3. What factors do you feel contribute to the success/failure of your company's most recent projects? (i.e. Communication, company culture, etc.) What would you do differently next time?

4. What prevents your company from adopting more product development tools/techniques?

- Insufficient budget
- The cost does not seem to be justified by the benefit
- Too difficult to implement from a technical perspective
- Too difficult to implement from a resource, culture, and/or process perspective
- Requires too much training
- Lack of awareness
- Lack of understanding
- Lack of time
- Not knowing how or when to get information
- Bad experience with product development or similar tools/techniques
- Other, please specify: _____

Thank you for your time and assistance!

Appendix III



Warren Baier
School of Technology and Engineering
Massey University
Albany

Ph: 021 250 7778
Email: warren.baier@gmail.com

26 June 2007

Pre-development Activities in the Small-to-Medium Enterprise Sector

To whom it may concern,

I am writing to you to ask for your assistance in research I am conducting into how **Small-to-Medium Enterprises (SMEs) approach the pre-development phase of product development**. This research forms the basis of my thesis and will enable me to complete my Masters degree. This study is therefore private research and has not been initiated by, nor does it involve, Government or any other agency or board.

The research project aims at investigating the pre-development activities of New Zealand SMEs. This area is **one which is not so widely known** therefore, I am interested to gauge the understanding and the importance of this early stage in NPD within New Zealand. The results of the research will be analysed and tools and/or suggestions will be made as a means of aiding New Zealand SMEs.

If you agree to take part in the research, could you please complete the accompanying consent form and questionnaire and then return those using the self addressed envelope provided. In addition to the consent form and questionnaire, an information sheet is enclosed which provides an overview of the research project and the participants rights.

All companies that agree to participate have the option of choosing if they would like to receive a brief summary and comments on the overall results (This option is provided as the contact details of the company are optional). This will **provide comparisons with industry norms and suggestions that may help SMEs improve their product development process**.

Thank you for your attention and I hope that you will take the time to complete and return the questionnaire. If you require any further information, do not hesitate to call me. I welcome any information or comment from the business sector.

Yours faithfully

A handwritten signature in blue ink, appearing to read "Warren Baier".

Warren Baier
Product Development Masters Student

Pre-development Activities in the Small-to-Medium Enterprise Sector

PARTICIPANT CONSENT FORM

This consent form will be held for a period of five (5) years

I have read the Information Sheet and have had the details of the study explained to me. My questions have been answered to my satisfaction, and I understand that I may ask further questions at any time.

I agree to participate in this study under the conditions set out in the Information Sheet.

If you would like to receive a brief summary of the results as discussed in the covering letter, please provide an address below.

** Denotes a required field.*

Signature:*

.....

Date:*

.....

Full Name:*

.....

Company Name:

.....

Telephone:

.....

Postal Address:

.....

.....

Please return the completed documents **WITHIN 28 DAYS** of receiving them.

Pre-development Activities in the Small-to-Medium Enterprise Sector

INFORMATION SHEET

Product Development is the initiating, developing, testing, and introducing to the market new or improved products or services (Rosenau et al., 1996). The **failure rate of new or improved products or services is estimated at well over 90 percent**, all seemingly good products and services, but torpedoed by the unforgiving consumer (Patrick, 1997). However, it is known that the **most significant improvements of products or services can be achieved through enhancements in the performance of the front end activities** which in turn results in the success rate increasing exponentially.

The research is aimed at **comparing the Pre-development Activities of the Product Development processes of New Zealand manufacturing Small-to-Medium Enterprises (SMEs)**. Focus will be placed on the techniques and methods currently utilised within New Zealand manufacturing industry, where the analysis of the findings will be used to gauge the understanding and importance during this phase of the NPD process. As a result the research will attempt to develop some techniques and/or suggestions for helping New Zealand and world-wide enterprises to utilise their Product Development resources to their fullest potential.

Procedures:

The research will be carried out in two parts. Part one will involve a pilot study to gain a better understanding of the research area. Part two will involve a brief questionnaire survey to a broader range of companies that are involved in product development.

Data Collection:

Data Collection for Pilot Study Companies (Part One)

The pilot study is intended to use the questionnaire to provide feedback for final developments/changes for the second phase of the research project, the main questionnaire. The questionnaire process is expected to take approximately **20 minutes to complete**. Where additional time may be required if the participant accepts to provide feedback.

Data Collection for the Questionnaire Survey Companies (Part Two)

The second phase of research, **the questionnaire**, will utilise a broader range of companies. The focus will be on companies in the product development, manufacturing, and production industries. Questionnaire surveys will involve numerical 'tick-the-box', mark on a scale, and short answer format. The questionnaire should take roughly **20 minutes to complete**.

Use of Data:

The collected information will mostly be analysed quantitatively, though some qualitative analysis will be undertaken, and conclusions for improvements in pre-development activities for New Zealand SMEs will be drawn.

Confidentiality:

The interviews for the pilot studies and the questionnaire surveys **will be conducted under the strictest confidentiality**. Companies can provide the researcher with information on the understanding that it will be confidential to the people responsible for the research project listed in the section "People Responsible for Research" below.

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Upon the completion of the project, **all key information will be retained in electronic form for a period of six months.** The consent form will be held for a period of five years. After these periods the information will be destroyed.

Rights of Participants:

You are under no obligation to accept this invitation. If you decide to participate, you have the right to:

- Decline to answer any particular question;
- Withdraw from the study (specify timeframe);
- Ask any questions about the study at any time during participation;
- Provide information on the understanding that your name will not be used unless you give permission to the researcher;
- Be given access to a summary of the project findings when it is concluded.

People Responsible for Research:

Researcher

Warren Arthur Baier
Product Development Masters Student (Master of Engineering)
Ph. 021 250 7778
Email: warren.baier@gmail.com

Supervisor

Doctor Aruna Shekar
Institute of Technology and Engineering, Massey University
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Email: A.Shekar@massey.ac.nz

Supervisor

Professor Olaf Diegel
Faculty of Design & Creative Technologies - Auckland University of Technology
Ph. +64 9 921 9485
Email: Olaf.Diegel@aut.ac.nz

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Pre-development Activities in the Small-to-Medium Enterprise Sector

Questionnaire Survey

Introduction:

This survey has been designed to gain an insight into your company's product development activities, technological capability and innovation.

Some questions may not apply to your company. In these cases simply:

- c. Leave blank if requires a check mark or a mark on a scale or,
- d. Simply respond N/A.

Please be assured that all answers and comments made in this survey will be treated in strictest confidence.

Product Development: The overall process of strategy, organization, concept generation, product and marketing plan creation and evaluation, and commercialization of a new product.

Pre-development/Front End: Precedes the more formal product development process, it generally consists of three tasks: strategic planning, concept generation, and, especially, pre-technical evaluation. These activities are often chaotic, unpredictable, and unstructured.

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Please return the completed documents **WITHIN 28 DAYS** of receiving them.

NOTE: PLEASE feel free to add further comments/feedback if applicable.

Section A: Background

1. Please identify the type of **market served** by the company:

- Primarily Consumer Markets
- Primarily Business-to-Business Markets
- Both Consumer and Business-to-Business Markets
- Other, please specify: _____

2. Please describe the industry competing in (e.g. food, electronics, etc.): _____

3. In number of years, **how long has the company been operating?** _____

4. Approximately, what is the **size of the company** in terms of number of employees?

- 0 – 5 Staff
- 6 – 49 Staff
- 50 – 99 Staff
- 100+ Staff

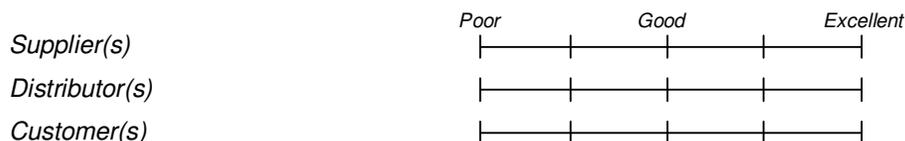
5. What **percentage of the company staff** has a (Place a mark on the scale):



6. Please indicate the company's **annual sales**:

- < NZ\$25 Million (M)
- NZ\$25 M to < NZ\$100 M
- NZ\$100 M to <NZ\$500 M
- NZ\$500 M to < NZ\$1 Billion (B)
- NZ\$1 B or more

7. How would you describe the **company's relationship with** the following? (Check all that is relevant by placing a mark on the scale)



Section B: New Product Development

1. Please tick the box that **most closely describes the company's Product Development process**:

- No standard approach** to new product development.
- While **no formally documented process** is followed, we **follow a clearly understood path of tasks** to be completed in product development.
- We **have a formally documented process** where one function completes a set of tasks, then passes the results on to the next function, which completes another set of tasks.
- We **have a formally documented process** where a **cross-functional team** completes a set of tasks; management reviews the results and gives the go-ahead for the team to complete the next set of cross-functional tasks.

2. Which department is usually **initiating the Product Development**? (Check all that is relevant)

- R&D
- Product Development
- Engineering
- Management
- Marketing
- Other, please specify: _____

4. New products/product features come about through (Check all that is relevant):

- New ideas/technology developed within the company (Internal)
- Suppliers, customers or through research in market gaps
- "Me too" products (Copy of competitor(s) product)
- Other, please specify: _____

5. Product planning is the responsibility of (Check one):

- An individual
- One department
- Group comprising a mix of different departments (inter-disciplinary team)
- Entire company

6. Please indicate **the company's main source of advice for Product Development** (including pre-development) **advice**:

- Bank Manager
- Accountant
- Lawyer
- Trade Associations
- Local Councils
- Business Development Board
- Private Consultants
- Universities
- Local Large Company(s)
- Local Small Company(s)
- Outside Individual
- Research Institute
- Other, please specify: _____

Section C: The Front End/Pre-Development

1. How are your new products ideas generated (Check all that is relevant)?

- Actively generated by formally planned activities** (such as brainstorming, competitor analysis, customer observation, etc.).
- Actively generated by informal activities.**
- Come **without prompting from a wide variety of people.**

2. A **breakdown of the pre-development activities often performed** during the development process is listed below. Please consider the last couple of products introduced to the market by the company and **indicate the approximate percentage of overall project time spent on each activity (if the company used the activities listed)**. Also **indicate how relevant you believe the use of the various activities is** to Small-to-Medium Enterprise development efforts:

Time spent (% of Project)		Not Important	Moderately Important	Vitaly Important
%	Initial Screening of the Idea (The initial decision where it was first decided to allocate funds to the proposed new product idea)	----- ----- ----- -----		
%	Preliminary market assessment (An initial market assessment)	----- ----- ----- -----		

%	Preliminary technical analysis <i>(An initial appraisal of the technical merits of the project)</i>	----- ----- ----- -----
%	Detailed market research <i>(Involving a reasonable sample, formal design, and collection method)</i>	----- ----- ----- -----
%	Business/Financial Analysis <i>(Leading to go/no-go decision)</i>	----- ----- ----- -----

3. For the company's product development activities, what is the **balance between Engineering/R&D, and Marketing** in terms of which function dominates (Please select one):

- Almost all Engineering/R&D with little, if any, input from Marketing
- 50% Engineering/R&D input and 50% Marketing input
- Almost all Marketing with little, if any, input from Engineering/R&D

4. Which of the following tools/techniques are **included in the initial stage of the company's Product Development process**? (Check all that is relevant)

- Idea generation (i.e. Brainstorming, etc.) (Please answer question 4a.)
- Idea screening (Please answer question 4b.)
- Assessment of the market
- Assessment of technology
- Assessment of the competition
- Product definition
- Project justification
- Action plan (Project Planning, etc.)
- Use of customer orientated tools (i.e. QFD, VoC, Focus groups, sales-representative data, etc.)

4a. The ideas were **generated by an inter-disciplinary team** (a team of individuals with skills from different disciplines that focuses on the same task or project)?

Strongly Disagree Strongly Agree

|-----|-----|-----|-----|

4b. The ideas were **selected by an interdisciplinary team**?

Strongly Disagree Strongly Agree

|-----|-----|-----|-----|

5. Please rate the **effectiveness of the Front End/Pre-development activities** within the company:

Poor Good Excellent

|-----|-----|-----|-----|

Section D: Technology/Market

1. Does the target market or customers differ between projects?

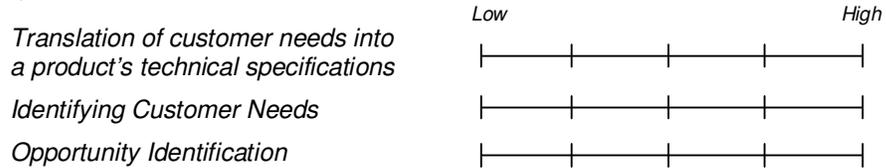
No Sometimes Yes

|-----|-----|-----|-----|

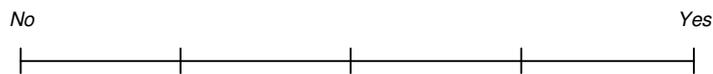
2. How new is the technology (of the product) to the company?



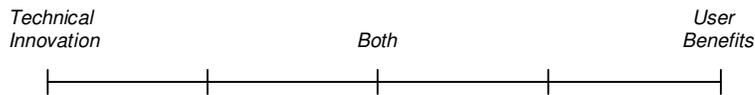
3. Within the company, what is the degree of difficulty in the following areas (Place a mark on the scale):



4. Are the **core benefits of the company's main product range based on technology?**

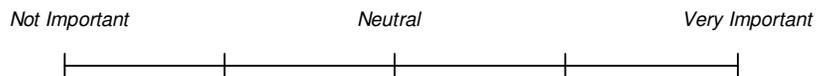


5. Are the **core benefits of the company's main product range derived from?**

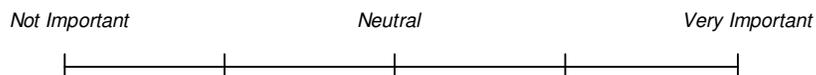


6. How important are your products':

a. **Market related criteria?**



b. **Technical criteria?**



Section E: NPD Performance and Barriers

1. Approximately how many **new products have been commercialised** by the company over the **past 5 years**? _____

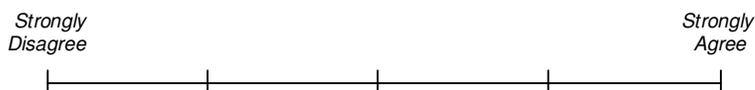
a. What is the approximate average development time of these new products?

2. How much do you agree that the following statements describe your company?

a. Our product development program meets the performance objectives set out for it



b. Overall, our product development program is a success



c. *The communication within the project team is excellent:*

Strongly Disagree Strongly Agree

d. *Products developed during the last 5 years have been commercially successful:*

Strongly Disagree Strongly Agree

3. *What factors do you feel contribute to the success/failure of your company's most recent projects? (i.e. Communication, company culture, etc.) What would you do differently next time?*

4. *What prevents your company from adopting more product development tools/techniques?*

- Insufficient budget*
- The cost does not seem to be justified by the benefit*
- Too difficult to implement from a technical perspective*
- Too difficult to implement from a resource, culture, and/or process perspective*
- Requires too much training*
- Lack of awareness*
- Lack of understanding*
- Lack of time*
- Not knowing how or when to get information*
- Bad experience with product development or similar tools/techniques*
- Other, please specify: _____*

Thank you for your time and assistance!

Appendix IV

Pre-development Phase in NZ Manufacturing SMES

Interview Guide

What would you consider reasons for SMEs having low performance levels and/or difficulties in implementing the pre-development activities?

The questionnaire survey results show NZ SMEs perform the marketing related activities well but struggle in the other three activities.

The use of techniques/methods during the pre-development activities were well perceived. Could you please be more specific in what techniques, tools, methods your company uses during this phase?

ROI, brainstorming, competitor analysis, etc.

What are your thoughts on SMEs benefiting from the use of a formal NPD process? What are your thoughts on SMEs having/not having a documented NPD process?

If there was a resource available, designed specifically for NZ SMEs, would your company consider using such a resource?

Access to tools, techniques, methods, information, advice, etc.

Are there any other concerns/comments you would like to make regarding this topic/research project?

Thank you for your time!

Appendix V

Question	What Was Asked/Reference to Question	Quantity	Per Cent
A1	Primarily consumer markets	8	27%
	Primarily business-to-business markets	11	30%
	Both consumer and business-to-business markets	5	23%
		22	
A2	Plastic/Rubber	7	27%
	Other	8	31%
	Electronics	4	18%
	Food	4	18%
	Agriculture	3	12%
		26	
A3	0 - 5 Years	5	20%
	6 - 10 Years	2	11%
	11 - 20 Years	2	11%
	21 - 30 Years	5	20%
	31 - 40 Years	2	11%
	41 - 50 Years	0	0%
	51 - 60 Years	3	10%
		19	
A4	Micro	9	36.4%
	Small	10	41.5%
	Medium	4	15.2%
	Large	4	15.2%
		22	1.00
A6	< \$25 Million	21	81%
	\$25 M to < \$100 M	4	16%
	\$100 M to < \$500 M	0	0%
	\$500 M to < \$1 Billion	1	4%
	\$1 B or more	0	0%
		26	
B1	No standard approach	3	14%
	No formally documented process - follow a clearly understood path of tasks	14	64%
	Formally documented process	1	5%
	Formally documented process - cross-functional team	4	18%
		22	
B2	R&D	2	6%
	Product Development	4	9%
	Engineering	3	7%
	Management	16	36%
	Marketing	15	33%
	Other	5	11%
		45	
B4	Within the company	13	32%
	Suppliers, customers, etc.	21	51%
	Me Too	6	16%
	Other	1	2%
		41	
B5	An individual	3	10%
	One department	1	6%
	Group	11	36%
	Entire company	5	26%
		20	
B6	Bank Manager	0	0%
	Accountant	0	0%
	Lawyer	3	16%
	Trade Associations	0	0%
	Local Councils	0	0%
	Business Development Board	0	0%
	Private Consultants	5	25%
	Universities	1	5%
	Local Large Company(s)	0	0%
	Local Small Company(s)	1	5%
	Outside Individual	0	0%
	Research Institute	2	10%
	Other	6	40%
		20	
	C1	Actively generated by formally planned activities	9
Actively generated by informal activities		15	41%
Without prompting from a wide variety of people		13	36%
		37	
C3	Almost all engineering/R&D with little input from marketing	8	32%
	50% engineering/R&D and 50% marketing	16	64%
	Almost all marketing with little input from engineering/R&D	1	4%
	25		
C4	Idea generation	15	11%
	Idea screening	10	13%
	Assessment of the market	21	18%
	Assessment of technology	17	12%
	Assessment of the competition	19	14%
	Product definition	14	10%
	Project justification	15	11%
	Action plan	12	9%
	Use of customer oriented tools	7	5%
		136	Overall
	B4	Insufficient budget	10
Cost not justified by benefit		2	8%
Too difficult to implement (technical)		0	0%
Too difficult to implement (resource/culture)		4	10%
Requires too much training		2	5%
Lack of awareness		3	7%
Lack of understanding		2	5%
Lack of time		8	19%
Not knowing how or when to get information		1	2%
Bad experience with tools/techniques		0	0%
Other		10	24%
		42	

Appendix VI

Need identified in discussion with end user/consultant or distributor
 Need checked with other distributors
 Technical architecture designed and rough cost estimated.
 Further discussion with distributors to find price point
 Technical design further developed.
 If costing still looks OK business case made to BOB
 Govt chart drawn up & development commenced.

Space to draw flowchart, etc. (Can leave blank)

Idea - search market and if product exist
 we don't continue.
 design -
 trial
 E.P. Protection
 marketing.
 pretty basic really !!

welcome - space is provided below. Alternatively you can photocopy a copy.

Customer's unfulfilled need identified
 Potential market assessed (ad hoc)
 Prototype feasibility assessed
 prototype created ✓
 customer testing
 refinement of prototype
 customer testing
 require manufacturing processes identified refined
 product manufactured

welcome (Space is provided below)

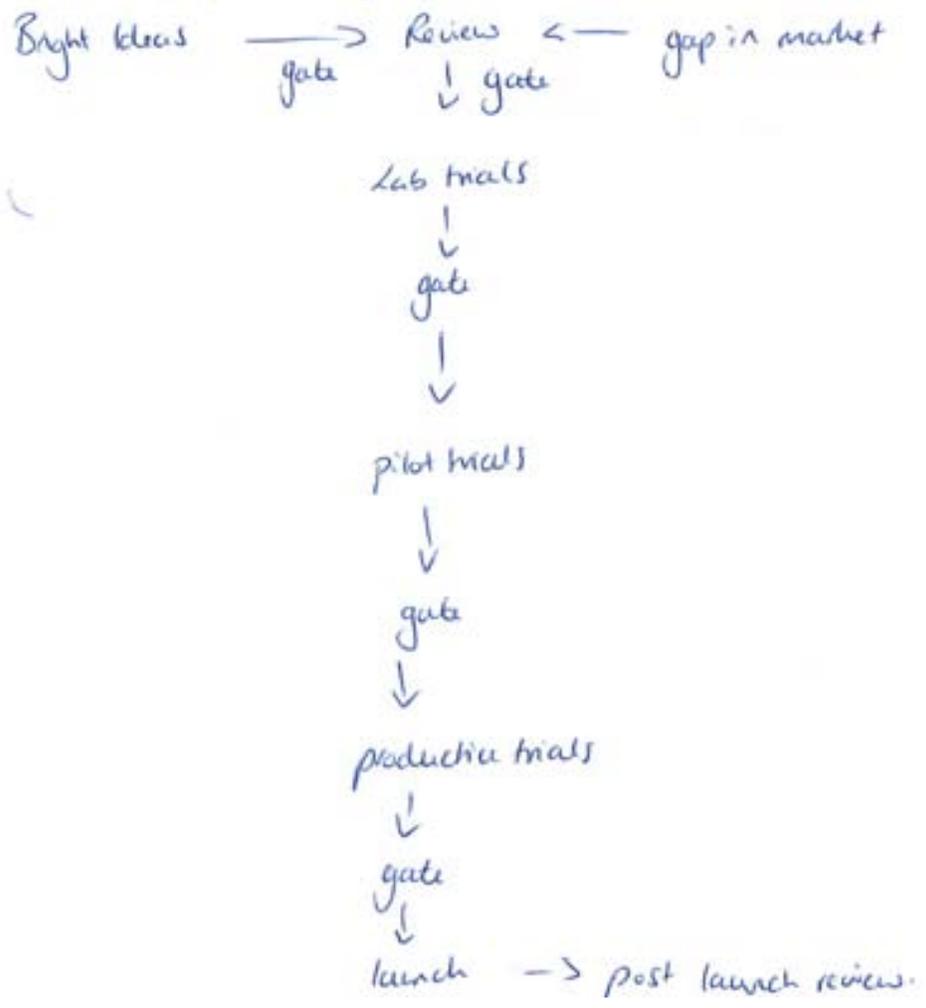
- ① Market research via internet and retail shelves for new and
 existing products that would fit or exceed.
- ② Research if possible - then look at how to make them better by
 improving the way, or look for gaps in market or own views
- ③ make samples
- ④ select packaging, select design - put all together for a retail product.

- (1) MARKET TO BE SATISFIED
- (2) DESIGN A BETTER, MORE EFFICIENT, LOWER COST METHOD OF
 MEETING MARKET EXPECTATIONS
- (3) INVOLVE TEAM OF POTENTIAL USERS OF PRODUCT & SEEK THEIR
 VIEWS ON FEATURES REQUIRED/IMPROVEMENTS DESIRED
- (4) REFINED DESIGN AND WHERE EVER POSSIBLE STANDARDISE ON
 EXISTING COMPONENTARY, JIGS, MOULD, PROCESSES.
- (5) MAKE PROTYPE & HAVE TEAM IN (3) EVALUATE
- (6) COST IN DETAIL PRODUCT & ESTABLISH MARKET PRICE/PROFIT MARGINS
- (7) DISPLAY PRODUCT AT FERIA'S, SHOWS, RETAIL OUTLETS & OBTAIN FEEDBACK/EVALUATE

Space to draw flowchart, etc. (Can leave blank)

- (8) * ENGAGE WITH IMPROVEMENTS TO DESIGN ETC FOLLOWING
 CUSTOMER USE & FEEDBACK FROM USERS & RETAILERS

- CLIENT INQUIRY
- ASSESS PRODUCT VIABILITY
- MARKET RESEARCH - ON GOING PRODUCT POTENTIAL
- MANUFACTURE SAMPLING FOR CLIENT APPROVAL
- SUBMIT FOR COMPLIANCE TEST.
- TOOLING
- MANUFACTURE.



Space to draw flowchart, etc. (Can leave blank).

Evaluation of projects from customer.



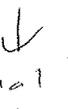
Selection of which to be produced.



Design product (TOD).



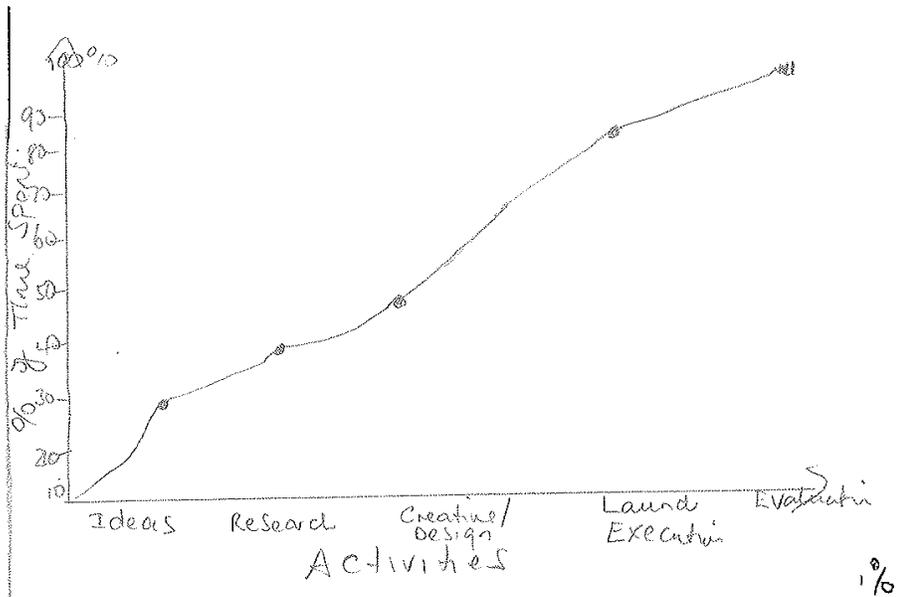
Make model



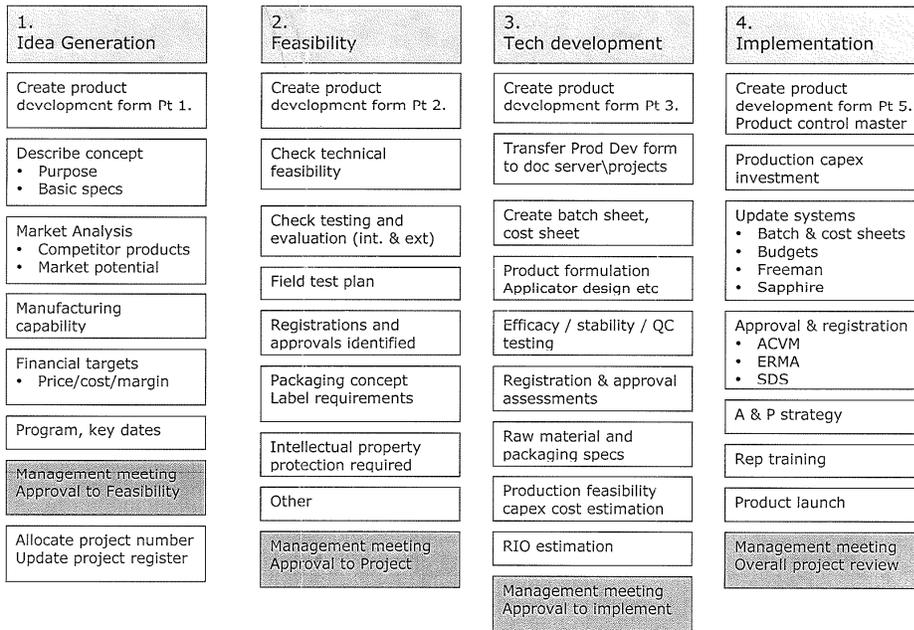
Trial TOD



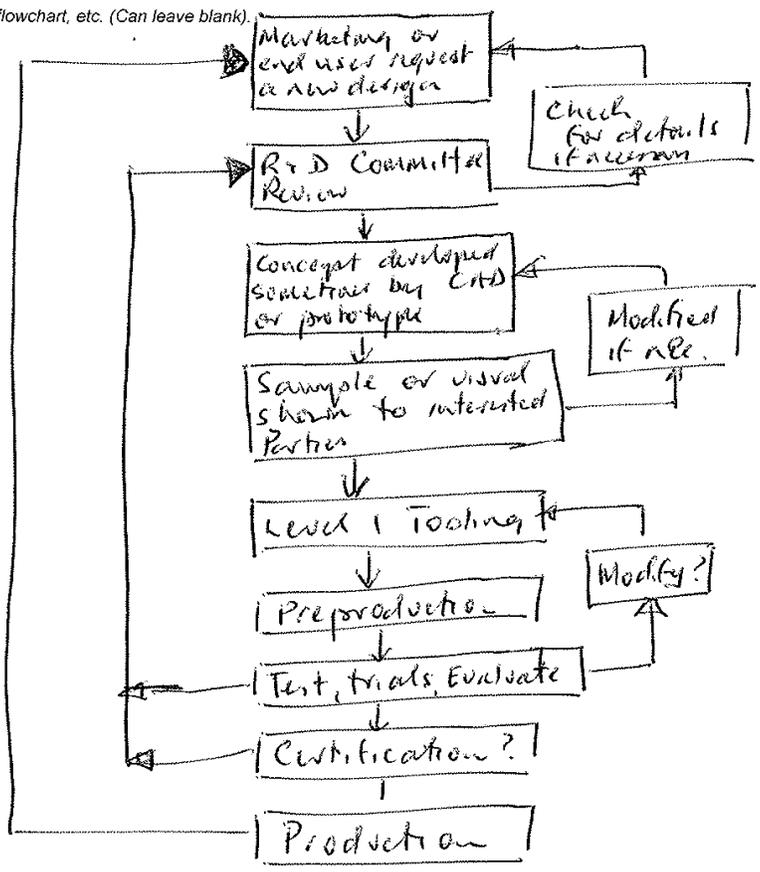
Make product



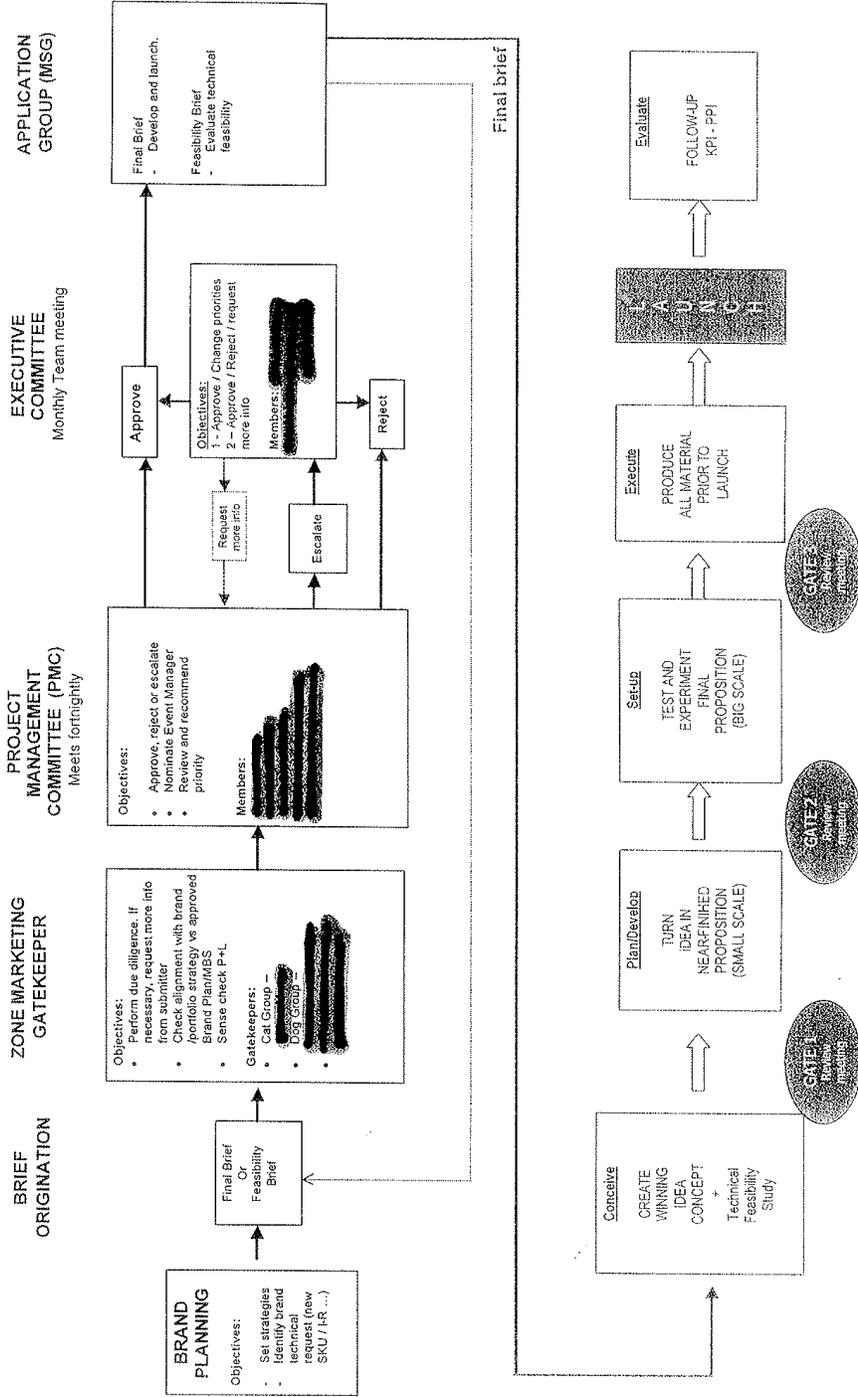
Product Realisation Top Down Flow chart



space to draw flowchart, etc. (Can leave blank).



Project Management Process



Section 13.0 Product Development

13.1 New Product Development Model

Overview:

To outline how new products are developed within Hubbard Foods Ltd. This model applies to all Hubbard brand products manufactured by Hubbard Food Ltd. Private label development is conducted according to their specifications. The Product Development Manager is responsible for this procedure

Procedure:

New products development is conducted following the basic flow-chart:



Idea Generation:

Ideas are sourced from both internal and external sources. e.g. customers, competitors, trends in other categories.

Product Development Brief:

This is prepared by the Sales & Marketing Manager and includes the following as necessary

- Market background information – information keys competitors
- Product description
- Brand name
- Packing – size, type, format
- Target market
- Key requirements – nutritional, flavour, texture
- Target cost price / sales price
- Research requirements
- Time – frame
- Budget – development, research, launch

Concept Development:

This involves a circular feedback loop to develop the key aspects of the product:

- Product formulation – preparing lab scale samples and assessing for taste, texture, appearance.

- Sourcing new raw materials as necessary
- Packaging determining type of inner rates packaging –packet, doy pack, film bag size of package for a given net weight.
- Concept artwork – initial design
- Initial costing
- Market research – may be conducted on a qualitative basis

Finalise Concept:

This involves confirmation of the parameters including:

- Product name – determined via brainstorming sessions
- Product formulation – product trials to confirm recipe and process parameters, production documentation (Refer to section 13.9 Recipes, Design, Control and Changes)
- Ingredient list and nutritional panel – laboratory testing or software analysis as required (refer to 13.2.2 Nutritional Claims Requirements)
- Packing – format, size (refer to First Packing Check Sheet.doc)
- Shelf life analysis (refer to 13.10 Shelf life verification)
- Nutrition claims confirmation – laboratory testing, National Heart Foundation Tick endorsement as required
- Artwork – retail pack and shipper – including all legal requirement – Food Standards Code, Fair Trading Act, Weights & Measures and other as appropriate (refer to 13.2.3 Standard Shipper Artwork Requirement - Standard Packet Artwork Requirements)
- Product costing – cost price, sales price, net contribution margin
- Product specification – new material, packing, finished good (refer to 13.6 Finished Products Specifications)
- Universal Buying Form (UBF) (refer to 13.3 Universal Buying Form - UBF)
- Barcode Generation and EAN verification (refer to 13.4 Barcodes generation & 13.4.1 Barcode verification)
- Bill of materials (refer to 13.5 Bill of Materials)
- Market research

Product Launch:

This involves the following:

- First production run (refer to First Packing Check Sheet.doc)
- Samples – for trade presentations and sales team
- Communication of new product:
 - All staff – communication meeting, company newsletter
 - Clipboard
 - Consumer services
 - Twin Agencies

Review:

After a period of time (12 months), the following are reviewed:

- Sales history

Product Development Process

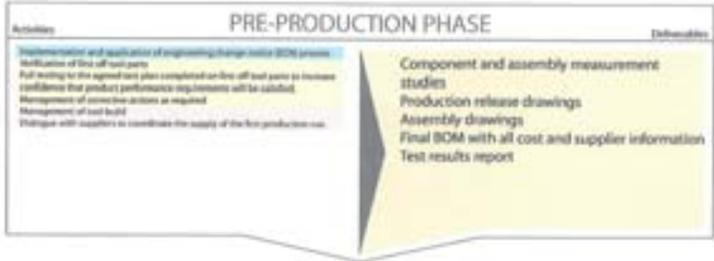
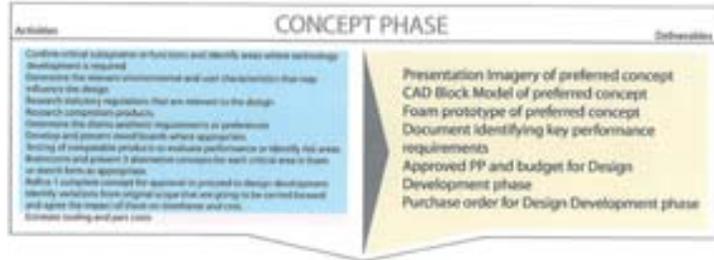


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for Privacy**

Design

Verify

Supply



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PROCESS

Stage One - Design Brief

Research:

- View and analyse existing products
- Review and analyse suitable materials and processes from which the product is to be manufactured
- Consult with you as to specific design and market constraints
- Liase with suitable manufacturers to isolate specific problem areas likely to arise in the design

Working Brief:

- Analyse findings of research to establish working brief. Written confirmation of working brief is required at the end of Stage One for the project to continue.

Stage Two - Design Development

Concept Development:

- Analysis of working brief
- Determine process and materials to be used
- Perform an ergonomic evaluation to determine optimum assembly servicing and user operation requirements
- Prepare concept drawings
- Do form studies within materials and processes constraints to obtain aesthetically pleasing appearance
- Prepare presentation drawings of concepts
- Prepare technical drawings suitable for rough quotations for manufacture of proposal

Design Proposal:

- Submit to you final design proposal at a working meeting

Stage Three - Final Design

Modifications:

- Make any changes to design based on Stage Two assessment
- Changes are also incorporated based on information received from favoured outside suppliers and manufacturers

Technical Drawings:

- Modify and prepare drawings. Drawings to be checked and approved by you and by any favoured manufacturers

Prototype/Model Making Supervision:

- Liase with you during assembly stages and testing of prototype or model

