AN EVALUATION OF THE PRODUCT DEVELOPMENT PARTNERSHIP PROGRAMME BETWEEN NEW ZEALAND BUSINESSES AND INSTITUTE OF TECHNOLOGY AND ENGINEERING, MASSEY UNIVERSITY

A thesis presented in partial fulfilment of the requirements

for the degree of Master of Technology

in Product Development at Massey University

SHIRLEY SIAW-HUI LIM

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ABSTRACT

This masterate thesis, *An Investigation of The Effectiveness of the Product Development Partnership Programme Between New Zealand Businesses and Massey University,* is the final report of a masters research undertaken throughout New Zealand from mid 2000 to mid 2001. The primary purpose of this research was to evaluate the Product Development Partnership Programme (PDPP) at Massey University from 1997 to 1999. The study intends to provide an in-depth understanding of (i) the PDPP, (ii) its design and management, and (iii) the survey outcomes to the client companies and Massey University.

A nation-wide self-administered survey was mailed to fifty-five New Zealand companies who had sponsored student projects from 1997 to 1999. The total survey sample accounted for the survey analysis was reduced to forty-six as a result of seven surveys returned with apologies of being unable to participate and two were returned uncompleted. An overall response rate of 48% was achieved by contacting the companies prior to the full-scale mail-out and follow-up calls when the deadline of returning the survey was drawing near and/or had past. A series of case study interviews with the selected mail survey respondents was conducted following the nation-wide mail-out. The objective for the interviews was to gain more depth and clarification on some of the answers given in the survey.

This thesis contributes new knowledge for the reason that, in spite of being almost a decade since the PDPP was first introduced at Massey University, no formal and/or comprehensive study has been undertaken to measure its performance. Other than meeting the domestic needs, this thesis would also be able to satisfy the international needs and interests on Product Development practice that incorporates the student-client relationship in the academic domain.

Results of this study show that more than three-quarters of the respondent companies carry out all the thirteen common stages in Product Development process, either formally or informally. The percentage of Product Development usage in the respondent companies was much higher in this research compared to studies conducted in related area and subject. Yet, the results also showed that all but one client company's utilisation of Product Development practice remained unaffected by their involvement in the PDPP. This was due to the insufficient time to introduce such a sophisticated system to companies untrained to it and with limited financial and human resources. It needs to be reminded that improving the client company's PD process or helping them to install a new PD process is not the objective of the PDPP. Companies of limited financial and human resources were mainly those of micro and small to medium-sized enterprises (SMEs) which were accounted for 73% (6 micro enterprises and 10 SMEs) of the total responses returned.

According to 95% of the mail survey respondents "consumer research information" was the most useful among the nine benefits listed in the questionnaire. The number of businesses favouring marketing research and marketing research information indicated that New Zealand companies are increasingly acknowledging the importance and usefulness of marketing research information in new product development (NPD). Overall, 68% of the survey respondents rated the information gathered and skills learned through the PDPP useful. Besides providing the client companies with information and skills useful to them, PDPP also gave them the opportunities and assistance needed to test the product concepts and reach commercialisation quicker.

Analysis of the survey found that student's ability and performance, and communication with students were the main obstacles to the progress of the project. The same aspects were also found to be the top three most important factors to Product Development projects. This thus demonstrated that project barriers and factors important to Product Development project were inter-related with each other.

The majority of the respondent companies considered "helping student and university" as their main objective to joining the partnership programme. Other notable objectives from the client companies' point of view on the joint-partnership project included economical reason to get a potential project underway and gaining access to research expertise. When asked about their opinion of the concept of working with Massey through the partnership project, all of the case study companies supported the concept. On top of that they also believed that the Programme is beneficial for both the student to gain practical experiences and assist them in testing the new product concepts quickly leading to economic benefits.

Overall, though there are improvements such as project scope that matches the student's ability and project timeframe, resources availability, and communication to be made in order to be continually successful, PDPP had received satisfying reception and recognition from the responded client companies. The recognition received from the client companies was based on the assistance given to the new projects, project benefits received which included information gained and skill learned, and to some also included project commercialisation.

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TABLE OF CONTENTS

Commentary ...

- Coverage

Statistics New Zealand conducts an Annual Business Frame Update Survey (AFUS) in mid-February each year, primarily to update the information held on Statistics New Zealand's Business Frame. The frame provides a list of businesses used for selecting populations for Statistics New Zealand's business surveys. The survey results are also used to produce statistics on changes in the number, type and location of businesses in New Zealand, i.e. the 'demography' of New Zealand business. The reference date for the annual statistics is February. Analyses can be undertaken using a range of variables including geographic area, industry, institutional sector, business type, overseas ownership, and employment levels.

In order to understand what business demographic statistics measure, it is important to put into context the businesses covered in the analysis. An enterprise is defined as a legal entity engaged in the provision of goods and/or services, or set up with the intention of providing goods and/or services, which earns income and/or incurs expenses. Enterprises can range from a sell-employed lawn-mowing contractor to large corporations such as Telecom or Fletcher Challenge.

The initial source of information about enterprises is the Inland Revenue Department client registration file. There are currently over 520,000 taxpayers registered for the Goods and Services Tax (GST).

The analysis of business demographics is limited for pragmatic reasons to those enterprises whose data is regularly maintained on Statistics New Zealand's Business Frame. These enterprises are termed 'economically significant'. At February 2000, there were 285,404 economically significant non-agricultural enterprises. Although they represent only 50 percent of enterprises on the IRD client registration file, they are estimated to represent over 99 percent of non-agricultural GST sales.

The Business Frame maintains data for enterprises that meet at least one of the following criteria:

- greater than $30,000 annual GST expenses or sales
- more than two full-time equivalent paid employees
- in a GST-exempt industry (except for residential property leasing and rental)
- part of a group of enterprises
- registered for GST and involved in agriculture or forestry.

Enterprises in agricultural production (ANZSIC A01) are not regularly maintained on the Business Frame and are therefore excluded from the business demographic statistics.

There are currently 72,000 enterprises in agricultural production held on the Business Frame.

All GST-registered enterprises recorded on the IRD client registration file are continually monitored to determine if they meet the 'economic significance' requirements for 'birth' onto the Business Frame. A buffer zone of $25,000 to $35,000 has been established to prevent enterprises switching excessively from 'economically significant' to 'economically insignificant'. The enterprises maintained on the Business Frame represent the target population from which Statistics New Zealand's economic surveys are selected.

- Limitations

There are a numbers of limitations with the business demographic data. These limitations include non-coverage of 'small' enterprises that fall below the $30,000 turnover threshold and exclusions of enterprises in agricultural production (as mentioned above), lags in recording businesses that have ceased trading or their activity has dropped below the $30,000 threshold, and difficulties in maintaining industrial and business classifications for smaller firms.

An enterprise which is outside the population scope for any of Statistics New Zealand's postal surveys is ceased on the Business Frame once it deregisters for GST or files 12-months of consecutive zero GST-returns.

Enterprises that are not part of a group of enterprises and have no paid employees are not covered by the postal AFUS. These enterprises do not currently have their industry and business classifications updated.

- Number of enterprises and geographic units

Excluding agricultural production, the number of economically significant enterprises at February 2000 was 285,404. The number of local or 'geographic units' attached to these enterprises was 313,563.

- Enterprises and geographic units by industry

There were 89,470 enterprises classified in property and business services at February 2000. This represents almost one third of all enterprises recorded in business demography, but accounts for only 13.0 percent of full-time equivalent persons engaged. By contrast, manufacturing accounts for 7.4 percent of all enterprises and 16.7 percent of full-time equivalent persons engaged. The smallest industry group in terms of the number of enterprises is electricity, gas and water supply with 149 enterprises.

Number of Enterprises by Industry

LIST OF EXHIBITS AND FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS AND ACRONYMS USED IN THE TEXT

PD	Product Development
NPD	New Product Development
PDPP	Product Development Partnership Programme
SPSS	Statistical Package for Social Sciences
SMEs	Small and Medium-sized Enterprises
MSMEs	Micro, Small and Medium-sized Enterprises
LOs	Large Organisations
ITE	Institute of Technology and Engineering
MUHEC	Massey University Human Ethic Committee
BAH	Booz, Allen and Hamilton
ROI	Return On Investment
R&D	Research and Development
MIT	Massachusetts Institute of Technology
LFM	Leaders for Manufacturing
SDM	System Design and Management
IIT	Illinois Institute of Technology
IPRO	Interprofessional Project

Chapter 1

INTRODUCTION

1.1 INTRODUCTION

The business environment is dynamic and is changing rapidly with the introduction of new technologies, innovation and the constantly evolving consumer needs. To remain competitive, effective and profitable, the company's management and product development process must change with the changing situation (Griffin, 1997). New product introduction continues to be a critical business activity of all companies, whether they are goods or service providers, or whatever the size of the company. Successful modification and implementation of the Product Development (PD) processes will help to speed a new product from the product development stage to the final product for the marketplace.

Massey University recognises the importance of the product development process and has a Product Development Partnership Programme (PDPP) with a number of companies since early 1990s whereby the 4th year PD major students get involved in a product development activity with a company as part of their training. This study uses this relationship with these companies as an opportunity to study aspects of their PD process and also to evaluate the PDPP at Massey.

1.2 PRODUCT DEVELOPMENT PRACTICE

Product Development is a multi-disciplinary practice. Development of successful products requires the combined skills of research design, marketing, technology and management.

The PD process is a set of activities beginning with the perception of a market opportunity and ending in the production, sale, and delivery of the product. Some organisations follow a well-defined formal PD process, while some use informal processes or have no systematic process at all. Different activities or steps may be used in the same organisation for different types of product projects. There are many models illustrating the PD process which include such key tasks as: generating and evaluating new product ideas, concepts testing and development, and market testing of products to commercialisation. Ulrich and Eppinger (2000) published a six stages generic Product Development process consisting of the stages of *Planning, Concept Development, Detail Design, Testing and Refinement*, and *Production Ramp-Up*. In the last three decades, the trends in New Product Development (NPD) have moved from functional and department-by-department sequential approaches to the more recently developed shorter cycle of multi-functional approaches.

Booz, Allen and Hamilton (BAH) conducted the first of several studies focused on investigating issues associated with New Product Development practices in 1968 with a second wave of research in 1982. Their 1968 report stated that the most successful companies were those that utilised a systematic process in the development of new products. In the 1968 report they also published a six-stage Product Development process model they had developed (refer Exhibit 2-1 in Chapter 2, p.28). This Product Development model consists of *Exploration, Screening, Business Analysis, Development, Testing and Commercialisation*. In their follow-up research in 1982, a seventh stage, *New Product Strategy*, was added to the front end of the six-stage process developed in 1968. This new stage was added to highlight the recognition and importance of using a strategy in the development and introduction of new products. Following BAH's investigation in 1968, other notable studies, an expanded research in Product Development practices have been undertaken, these including research from Earle (1971), Crawford (1983), Cooper and Kleinschmidt (1986), Moore (1987), to the more recent studies by Snelson and Hart (1991), Page (1993), Griffin (1997), and McDougal and Smith (1999).

A Product Development model (Exhibit 2-12) developed by Shekar in 1996 (published by Lim et al in 1999) illustrates the multi-functional relationship of finance, technical/manufacturing and marketing as a simultaneous process. The model incorporating the student-client relationship also highlights the interdependence, iterative and concurrent nature of activities. The Product Development Partnership Programme of the Institute of Technology and Engineering (ITE) at Massey University has been following this model in the last seven years. The Partnership Programme involves a Bachelor of Technology student working on an eight-month product development project with an industrial sponsor. Aspects such as the sequence of activities and responsibilities of the Product Development team, nature of periodic decision-making and outcomes, and approximate time-scales are outlined clearly in this model.

Massachusetts Institute of Technology (MIT) and Stanford University in the United States of America and Salford University in England are other institutes or universities offering similar commercial Product Development project programmes. Majority provides to each group of students a Product Development project, while the PDPP provides each student with one project with a company, encouraging a closer partnership between the individual student and the company. Further discussion on similar partnership programmes offered by other overseas institutes or colleges will be made in Chapter 2 – Literature Review.

1.3 PRODUCT DEVELOPMENT MAJOR AT MASSEY UNIVERSITY

Product Development is one of the four-year Bachelor of Technology majors offered at the Institute of Technology and Engineering (ITE) in College of Sciences, Massey University. The Product Development major aims to educate, train, and provide the design-oriented technologist with a multi-discipline background. The graduate then could contribute more effectively to the economic growth and competitive advantages in businesses through the systematic application of product development. The major is divided into two sections. The first is more academic-oriented where students study a fixed schedule of papers in the subjects of physics, chemistry, mathematics, industrial process, design, marketing, and

project management, which have strong cross-links between them over the four years. Papers that students have to study are:

First Year

Physics I (a)

Physics I (b)

Technology and Engineering for Industry

Engineering Fundamentals

Programming Fundamentals

Computer Science Fundamentals

Introductory Calculus

Principles of Statistics

Second Year

Electronics and Design I

Engineering Principles

Technological Mathematics A

Design for Industry

Industrial Innovation and Improvement

Marketing Planning

Product Innovation Process I

Together with a paper from those listed below:

Chemistry and Living Systems

Industrial Microbiology

Mechanics and Materials I

Algorithms and Data Structures

Third Year

Project Engineering and Design

Production Systems Design and Synchronisation

Computer-aided Design and Manufacturing

Industrial Research Techniques

Packaging Materials Technology

Product Innovation Process II

Consumer Research and Innovation

Together with a paper from those listed below:

The Physics of Consumer Products II

Industrial Biotechnology

Chemical Technology I

Concurrent Systems

Fourth Year

Quality and Reliability Management

Packaging Design

Product Development Project I

Product Development Project II

Future-focused Product Innovation

Together with a paper from those listed below:

Advanced Manufacturing Strategies I, and

An approved elective

The second section of the course, which is the final year, besides having to complete the remaining relevant papers, the students will also be assigned to a "real-life" commercial product development project sponsored by an industrial partner as part of the Massey PDPP.

1.3.1 THE PRODUCT DEVELOPMENT PARTNERSHIP PROGRAMME

The Product Development Partnership Programme is a scheme where the 4th Year Bachelor of Technology PD students work closely with their industrial sponsors on an eight-month-long PD project. Their responsibility is to develop a product from its conception as a market opportunity to the finalised product launch. During the eight months development period, the student is required to produce four progress reports detailing the progress they have made on the milestones set by the course controller. Each progress report describes the concepts or solutions that they have initiated, milestones achieved, and future plans for each milestone. Besides the four progress reports, the students also need to give two project presentations to an audience consisting of their clients (the project sponsors), advisor, supervisor and the panel who is marking the project. During the presentation sessions, the students are given the opportunity to practice and develop their presentation skills in communicating their ideas and progress to the audience. The project presentations are also significant in showing the audience, especially the project marking-panel, the student's capability and skill in prototype building and the working of their prototype(s) (if one is made). The client companies were reminded and exposed to the process of product development throughout the eight months through the progress reports and the project presentations.

The Partnership Programme provides students with the opportunity to apply their recently learnt skills and techniques in product design, marketing and management, to the industrial projects. The main elements of the PDPP are market research, financial feasibility study, idea generation, concept development, manufacturing and commercialisation plans, and consumer evaluation. At the same time, it also allows the students to learn how to relate

the product to the market and the consumer. Over the years, the partnership between industrial partners (clients) and ITE has provided the participants with mutually beneficial opportunities. The students have wider career opportunities, some were employed by the clients of the PDPP, while the industry can employ graduates with useful practical product development principles and management skills.

Verbal feedback from clients and students indicates that the PDPP has been well received. However a formal evaluation was needed to see how it really performed and how it could be improved. Research would also provide written information to the limited literature on the Product Development project programme in the academic-domain, and New Zealand-based Product Development facts and statistics.

1.4 RESEARCH AIMS AND OBJECTIVES

The aims of this research study were to evaluate the Product Development Partnership Programme at Massey University from year-1997 to -1999 and to explore issues and/or aspects of the Product Development process of the companies involved with the Partnership Programme.

The objectives to achieve the aims addressed above were:

1.4.1 To gain an overview of the Product Development process at the client company.

1.4.2 To evaluate the Product Development Partnership Programme in terms of:

a) Benefits to client

b) Achieving client's expectations

1.4.3 To present recommendations and future research directions to improve the Programme.

1.5 RESEARCH HYPOTHESES

A brief review of the literature following the establishment of the research aims and objectives had highlighted several leading issues in Product Development, innovation management and their relation to the focus of this research. The primary issue of evaluating the performance of a Product Development Partnership Programme revolved around (i) the Product Development Process, (ii) techniques used in PD (such as those illustrated in Figure2-13, p52), (iii) innovation management, and (iv) performance factors and measures. Secondary issues being the relationship between the above primary issues and the size of companies (ie. Micro, Small and Medium Sized, Large Enterprises) were also explored in this research.

This research was set to examine the performance of the Product Development Partnership Programme between New Zealand businesses and Massey University through quantitative and qualitative data collections. The quantitative and qualitative data collections were done through nation-wide mail survey and case study interviews, respectively. A set of hypotheses were developed as a result of grouping the above issues of concern, which include:

a. The Partnership Programme had helped to assist the industrial partners in developing their idea or concept into a tangible product,

b. The benefits gained by the industrial partners were diverse and useful to their companies,

c. Barriers encountered in the Partnership Programme from project development to product launch plan were diversified,

d. The clients are interested and looking forward to forming another Product Development project partnership with Massey University,

1.6 RESEARCH BENEFITS

Benefits of conducting research studying the effectiveness and performance of the Product Development Partnership are many. Research results gained from this research could help to,

1.6.1 Improve the design and management of the Partnership Programme,

1.6.2 Justify more resources and continual support for the Product Development major building on the success of the Partnership Programme,

1.6.3 Attract more potential enrolment in Product Development major,

1.6.4 Draw the attention and interest of the manufacturing industry for more project partnership, and/or

1.6.5 Provide New Zealand based Product Development information.

1.7 RESEARCH OUTLINE

Following is an outline of the remaining chapters presented in this thesis:

❖ Chapter 2 Literature Review

This chapter looks at and reviews studies that had been done in the past. Areas of review include PD process, techniques of the PD process, management issues within PD, success and failure factors, and New Zealand businesses and PD system. The literature review helped provide this research with the recent approaches and trends in PD and what other research directions that can be taken.

❖ Chapter 3 Methodology

This chapter entails the research methodology employed in this research study. It also explains the sample included in both the mail survey and case study interviews, questionnaire design, tools used for data analysis, response rate, and characteristics of the sample.

❖ Chapter 4 Research Results and Analysis: Mail Survey

This chapter explores the client's feedback of the Product Development process in their companies, and aspects in the Product Development Partnership Programme. The first part provides an overview of the Product Development practice and activities performance before and after the partnership project. The second part explores the benefits to clients, followed by achieving client's expectations.

❖ Chapter 5 Research Results and Analysis: Case Study Interviews

This chapter details the case study interviews conducted with companies within the Manawatu region. Main topics of the interview include, company/business background, company's background to Product Development, student project background, student project outcomes, company's opinion on the PDPP, and recommendations from the client companies interviewed and likelihood of future project partnership.

❖ Chapter 6 Results Comparisons and Discussions

This chapter discusses and compares the research results with both New Zealand-based and international studies. Topics of discussion are: Product Development practice and the process within, usefulness of information gained and skill learned, expected and actual occurrence of benefits, barriers that inhibited the progress of the partnership project, reasons of participation and level of achievement, factors important to Product Development project, and measures of new product performance.

❖ Chapter 7 Conclusions and Recommendations

This chapter draws together the key findings and conclusions presented in previous chapters, and identify areas or directions for future investigation.

❖ Chapter 8 Research Limitations and Future Research Directions

This chapter outlines limitations faced in this research and future research directions, which hopefully will benefit individual or research team wanting to explore research topics similar or relating to this research.

Chapter 2

LITERATURE REVIEW

2.1 INTRODUCTION

This chapter introduces and explores other corporate partnership programmes offered by other institutes or colleges, characteristics of the multi-disciplinary product development (PD) practice and its evolutionary changes over the last three decades. Models illustrating the stages or key activities of the practice, and success and failure factors are also included.

2.2 CORPORATE PARTNERSHIP PROGRAMME

MASSACHUSETTS INSTITUTE OF TECHNOLOGY (MIT), UNITED STATES OF AMERICA

There are currently two corporate programmes, Leaders for Manufacturing (LFM) and System Design and Management (SDM), being offered at MIT. LFM focuses on addressing issues of "Big M" manufacturing, from concept to product delivery. While the SDM addresses the "Big E" engineering issues of product design and complex systems involved in the end-to-end product development process.

Leaders for Manufacturing (LFM)

LFM offers a two-year dual degree programme in which students have the opportunity to gain skills and training in management and engineering sciences. In LFM, students are able

to obtain a Master of Business Administration (MBA) or Master of Science from MIT's Sloan School of Management or Master of Science from the School of Engineering.

The LFM programme is a graduate-level academic and research programme sponsored by MIT's Sloan School of Management, the School of Engineering, and the industry partners. MIT is established into five schools within the School of Engineering. Admission to the LFM Programme is highly competitive due its rigorous nature and MIT's commitment in recruiting the finest calibre of students. Currently each LFM Programme candidate receives extensive funding from LFM and all its students receive full tuition support.

LFM is part of the Engineering Systems Division which develops academic and research programmes which reflect the integrative aspects of engineering, engineering science strengths and enable student to better understand complex systems. LFM's curriculum is designed to inspire students to appreciate continuous, incremental improvement as well as groundbreaking innovation. The programme also gives the students a solid background in engineering, operation management, information technology, teamwork, and change management. As part of their curriculum, the LFM students have to participate in several plant tours and a six-and-a-half months internship (at the partner companies) leading to the completion of a project thesis. The internship is one of many defining experiences provided by LFM Programme. The LFM internship provides the basis for a joint engineering-management thesis that each student writes prior to graduating from the programme.

The internship consists of a unique partnership, which involves the students, faculty, and industry. The partner company sites serve as the laboratories for the interdisciplinary teams of students, faculty, and manufacturing practitioners. Representatives from the partner company work with the faculty (during the student's first summer and fall terms) to give an overview of their organisation to students, describing manufacturing challenges at their organisations, and possible internship project areas. Faculty members at LFM are involved

in project identification by liasing with the company representatives at all levels to determine significant challenges and to assure thesis topic suitability.

To be eligible for the LFM Programme, the candidates have to:

i. Have an undergraduate or graduate degree in engineering, computer science, or physical science,

ii. Satisfy admission requirements of the MIT Sloan School of Management,

iii. Demonstrate business experience and a strong interest in a manufacturing or operation-related career,

iv. Posses the abilities both to lead and to work effectively in teams, and

v. Have at least two years of full-time work experience (3 ~ 5 years recommended). (The average work experience of accepted candidates is five-and-a-half years.)

System Design and Management (SDM)

Similar to LFM, SDM is also a graduate-level academic and research programme sponsored by Sloan School of Management and School of Engineering at MIT, and its industry partners. Unlike LFM, SDM offers both distance learning, which takes 24 months to complete, or 13-month on-campus degree programme for experienced engineers. Upon completion, the students earn a Master of Science degree in Engineering and Management. Their goal is to educate future leaders in architecture, engineering, and designing complex products and systems, while at the same time preparing them for careers as the technically-grounded senior manager.

SDM currently offers students the choice of two tracks – product development or system design. In each, students have to complete nine core and fundamental courses and a minimum of four electives. Students select the electives based on the track that they choose. Such as:

i. Product Development Track - Two product development electives plus one management and one engineering elective.

The Product Development Track builds upon SDM's close relationship with the MIT Center for Innovation in Product Development (CIPD), drawing upon leading-edge MIT research validated in industry.

ii. System Design Track: Two design electives plus one management and one engineering elective.

On top of the courses, the student also must complete a project-oriented thesis. This typically involves applying knowledge gained through the programme to a company-related challenge.

The SDM curriculum builds around three core courses: system architecture, system engineering, and system and project management. The curriculum combines technical depth by delivering a series of engineering and design electives, with engineering and management breadth, obtained through a suite of foundation courses. The SDM academic programme consists of the following:

a. Coursework

Thirteen courses – three cores, six foundations, and four electives. Core and foundation courses, as well as many electives, are taught on-campus and transmitted live to distance-learning students.

b. The January Programme

A one-month, in residence session required by all SDM students. The January Programme consists of intensive coursework; two design challenges in which students work in multi-disciplinary, cross-industry teams; leadership modules; and cohort-building experience.

c. Business Trip to the MIT campus

Distance students return to the MIT campus once each term to participate in SDM "business trips'. Returning to the campus enables students to renew relationships and engage in networking opportunities, thus adding an important dimension to the educational experience. These return trips to MIT are designed around a particular topic or theme to pick up where the four-week January Programme leaves off.

d. International business trip

On this seven-to-ten-day international business trip to several world-class organisations outside of USA, SDM students will have the opportunity to learn about cutting-edge system design and new product development practices, thus enabling them to acquire or enhance a global perspective.

e. One full term in residence at MIT

Required for all twenty-four-month distance-learning students.

f. Research and project-oriented thesis

Students begin to identify systems issues that might be suitable research topics at the early stage of the programme. SDM faculty members also help direct the project identification process by extensive communication with company representatives at all levels. While the study topic is a six-to-twelve-month project for students, it often represents a continuum for the faculty and company colleagues who lead the work.

During their thesis research, students must effectively use their time and facilities provided at their work site and on campus to address very real, significant industry needs to achieve substantial results. In the thesis presentation, students draw upon past SDM projects as well as the collaborative relationships the faculty have established with company experts or specialists.

Both LFM and SDM programmes are rooted in a tripartite partnership, which includes the students, faculty and staff from MIT's School of Engineering, Sloan School of

Management, the industry partners, and the alumni. LFM and SDM partners work together to develop, design, implement, and participate in cutting-edge integrative programmes in engineering, manufacturing, and new product development. LFM-SDM recognises to operate the world-class graduate-level programme that focuses on developing complex products and services, the partnership between industry and academic is critical. Therefore, industry partners are important members of the LFM-SDM community. They participate actively in LFM-SDM governance, the admission process, internships, faculty research, thesis development, and other initiatives. The benefits for industry participation include sponsoring students, hiring programme graduates and developing a cadre of LFM and SDM alums, access to MIT faculty and research, and company-to-company networking.

STANFORD UNIVERSITY, UNITED STATES OF AMERICA

Stanford Computer Industry Project (SCIP) Corporate Partnership Programme is another partnership programme offered by one of the leading universities in the USA. Through its research initiatives, Stanford brings industry together with scholars from a broad spectrum of academic disciplines to identify and address the challenging business issues and obstacles.

Funding for the initial establishment of SCIP was provided by Sloan Foundation while the corporate partners (which can be both information technology vendors and/or users) provide both intellectual and financial resources to the SCIP Corporate Partnership Programme. Besides the intellectual and financial resource contribution, the corporate partners are actively involved in project initiatives. The partners will enjoy a number of benefits, but primarily access to the findings of an in-depth examination of the future of the computer industry. Other benefits for the corporate partners include:

i. The opportunity to stay abreast of cutting-edge research on the computer industry,

ii. Where faculty and corporate interests align, the opportunity to become an active participant in ongoing research; share expertise with project researchers, and when

and if appropriate, have the opportunity to influence the research agenda, provide data or offer their companies as research sites,

iii. Appointment of a liaison to serve on the SCIP Advisory Board,

iv. Interaction with researchers and executives from other partner companies at annual forums, conferences, briefings, and weekly workshops,

v. Frequent opportunities to learn from other companies, sharing ideas and insights, including access to a database of research findings and publications,

vi. Priority on participation in a new Executive Education course on Strategic Uses of Information Technology which brings together the fruits of research and curriculum development, and

vii. On certain occasions industry partners may be class visitors or speakers in research colloquia or classes.

SALFORD UNIVERSITY, ENGLAND

The School of Art & Design within the Faculty of Arts, Media & Social Sciences in the University of Salford is offering a similar bachelor degree like BTech Product Development at Massey. The course, BSc (Hons) Product Design and Development, is for those who wish to pursue a career as professional product designers.

Strong industry links between the Faculty of Arts, Media & Social Sciences and the corporate companies allow the course to provide its students real world focus through collaborative projects and industrial placements. The course encourages the integration of design with manufacturing, business and marketing input, thus providing appropriate understanding of the issues affecting the design process within a commercial framework. The course consists of three levels:

i. Level 1

A broad-based approach introduces the core skills required within product design supported by the study of computer aided design (CAD); business and marketing issues; material and manufacturing technologies; and product visualisation and presentation. In addition, students choose to study either a foreign language or design history.

ii. Level 2

Students undertake a number of in-depth projects that explore product design from a user and manufacturing perspective. Subject areas include market and user analysis, interface design, presentation skills, design for manufacture, model-making, and product prototyping.

iii. Level 3

Final year students undertake a dissertation and two major design projects. One of which is self-directed in line with career aspirations. The course culminates with participation in the prestigious New Designers Exhibition in London.

Other than the real world industrial project, the course also gives the students opportunities to study abroad in Europe and USA to gain an international dimension to the course. The course also provides an optional work placement to the Level 2 students in a variety of positions from design consultancies to manufacturing companies. Assessment is done based on the coursework performance and examination results. Examinations take place during Level 1 and 2, and do not contribute to the final degree award.

ILLINOIS INSTITUTE OF TECHNOLOGY, UNITED STATES OF AMERICA

The Interprofessional Project (IPRO) Programme was founded within the Illinois Institute of Technology (IIT) in 1995, offering team-based projects to students. The IPRO Programme engages multidisciplinary teams of student in semester-long undergraduate projects based on real-world topics from sponsors that reflect the diversity of workplace:

corporations, entrepreneurial ventures, non-profit organisations, and government agencies. The IPRO Programme prepares students for the practical challenges they will face in the workplace later on in their career. This opportunity gives the technology and engineering-oriented students a greater appreciation for non-technical considerations, while at the same time infusing students of law or business background greater insight concerning the process of research and development.

The IPRO project teams are led by a graduate student and guided by co-mentors from the faculty and sponsor. Teams may include five to fifteen students from all academic levels (sophomore through to graduate school), and across IIT's professional programmes (engineering, science, business, law, psychology, design, and architecture). Students from IIT programmes in engineering and science, law, business, design, psychology and architecture may join a team, depending upon the needs of the project and their own interest. Each lead faculty member is provided a IPRO Record Book to compile a complete record of the group's activity throughout the term. Upon completion, each IPRO Record Book should consist the following elements.

i. Course Syllabus (prepared by the lead faculty)

   The syllabus is expected to include a description of the course learning objectives, assessment mechanisms to be used for grading, reference materials, and relevant contact information.

ii. Project Plan (due within the first three weeks of the semester)

   The plan summarises each team's understanding of the work or task that needs to be achieved during the term, including:

   - Project objectives,
   - Background information,
   - Methodology to be used,
   - Expected outcomes,
   - Schedule of tasks and milestone events, and

- Assigned responsibilities for each member on the team.

iii. Mid-Term Progress Report

The progress report formalises the process of midterm reporting by the team to the faculty and the sponsor. It thereby provides an opportunity for feedback and dialogue among all concerned before the term ends.

iv. Team Web Site

The team web site is an active resource for the team to organise and manage its business, create a record of the team's work during the semester, and record the team's accomplishment at the end of the semester.

v. Final Oral Presentation

The IPRO teams give final presentations on IPRO Project Day to a panel of judges from representatives of industry, faculty, staff, and student peers. The IPRO teams may also be asked to give oral presentations to sponsors at other venues and special events.

vi. IPRO Poster

Each team is required to create a professional-styled poster for inclusion in a general poster session on IPRO Project Day.

vii. Project Abstract

A one-page IPRO Project Abstract is prepared and provided on IPRO Project Day as a handout for people attending the oral presentation or visiting the poster session.

viii. Final Written Report

The final IPRO project report is required from each team on the last day of the semester. The final report summarises both the work of the team, its accomplishment, and the process of working as a team. A detailed guideline for preparing this report is provided to each team.

ix. Team Log

The team log is used to maintain a record of team activities and information that supports the project. The log must include:

- up-to-date list of team member and their contact information,
- agenda and minutes of team meetings and sponsor meetings,
- information gathered through field trips and information searches,
- information gained from the IPRO Keystone Seminar Series or Business Planning Seminar Series,
- List of IIT faculty, staff professionals and external organisations/individuals contacted for various purposes, with supporting documentation of these contacts,
- Laboratory procedures and data sheets, if relevant, and
- Pictures of team meetings, field trips, prototypes, etc.

x. Individual Member Journal

At least one student member in each team is encouraged to voluntarily keep an individual weekly diary of personal reflections as specific activities, perspectives, and thoughts about the experience emerge. The journal should not disclose confidential or personal information about the project or other members in the team.

Methods used to assess the performance of individual students on their teams include peer and self assessment, formal reports by individual students describing their contributions to the project, and "sign-offs" in which students identify those segments of the project for which they were responsible for. Several formative assessment tools are in place by IIT for continuous improvement, which include the IPRO Record Book, pre- and post-surveys of students, student and faculty interviews, and sponsor and client feedback. The pre- and post-surveys were conducted to assist IIT in evaluating the impact of the IPRO experience in the development of students' skills, attitudes, and competencies. A series of student interviews were conducted by an independent evaluator to comment on issues such as:

- How they learned about the IPRO Programme?
- What they had expected to learn or gain by participating in the programme?
- How effectively their team(s) had functioned?
- How well their teams had met the project goals? and
- What they learned from their IPRO experience?

Extensive interviews with faculty member who are leading the IPRO teams are also being conducted to identify ways to support IIT faculty in further developing and delivering the programme. Key issues that are being addressed in these interviews are:

- Programme Infrastructure,
- Faculty Development Support,
- Grading and Assessment, and
- Obstacles and Benefits.

The IPRO Office constantly monitor the project sponsors, clients satisfaction, and feedback through telephone conversation, written correspondence, and personal meetings. A more formal and comprehensive interview on the satisfaction of the project sponsors and clients (similar to those being conducted with faculty members) was in place in Spring 2002 in order to acquire more formal and independent feedback.

The IPRO Programme offers values or benefits at various level to the sponsors and students are many. Values or benefits to the sponsors include:

i. Support a team-oriented, project-based component of the traditional undergraduate curriculum to strengthen strategic involvement in higher education,

ii. Access to student strength, fresh ideas, and faculty expertise, and

iii. Advantage to identify future graduates with experience in teamwork and workplace issues.

Values or benefits for the students include,

i. Enhancing the traditional undergraduate curriculum by addressing real-world issues and problems, and evaluating viable approaches and solutions,

ii. Creating teams that cut across the boundaries of disciplines and professional programmes at IIT (engineering, science, law, business, psychology, design, and architecture),

iii. Close interaction with faculty, and

iv. Advantage to choose from a continuously-refreshed array of unique project possibilities that develop common skills and perspectives (teamwork, communications, leadership, project management, technology transfer, creativity and problem-solving processes, and client and customer relations).

CARNEGIE MELLON UNIVERSITY, UNITED STATES OF AMERICA

"Novum: design" in The Center for Design Research & Innovation in Carnergie Mellon University was established in 1996 to advance the understanding of design and contribute to the innovative development of professional design practice. Activities include formal research and development projects sponsored by corporations, government agencies, and foundations.

Research and development projects in the School of Design are currently organised around five major themes: 1) Interactions Design, 2) Kinetic Information, 3) Integrated Product Development, 4) Design and Culture, and 5) Design Education. Individual faculty member and teams pursue a variety of specific projects and lines of inquiry among these themes. Unlike IPRO Programme, Novum: design is not a team-based learning project but

individual project programme where each student is fully responsible for the design, development, and implementation of the assigned project.

Interdisciplinary team-based project learning has been embraced by higher education, partly due to the industry's desire to hire graduates who have skills and knowledge beyond technical competence within their own disciplines. Among the many leading universities and colleges that have established programme designed to meet these need are:

Lehigh University, United States of America

Established the Integrated Product Development (IPD) Programme in 1994 that integrates teams of engineering, design arts, and business/economics students through a three-course, nine-credit-hour sequence spanning the freshman through senior years.

SUCCEED Coalition (Southeastern University and College Coalition for Engineering Education), United States of America

This coalition has ten years of experience in developing, testing, and implementing various vertically- and horizontally integrated multidisciplinary student team project courses. Several of the project courses include two-semester sequences that focus upon themes such as student professional development, problem solving, design, prototyping, testing, and reporting.

University of Maryland, United States of America

As part of the National Science Foundation (NSF) funded Gateway Coalition, this institution forms freshman teams that continue as a group through to graduation.

Dartmouth, United States of America

Within the Thayer School of Engineering, student teams plan, design, and implement projects that are completed over a two-semester period.

Harvey Mudd College, United States of America

Established the Engineering Clinic in1964 that requires nine credit-hours of team project work, in addition to six credit hours of freshman and sophomore design, as an integral part of a student's completion of a BS in Engineering degree. This programme has led to the Computer Science and Mathematics Clinics.

University of Illinois Urbana-Champaign, United States of America

Organises teams comprised of manufacturing, engineering, and business students working on topics sponsored by companies, and also organises teams within engineering departments that involve students from freshman through senior years.

Michigan State, United States of America

Began with the formation of freshman teams and is now expanding team-based learning throughout curricula.

Colorado School of Milnes, United States of America

Continues to expand its traditional focus on team-based learning.

Purdue University, United States of America

Established a formal community service programme (known as EPICS) through which teams of students from various disciplines work on technology-based social sciences projects that continue over multiple semesters, with sustained funding from Microsoft.

Stevens Institute of Technology, United States of America

Threading and embedding principles of multidisciplinary design throughout the four-year curriculum.

Worcester Polytechnic Institute, United States of America

Since 1972, the Institute requires every student to complete team projects that include a nine-credit-hour design project in the student's major field, a nine-credit-hour project addressing the impact of technology on society, and a humanities and a social science project.

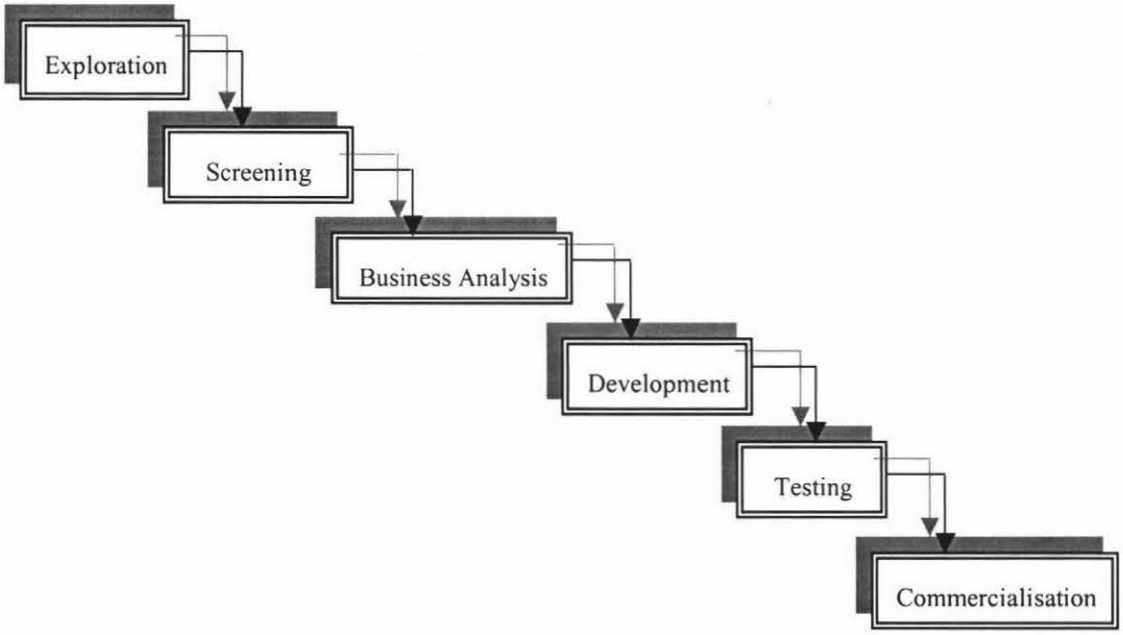
2.3 THE PROCESS OF PRODUCT DEVELOPMENT PRACTICE

The introduction of new products continues to be a critical business activity to all companies. New product development has been identified as a critical process in retaining a company's competitive advantage and profitability. Product Development (PD) is a multi-disciplinary practice combining skills in research, design, marketing, technology and management. The primary goal behind the practice is to produce a stream of successful product innovations to achieve business growth and create revenue.

There are many models illustrating the product development process, which include such key tasks as generating and evaluating new product ideas, concept testing and development, and products and market testing to commercialisation. In the past three decades, the trends in new product development have moved from functional and department-by-department sequential approaches to the recent shorter cycle of multi-functional approaches.

Booz, Allen and Hamilton (BAH) did the first of several studies focused on investigating issues associated with new product development practice in 1968. A second wave of research took place in 1982. Their 1968 report stated that, independent of types of industry, almost 1/3 of all product development projects launched failed and that the most successful companies were those that utilised a systematic approach in the development of new products.

Exhibit 2-1: Stages of Product Evolution - Booz, Allen and Hamilton (1968)



Booz, Allen and Hamilton (1968) commented that a product development process should act as a road map presenting the management with directions to the development and introduction of new products. The role of the process is to remind and provide the management with the relevant activities they need to follow in the proper order. The new product activity can be and had been broken into manageable stages in terms of planning and control. Companies with more consistent New Product Development success were found to be those that had formed new products departments, product teams and a new product committee in-house. The six stages shown in Exhibit 2-1 and Exhibit 2-2 are the

stages used by most successful new product development. Key activities of the six stages of product evolution are: Exploration, Screening, Business Analysis, Development, Testing, and Commercialisation.

Exhibit 2-2: Product Development Process with Key Activities – Booz, Allen and Hamilton (1968)

1. Exploration

- Determine the company's primary interest in product fields.
- Establish an idea generation plan or procedure.
- Collect the ideas generated via coordinated network.

2. Screening

- Expand and translate each idea into product concept.
- Select evaluation techniques to fit the specific idea.
- Identify the key implications of the product concepts and its development.
- Estimate the magnitude of the profit opportunity.

3. Business Analysis

- Determine characteristics of the desirable market and its trends.
- Establish feasibility of developing and manufacturing a product with these characteristics.
- Evaluate the business alternatives to determine the desired product specifications.
- Develop the selected specifications and establish a definite programme for the product.

4. Development

- Schedule the development activities within the approved resources and timetable.

- Build product to the agreed and revised specifications.
- Run laboratory tests

5. Testing

- Plan commercial experiments necessary for product testing and verification
- Conduct laboratory, production and market testing
- Interpret test findings objectively; call off or modify products that fail the tests

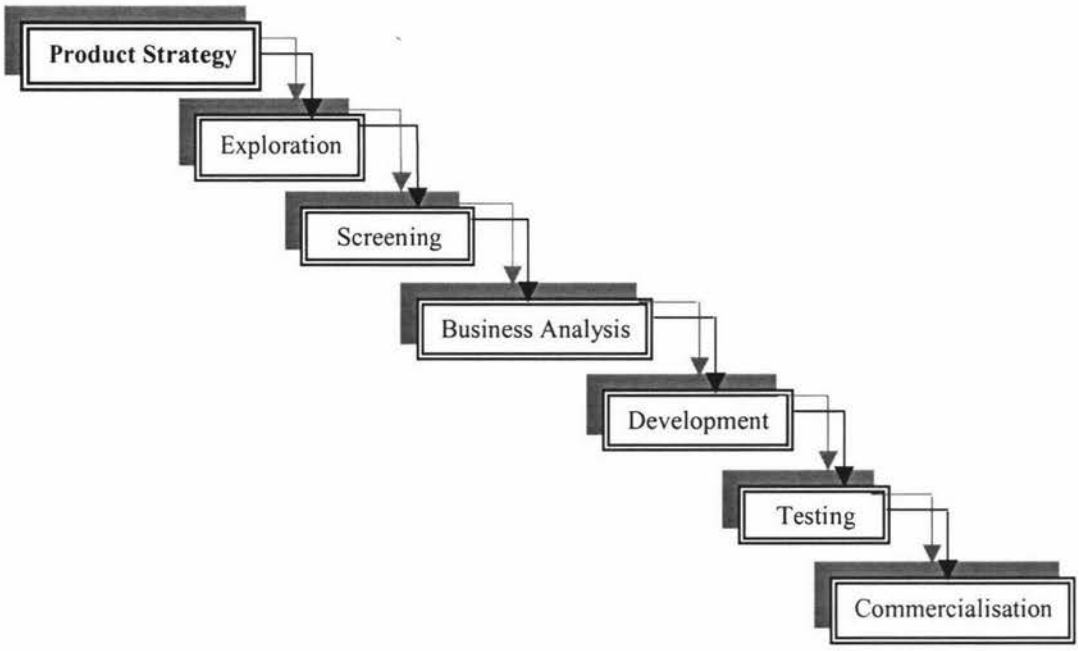
6. Commercialisation

- Establish plans for overall direction and co-ordination of the product
- Initiate the co-ordinated production and selling programmes
- Make necessary improvements in product, manufacturing or sales
- Maintain the necessary teams until the product is a going commercial success, absorbed by established organisation.

In examining the management process of new product development, Booz, Allen and Hamilton (1968) later reached the conclusion that to maximise product success rate, a great deal of attention should be focused on the first three stages of the process.

Booz, Allen and Hamilton's 1982 report, based on the in-depth interviews with New Product Development executives found that companies with successful new product records were not only more likely to have formal new product process in place, but operated under the process for an extended period of time. A seventh stage was added to the front end of the six-stage process outlined in their 1968 publication.

Exhibit 2-3: New Product Development Process - Booz, Allen and Hamilton (1982)



The new stage, New Product Strategy, (Exhibit 2-3) is added to highlight the recognition and importance of a strategy in the development and introduction of new product. Product strategy includes phases such as product planning with clear definition of agreed aims and objectives, defining the basis of competitor and target market, and identify production and/or technology constraints.

Following BAH's investigation into Product Development was a study by Earle in 1971, in which she proposed a systematic product development process constructed through her development experiences in large European and New Zealand companies. This development process, as outlined in Exhibit 2-4, detailed the sequence of steps and activities to be undertaken for companies or organisations wishing to be systematic in managing and organising the development of new products.

Exhibit 2-4: Product Development Process - Earle (1971)

1. Planning

- Defining project aims, objectives, constraints
- Idea generation

2. Literature Investigation

- Market, technical information research
- Screen ideas
- Define product concept

3. Detailed Study of Market, Product and Process

- Consumer survey
- Preliminary product tests
- Project costings
- Evaluate and select final product concepts

4. Develop Prototype

- Laboratory tests
- Design specifications
- Build prototypes
- Packaging, patents, legal considerations
- Analyse prototypes

5. Develop Production Plan

- Quality control
- Final product specifications
- Small production run

- Costings

6. Plan Production and Marketing

- Determine pricing and market potential
- Advertising and packaging design/storage tests

7. Organise Launch

- Organise advertising/promotion material
- Organise equipment/labour/raw materials
- Test market

8. Launch

- Train salespeople
- Product production
- Distribution
- Release promotion

In 1983, Cooper conducted another useful study on Product Development evolution. This study was built on reviewing the history of the development of the Product Development practice and analysing previous normative models already published. A Product Development model of seven stages, Exhibit 2-5, was later proposed at the conclusion of his study. Great similarity in terms of process structure is shown between the models of Booz, Allen and Hamilton (1968) and Cooper (1983). Sixteen key activities that are often found as part of a new product project were assigned to this seven-stage model. Clear implementation and management techniques were demonstrated with clear allocation of key activities to each stage of the model.

Exhibit 2-5: Product Development Process - Cooper (1983)

Stage 1: Idea
- Idea Generation
- Idea Screening

Stage 2: Preliminary Assessment
- Preliminary Market Assessment
- Preliminary Technical Assessment

Stage 3: Concept
- Concept Identification
- Concept Development
- Concept Test

Stage 4: Development
- Product Development
- Marketing Plan

Stage 5: Testing
- In-house Prototype Testing
- Consumer Prototype Testing

Stage 6: Trial
- Finalisation of Design
- Finalisation of Marketing Plan
- Trial Production
- Test Market

Stage 7: Launch
- Full Production
- Market Launch

Cooper (1983) concluded with points of positive impacts of implementing a systematic process for new product development. These included:

a. A multi-disciplinary approach to marketing, technical and production integration,

b. Incremental nature of the process progressively refines information and manages risk through evaluation at each stage, and

c. A marketing orientation.

Cooper and Kleinschmidt (1986) conducted a more detailed and extensive study on the deployment of Product Development within companies. This study involved detailed investigations of 203 new product projects in 123 industrial product companies. Managers from the selected companies were asked to take a step-by-step review of the new product process (ie. from idea to launch) on each of their projects. A thirteen-key-stage new product process, Exhibit 2-6, was developed and used to study and test the actual development practice of the 203 projects.

Exhibit 2-6: Product Development Process - Cooper and Kleinschmidt (1986)

1. Initial Screening
2. Preliminary Market Assessment
3. Preliminary Technical Assessment
4. Detailed Market Study
5. Pre-Development Business and Financial Analysis
6. Product Development
7. In-House Product Tests
8. Customer Product Tests
9. Trial Sell
10. Trial Production

11. Pre-Commercialisation Business Analysis

12. Production Start-Up *(*Full-Scale Production Plan)*

13. Market Launch *(*Product Launch Plan)*

Each development stage was then studied in more depth to determine the type and nature of the techniques the company employed in each stage. The survey findings implied that "what the literature prescribed and what most firms do are miles apart when it comes to the new product process". Reviews of the 203 projects revealed that the commonly recommended stages or activities such as marketing research, market testing, trial production and pre-commercialisation business analysis were omitted from the process in more than half the projects studied. Only 1.9% of the projects featured all the thirteen stages, while the majority of them applied less than nine stages, resulting in a very limited and truncated new product process. However, the majority of companies that applied the process to their new Product Development had very little success because of management's failure to fully implement the process.

Cooper and Kleinschmidt (1986) had also determined that the inclusion of several key product development stages or activities, namely *Initial Screening, Preliminary Market Assessment* and *Detailed Market Study* are highly co-related to the success or failure of the projects.

Their conclusions of the research study are:

a. No activities are rated as top quality

However, there is still much room to push for improvement.

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* Replaced and used by the PDPP student and the mail survey of the current research.

b. *The worst rated activities are typically the "up-front" actions.*

The greatest weakness occurred at the front end of the process, the particularly poorly handled stages include, Initial Screening, Preliminary market Assessment, and Detailed Market Study.

Their recommendations to the deployment of the Product Development process include:

a. Have a Product Development process model, and implement it in a disciplined manner (will help to avoid omission of necessary activities),

b. More time, effort and resources be allocated to the new product development process, and

c. More attention be placed on certain key activities (particularly activities at the front-end) to ensure that they are being applied systematically and effectively.

The Product Development and Management Association (PDMA) in United States of America is a non-profit professional organisation, which has long been dedicated to address and investigate practical aspects of new products or services development. PDMA supports innovation directly by investing in research such as its "Best Practices Study". The Best Practices Study is a survey of new product development practices by a large number of companies.

A research study by Page in 1993 was one of many studies sponsored by PDMA. Page (1993) surveyed 189 companies, which were conducted with two main objectives (1) to provide information of product development practice and performance which can serve as norms for companies to assess each company's and performance, and (2) to provide a longitudinal picture of some of the changes resulting from Booz, Allen and Hamilton's studies in 1968 and 1982. Notable findings in Page's (1993) report include:

i. Over 76% of the businesses used multi-disciplinary teams as an organisational structure for new product development,

ii. It took eleven new product ideas to yield one successful new product, compare to seven from Booz, Allen and Hamilton's 1982 report,

iii. Over the recent five-year period, the companies achieved a success rate of 58% of their new product introduction,

iv. 56.4% of the companies have specific new product strategy for its new product activities, 54.5% followed a well-defined, structured new product development process, while 32.8% still had no standard approach to product development (ie. no new product strategy or new product development process),

v. The main obstacles to successful product development as listed from the survey were:

- Resources (financial, people and others)
- Executing activities within the new product development process
- Top management support, and

vi. R&D, engineering, and marketing are the three primary functional areas involved in new product work. The percentage of time these three functional areas dedicated to the new product work are, 55.8%, 34.1, and 28%, respectively. Exhibit 2-7 below demonstrated the Product Development process model used by Page (1993) to investigate the practice, stages or activities involved in, the usage of and time spent on each of the Product Development stage.

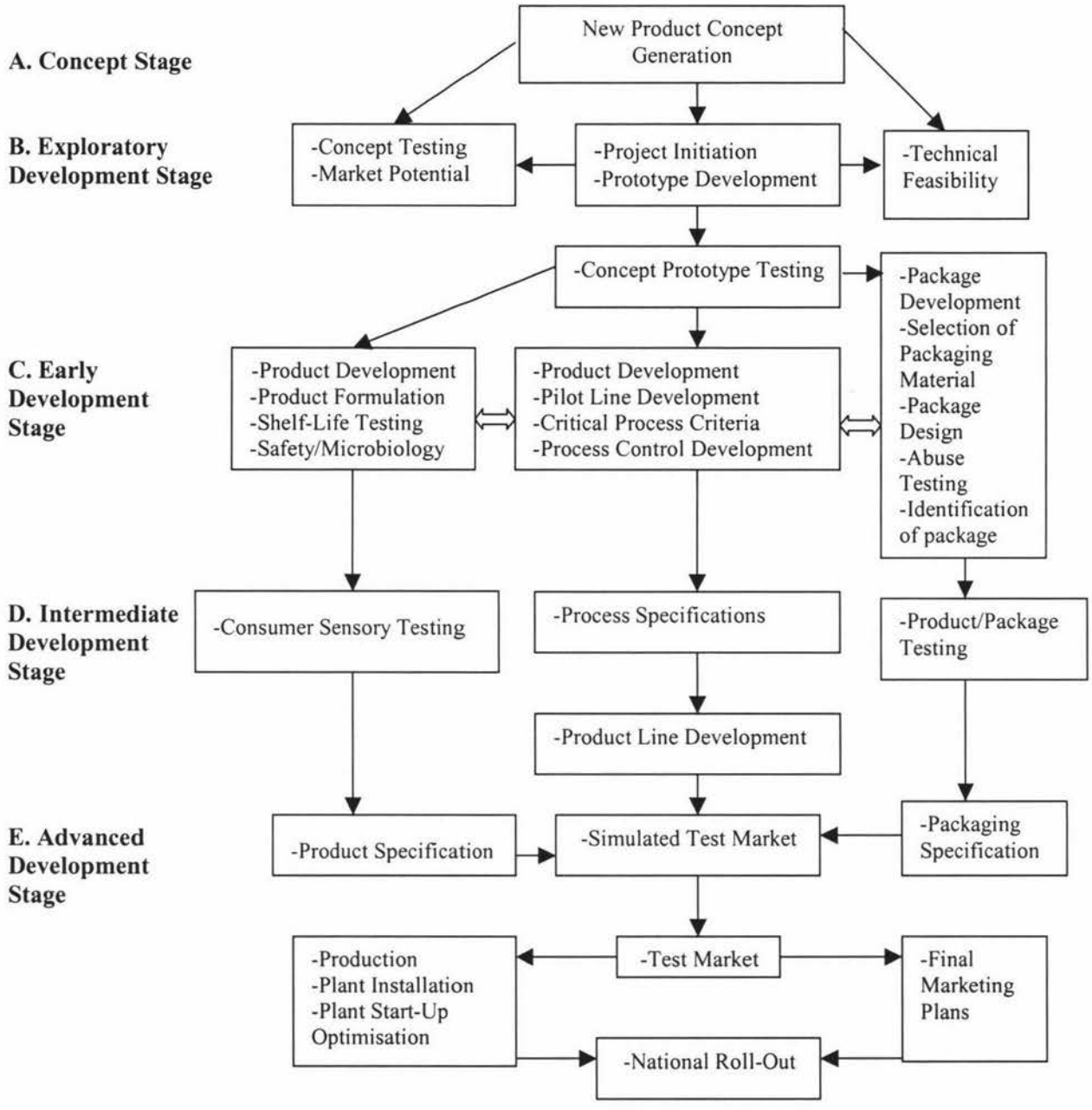
Exhibit 2-7: New Product Development Process - Page (1993)

Activities	Percent Using (%)	Time Spent (Months)
Concept Search - Brainstorming, preliminary product design discussion, and identifying new product opportunities	89.9	3.51
Concept Screening - Ranking concepts according to criteria, eliminating unsuitable concepts	76.2	2.96
Concept Testing - Preliminary market research to verify the market need, niche and attractiveness	80.4	3.63
Business Analysis - Evaluation of product concepts in financial terms	89.4	2.58
Product Development - Technical work converting concepts into working product	98.9	14.37
Product Use, Field and/ market Testing - Offering the product to a pre-selected group of potential customers to determine its suitability and marketability	86.8	6.04
Commercialisation - Launching the new product into full-scale production and sales	96.3	6.46
Other Process Activities - Including regulatory approval/registration and patent filing	20.1	8.59

In another research sponsored by PDMA, Stinson, Jr. (1996) looked at the foundation and groundwork for subsequent product development stages in consumer goods. The Product Development process was segmented into five development stages (1) Concept, (2) Exploratory Development, (3) Early Development, (4) Intermediate Development, and (5) Advanced Development. Stinson, Jr.'s comment to the segmented new product development process flow as shown in Exhibit 2-8 was an "ideal" model and that it should be tailored in-conjunction to the company's needs and goals.

As stated in other studies (Booz, Allen and Hamilton, 1968; Cooper and Kleinschmidt, 1986; Page, 1993), Stinson, Jr. also called for adequate attention of the front-end activities/stages of the product development process. In addition, he introduced five important elements of new product development process that needed to be recognised and followed in order to maximise the product success rate. These five elements are: (1) Parallel and concurrent development activities, (2) multi-functional team work, (3) continuous and connected communications, (4) Quality by design, and (5) continuous feedback from the consumer. In his opinion, the most important element among the five named is obtaining continuous feedback from the consumer, and later uses this information to optimise the new product introduction.

Exhibit 2-8: New Product Development Process - Stinson, Jr (1996)



Wilson, Kennedy and Trammwell developed a superior Product Development process of innovative products, shown in Exhibit 2-9 and Table 2-1, in 1996. This model is outlined based on case studies of successful competition of leading US companies against world-class competitors, particularly the Japanese. The process begins with *Product Ideas* phase and ends with *Product Manufacture, Delivery, and Use* phase, has nine distinctive phases in total. It shows clearly that the marketing, design engineering, and manufacturing development take place concurrently with product planning and converge in the fifth phase of Final Product Definition and Project Targets.

Exhibit 2-9: Superior Product Development Process for Innovative Products - Wilson, Kenney, and Trammwell (1996)

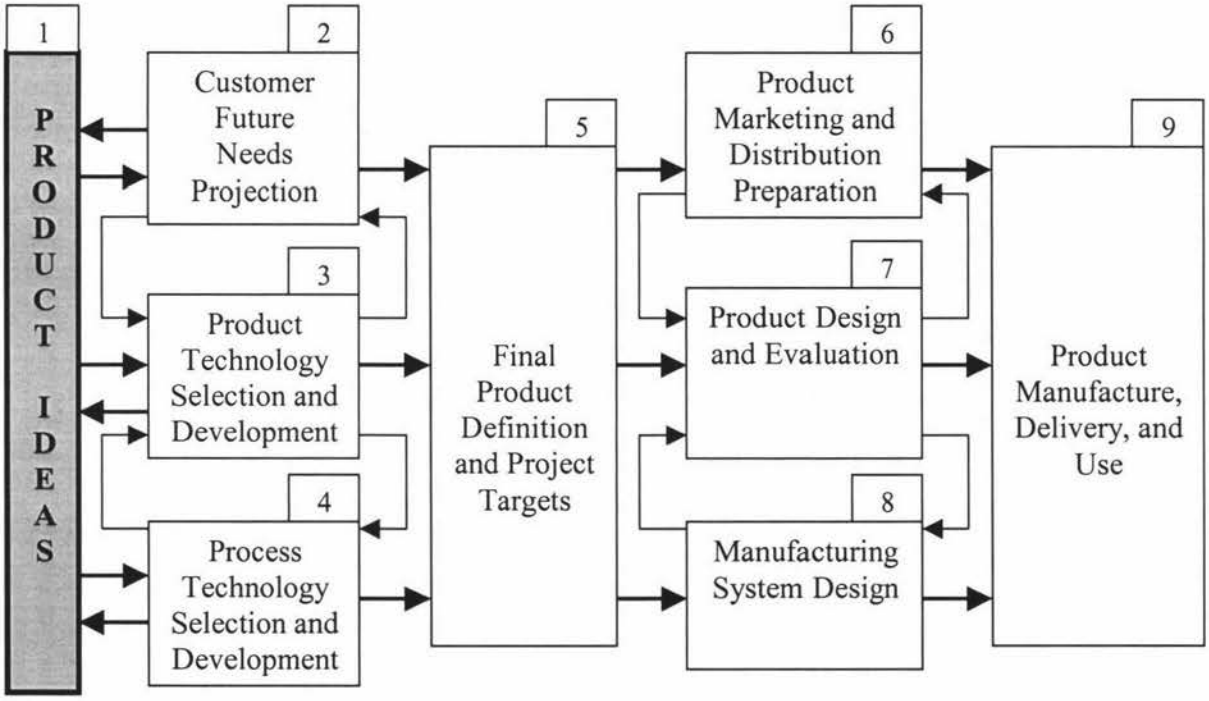


Table 2-1: Product Development Process Milestone Goals - Wilson, Kenney, and Trammwell (1996)

1. Potentially "high value" product concepts, consistent with future customer needs and the firm's goal/strategies.
2. Definition of target customers and their future needs, understanding of competitive offerings ("benchmarking").
3. Appropriate, timely selection and development (as necessary) of robust product technologies.
4. Appropriate, timely selection and development (as necessary) of robust process technologies.
5. "Frozen" final product definition (of "base" product plus derivatives); market, business, and resource targets.
6. Development of marketing/sales, customer support, and distribution system that reflect customers' needs.
7. Development of product design specification that addresses customer needs; "design-build-test" of product and its subsystems; verification of product's value and "fitness."
8. Selection and construction of cost-effective, capable processes for parts manufacture and product assembly.
9. Manufacture and assembly of quality product, consistent with customer demand; process control and improvement.

The only difference between this model and the models previously discussed is that it includes lists of "milestone goals" (Table 2-1) to be achieved at each stage of the Product Development process. Major management phase reviews take place in conjunction with the completion of each milestone goal to grant a Go/No Go decision. Consideration in every aspect, engineering, marketing, financial, manufacturing and distribution were taken into great account in the management phase reviews. Wilson et al (1996) later named four essential fundamental elements to ensure heavy emphasis for successful product development implementation. These four elements are,

i. Control by a single team (Team integrates broad skills needed to develop product, and control all aspects from technology selection to manufacturing),

ii. Creation of a vision for future products,

iii. Information convergence at the Product Definition phase, and

iv. Information continuity for critical product characteristics.

Many companies are discovering that product development must start with the customer, and the involvement of a cross-functional representative amongst its development teams. Yet, many often neglect the sales teams as a functional area even though it is closest to the customer. McDougal and Smith (1999) published a study concerning the involvement of sales people in the new product process. As found from their survey, nearly 50% of leading marketing companies do not formally included their sales people in their new product initiatives, and even when they are included, only a minor role was assigned to them.

Along with their report, an eight-step new product development process model was presented incorporating the role of sales people into the major steps of the development of new products or services. The Eight-Step New Product Development Process, Exhibit 2-10, now reads:

Exhibit 2-10: The Eight-Step New Product Development Process – McDougal and Smith (1999)

1. Planning and Direction Setting
2. Market Problems and Needs Exploration
3. Problem Solving and Idea Generation
4. Concept Development and Business Analysis
5. Prototype Development
6. Plant Scale-Up

7. Commercialisation

8. Post-Launch Check-Up

At closing they summarised the benefits of the involvement of salesperson in new product development, which included:

i. Better understanding of consumer input,

ii. An improved understanding of channel issues, and

iii. An improved understanding of competitors and their selling tactics.

An article, Growth Through Product Development, published in *New Zealand Manufacturer* by an anonymous author, was one of a few articles found discussing product development issues in the New Zealand's business environment from the electronic database search. The author commented that in order to plan ahead the commitments to their business, it is important to have clear and defined consideration of all the business factors (BAH, 1968; Cooper & Kleinschmidt, 1986, 1995; Page, 1993). Such factors include:

i. Market size,

ii. How to find customers and promote the product,

iii. Distribution,

iv. Preliminary financing, and

v. Commercial quantities.

These factors show that for manufacturing organisations to continually grow and stay competitive, they need to introduce and develop a greater number of new products to the market in which they are competing. One way of addressing these issues is to invest in a continuous research and development programme. In most cases, there are definable stages within a development project and each of the stages has an iterative procedure detailing

what activities are required and ways to go about them. In this article, the author also took the opportunity to propose a simplified version of the product development process. Which is as follows:

- Need identified
- Planning including market evaluation of business and customer requirements
- Identification of product critical success requirements (feasibility study)
- Detailed engineering design of product options and prototype development
- Production process requirements for prototype and commercialisation
- Product evaluation and improvement
- Product release and technical support

It is however rather distressing to learn from this article that most New Zealand business or enterprises do not invest in a specific operating department for research and development in the same way as the larger corporations, and new products would often just eventuate through a new idea within the organisation or at senior level.

Results of Kyriazis and Patterson's (1996) study on the use of marketing research information in the new product development process revealed that most of their respondent firms, which covers firms from the industrial, consumer and service sectors, are reasonably sophisticated to the extent that they proceed through all the formal new product development stages for their new product and process development. Nevertheless, two critical stages, concept testing and test marketing, were found to be less frequently employed compared to the other stages. Their survey results showed that only 75% and 70% utilised formal concept testing and test marketing, respectively. Comparable findings from Page (1993) indicated a low rate of usage on concept screening (76.2%) and concept testing (80.4%).

In summary, Kyriazis and Patterson outlined the key factors of new product failures, which agreed with findings from other researchers:

1. Lack of management commitment and support (Cooper 1988, Cooper and Kleinschmidt, 1986)
2. Not introducing a "superior" differentiated product (Cooper and Kleinschmidt, 1987)
3. Not following a formal product development process (Cooper, 1988)

A generic Product Development process consists of 6 phases: *Planning*, *Concept Development, System-Level Design, Detail Design, Testing and Refinement, and Production Ramp-Up* was developed by Ulrich and Eppinger (2000) blending the perspectives of marketing, design and manufacturing into a single approach. This model as illustrated in Exhibit 2-11 is a modification of a model they developed in 1995, which consisted of only five phases - *Concept Development, System-Level Design, Detail Design, Testing and Refinement, and Production Ramp-Up.* Clearly, their latest model had also recognised the significance of the project/product planning in product development as proposed by Booz, Allen & Hamilton in 1982.

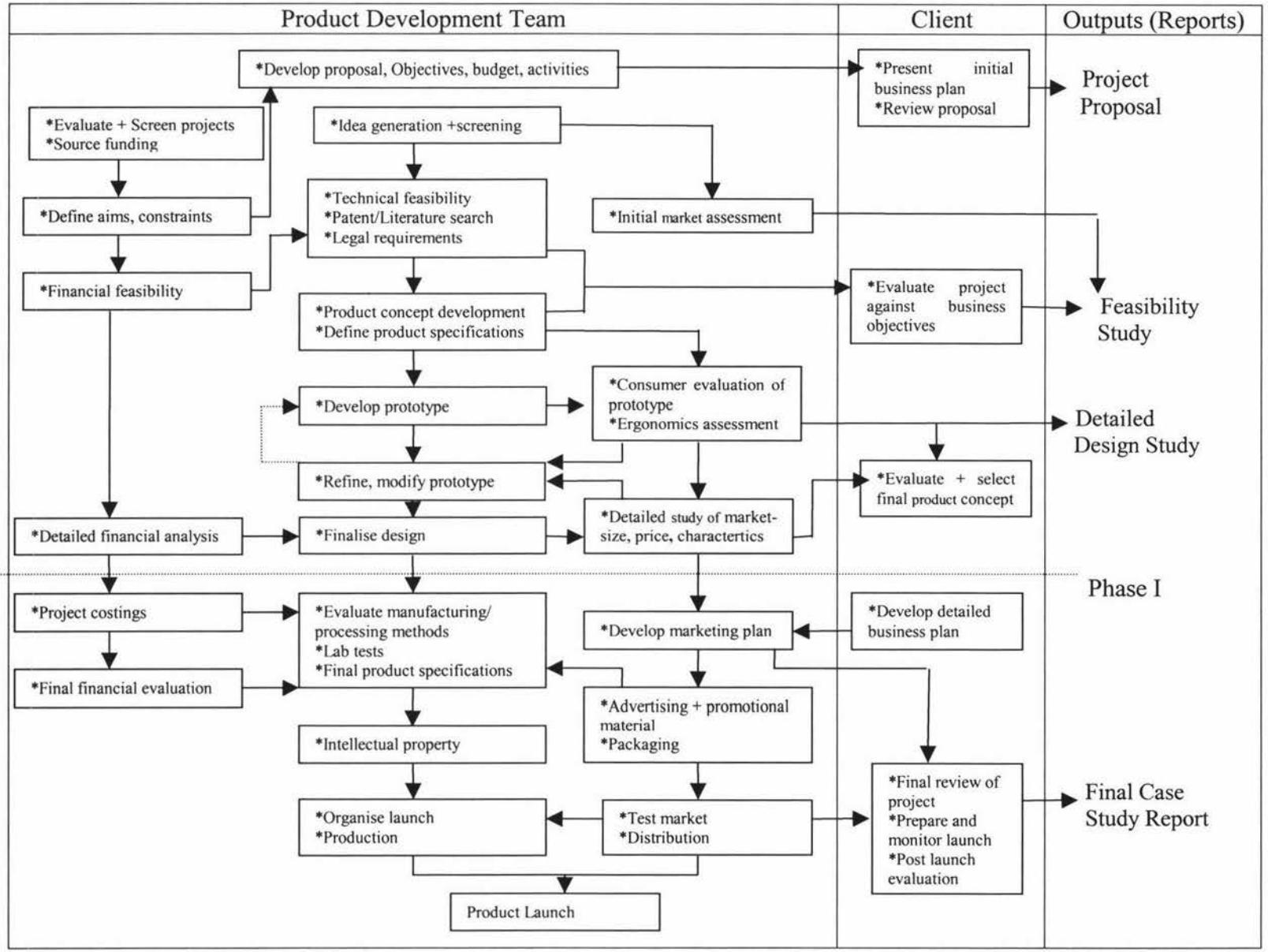
Exhibit 2-11: The Generic PD Process - Ulrich and Eppinger (2000)

Planning	Concept Development	System-Level Design	Detail Design	Testing & Refinement	Production Ramp-Up
Marketing					
* Articulate market opportunity * Define market segments	* Collect customer needs * Identify lead users * Identify competitive products	* Develop plan for product options and extended product family	* Develop marketing plan	* Develop promotion and launch materials	* Plan early production with key customers
Design					
* Consider product platform and architecture * Assess new technologies	* Investigate feasibility of product concepts * Develop industrial design concepts * Build and test experimental prototypes	* Generate alternative product architectures * Define major sub-systems and interfaces * Refine industrial design	* Define part geometry * Choose materials * Assign tolerances * Complete industrial design control documentation	* Reliability testing * Life testing * Performance testing * Obtain regulatory approvals * Implement design changes	* Evaluate early production output
Manufacturing					
*Identify production constraints * Set supply chain strategy	* Estimate manufacturing cost * Assess production feasibility	* Identify suppliers for key components * Perform make-buy analysis * Define final assembly scheme	* Define piece-part production processes * Design tooling * Define quality assurance processes * Begin procurement of long-lead tooling	* Facilitate supplier ramp-up * Refine fabrication and assembly processes * Train work force * Refine quality assurance processes	* Begin operation of entire production system
Other Functions					
* Research: Demonstrate available technologies * Finance: Provide planning goals * General Management: Allocate project resources	*Finance: Facilitate economic analysis *Legal: Investigate patent issues	*Finance: Facilitate make-buy analysis *Service: Identify service issues		* Sales: Develop sales plan	

It is important to note that there is no standard development process that will work or can be used across every company and industry. The state of the Product Development Practice has improved over the years. However, there is substantial room for further improvement in the theory and practice of Product Development (Page, 1993). One critical stage, concept testing, was found less frequently employed than the other PD stages (Page, 1993 and Kyriazis & Patterson, 1996). Concept screening (Page, 1993) and marketing testing (Kyriazis & Patterson, 1996) are also less-practised stages.

A Product Development model developed by Shekar (cited in Lim et al, 1999) roughly divides the process into three main functions of finance, technical/design/manufacturing and marketing. The model also highlights the interdependence, iterative and concurrent nature of activities. The Product Development Partnership Programme (PDPP) at Massey University has followed this model for the last six years. The programme involves a Bachelor of Technology student working on an eight-month-long product development project with individual companies. The uniqueness of Shekar's model is the incorporation of the *student-client relationship*. The sequence of activities and responsibilities of the Product Development team, nature of periodic decision-making and outcomes, and approximate time-scales are outlined clearly in this model (Exhibit 2-12).

Exhibit 2-12: Product Development Process - Shekar (cited in Lim et al, 1999)



2.4 PRODUCT DEVELOPMENT PROCESS TECHNIQUES

The Product Development process is largely an information collection process. Though Product Development practice had received quite extensive attention for the last 3 decades, literature and research focusing on the techniques used throughout the Product Development process is lacking (Kerr, 1999).

Studies conducted by BAH (1968), Earle (1971), Cooper & Kleinschmidt (1986), and Mahajan & Wind (1991) are the few that had essentially looked into the techniques utilized in Product Development process. Summaries of these studies have suggested that the techniques used for the Product Development industry were more primitive than those described in the literature. Furthermore, fewer sophisticated analytical and management techniques were used for this purpose. These sophisticated techniques, such as Conjoint Analysis, Multi-Dimensional Scaling and Internal Rate of Return (IRR) were developed for the purpose of providing more detailed information for decision making at management level.

Exhibit 2-13 shows a selection of techniques used in the Product Development process compiled by Kerr (1994). The exhibit below shows both the techniques suggested by academics and the Product Development practitioners in the industry. It needs to be noted that the techniques listed in Exhibit 2-13 are those that are cited in texts or reported from empirical studies.

Exhibit 2-13: Techniques Used in Product Development – Kerr (1994)

Idea Generation:
Focus groups, brainstorming, attribute analysis, gap analysis, lateral thinking, employee's suggestions*, manager's ideas*, observations, customer requests*

Initial Screening:
Scoring methods using criteria and weightings, informal group evaluation* by one person

Preliminary Market Assessment:
Analysis of the marketplace including information on competitors, market shares, market shares, market size, consumers, customers*, product positioning

Preliminary Technical Assessment:
Analyse information on government regulations, patents, capability analysis*, engineers assessment*, drawings* or specifications

Detailed Market Research:
Concept testing, conjoint analysis, a study of competitive products and prices*

Business/Financial Analysis:
Costs and sales forecast*, discounted cash flows*, return on investment*, payback period, profit

Prototype Development:
Physical construction of the product

Prototype Testing – In-House:
Product use tests*, field tests, technical tests, expert evaluations

Prototype Testing – Customer:
Repeat of concept test, customer evaluations*, structured consumer evaluation testing

Trial Production:
Pilot plant production, small run*

Test Market:
Test market, sales tests, roll-out assessment, controlled conditions testing, sample given to customers to try*

Pre-Commercialisation Business Analysis:
Sales forecasting*, Net Present Value, payback, Rates of Return, financial analysis*, cost review*

Production Start-Up:
Purchasing of new equipment*, commissioning*, plant trials

Market Launch:
Organise distribution/personal selling, advertising*, marketing plans, trade show*, trade literature prepared*

**Techniques found from empirical research to be significantly used by companies*

2.5 MANAGEMENT ISSUES OF PRODUCT DEVELOPMENT

The importance of a systematic Product Development process has been widely reported dating back to as early as Booz, Allen and Hamilton's report in 1968 to the recent studies by Kerr (1994), Griffin (1997), Schilling & Hill (1998). Yet, having a systematic Product Development process does not necessary ensure the success for the organisation if relating management issues are not being carefully considered.

According to Myers & Sweezy (1978), Calatone & Copper (1981), and Burgelmann (1984) the most critical problems in the development process occurs after the decision has been given to develop a new innovation. So unless the structured Product Development process is incorporated with a clearly defined product planning or strategy (BAH, 1982; Cooper & Kleinshmidt, 1987, 1993; Page, 1997), and other essential issues like allocation of adequate resources (Cooper & Kleinschmidt, 1988), good communication and co-ordination (Barlay, Holroyd & Poolton, 1994) within and between the teams, and most importantly the support of the top management who are committed to the project (Barclay, Holroyd &Pooltoon, 1994; Kerr, 1994) were considered, the process cannot be fully executed according to the expectations. A remark from Tushman and Nadler (1996) stated "management of innovation and change is the most vital of management's tasks. Innovation is the outcome of management that is strategic and leadership that is visionary" has again shown the importance of management issues in product innovation and development.

International research on small enterprise management processes by Jennings and Beaver (1997) found that the management process within small businesses is unique with little or no resemblance to the management process in larger organisations. The extent of involvement of the small business owner-managers was found to be throughout their company which indicated that as well as running the day-to-day business of the company, the owner-managers are often in charge of the product development team, overlooking all major decisions such as purchasing and production, simulating innovation, and monitoring employees' progress and

performance. Similar finding of management process in small business was found in research by McGregor and Gomes (1999).

In their recent research on integrating product innovation management and business excellence, Martesen & Dahlgaard (1999) recommended organisation adapt an extended Plan-Do-Study-Act loop (PDSA) when integrating business and innovation management. The first loop, the Strategy Loop, is used for achieving excellence in strategy and planning in innovation management. The second loop, the Culture Loop, is to improve the overall setting where innovation takes place, namely the company culture. Their point of argument in this report was concentrated on the "Plan" phase of the Strategy Loops that a close link must exist between innovation strategies and overall business strategy and visions.

Booz, Allen and Hamilton identified various management factors that had influenced the success of Product Development in their 1968 research. The first of these factors was that Product Development was substantially more successful when top management was directly involved in the process. Later in their research in 1982, they suggested that to improve the Product Development performance, the following are essential:

a. A well-defined new product strategy,

b. A consistent management commitment, and

c. A company environment conductive to achieving company-specific new product and corporate objectives.

They concluded that being successful at Product Development was not a simple process and that new product management is a crucial process, not subject to broad generalisations or universal guidelines.

2.6 SUCCESS AND FAILURE FACTORS

The key to gaining and maintaining the competitive advantage in the marketplace is to repeatedly introduce or commercialise successful new products or services. One way to find out the performance of the products or services is to conduct a performance evaluation either in financial or non-financial terms or both. Different strategies produce different levels of success. An organisation can measure its project performance with many criteria as there is no single measure alone that is adequate for measuring or estimating the project's success.

Project SOPPHO (Rothwell *et al.* 1974) was the first empirical study to systematically compare successful and unsuccessful innovations from the same market. The study identified "route to success" elements, which were shared by many successful companies. The elements are:

a. Had a much better understanding of user needs,

b. Paid more attention to marketing and publicity,

c. Performed their development work more efficiently, but not necessary more quickly,

d. Made more use of outside technology and scientific advice,

e. Had responsible individuals in more senior positions with greater authority than their counterparts.

Rothwell et al (1974) concluded that a successful innovation is the creation of a coupling process of matching the company's technological capacity to the needs of the marketplace. This is consistent with a study by Souder (1987). Separately, the needs of the marketplace or voice of the customer has been mentioned as one of the critical success factors in many studies (Cooper, 1999; Languish et al., 1972; Rubenstein, 1976; BAH, 1982; Souder, 1987; Carter & Williams, 1957).

Booz, Allen and Hamilton's (BAH) report in 1982 was based on in-depth interviews with more than 150 new product development executives and survey responses from more than 700 US manufacturers showed that 2/3 of their sample measured new product performance and nearly 2/3 used more than one measure of success. Profit contribution, return on investment, and sales were the most frequently used financial measures of the new product performance among companies surveyed. Responses of a comparative survey, built upon BAH's work in the 1968 and 1982, by Page (1993) showed an increase of almost 10% of the companies from BAH's 1982 findings, had developed formal financial objectives against which the actual product performance will be measured.

Eleven different financial criteria employed to measure new product performance were reported in Page's 1993 report, including the three most frequently used measures mentioned in BAH's 1982 report. The four most used were return on investment, profit margin measures, sales and sales growth, and profit measures. Similar findings were disclosed in research by BAH (1982) and Mahajan and Wind (1992). These similarities not only tell the criteria most firms use to measure their new product performance but also that there has been little change in the criteria in the last three decades.

Only a small number of firms are routinely measuring their new product development performance. Then again even those that seem to be associated with higher levels of measurement and higher expectations for new product development performance do not consistently measure it across all their projects. Results from Griffin's 1997 research on new product development practices demonstrate that 75.6% of firms develop formal financial objectives against which actual performance is to be evaluated. Her finding of 75.6% insignificantly differs from the survey by Page in 1993 (ie. 76.2%). Notable findings from Griffin (1997) include,

i. 63.2% of the best practice firms' projects were assessed against their objectives,

ii. On average, the performance evaluation for all product and firm types were carried out only 16 months after their initial introduction,

iii. More firms prefer to focus more on improving the performance of their current product line rather than undertake more re-positionings, cost reductions and line extensions products,

iv. The proportion of improvement in both the goods and services is reported to be 35% higher than it was 13 years ago,

v. No difference in success rate across product type (ie. manufactured goods or services) was detected in this study,

vi. Overall survey results show that success rate for a broad US industry sample had declined slightly since the early 1980s, but had steadily remained in the range of 55% and 60%.

Cooper and Kleinschmidt conducted a series of studies on product performance in 1987, 1993 and 1995. In their 1987 study of factor(s) that distinguish new product winners from losers, a series of hypotheses were used to test against a sample of 203 new products. Of the ten hypothesised factors, nine were found to be significantly related to new product success. Three of the nine were singled out as the most vital factors to success, they are: *Product advantage, Product definition and "up-front" activities* (BAH 1968, Cooper and Kleinschmidt 1986, Page 1993) and *The role of protocol*. The role of protocol was defined as gaining agreement on target market and product strategy prior to the development activities. Other "second level" factors included,

a. Proficiency of technological activities,

b. Proficiency of market-related activities,

c. Technological synergy,

d. Market potential, and

e. Market synergy.

Market competitiveness was the factor found to have no impact on product performance. Top management support on the other hand was found to be insignificantly related to new product success. Review of the 203 new products

showed that failed products shared the same level of top management commitment and involvement as the successful one. This, however, was not the case in studies conducted by Rubenstein (1976), BAH (1982), Barclay (1992), and Cooper & Kleinschmidt (1995) where support from the top or senior management was identified positively related to the success of new products.

In the same year, Cooper and Kleinschmidt (1987b) developed a set of different measures of new product success for the project-level research, Table 2-2, which include:

Table 2-2: Measure of New Product Success – Cooper and Kleinschmidt (1987)

Measure of New Product Success	
Financial success/failure:	Relative profits
Profitability level:	Sales vs. Objectives
Payback period:	Profits vs. Objectives
Domestic market share:	Opportunity windows on new categories
Foreign market share:	Opportunity windows on new markets

Then in 1995, Cooper and Kleinschmidt looked at the drivers of New Product Development at company-level in a review of performance factors in which they proposed the following elements to determine a company's overall new product performance: New Product Development **process** and specific activities within the process; New Product Development **organisation**; company's New Product Development **strategy**; company's **culture**, and climate for innovation and senior management **commitment** to New Product Development. These five elements (process, organisation, strategy, culture, and commitment) were also identified in studies on new product performance by Shrivastava & Souder (1987), Griffin & Hauser (1992) and Cooper (1979).

Nine factors were identified as responsible for the drive of new product performance, where a **high-quality new product process** was found to be the **most critical driver** to separate the high performance companies from the low performance companies, followed by having **a clear, well communicated new product strategy**. Adequate resources and senior management commitment are the third and fourth most vital drivers to new product performance. Conclusions of this review were,

i. No one cluster of firms from their analysis of the 135 firms excelled in all the dimensions of performance, and

ii. It is remarkably difficult to achieve excellent performance on the dimensions of profitability.

Various studies, Project SAPPHO, Stanford Innovation Project, and NewProd I and III, have probed new product performance in recent decades. Studies focused on new product failure have verified the deficiencies in how new products were conceived, developed and launched (Cooper, 1975; Hopkins & Bailey, 1971; Hopkins, 1980; National Industrial Conference Board, 1964) while product successes surveys yielded only generalised results in success factors (Cooper, 1976; Roberts & Burke, 1974). The majority of these success versus failure studies were unfocused (ie. samples were selected from a broad range of industries and results presented were averaged or generalised) (Cooper & Kleinschmidt, 1993). One of the reasons this trend had taken place is the lack of feasible sample size within any one industry for a relevant study.

In trying to resolve this, Cooper & Kleinschmidt (1993) took the opportunity to conduct an investigation on factors that distinguish the winners in the chemical industry (sample size = 103 projects). A conceptual model (with critical factors to success integrated) developed in their previous study in 1987 was used and modified for the cross-country (USA, Canada & Europe) investigation on the success determinants in the chemical industry. This model as shown in Exhibit 2-14 postulates that new product outcomes (ie. success or failure) are the result of the interaction of the new product strategy. This interaction included the product itself (ie. its features, benefits and advantages) and aspects of product launch (ie. sales force, advertising) with both the new product's market and its competition.

The sets of variables found to have impacts on new product performance are:

a. The Strategy,

b. Nature of Project,

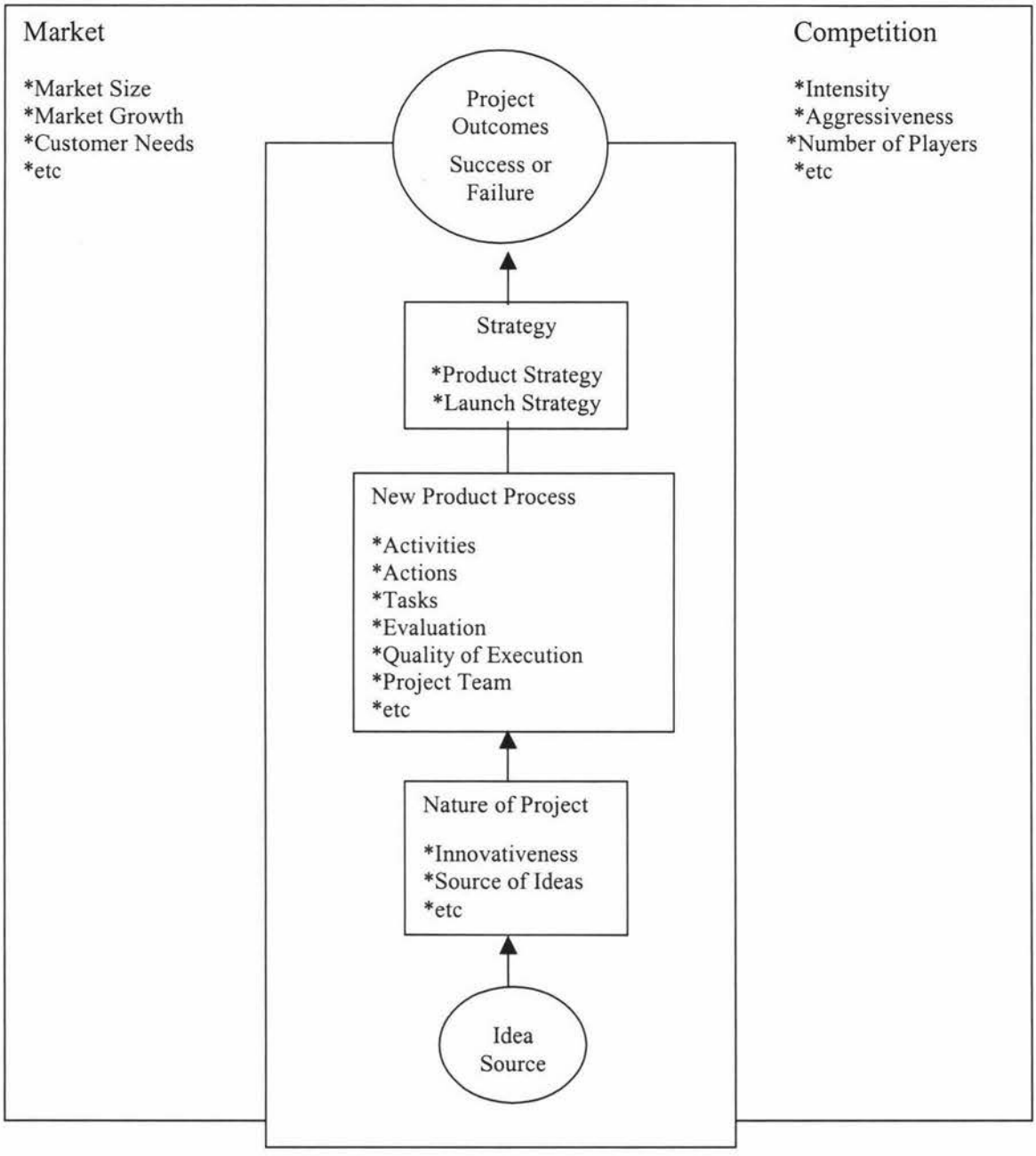
c. The Corporate Environment - Synergies (Marketing, Production, Technology and Management),

d. The Corporate Environment - Project Familiarity,

e. The Market, and

f. The Competition.

Exhibit 2-14: A Conceptual Model of the Factors Influencing New Product Outcomes - Cooper and Kleinschmidt (1987)



Survey results of the 103 projects found that 66% of the projects were rated as a commercial successes, with 34% rated failures, corresponding closely to findings in Booz, Allen and Hamilton's report in 1982.

The results are no surprise since *Product differentiation* is the number one discriminator between new product winners and losers in the chemical industry. New products featuring differential advantage were ranked more successful than those that lacked it. New product winners were those that:

a. Offered relatively higher product quality,

b. Had superior price or performance characteristics,

c. Provided good value for money to the customer,

d. Superior to competing products in meeting customer needs,

e. Had unique attributes, and

f. Had benefits visible to customer.

However, such important aspects of the external environment like the market attractiveness and competitive situation were not listed as strong success determinants in this particular industry (chemical industry).

For reason of its dominance in the chemical industry, product advantage had become an important screening criterion for project selection as well as the project objectives. Lower price strategy, product novelty and the use of an embryonic technology were found to hold the least connection to new product success.

There are eight common dominators of new product success (Exhibit 2-15, Cooper 1998) based on thorough research over the past decades. Yet, businesses and projects still perform poorly on each of these success factors. It is somehow a mystery that if

these drivers are so fundamental to success, why so many businesses and project teams still fail to incorporate them into their product development process.

Exhibit 2-15: Eight Actionable Critical Success Factors - Cooper (1998)

1. Solid up-front homework - to define the product and justify the project.
2. Voice of the customer - a slave-like dedication to the market and customer input throughout the project.
3. Product Advantage - differentiated, unique benefits, superior value for the customer
4. Sharp, stable and early product definition - before development begins
5. A well-planned, adequately resourced, and proficiently executed launch
6. Tough Go/Kill decision points or gates - funnels not tunnels
7. Accountable, dedicated, supported cross-functional teams with strong leaders
8. An international orientation - international teams, multi-country market research, and global or local products.

Barriers to success or "blockers" which made these success factors invisible were the focus of Cooper's research in 1999. The seven blockers identified: (i) *Ignorance, (ii) Lack of skills, (iii) Faulty or mis-supplied new product process, (iv) Too confident, (v) Lack of discipline, (vi) Big hurry, and (vii) Too many projects but lacking resources (financial and people)* were extensively discussed with possible solutions explored. Cooper concluded the investigation by offering eleven actions, which could eliminate the blockers if they were taken into consideration. These actions are:

1. Your leader must lead,
2. Design and implement a new product process,
3. Overhaul your process,

4. Define standards of performance expected,
5. Install a process manager to oversee the process,
6. Build in tough Go/Kill decision points,
7. Use true cross-functional teams,
8. Provide training,
9. Seek cycle time reduction,
10. Move to portfolio management,
11. Cut back the number of projects underway.

Two PDMA approved and sponsored projects were conducted by Griffin and Page in 1993 and 1996. The primary purpose of both these projects was to suggest the most appropriate sets of success and failure measures covering all possible levels such as the project-level, programme-level, and company-level.

Measures of product development success and failure (Griffin and Page, 1993) were obtained independently from the literature and companies of practitioners who had attended the PDMA conferences. A total of seventy-five measures were generated through the surveys and the literature review; and were statistically grouped into the categories of:

a. Firm Benefit Measures,
b. Programme-Level Measures,
c. Product-Level Measures,
d. Financial Performance Measures, and
e. Customer Acceptance Measures.

Sixteen out of the seventy-five measures were found to be commonly presented across the sources of: measures from literature review, measures actually used by the

practitioners, and measures that they would like to use. These sixteen measures were then used as the core success/failure measures in their project. The core measures in each category are shown in Table 2-3.

Findings from their 1993 project include:

i. The number of measures used by firms does not vary in total or across the categories by function of respondents, regardless of whether it is technology- or marketing-driven or a balance mixed of both.

ii. The top three most used success measures among the companies are:

- Meeting revenue goals,
- Meeting share goals, and
- Meeting unit volume goals

iii. Three most desired success/failure measures companies would like to use are:

- Customer satisfaction,
- Meeting unit volume goals, and
- Meeting share goals

iv. In terms of most interested success measure, academics favour the overall success of product development programmes and their impact at the firm level while corporate respondents are more interested in measures associated with the success and failure of individual projects.

v. Reasons why companies do not measure development success and failure include: (The percentage in the bracket indicated the percentage of companies held that particular reasons for not measuring success/failure)

- Have no system in place to measure success/failure (37%)
- Company culture does not support measuring (17%)
- No one is held accountable for results (12%)
- Do not understand the development process (10%)
- Short-term orientation, cannot wait for results (10%)

- Have no time to measure results (8%)
- Measuring is unimportant (6%)

Conclusion drawn from this project study was that the concept of product development has many dimensions and that each may be measured in a variety of ways with a variety of measures.

Table 2-3: Core Measures of New Product Success and Failure - Griffin and Page (1993)

Customer Acceptance Measures	Customer Acceptance
	Customer Satisfaction
	Meet Revenue Goals
	Revenue Growth
	Meet Market Share Goals
	Meet Unit Sales Goals
Financial Performance Measures	Break-even Time
	Attains Margin Goals
	Attains Profitability Goals
	Internal Rate of Return (IRR) / Return on Investment (ROI)
Product-Level Measures	Development Cost
	Launched on Time
	Product Performance Level
	Meet Quality Guidelines
	Speed to Market
Firm Benefits Measures	% of Sales by New Products

Interdepartmental integration is believed to have a certain degree of influence on the product performance. The missing puzzle is what level of integration and to what extent is it needed? Results of Kahn's (1996) survey indicated that collaboration has a stronger and more positive effect on product development performance than

interaction. A certain level of interaction is necessary in many situations. However, it does not have a significant effect on either the performance of product development or product management. The interaction philosophy favours communication between departments, which encourages managers to hold many meetings and establish extensive information flows between departments. Results of Kahn's survey suggested otherwise. Responses of his survey indicated negative effects for meetings and the exchange of documented information on product development or product management performance. In conclusion, Kahn recommended that managers should first assess the level of interdepartmental collaboration in their company before integration could be effectively administered.

Study of success and failure factors has consumed quite a substantial segment in the research of Product Development that both the industrial and academic communities are searching for the key to successful new product development. Most of the studies conducted so far have been unfocused and inconclusive due to the lack of feasible sample size within a particular industry. Furthermore, success is difficult to measure, which again, is complicated by the fact that success can not only be measured at various levels (individual project level, programme level and/or company level) but with different sets of measure.

2.7 NEW ZEALAND BUSINESSES AND PRODUCT DEVELOPMENT SYSTEM

It is generally accepted that the number of employees and turnover are the most commonly used statistical company size criteria. Whereas, the non-statistical but still quite commonly cited criteria stated in the Bolton Report (1971) defined small businesses as:

a. In economic terms, a small firm is one that had relatively small share of its market,

b. An essential characteristic of a small firm is that it is managed by its owners or co-owners in a personalised way, and not through the medium of formalised management structure,

c. It is independent in a sense that it does not form part of a larger enterprise and that the owner-managers should be free from outside control in making their principle decisions.

These non-statistical definitions, describing small businesses in terms other than numerical or monetary, are found to be impractical to use when conducting research (Curran, 1986). This current research adopted the definition of company size used by Cameron and Massey (1999) where a micro business is defined as having five or fewer employees; a small business as having six to 49 employees; a medium-sized business as having between 50 and 99 employees; and a large organisation as having 100 or more employees. For reasons that definitions of a small business vary considerably between countries, careful consideration must be taken when making international comparisons. The most common definition of SMEs in Organisation for Economic Cooperation and Development (OECD) countries is firms with fewer than 500 employees (OECD, 1997).

The latest statistic figures (Statistics New Zealand, 2000), Table 2-4, show the dominance and significance of Small and Medium–sized enterprises (SMEs) in New Zealand's economics and business activity, with a mere 1,270 enterprises being large organisations. SMEs as defined in the New Zealand context are businesses with less than one hundred full-time employees, and Large Orgnisations (LOs) are those that employing more than one hundred people. By far, the SMEs sectors account for 99.6% of the entire business population in New Zealand.

A large organisation was regarded as the backbone of economic development throughout the developed countries until recent decades when the significance of SMEs is increasingly recognized (Cameron & Massey, 1999; Gomes, 1998). As stated in Bolton's (1971) report, SMEs are as important as the big business in creating

and maintaining a dynamic economy. SMEs' contributions to the economy (Storey, 1983) include:

a. Generating jobs at comparatively low cost,

b. Providing both actual and potential competition to the big businesses,

c. Providing career opportunities to individuals who prefer working in the unstructured environment of small businesses,

d. Providing an important source of innovation and invention, and

e. Helping to spread employment more evenly on a regional basis.

Table 2-4: New Zealand Enterprises as at February 2000 – from Large to Small

Category	Number of employees	Number of Enterprises	
		Numbers	%
Micro	0 to 5	247,318	86.7%
Small	6 to 49	35,336	12.4%
Medium	50 to 99	1,480	0.5%
Total SMEs		284,134	99.6%
Large	100+	1,270	0.4%
Total:		**285,404**	**100%**

Source: New Zealand Business as at February 2000, Statistics New Zealand.

Comparison of the business demographics statistics from 1998 to recent published figures of 2000 illustrates only a very slight increase in SMEs but a mere decrease in LOs in terms of numbers of enterprises.

Table 2-5 shows the population of New Zealand enterprises in the last three years, which is typically concentrated in the smallest size of enterprises.

Table 2-5: Comparison of New Zealand Business Demographic Statistics for the years 1998 to 2000

Number of Employees	Number of Enterprises		
	1998	**1999**	**2000**
0 to 5	86.5%	86.1%	86.7%
6 to 49	12.5%	12.9%	12.4%
50 to 99	0.6%	0.5%	0.5%
100+	0.5%	0.5%	0.4%
Total:	**100%**	**100%**	**100%**

Source: New Zealand Business as at February 1998, 1999 and 2000, Statistics New Zealand.

McGregor and Gomes (1999) identified three areas of weaknesses in their investigation of technology uptake within New Zealand SMEs. These relatively weak areas are product development systems, managerial skills, and technology-adoption strategies. Twenty-one percent of their sample recognised Product Development as the area that needed further improvement. Evidence from Griffin's studies on new product and product development showed that the cross-functional tasks of product development are frequently not yet treated as something to be managed as a critical process within many SMEs.

A study of Danish SMEs (Hansen et al, 1994) had revealed that 47% (total sample of 188) of manufacturers regarded investment in information is just as important while another 23% considered it very important. Yet, the perceived importance of information investment within New Zealand SMEs relative to investment in physical plant and equipment is evidently very low (McGregor and Gomes, 1999).

A summary of the negative factors that had direct or indirect influence on the low usage of Product Development practice by companies in New Zealand was presented in Kerr's study (1994) of Product Development practices within New Zealand small manufacturing companies. These negative factors include:

a. Little research on Product Development in New Zealand was conducted,

b. Very low levels of R&D spending by both the Government and the private sector,

c. Little perceived need for developing new and competitive products, and

d. Few employees engaged in Product Development or R&D.

Table 2-6 below details the comparison of different size's average scores across all practice indices in different company size within New Zealand firms. This study undertaken by Knuckey et al (1999) involved 722 medium* firms and 441 large** firms within New Zealand. Figures in the table show that, on average, a large sized firm has out-rated medium sized firms' average scores across all practice indices, except for the outcome index. Nevertheless, it is important to acknowledge the existence of bias in this survey where companies with less than 10 employees were not sampled.

Table 2-6: Average Practice and Outcome Scores by Size of Firm - Knuckey et al (1999)

	Medium Sized*	Large Sized**	Industry Average Score
Strategising/Practices	53	60	55
Outcomes	59	59	59
Leadership & Planning	44	57	48
Employee Practices	47	55	49
Customer Focus	68	73	70

* Medium sized enterprises were defined as having 10 to 39.5 full-time equivalent employees in survey by Knuckey et al (1999)

** Large sized enterprises were defined as having 40 or more full-time equivalent employees in survey by Knuckey et al (1999)

Operations and Quality	52	66	56
Supplier Relations	54	55	54
Information and Benchmarking	55	62	57
Innovation and Technology	48	53	49

** Medium sized = having 10 to 39.5 full-time equivalent employees*

*** Large sized = having 40 or more full-time equivalent employees*

Small, medium and large enterprises, while individually insignificant, in aggregate play an important role in the New Zealand economy and business structure. The growing and significance of SMEs over the past decades has overwhelmed many, as the economy previously appeared to be contradicting the economies of scale, which was favouring the large organisations by lowering the prices to customers. Nevertheless, large organisations still play an important influence as major suppliers and employers to New Zealand business as a whole. "Small is beautiful, large is powerful and together they are wonderful" is how Acs, Carlsson & Thurik's (1996) describe of the unique relationship between SMEs and LOs.

2.8 SUMMARY

More and more educational organizations (ie. universities, colleges, and/or institutes) have realised the significance of training students with multidisciplinary skills while at the same time being involved in the design and development of real-world projects. This realisation is mainly due to the increasing desire and interest in the industry to hire graduates with skills and knowledge beyond technical competence within their own disciplines.

Besides the IPRO Programme at Illinois Institute of Technology, neither discussions nor evidence of internal or external evaluations on these programmes were being disclosed to the general public. LFM and SDM programmes at MIT and IPRO Programme at IIT share the similarity with the PDPP at Massey in terms of programme design, and curriculum. The difference between IPRO and PDPP is that IPRO is a team-based project programme while PDPP is an individual project programme. Among the six corporate project programmes discussed, LFM Programme at MIT has the most strict pre-requisites in order to be considered eligible for entry to the programme.

The product development process for commercial product/project in the business arena has received much attention with various studies published and models developed over the past decades. Studies conducted by well-known researcher and PD practitioners such as Booz, Allen & Hamilton, Griffins, Page, Cooper, Kleinschmidt, and Earle had shown that the new product development processes had evolved quite considerably in the past three decades and continue to be so. Findings of these studies also indicated that for companies to be competitive in the marketplace and to have higher product success rate, they will need to 1) have a new product development process in place, 2) apply the NPD process when developing new products, and 3) continually bring their process up to date with the current new product development trend.

An important part of the front end work necessary for product development is to evaluate the new product performance in financial terms as a business proposition (Page, 1993). Measures used by the companies to measure their new product performance can be classed into two major categories, 1) financial, and 2) non-financial. Financial measures identified by various previous studies included ROI, sales, sales growth, market share, and profit margin. Non-financial measures included customer satisfaction and/or acceptance, speed to market, technical performance, top management support, and market competition.

The elements and/or factors that drive a company's overall new product performance had also been the focus of new product development studies in the past three decades. The success drivers recognised were applying step by step NPD process in the new product development, project/product strategy, well-defined project aims and objectives, top management support and commitment, resources, and communication.

New product development processes have received increasing attention by businesses in New Zealand. Yet, in comparison to overseas businesses the NPD process usage in New Zealand is still considered low. As indicated by Kerr (1994), the low NPD usage in New Zealand businesses were induced by four negative factors. These negative factors were, a) little research on PD in New Zealand was conducted, b) very low levels of R&D spending, c) little perceived need for developing new and competitive products, and d) few employees were engaged in PD or R&D.

Chapter 3

METHODOLOGY

3.1 INTRODUCTION

The literature review conducted and detailed in Chapter 2 has provided this study with the recent approaches to and trends in Product Development as well as insight into what has been achieved in the past. Further research planning was allowed with the input and backing of the review conducted.

This chapter looks at

3.2 Research Planning and Design

3.3 Sample Selection and Background Check

3.4 Questionnaire Design

3.5 Measurement and Scales Determination

3.6 Data Analysis Methods and Tools

3.7 Pilot Study

3.8 The Full Survey

3.9 Response Rate

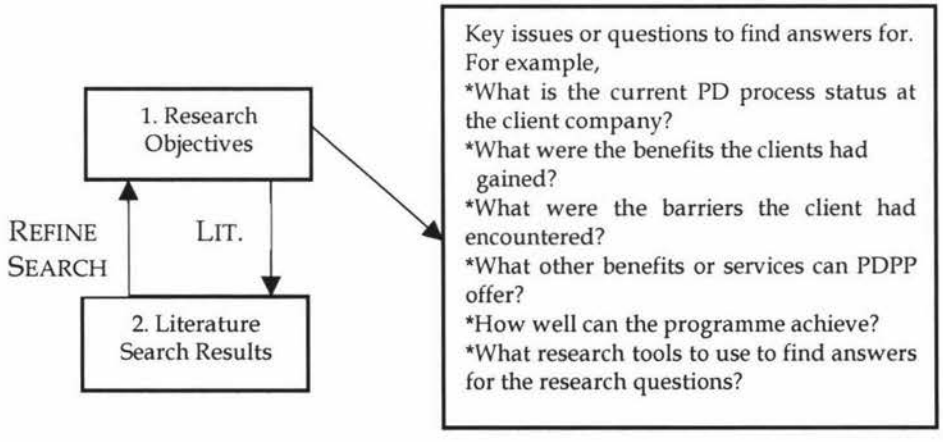
3.10 Characteristics of the Sample and Responses

3.2 RESEARCH PLANNING AND DESIGN

Literature and research regarding Product Development practice, programme evaluation measures, success and failure factors and best practices were gathered and studied prior to the development of the Product Development Project Programme research. Sources from the campus library and Internet were used to cover the multi-facet of issues investigated.

The objectives of this research were again reviewed after the literature review to refine the questions and clarify the topics the survey sought to cover. Figure 3-1 shows the flow diagram of the research planning. The research planning helps to develop the design and management of the survey. The sample selected, client companies from 1997 to 1999, were spread all over New Zealand, from the North to the South, it is thus decided that mail survey following by pre-selected samples for case study interview were the best tool to gather the information needed to satisfy the research objectives.

Figure 3-1: **Research Plan**



The size of the sample and how far back should the PDPP projects be chosen were then determined.

3.3 SAMPLE SELECTION

A list of the industrial partners over the last three years (1997-1999) was obtained from the Institute database. Projects with development histories older than three years were excluded from the research. The exclusion was based on the assumption that the key personnel associated with the projects may have left the company and documentation or records would no longer be available. Another reason for the exclusion was based on the details recalling of the projects and the students' performance. Research by Heneman and Wexley (1983) indicated that the recall power of key subjects degrades in respect of time. Also a balance between response accuracy and maximisation of the number of projects is possible by limiting the ages of the projects (Souder, 1983). The lists obtained covers a wide spread of industry sectors. These include the furniture manufacturing industry, software industry, food industry, electronics industry, construction products, leisure accessories, and packaging manufacturers.

A background check on the selected sample was carried out by phone calls and Yellow Pages information on the internet (www.yellowpages.co.nz) prior to the full-scale survey. The background check was to ascertain the validity of the last obtained contact detail and, most importantly, was to verify whether the companies selected are still in business. This step had proved to be essential as nine out of sixty-eight companies were found to have closed down, and four others were found to have been either relocated or had changed their contact network. A total of fifty-five companies were obtained and approached to participate in the study. A questionnaire along with a cover letter and statement of the ethics protocol were mailed to the interested companies.

Sample for the case studies interviews were selected after the questionnaires were returned and analysed. The interview sample were limited to the Manawatu region due to budget constraints. Only company personnel most knowledgeable about and familiar with the

project were invited to take part in both the mail surveys and face-to-face case study interviews.

3.4 QUESTIONNAIRE DESIGN

A questionnaire is a measuring instrument designed to draw out facts and opinions. Careful planning, extensive reviews and testings were essential to ensure that the questionnaires were designed to meet the research aims and objectives efficiently and effectively.

3.4.1 MAIL SURVEY

Before the development of the mail survey questionnaire, it was essential to conduct a literature review in the area of interest and from there, plan and decide what information this research was seeking to collect. The survey procedures and questions were guided by the research objectives established and reviewed as mentioned in 3.2 above. The questions also need to be understandable and obligation-free to the respondents so that they do not feel their rights being threatened. They would, therefore, be more willing to participate. To achieve this, the questionnaire needs to be specific, free from jargon, and provide respondents with relevant information and explanation as needed, and be kept as simple as possible.

A comparative analysis of similar research and programmes was undertaken for the purpose of gathering relevant information and provide insight that could be useful in the development of this research study. Questions were then designed and compiled using results of the analysis and including studies on trend in New Product Development (Griffin and Page 1993; Page 1993; Kerr 1993), PD measures and success and failure factors (Booz, Allen and Hamilton 1982; Cooper and Kleinschmidt 1986, 1987, 1995; Crawford 1983). The intent of the questionnaires was to collect and address desired feedback regarding the PDPP.

Questions set for the mail survey were a mix of closed-ended and open-ended questions. Formats used in the closed-ended questions were the "Yes/No" questions and rating scales. An example of rating scales used in the questionnaires were "Not At All Important" rated as 1 point, "Important" as 3 points, and "Very Important" as 5 points. Open-ended questions required a response that was more than a yes or no and require a narrative answer. Open-ended questions were only asked as follow-up questions after the Yes/No or rating scales questions, and in the Suggestions and Recommendations section at the end of the questionnaire.

The greatest concern with the open-ended question that required the narrative answer was that many respondents were leaving them blank; with maybe only between 20% to 50% of the respondents answering (Mangione, 1995). Nonetheless, the response rate is not the only problem to this type of questions. Among those that answer, additional problems are faced with the handwriting and answers with inadequate details. Therefore, the use of this type of questions was avoided as much as possible in the mail survey.

The mail survey questionnaire was divided into three main sections (ie. Section I and Sections II and III)

I. A brief introduction of the purpose of the mail survey (See questionnaire in Appendix II),

II. An overview of the respondent's PD practice before and after the project partnership (See questionnaire in Appendix II), and

The purpose of this section was to satisfy research objective 1.4.1 of gaining an overview of the PD process at the client company.

III. To explore companies' opinions of the Programme in terms of benefits gained, barriers encountered, meeting client companies' expectations of the partnership, and suggestions/recommendations for PDPP (See questionnaire in Appendix II).

Questions in this section were aimed to satisfy research objectives 1.4.2 and 1.4.3. Which were, to evaluate the PDPP in terms of (a) benefits to client, and (b) achieveing client's expectations, and to present recommendations and future research directions to improve the PDPP, respectively.

The third section was then split into four sub-sections to extend the understanding and verification of the issues addressed. The four sub-sections are:

3.4.1.1 BENEFITS TO CLIENTS

This sub-section was set to find out:

- What were the benefits or opportunities gained by the clients from the Partnership Programme? (See Question A1 Appendix II),

- What were the benefits they were expecting to gain from participating in the Programme, and did they receive them? (See Question A2 in Appendix II), and

- What were the major barriers or obstacles they had encountered during the project partnership? (See Question A3 in Appendix II)

3.4.1.2 ACHIEVING CLIENT EXPECTATIONS

The main focus of this sub-section was to measure the client's satisfaction towards the design and management of the Programme. (See Section B of Questionnaire in Appendix II).

3.4.1.3 SUGGESTIONS AND RECOMMENDATION

This sub-section, as suggested by the sub-heading, was for the clients to voice their suggestions and/or recommendations that they thought are essential for an improved Programme implementation. It also intended to give the PDPP co-ordinator an indication of the number of client companies taken part in this research that were interested in taking on another PDPP project with Massey. (See Section C of Questionnaire in Appendix II).

3.4.1.4 DEMOGRAPHICS

The final sub-section focused on gathering demographic information of the respondents, which was optional. (See Section D of Questionnaire in Appendix II).

3.4.2 CASE STUDY INTERVIEWS

The topics and questions for the interviews and the companies to be interviewed were determined after the data collected from the mail survey were reviewed and analysed. The reasons for this were so that some answers given in the mail survey could be justified, and also to obtain further information on gaps identified or questions raised from the preliminary mail survey analysis. Once the questions were set, thorough reviews were carried out and changes were made until a final version of the questions was achieved. Role-play of the interview between the researcher and the thesis supervisors, and between fellow post-graduates were organised in order for the researcher to become familiarised with the flow of the questions and the questions themselves, the setting and most importantly to keep track of the approximate time taken.

The topics of the case study interview were:

3.4.2.1 GENERAL INFORMATION OF THE CLIENT COMPANY

The purposes of this section were to set the scene and for the company to revise or add company information that was not previously found in the student's progress report or ITE's client database. This section covered a brief history of the company, company structure and size, and product range (see Section 1 General Info of Company in Appendix III for questions in detail).

3.4.2.2 PRODUCT DEVELOPMENT PARTNERSHIP PROGRAMME

This section focused on the product development practice at the client company, their expectation and evaluation of the Partnership programme, and lastly their opinion on the design and management of the PDPP. Questions asked included (see Section 2 Product Development Partnership Programme in Appendix III for questions in detail),

- Do you follow any particular process of Product Development?
- Did you evaluate the student project (against your expectations) at its completion?
- Do you think in overcoming the obstacle, the outcome would have turned out to be what you company expected?
- What was your opinion of the design and management of the Programme?

3.5 MEASUREMENT AND SCALES

To evaluate the Partnership Programme, a five-point Likert-type performance scale was used (see Question B1 in Appendix II) with written or verbal guidance and explanation in the mail survey and face-to-face interviews. Scores lower than 3 (ie. 1 and 2) were labelled as "Not At All Successful" or "Poor" and score of 5 was "Very Successful" or "Excellent".

Score of 3 was average or neutral, such as "Successful" or "Average". The validity of these scales has been tested in studies by Cooper & Kleinschmidt (1987) and Crawford (1983). The scales were used to indicate the Programme performance with the measurement criteria being benefit to clients and achieving client expectations. These performance criteria were used to obtain more in-depth discussion in the exploratory interviews with the participating companies.

3.6 DATA ANALYSIS

Mail Survey

Data obtained from the mail survey were compiled and sorted into two groups. One for information gathered on PD practice and the PDPP and another for the general information of the responded companies. The raw data was then edited and coded before being analysed using available statistical tools. Before useful information and conclusions can be derived from the data they need to be tabulated by counting the number of cases and responses in every category. The purpose of data tabulation is to determine the empirical distribution of the variables and to measure the central tendency (i.e. mean, median and model) and dispersion (i.e. standard deviation) of the sample (Aaker et al 1995). The data was then organised as a general data set for the process of more detail statistical analysis.

Case Study Interviews

Audio tapes of the interviews were reviewed and transcribed on a case-by-case basis. The transcripts of the in-depth interviews were reviewed for ease of analysis and evaluation. Summary of each interview conducted was done to show the key findings and to address the questions raised in the data analysis of the mail survey.

Evaluated data was presented in the format of graphs, charts and tables, and then compared with findings drawn from other similar research studies.

3.6.1 STATISTICAL TOOLS USED

Data obtained from the mail survey were analysed using Microsoft Excel and SPSS (Statistical Package for Social Sciences). Microsoft Excel was mainly used for simple statistical analyses like calculating the frequencies, percentages and average scores of cases in every category. While, SPSS was used to run more advanced analyses such as correlation and cross-tabulation with Monte-Carlo Estimates[1].

Correlation analysis was used to evaluate the degree of relationship or correlation between the scores of two distributions. The correlation coefficient, r, ranges from +1 through zero to –1. The sign of the coefficient indicates the direction of the relationship, as +1 indicates a direct or positive relationship; zero indicates no relationship exits; and –1 indicates an inverse or negative relationship between scores. Pearson's product-moment correlation coefficients were computed at a 2-tailed significance level of 5%.

The following scale tested in study by Ho (2001) was used for this research to interpret the correlation coefficient:

0.0 - 0.5	Weakly correlated
0.5 - 0.7	Moderately correlated
0.7 - 0.8	Strongly correlated
0.8 - 1.0	Very strongly correlated

Later, a cross-tabulation on the selected mail survey questions were conducted to find out the significance level of the underlying factors that led to commercialisation of the student projects.

[1] Monte Carlo Estimate
An unbiased estimate of the exact significance level, calculated by repeatedly sampling from a reference set of tables with the same dimensions of row and column margins as the observed table.

3.7 PILOT STUDY

A pilot study was conducted after the formatting and compilation of the questionnaire with the purpose of improving the clarity and usefulness of issues addressed in the questionnaire. The pilot questionnaires were circulated with a covering letter and ethics protocol used (see Appendix I and Appendix IV, respectively) to twenty companies, which were randomly selected from the survey sample.

The major concern of the pilot study was the optional aspect of the Demographics section where the identity of the individual and the company answering the questionnaire were protected. This would create some problems in the analysis of company sizes (Micro[2], SMEs[3] and Large Organisations, LO[4]) and project commercialisation. Fortunately only one company from the seven pilot survey returned did not reveal its identity. Another concern was the failure to use an identification code to allow identification of the name or the nature of the project and the student involved especially where companies had sponsored more than one project over the investigation period.

A minor modification to add an identification code was made to identify which student project the survey was directed to for the case studies interviews. This minor modification had proven to be very useful of which it had made contacting the client companies possible to clarify on narrative answers given in the mail survey and/or, most importantly, to make arrangement for the case study interviews. Besides the addition of the identification code, no further major changes were made to the structure or design of the questionnaires, and no variation in terms of data analysis and evaluation were necessary as a result of the minor changes. Responses from the pilot study were included in the final research analysis after

[2] Micro - Having 5 or fewer employees
[3] SMEs – Having 6 to 99 employees
[4] LOs – Having 100 or more employees

consultation with a research expert (Associate Professor Cliff Studman) in the Institute of Technology and Engineering.

3.8 THE FULL SURVEY

The full-scale survey (after the completion of the pilot study) were carried out based on Massey University's Code of Ethical Conduct (www.massey.ac.nz/~muhec/points.html, Appendix VI) and the Market Research Society of New Zealand Inc. (www.mrsnz.org.nz, Appendix VII). The major principles of the Massey University Human Ethic Committee's (MUHEC) code of conduct include:

- Informed Consent (of the participants),
- Confidentiality (of the data and the individuals providing it),
- Minimising of harm (to participants, researchers, technicians etc),
- Truthfulness (the avoidance of unnecessary deception),
- Social Sensitivity (to the age, gender, culture, religion, social class of the subjects).

Source: Principles of the Code, MUHEC.

3.8.1 MAIL SURVEY

Questionnaires for the mail survey were pre-tested with twenty randomly selected clients. To conduct the full-scale mail survey, a set of survey questionnaires (Appendix II) were accompanied by:

i. a letter of brief research introduction and explanation (Appendix I),

ii. a self-addressed, freepost envelope, and

iii. statement of the ethics protocol (Appendix IV) required by the MUHEC

and sent to the selected companies. The selected companies were contacted prior to the mailing for their interest in participating in the survey. Follow-up phone calls were made when the survey questionnaires were not returned three weeks after the mail-out. This step is highly relevant to encourage a higher response rate in mail survey. The mail survey response rate was improved by 7% with the aid of follow-up phone calls.

3.8.2 CASE STUDY INTERVIEWS

Four face-to-face in-depth interviews with respondent companies in Manawatu region were arranged following the preliminary analysis of the survey data. Objectives of the interviews were to gain more depth and clarification on some of the answers given in survey, and to get answers for questions raised as a result of the preliminary data analysis of the mail survey.

Each interviewee completed a consent form allowing audio recording of the interview as a requirement of the MUHEC (Appendix V) protocol. All the interviews lasted thirty to forty-five minutes, and took place at the interviewees' company premises. The first ten minutes of the interview was focused on the understanding of the project and company background, followed by the clarification of their answers in the questionnaire returned. They were also encouraged to extend their answers with more details and to give suggestions on the deployment of the PDPP.

3.9 RESPONSE RATE

Twenty pilot questionnaires were mailed to randomly selected companies in early October of year 2000. This was followed by a full-scale mail-out to the remaining thirty-five companies, who were involved in the PDPP in the year 1997 to 1999, throughout New Zealand in late November 2000. Seven of the pilot companies returned their surveys in the second week of the mail-out. The response rate of the full-scale mail-out was rather

disappointing with only twelve of the thirty-five surveys being returned. Poor timing was given as the reason for the slow responses.

As a result of follow-up calls, three weeks after the mail-out, seven companies withdrew from the survey and two questionnaires were returned uncompleted reducing the number of total mail-outs to forty-six (ie. twenty mail-outs in the pilot study and twenty-six in the full-scale mail-out). A total of twenty-two responses were received and counted in the data analysis. Consultation with a statistician from the Statistics Research & Consulting Centre at Massey University, Duncan Hedderly, advised that in research of this nature, a response rate between 30% and 40% would be considered insufficient. Study by Edmunds (1996) suggested that the typical response rate for a small business mail survey is approximately 15%, therefore the 48% response rate achieved by this survey was considerably satisfactory and acceptable by the author. Table 3-1 below outlines the total number of questionnaires sent out and returned along with numbers of Micro, Small and Medium-sized Enterprises (SMEs) and Large Organisations (LOs) participated in the survey.

Table 3-1: Questionnaire Responses

	Total Surveys Sent	Total Surveys Returned	Response Rate
Pilot	20	7	35%
Micro - SMEs		7	
LOs		-	
Full-Scale	26*	15	61%
Micro - SMEs		9	

* 26 = 35 - 9.
35 = Total number of companies selected for full-scale mail-out.
9 = 7 withdrawn companies + 2 questionnaires returned unanswered.

LOs		6	
Total	**46**	**22**	**48%**

3.10 CHARACTERISTICS OF THE SAMPLE

The majority of the twenty-two questionnaires returned were from smaller sized enterprises, represented by 27% (6) Micros and 46% (10) SMEs, while LOs dominated only 27% (6) of the 22 responses received. The sample characteristics of this survey is another step further in showing that 99.5% of the entire business sector in New Zealand is occupied by Micro and SMEs sectors. The over-dominant of the Micro and SMEs (46% + 27% = 73%) in this sample is consistent with the figure from Statistics New Zealand.

3.10.1 PRODUCT CLASS

As shown in Table 3-2, the product class of the sample was widely spread, ranging from furniture, food product and packaging to software development. The majority of the sample returned were leisure accessory projects, which was counted at 32% (7), with industrial accessories projects such as the Four Wheel-Drive attachment and industrial control panel followed closely at 18% (4). Two replies each were received from both the construction/building products and packaging project categories. Projects grouped in "Others" category like, healthcare products and recycling units was counted 5 out of the 22 questionnaires returned.

Table 3-2: Product/Project Class in the Sample

Product/Project Class	Total Sample, % (no.)	Survey Received, % (no.)
Furniture	19% (9)	0
Leisure Products	17% (8)	32% (7)
Industrial Accessories	13% (6)	18% (4)
Construction/Building Product	9% (4)	9% (2)
Food Product	9% (4)	4.5% (1)
Software	7% (3)	4.5% (1)
Packaging Shop Fittings	7% (3)	9% (2)
Others	19% (9)	23% (5)
Total:	**100% (46)**	**100% (22)**

3.10.2 INDUSTRY SECTOR

Table 3-3 below shows the combined characteristics of the sample in types of industry and company sizes. It is evident from the data in Table 3-3 that the majority of the projects came from the furniture industry. It was noted, however, that none of the client from the furniture category returned the survey. It would have been beneficial to this research and the University to hear comments or suggestions of their experience of the partnership programme. The highest response rate of the total survey returned came from the plastic industry, where all five surveys sent out were returned.

Table 3-3: Number and Size of Company by Industry

Industry (n)	Company Size (No. of Employees)	Total Sample (N=46)	No. of Responses (n=22)
Electronics (7)	Micro (1 ~ 5)	-	-
	SMEs (6 ~ 99)	4	2
	LOs (100+)	1	1
	Not Known	2	-
Furniture (9)	Micro (1 ~ 5)	-	-
	SMEs (6~ 99)	6	-
	LOs (100+)	2	-
	Not Known	1	-
Information	Micro (1 ~ 5)	1	1
Technology (3)	SMEs (6~ 99)	2	-
	LOs (100+)	-	-
	Not Known	-	-
Plastics (5)	Micro (1 ~ 5)	2	2
	SMEs (6~ 99)	2	2
	LOs (100+)	1	1
	Not Known	-	-
Food (5)	Micro (1 ~ 5)	2	1
	SMEs (6~ 99)		
	LOs (100+)	3	1
	Not Known	-	-
Construction	Micro (1 ~ 5)	1	1
/Industrial (7)	SMEs (6~ 99)	3	1
	LOs (100+)	2	2
	Not Known	1	-
Other (10)	Micro (1 ~ 5)	1	1
	SMEs (6~ 99)	5	5
	LOs (100+)	3	1
	Not Known	1	-
Sub-Total:	**Micro (1 ~5)**	**7 (15%)**	**6 (27%)**
	SMEs (6 ~ 99)	**22 (48%)**	**10 (46%)**
	LOs (100+)	**12 (26%)**	**6 (27%)**
	Not Known	**5 (11%)**	**-**
TOTAL:		**46**	**22**

3.10.3 COMPANY SIZE

Table 3-3 above also details the breakdown of company size and industry sectors of both the total sample and those that returned questionnaires. Over half of the sample companies (63%) were of Micro-SMEs. As the figures in Table 3-3 suggests, the majority of the total sample, 48%, are SMEs. Twenty-six percent of the total sample is LOs, and less than a quarter, 15%, is the Micro-size enterprises who employs less than six full-time employees. Company size to the remaining five companies was not known. This was due to the respondents' choice not to disclose the total number of employees at their companies in the mail survey.

In comparison to the total population of the manufacturing enterprises in New Zealand of 21,078 (Statistics New Zealand, 2000, Appendix VIII),

- A great number of enterprises surveyed (46%), employed 6 to 99 employees on full-time basis,
- Nearly three-quarter of the total manufacturing enterprises in New Zealand are Micro-sized, compared to those that returned their questionnaire which was less than a quarter.

The year 2000 statistics were used for reason that it was the year when this research was conducted.

3.10.4 ANNUAL TURNOVER

Only 73% (16) of the companies agreed to supply the financial information of their annual turnover of the last financial year. Over half of the responded companies, 64% (14), had annual turnover of above $1million. The two companies with annual turnover less than $500,000 were micro-sized companies. Table 3-4 below exhibits the number of responses over the spread of the annual turnover in the last financial year.

Table 3-4: Annual Turnover of Companies in the Sample - Last Financial Year

Annual Turnover	Number of responses (n=22)
$0 ~ $49 000	1
$50 000 ~ $99 000	-
$100 000 ~ $499 000	1
$500 000 ~ $999 000	-
$1 000 000 ~ $4 999 000	9
$5 000 000 ~ $ 10 000 000	1
>$10 000 000	4
Refused/Not Available	6
Total	**22**

The following chapters (Chapter 4 Research Results and Analysis – Mail Survey and Chapter 5 Research Results and Analysis – Case Study Interviews) explore the way the mail survey respondents and case study interviewees look at the PD practice, PDPP, the aspects within PDPP, and its benefits or potentials to the client companies.

Chapter 4

RESEARCH RESULTS AND ANALYSIS: MAIL SURVEY

4.1 INTRODUCTION

This chapter consists of the analysis of the four main sections covered in the mail survey, key findings of the analyses, and a summary of the chapter. It reports mainly on the client's perception of the Product Development Partnership Programme, including an overview of their Product Development process, benefits gained or skills learned, achieving client expectations, and their level of satisfaction on their Product Development Partnership Programme experience. Other issues that were explored included investigating and identifying the factors that have affected the outcomes of the project (ie success/barriers factors).

4.2 PRODUCT DEVELOPMENT OVERVIEW - BEFORE/AFTER PARTNERSHIP PROGRAMME

The first section of the questionnaire consisted of two questions asking the respondents to review and rate the performance of their Product Development process and the activities within the process before and after their participation in the Partnership Programme. These two questions were designed to see whether the Programme had had any impact on the working of the client's Product Development practice.

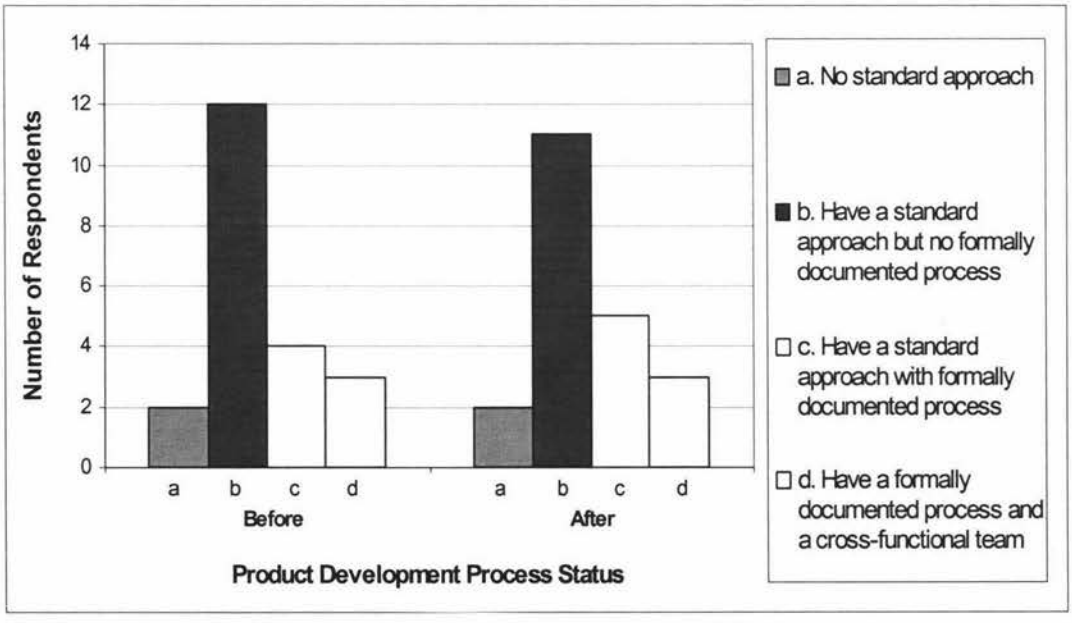
4.2.1 PRODUCT DEVELOPMENT PROCESS AND STAGES USED

Brief descriptions of the Product Development process status and glossary of terms as sourced by Griffin (1997) in her research on the trends of New Product Development

practices were given in the questionnaire to avoid misinterpretation of different terminology in Product Development. Where, *Standard a* was defined as "No standard approach", *Standard b* was defined as "Have a standard approach but no formally documented process", *Standard c* as "Have a standard approach with formally documented process", and *Standard d* as "Have a formally documented process and a cross-functional team". Figure 4-1 below shows the results of the Product Development Process overview of the responded companies.

It can be seen from Figure 4-1 that there was no significant change of process status before and after the Partnership Programme. This suggests that the participation in the PDPP had only little or no influence over the company's own Product Development process.

Figure 4-1: Product Development Process Overview – Before/After Partnership Programme



Besides showing the progress of the company's Product Development process over the partnership project period, the figure also illustrates the status of the Product Development process at the client company. Fifty-four and a half percent, that is twelve

out of twenty-two companies, categorised the status of their Product Development process as "Have a standard approach but no formally documented process", (which is *Standard b* in the criteria given in the mail survey questionnaire) prior to the Partnership Programme. The figure shows a drop in *Standard b* before the PDPP, and a gain of one point in *Standard c* ("Have a standard approach with formally documented process") after the PDPP. This occurred as one of the respondent companies had undergone changes in the working of their Product Development practice after the Partnership Programme. The Product Development status before and after the partnership of the remaining respondent companies remains unchanged. This is further discussed in Results Comparisons and Discussions in Chapter 6.

It is of interest that all companies that selected *Standard a* ("Have no standard approach") as a response, and 73% of the responses in *Standard b* were micro to Small to Medium-sized Enterprises (SMEs). This may be that SMEs either have little or do not have Product Development skills or knowledge, or they do not consider Product Development important or vital (Kerr, 1994). It could also be that they simply do not have the necessary resources (especially the micro size companies) to formalise the practice or that their process is "flexible" (ie. sometimes certain stages are omitted depending on the resource available at time).

As seen in Figure 4-1 (Product Development Process Overview – Before/After Partnership Programme, p.95), there is almost no significant change in the Product Development practice at the client company after the Partnership Programme. However, responses of Question 2 of Section I that asked the respondents to rate the performance of the Product Development activities at their companies before and after their participation in the PDPP tell differently. Seventy-seven percent of the mail survey respondents indicated that their PD activities had been improved after their participation in the PDPP. The extension of improvement ranged from "Poor" to "Average", or "Average" to "Excellent". The rating scales used here were the 5-point Likert scales ranged from 1 (ie. "Poor") to 5 (ie. "Excellent").

There were four PD activities that had experienced considerable changes after the PDPP. These four activities were (i) Preliminary Market Assessment, (ii) Detailed Market Research, (iii) Full-Scale Production Plan, and (iv) Product Launch Plan. This finding, improvement on the PD activities after PDPP participation, was what this research hoped to find in relation to the research aims and objectives.

Figure 4-2: Comparison of the Performance Rating of the Four Product Development Activities with Significant Changes Before/After PDPP

Figure 4-2a: PD Activities Performance – Preliminary Market Assessment Before/After PDPP

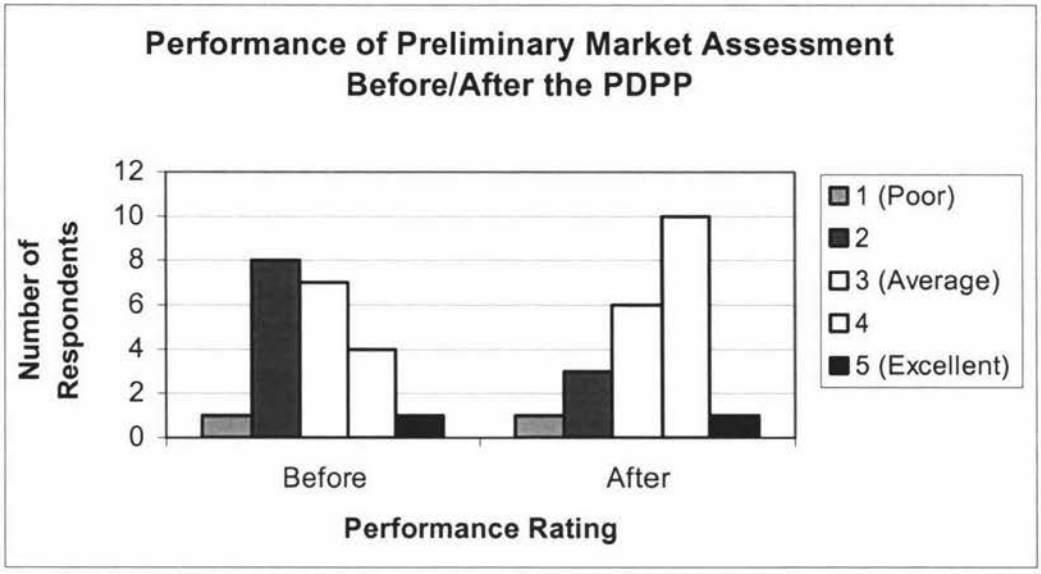


Figure 4-2b: PD Activities Performance – Detailed Market Research Before/After PDPP

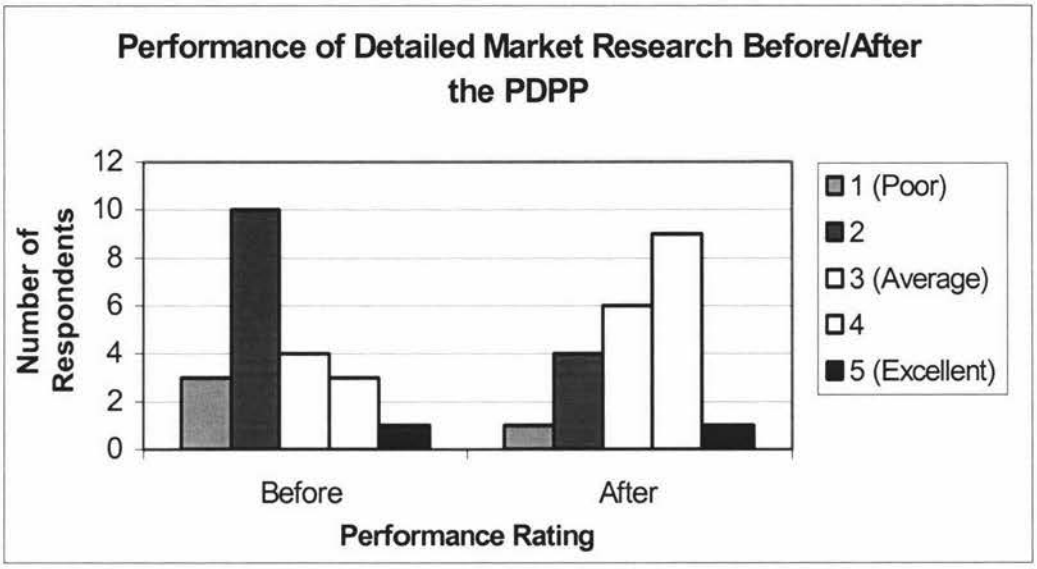


Figure 4-2c: PD Activities Performance – Full-Scale Production Plan Before/After PDPP

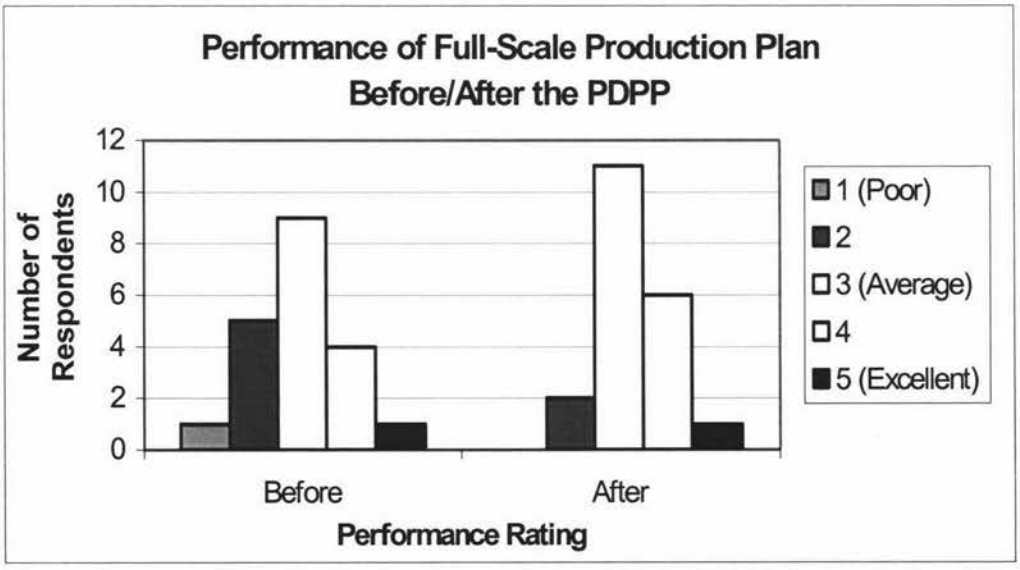


Figure 4-2d: PD Activities Performance – Product Launch Plan Before/After PDPP

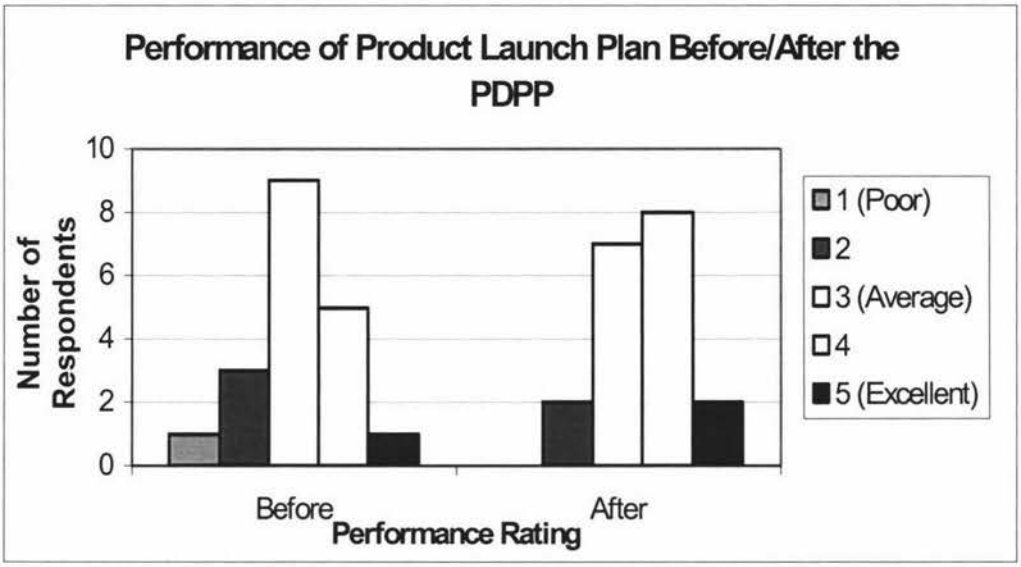


Figure 4-2 above shows the four activities (details are presented in individual graphs of Figure 4-2a, 4-2b, 4-2c, and 4-2d.), which have had considerable changes on the company's Product Development activities after the Partnership Programme. A collective number of 20 respondents (5 responses in Preliminary Market Assessment; 4 responses in Detailed Market Research; 5 responses in Full-Scale Production Plan; and 6 responses in Product Launch Plan) rated the performance of these four activities after the PDPP above average (more than 3 on the scale). These four activities are located at two extreme ends (ie. the front-end and the rear-end) of the thirteen-activity process used in this research as well as research conducted by Cooper & Kleinschmidt (1986), Sanchez & Elola (1991), Kerr (1994), Campbell (1999), and Ho (2001) (Exhibit 2-6, p.35 ~ 36). A presumption that there was a relationship between the performance of the two front-end activities (i.e. Preliminary Market Assessment and Detailed Market Research) and the two rear-end activities (i.e. Full-Scale Production Plan and Product Launch Plan) was made. Further analysis was conducted to justify the presumption of the correlation of the four activities (see Table 4-1).

Table 4-1: Correlationship Between the Front-End and Rear-End Product Development Activities After PDPP

PD Activities	Correlations Rating (r)
Preliminary Market Assessment/Full-Scale Production Plan	0.356
Preliminary Market Assessment/Product Launch Plan	-0.014
Detailed Market Research/Full-Scale Production Plan	0.035
Detailed Market Research/Product Launch Plan	0.276

Scales: 0.0 ~ 0.5 = Weakly correlated, 0.5 ~ 0.7 = Moderately correlated, 0.7 ~ 0.8 = Strongly correlated, 0.8 ~ 1.0 = Very strongly correlated.

Figures in Table 4-1 show weak correlation between (i) Preliminary Market Assessment and Product Launch Plan, (ii) Detailed Market Research and Full-Scale Production Plan, (iii) Detailed Market Research and Product Launch Plan, and (iv) Preliminary Market Assessment and Full-Scale Production Plan, in the order of r value. The weak correlation signified that whatever outcomes the two front-end activities carry, they do not or have only a very small effect on the development or outcomes of the two rear-end activities. Although the correlation analysis did not show any significant correlation between the two sets of the activities (ie. the front-end and the rear-end activities), there was however a moderately strong relationship between Preliminary Market Assessment and Detailed Market Research, r=0.693 (refer to figures in Table 4-3). This means that results in Preliminary Market Assessment are correlated and useful to the development of Detailed Market Research.

It can be seen from the correlation analysis conducted that performance of some of the thirteen PD activities (both *BEFORE* and *AFTER*[1]) was highly correlated between one and other. Among them, for activity performance before the partnership programme, the seventh and the eighth activities, Prototype Development and In-House Prototype Testing, respectively, had the strongest correlation, reading at r=0.833. This figure means better prototype development called for better implementation or less repetition

[1] After: The present Product Development activities performance when the mail survey was filled.

in the in-house prototype testing. Table 4-2 below shows the pairs of Product Development activities ranged from moderately correlated to very strongly correlated. Performance of the Product Development activities and the size of the companies were, however, unrelated, with r as low as -0.458. This indicated that with adequate resources, smaller sized companies will be able to achieve high performance PD activities like their larger sized counterparts.

Table 4-2: Product Development Activities with Significant Correlation Before PDPP

PD Activities (Before PDPP)	Correlation Rating (r)
Very Strongly Correlated (0.8 - 1.0):	
Prototype Development / Prototype Testing – In-House	0.833
Strongly Correlated (0.7 - 0.8):	
Detailed Market Research / Preliminary Market Assessment	0.752
Moderately Correlated (0.5 - 0.7):	
Preliminary Technical Assessment / Product Launch Plan	0.674
Preliminary Market Assessment / Pre-Commercialisation Business Analysis	0.663
Prototype Testing – Customer / Prototype Testing - In-House	0.659
Detailed Market Research / Pre-Commercialisation Business Analysis	0.656
Preliminary Technical Assessment / Business Financial Analysis	0.647

Scales: 0.0 ~ 0.5 = Weakly correlated, 0.5 ~ 0.7 = Moderately correlated, 0.7 ~ 0.8 = Strongly correlated, 0.8 ~ 1.0 = Very strongly correlated.

Table 4-3: Product Development Activities with Significant Correlation After PDPP

PD Activities (After PDPP)	Correlation Rating (r)
Very Strongly Correlated (0.8 - 1.0):	
Prototype Development / Prototype Testing - In-House	0.852

Moderately Correlated (0.5 - 0.7):	
Preliminary Market Assessment / Detailed Market Research	0.693
Idea Generation / Prototype Development	0.681
Prototype Testing – In-House / Prototype Testing - Customer	0.668
Preliminary Technical Assessment / Product Launch Plan	0.655
Preliminary Market Assessment / Pre-Commercialisation Business Analysis	0.647

Scales: 0.0 ~ 0.5 = Weakly correlated, 0.5 ~ 0.7 = Moderately correlated, 0.7 ~ 0.8 = Strongly correlated, 0.8 ~ 1.0 = Very strongly correlated.

Similar findings to those before the PDPP were obtained from the correlation of the performance between the thirteen activities after the PDPP. As shown in Table 4-3, correlation between Prototype Development and In-House Prototype Testing (r=0.852) also emerged a high significance in correlation between respondent companies' activities after the PDPP. Other activities with moderate correlation include, Preliminary Market Assessment and Detailed Market Research (r=0.693), Idea Generation and Prototype Development (r=0.681), Prototype Testing - In-House and Prototype Testing - Customer (r=0.668), Preliminary Technical Assessment and Product Launch Plan (r=0.655), and Preliminary Market Assessment and Pre-Commercialisation Business Analysis (r=0.647).

In discussing the correlation of company size and the performance of the Product Development activities (after PDPP), results of the analysis showed that company size was not the factor of the PD activities performance or how the Product Development activities were carried out. Conversely, company size and the performance of the Product Development activities were negatively correlated, reading at as low as r = -0.425.

Ten responses (43.5%) rated their *Preliminary Market Assessment* above average (score higher than 3). Eleven responses (47.8%) regarded the activity, *Initial Idea Screening* and nine responses (39.1%) considered both the *Detailed Market Research* and *Product Launch Plan* had performed better than their other activities **after** the project

partnership indicating that the performance of the Product Development activities at the client companies was fairly satisfying. In contrast, 47.8% respondents believed *Preliminary Technical Assessment,* and 52.2% respondents considered *Market Testing* and *Business/Financial Analysis*, badly executed and rated them below average.

Overall, although improving the Product Development process, or PD activities advancement, was not the objective of the student project, performance of the Product Development activities at the client companies had improved extensively after the Partnership Programme. Even so, this research cannot 100% attribute the improvement to the PDPP as with adequate resources the PD process and activities could be improved by the companies anyway. Also this research did not include a control group, companies who did not participate in the PDPP, hence there was no evidence to comment that the improvement in PD process and PD activities advancement was due to the participation in PDPP.

4.3 BENEFITS TO CLIENTS

4.3.1 USEFULNESS OF INFORMATION GATHERED AND/OR SKILL LEARNED

In this section, the respondents were asked to evaluate the usefulness of information and/or skills that they had gained or learned during the project partnership. Four areas of information were identified by more than 90% of the respondents as possessing greater usefulness to their companies than the other areas of information listed (Table 4-4). These four most useful areas of information were, *Consumer Research Information, Information of Competitors, Systematic Procedures, and Product Development Skills*. Nearly all, 95.5%, of the respondent companies appraised *Consumer Research Information* as the most useful information not only to the partnership project itself but also to other projects at the company. Reasons that the *Consumer Research Information* had received such high profile than the other areas of information could be due to the fact that 73% (16 out of 22) of the responded companies were medium-sized enterprises or smaller where only limited resources were allocated for marketing activities such as market or consumer research. However, this presumption is yet to be proven in further research of related areas.

Other areas of information nominated by the respondents which received high credit of usefulness in the client companies included identification of new opportunities and fresh idea generation. Both area of information had an average usefulness score of 3.0 as nominated by the 95.5% of the responses.

One of the responded companies mentioned that the project assigned to the student was actually a project of a client of theirs. Simply put, the company was playing the role of a "middle-man" between the client and Massey University. It was not clear whether the student was aware of the arrangement or had had any contact with the client's client, but all the information on the product development collected by the student was passed on directly to their client. Consequently, very little knowledge of the usefulness of the information to their client was known. Further recommendations on cases like this will be made in chapter 7.

In contrast to the most useful information, 90.9% and 86.4% of the respondents selected *Identification of New Material/Technology* and *Technical Information*, respectively, as not so useful information gained during the project partnership. Two possible assumptions for this are that maybe the companies already have their own technicians and that the majority of the respondent companies were small companies with limited resources allocated to marketing activities. Further research or clarification is very much needed in order to make any judgement or conclusion based on these assumptions.

Table 4-4: Average Scores of Usefulness of Information Gained and Skill Learned Through Participation in the PDPP

Area of Information	Average Usefulness Scores	% Response
Very Useful		
Consumer Research Information	3.4	95.5
Information of Competitors	3.3	90.9

Systematic Procedures	3.1	100.0
Product Development Skills	3.1	95.5
Useful		
Identification of New Opportunities	3.0	95.5
Fresh Ideas	3.0	95.5
Design Skills	2.8	90.9
Not At All Useful		
Identification of New Material/Technology	2.6	90.9
Techniques of Technical Information	2.5	86.4
Other areas of information suggested by respondents:		
Background Information for an Ongoing Project	2.5	9.1
Prototyping	2.0	9.1

Scales: 1 = Not At All Useful, 3 = Useful, 5 = Very Useful

Comments received from the mail survey respondents regarding the usefulness of information gained and skills learned included:

"I value all skills that help you contribute to society by supplying products that enable skills, thinking, and positive outcomes for people"

"Finding our opposition's products was very useful as were patent searches. Product (testing) development was very good"

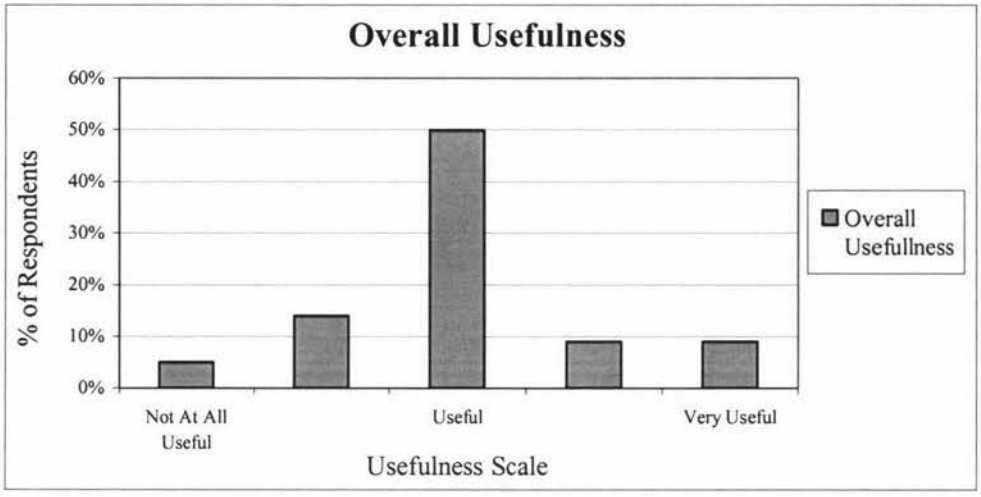
"A thorough report with some useful ideas"

"Market research and competitor intelligence are the areas that are very useful"

Overall, 68% of the mail respondents rated the information gathered and skills learned moderately or very useful. Comments that some respondents made in regards to the usefulness of the information gathered included the manipulation of the information and practicality of student's ideas or concepts. The majority of the respondents found market or consumer research information very useful especially if it could be used in the development of other projects. On the scale of 1 (Not At All Useful) to 5 (Very Useful), eleven respondents from the mail survey, indicated that in terms of the overall

usefulness, the information gathered and skills provided by the student were useful to their company (Figure 4-3).

Figure 4-3: Overall Usefulness of Information Gained or Skill Learned Through Participation in the PDPP



4.3.2 EXPECTED AND ACTUAL OCCURRENCE OF BENEFITS

Another objective of this research was to find out what benefits the client companies were expecting and had actually gained from their participation in the Programme. The respondents were asked to mark or score the benefits pertaining to their expectations, and add benefits if they were not listed in the table. The respondents were also asked to indicate if the expected benefits were being delivered.

The benefits listed in the questionnaire relate to competitions, markets and items relating to the PD process. However, they could also be divided into financial and non-financial. Financial benefits include, enhancement of market share, and reduction of development cost, whereas non-financial benefits range from ability to compete with larger competitors to design skills and fresh ideas.

Table 4-5: Expected and Actual Occurrences of Benefits

Benefits	Expected Benefits, No. (%[a])	Occurred, No. (%[b])	Did Not Occurred, No. (%[c])
Ability to compete with larger competitors	4 (18%)	4 (100%)	0 (0%)
Design skills*	9 (41%)	8 (89%)	2 (22%)
Marketing techniques	7 (32%)	6 (86%)	1 (14%)
Technical information	7 (32%)	6 (86%)	1 (14%)
Consumer research information	13 (59%)	11 (85%)	2 (15%)
Enhancement of market share	5 (23%)	4 (80%)	1 (20%)
Information of competitors*	12 (55%)	9 (75%)	4 (33%)
Developing Product Development techniques	8 (36%)	5 (63%)	3 (37%)
Identification of new material/technology	10 (45%)	6 (60%)	4 (40%)
Fresh Ideas	16 (73%)	9 (56%)	7 (44%)
Access to larger markets	6 (27%)	3 (50%)	3 (50%)
Faster time to market	7 (32%)	3 (43%)	3 (43%)
Identification of new opportunities	12 (55%)	4 (33%)	8 (67%)
Reduction of development costs	5 (23%)	1 (20%)	4 (80%)
Others - Make Money	1 (0.05%)	0 (0%)	1 (100%)
Others – Improved product performance	1 (0.05%)	0 (0%)	1 (100%)

** The unexpected but gained benefits by one respondent company.*

*** Total Number of Responses = 22*

*** %[a] = (Total Number of Expected Benefits) / (Total Number of Responses)*

*** %[b] = (Total Number of Occurred) / (Total Number of Expected Benefits)*

*** %[c] = (Total Number of Did Not Occurred) / (Total Number of Expected Benefits)*

As shown in Table 4-5 above, the most expected benefit selected by 73% of respondents was *Fresh ideas*. The second and third most expected benefits were, *Consumer research information* at 59% and *Information of competitors* and *Identification of new opportunities* were both scored at 54.5%. The least expected benefit found from the mail survey was ***Ability to compete with larger competitors***, which was nominated by only four respondents. Though it was the least expected, "Ability to compete with larger competitors" had the 100% occurrence rate, meaning the benefit was delivered to all the expecting respondents.

Table 4-5 also shows the numbers of expectance and actual occurrences of benefits from respondent companies and the percentage of occurrences. High percentages of respondents gained knowledge on design skills (89%) and marketing techniques (86%), and information on technical progression (86%), and consumer research information (85%). Identical results were found in similar research studies by Grimes (1996) and Ho (2001), where a high percentage of their respondents (New Zealand companies) also gained Ability to Compete with Larger and Foreign Competitors from participation in the Technology for Business Growth programme (TBG) provided by Foundation for Research, Science and Technology (FRST), New Zealand. Further discussion on similarities and discrepancies in terms of benefits on this research study and the above two studies will be made in the Chapter 6.

There were two additional benefits added by the respondent companies, *Make money* and *Improved product performance*. One of the possible reasons that the expectance score was so low was, as will be discussed in 4.4.1 Reasons of Participation and Level of Achievement (p.113 ~ 115; Table 4-9, p.114), the majority of the respondents (82%) considered "Helping the student and university" as their main reason to participate in the PDPP. Hence for majority of the respondents, financial returns though important were not their main focus.

One of the objectives for the mail survey Question A2 (ie. Expected and Actual Occurrence of Benefits) was to find how many and which benefits were gained by the respondents unexpectedly. It was thus rather disappointing to find that only one respondent returned the mail survey indicating gaining unexpected benefits from the programme partnership. The unexpected benefits gained by this respondent were *Design Skills* and *Information of competitors*. In terms of the "expected but failed to deliver benefits", *Reduction of development cost* and *Identification of new opportunities* were the two highest scorings benefits.

4.3.3 BARRIERS INHIBITING THE PROGRESS OF THE PARTNERSHIP PROJECT

The level of success or failure of a product is heavily reliant on the number of barriers encountered and the magnitude of damage the barriers bring during and after the development process. The third question in the second section of the mail survey asked the respondents to indicate and rate the crucial barriers that had inhibited the development of the partnership project.

Table 4-6: Barriers Inhibiting the Progress of the Partnership Project

Project Barriers	Average Concern Scores	% Responses
Extreme		
Student's ability to perform	2.8	77.3%
Communication with the student	2.9	72.7%
To Some Extent		
Competition in the market	2.2	59.1%
Pricing strategy	2.1	59.1%
Lack of resources	2.0	68.2%
None		
Suppliers problems	1.7	59.1%
Company's internal problems	1.6	54.5%
Company's top management support	1.5	59.1%
Others Barriers:		
Project Time Allocation	3.5	9.1%
Massey's commitment (marking agenda)	5.0	9.1%
Massey Supervision	5.0	4.5%

Scales: 1 = None, 3 = To Some Extent, 5 = Extreme

Table 4-6 outlines all the proclaimed barriers that have inhibited the progress of the student project. Barriers shown in the table were categorised in the order of their level of disturbance in the project partnership. In many managers' views, *student's capabilities* and *communication between company and student* were the two most crucial factors inhibiting attempts to deliver the project aims and desired outcomes. The

student's lack of ability to execute some of the development plan may be explained by his/her lack of practical experience and training, especially in technical and/or mechanical areas. The client companies were generally pleased with the progress reports and project presentations over the project development period. Yet, they were concerned that the students did not keep the company well informed by "drop in" visits (most preferred by clients) or phone calls frequent enough throughout the project but only whenever that suits the students. As one of the companies put it, "the student only turned up when the report is about to due and he needs some technical assistance". However the client needs to realise that not all the projects were sponsored by local companies. Some of the clients were located as far as in Auckland and Christchurch and with the travel expenses not covered by the sponsorship fund, frequent visits to the out of town client would be expensive.

Student's as well as the client company's attitude toward the project also played an important role in the partnership. Three responses pointed out that the student adopting the project at their companies relied on or left too much responsibility to the client companies. Other "To Some Extent" barriers as encountered and indicated by the respondent companies included *market competition* (average scores: 2.2, by 59.1% respondents), *pricing strategy* (average scores: 2.1, by 59.1% respondents), and *company's top management support* (average scores: 2.0, by 68.2% respondents). Other barriers that were not provided in the questionnaire but specified by the respondents include, *project time allocation, Massey's marking agenda towards the project* and *project supervision by Massey.*

Further analysis on the relationship between the proclaimed barriers and project commercialisation will be discussed in the next section – 4.3.4 Project Commercialisation.

4.3.4 PROJECT COMMERCIALISATION

One of the advantages of going into the partnership with Massey University through the PDPP is that companies are able to get the potential project underway by an economical

investment. This is made possible by the resources provided by Massey, such as student and project supervision. This, with the right combination of factors, and team play could lead to product introduction or commercialisation at minimal cost to the company.

Table 4-7 below details the number of student projects undertaken and the resulting commercialisations in 1997, 1998, and 1999. As the figures in Table 4-7 indicate, Year 1999 appeared to be the most productive year of all as five projects from the 13 responses returned had been successfully commercialised. However, it cannot be assumed that students in year-1997 and -1998 had achieved poor results. The perception that only a few of the 1997/1998 student projects were commercialised could be due to various reasons, including the comparatively low response rate of the mail-out for 1997 and 1998 projects. It is possible that some projects during those two years were commercialised and as a result of the low response rate, the information is lost to this research.

Table 4-7: Numbers of Project and Commercialisation in 1997, 1998, and 1999

Year of development	Total of survey sent out	Number of Responses	Number of commercialisation
Year 1997	12	5	1
Year 1998	12	4	0
Year 1999	22	13	5
Total:	46	22	6
Number of projects failed to commercialise			16

The percentage of commercialisation for projects included in this evaluation is 27% (six commercialisations out of twenty-two projects). It thus can say that it took 22 projects to yield 6 successfully commercialised projects. This statistic is much higher compared to Page's research in 1993 and BAH's in 1982, which were one in eleven (9%) and one in seven (14%), respectively.

A correlation analysis was conducted to find if there was any relationship between the resulting commercialisation and the proclaimed barriers (discussed in section 4.3.3 Barriers Inhibiting the Progress of the Partnership Project). Results of the correlation analysis indicated, none of these "Extreme" and "To Some Extent" factors were related to the commercialisation of the student project except *Pricing Strategy* (r=0.449). *Pricing Strategy* is one of two barriers that had a positive Pearson Correlation reading to project commercialisation. *Supplier Problem* was another barrier positively correlated to project commercialisation at r=0.553. Correlation readings between the barriers and project commercialisation were outlined in Table 4-8.

Factor analysis indicated a dominance of two factors that contributed to the development or progress of the project. These two factors were identified as *Student's ability to perform*, and *Communication with the Student*. Nevertheless, neither factors were solely responsible for commercialising the student project. As shown in Table 4-8, both factors were negatively correlated to project commercialisation, reading at -0.603 and -0.477, respectively. The correlation analysis showed that there was a strong relationship between *Student's Ability to Perform* and *Communication with the Student*, reading at 0.859. Another strong relationship existed between the barriers inhibiting the progress of the project was between *Company's Top Management Support* and *Company's Internal Problem*. The correlationship between company's top management support and its internal problem was the second strongest correlation between the barriers, which reads at 0.831.

Table 4-8: Correlation Analysis between Project Barriers and Project Commercialisation

Project Barriers	Correlationship to Project Commercialisation, r
Extreme	
Student's ability to perform	-0.603
Communication with the student	-0.477
To Some Extent	
Competition in the market	-0.084

Pricing strategy	0.449
Lack of resources	-0.046
None	
Suppliers problems	0.553
Company's internal problems	-0.510
Company's top management support	0.000

4.4 ACHIEVING CLIENT'S EXPECTATIONS

4.4.1 REASONS FOR PARTICIPATION AND LEVEL OF ACHIEVEMENT

As the results of the mail survey indicated, there were various reasons that encouraged or motivated the companies to take part in the Partnership Programme either as a first time or a returned partner.

This particular question in Section B of the mail survey asked the participants to name the reasons that encouraged them to partner with Massey University through the PDPP and rate the levels of their subsequent achievement. The scales used for this question is a five-point Likert type scale ranged from 1, being "Not AT All Successful", to 5, being "Very Successful". Table 4-9 shows the percentage of companies agreeing to the corresponding reasons to participation and the level of achievement. Results of the survey showed that the majority of the respondents (82%) considered "Helping the student and university" as the main reason for participation in the PDPP but scored at only 3.2, which indicates moderately successful. The reason of "Economical way to get a potential project started" scored 64% and "To gain access to research expertise" scored 50%.

Table 4-9: Reasons for Participation and The Level of Achievement

Reasons	Average Level of Achievement Scores	% Companies
Very Successful		
To keep up with competitors	3.8	23%
Economical way to get a potential project started	3.4	64%
To get fresh perspective on PD procedures	3.4	41%
Successful		
To help students and university	3.2	82%
Good previous experience with Massey	3	36%
Not At All Successful		
To gain access to research expertise	2.8	50%
To gain access to the latest science and technology	2	36%
Others:		
To get fresh perspective on production methods	3	9%

Scales: 1 = Not At All Successful, 3 =Successful, 5 = Very Successful

Although "Keeping up with competitors" was not the most encouraging reason that an industrial partner chose to be part of the Programme, however, it scored the highest success rate of 3.8 among the other 6 reasons. Two other reasons that scored the success rate higher than 3.3 were "Economical way to get a potential project started" and "To get fresh perspective on PD procedures". As indicated by the percentage of the respondent companies in "Getting fresh perspective on PD procedures" in Table 4-9, less than half of the total company samples are holding this reason as the purpose to be part of the PDPP, yet it was one of the three most successful reasons with an average score at 3.4.

Thirty-six percent of the respondents, (ie. eight out of the twenty-two responses), said their reason for joining the Partnership Programme was due to good experience with Massey in previous years.

Gaining access to research expertise and the latest science and technology were not as successful as the respondent companies hoped it would. Due to the lack of resources, both these reasons achieved only scores of 2.8 for gaining access to research expertise and 2.0 for gaining access to the latest science and technology.

4.4.2 FACTORS IMPORTANT TO PRODUCT DEVELOPMENT PROJECT

In the evaluation of the PDPP, the mail survey respondents were asked to rate the importance of factors that had contributed to the success of the partnership project. All the twenty-two responses rated resource availability or adequacy as an important factor to the Product Development project. Other important factors nominated by the majority of the responses (95%) included: *Supervision of Student by Massey, Supervision by Company, Company's Top Management Commitment, and Technology Availability* (Table 4-10). The averaged importance scores received by these four factors are, 3.7, 3.7, 3.6, and 3.6, respectively.

Factors with the highest averaged importance score were *student's performance* (4.5), followed by *clear definition of agreed project aims* (4.4), and *communication with student* (4.3). These results are again consistent with previous findings from the correlation and factor analyses, which showed a strong relationship between student performance and communication with student. Although the project outcomes such as the commercialisation does not depend solely on the student's performance and the company's communication with the student, these factors did play a crucial role in the product or project development.

Communication with the student was regarded by the respondent companies as one of the very important factors for the partnership project as well as one of the extreme barriers that had inhibited the progress of the partnership project. Another form of communication, *communication within the company*, however did not receive as much recognition. *Company's communication with Massey's staff* was only regarded as the "Not At All Important" factor to the development of the partnership project with the average important score of 2.8. This view was shared by 91% of the mail survey

respondents. This may be explained as the student was regarded as the project manager of the joint-partnership project instead of the Massey staff. Also, the student's involvement in the project was far more direct and involved than the third party, the Massey staff. Yet, when the client companies were questioned about how satisfied they were towards the communication with the Massey staff in the mail survey and case study interviews, their responses were they were not satisfied with the low degree of communication or liaison between them and the Massey staff.

Research by Cooper (1987) has indicated that *Market Competition* had no impact on product performance or new product success. This is consistent with the results gathered from this present research, which showed only a fair importance from the respondent companies' point of view.

Another supporting point of the insignificant role of market competitive role in product commercialisation is shown in Table 4-8 (Correlation Analysis between Project Barriers and Project Commercialisation). As can be seen, results of the correlation analysis showed negative relation between "market competitiveness" and "project commercialisation" with the reading of r=-0.089.

Table 4-10: Level of Importance of Factors for the Product Development Partnership Project

Factors	Average Importance Scores	% Companies
Very Important		
Student Performance	4.5	86%
Clear Definition of Agreed Project Aims	4.4	91%
Communication with the Student	4.3	91%
Important		
Communication within the Company	3.7	91%
Resource Availability	3.7	100%
Supervision of Student by Massey	3.7	95%
Supervision of Student by Company	3.7	95%
Company's Top Management Commitment	3.6	95%

Technology Availability	3.6	95%
Market Competitiveness	3.5	86%
Detail Project Planning and Management	3.5	86%
Not At All Important		
Communication with Massey's Staff	2.8	91%

Scales: 1 = Not At All Important, 3 = Important, 5 = Very Important

4.4.3 CLIENT'S DEGREE OF SATISFACTION TOWARDS THE PARTNERSHIP PROGRAMME

In evaluating satisfaction of the PDPP, the survey participants were given a list of aspects ranging from the student's overall performance to the project exposure to the public.

Table 4-11: Satisfaction of the Partnership Programme

Different Aspects in Partnership Programme	Average Satisfaction Scores	% Companies
Very Satisfied		
Sponsor Company - Supervision by Company	3.3	95%
Partnership Programme - Progress Reports	3.0	95%
Partnership Programme - Student's Overall Achievement	3.0	100%
Satisfied		
Partnership Programme - Prototyping	2.9	77%
Partnership Programme - Supervision by Massey	2.8	86%
Partnership Programme - Publicity	2.8	82%
Not At All Satisfied		
Partnership Programme - Staff Liaison	2.5	86%
Partnership Project - Financial Returns on Project	2.5	82%

Scales: 1 = Not At All Satisfied, 3 = Satisfied, 5 = Very Satisfied

Three aspects, which gained exceptional satisfaction, were: *student and project supervision by the company, the four progress reports produced by the student*, and *the student's overall performance.* As outlined in Table 4-11, 95% of the respondents showed an average satisfaction, scoring 3.3 and 3.0 for company supervision and

progress reports, respectively. The third "Very Satisfied" aspect selected by all mail respondents was student's overall achievement, with the average satisfaction scores of 3.0. Other "Satisfied" PDPP aspects included *prototyping, student and project supervision at Massey University*, and *project and company publicity*. Areas that need extra attention and improvement were, *staff liaison* and *financial returns* on the student project. The client companies' responses were rather subtle where in section 4.4.2 (Question B2 in mail survey questionnaire) staff liaison or communication with Massey staff was rated the least important factor for PDPP project (refer Table 4-10). Recommendation here is, in order to avoid any confusion as to whether Massey staff are oblige to contact the client on a periodic basis, ITE must that state in the written contract with the client company details on Massey staff's obligation on communication and supervision. Once the obligation clause is asserted in the contract it is also important to review it as regularly as possible by both party (client company and Massey staff) in a pre-arranged formal meeting. This way both the client company and Massey staff are clear of the extent of the staff's obligation or responsibility and what were expectations from the client.

As shown in Table 4-11, the mail respondents shared a split opinion on the level of satisfaction in student supervision by Massey. As later found out in the case study interviews, this may be due to the lack of communication and understanding between the company supervisor(s) and the Massey supervisor(s).

4.4.4 CLIENT'S EXPECTATION RATING OF THEIR EXPERIENCE OF THE PARTNERSHIP PROGRAMME

In assessing the client's satisfaction, five out of twenty-two respondents (23%) rated their experience of the partnership programme to be better than what they had expected. Seven responses (32%) rated the programme met their expectation in terms of benefits gained. The results are given in Table 4-12. General comments from the mail survey respondents included:

"All the information gathered was very useful for an ongoing project and in developing a successful product"

"Student needed more assistance in technical and machinery operation"

"The progress reports are very informative and well-documented"

For the remaining ten respondents who rated the programme below their expectations, the main concerns were the disagreement of the tasks set by Massey and the amount of time allocated to each task versus what the clients wanted the student to achieve. This was rather serious considering 45.4% (10) of twenty-two respondents shared the same opinion (low return on expectations) of the programme.

Table 4-12: Expectation Ratings

Expectation Scale	Frequency
Much Better Than Expected	3
Better Than Expected	2
Just As Expected	7
A Little Below Expected	5
Much Worse Than Expected	5

As shown in Table 4-12, only a low percentage of the respondents gave high rating on the expectation of the partnership programme. Thus, the next step in analysing the expectation ratings was to question whether the ratings were related to other aspects of the Partnership Programme. If they were, what was it (or were they)? Results of the correlation analysis had revealed that the clients rated their experience with respect to their satisfaction of various aspects in the PDPP and the commercialisation status of the student project.

Table 4-13: Correlation Analysis between Expectation Ratings, Various Aspects of PDPP, and Project Commercialisation Status

Various aspects of PDPP	Correlationship to Expectation Ratings, r
Student's overall achievement	0.905
Publicity	0.854
Financial returns on project	0.789
Project commercialisation status	0.728
Progress reports	0.674
Prototyping	0.628
Supervision by company	0.541
Supervision by Massey	0.493
Staff liaison	0.467

As can be seen from Table 4-13, the client's rating of their experience was highly dependent on the student's overall achievement (r=0.905), followed by the level of publicity resulting from the project exposure (r=0.854), financial returns on the project (r=0.789) and whether the project was commercialised (r=0.728). Five of the six commercialised projects were rated above average on the expectation scale. This shows that client's feedback of their expectation of the programme was highly correlated to the commercialisation of the project. This indicated the PDPP supervision must emphasise to the students that they are doing a real world job and with the resources available must do their best to make it happen. The student needs to be reminded that it is not just an academic assignment associated with A, B, C, or D grade.

4.5 SUGGESTIONS AND RECOMMENDATIONS FROM CLIENTS

4.5.1 SUGGESTIONS AND RECOMMENDATIONS

Ninety-one percent of the respondents did not consider communication with Massey staff important to the progress of the project, yet five out of the twenty-two companies (23%) had suggested or requested more interaction with the Programme co-ordinator and/or project supervisors. The purposes of constant communication with Massey staff

as indicated by the respondents were to monitor the project and also to be kept aware of the developments and updates at Massey that may be related to the project. The question of staff liaison was discussed in the case study interviews with selected companies. This thus showed the need and important of the exploratory case study interviews.

Other concerns received from the mail respondents included the amount of time the student could be allowed to spend on the project or with the company because of their commitment to other papers or courses that they are taking. Below are the most frequently raised suggestions to the improvement of the PDPP.

1. *More interaction with Massey (project supervisors and programme co-ordinator)*

The respondents would like to see the programme as a joint partnership between the three parties of Massey University, company and student, rather than a student-oriented partnership project. With this team approach, it is believed that the student could achieve better results, generate more energy with less time.

2. *A more flexible Product Development process and report format with respect to the nature of the project and the client's expectations*

Client came into the partnership with different needs and expectations, and the different projects had specialised needs and expectations to the development process. The question raised was the relevance of certain stages and marking requirement of the standardised Product Development process and marking format used by Massey staff on the project.

3. *Limited design and technical resources at Massey*

It was frustrating to both the client and the student that the project progressed slowly or struggled due to the lack of adequate resources at Massey.

4.5.2 PROPORTION OF PROMISING FUTURE PARTICIPATION

In the last question of the mail survey, the respondent was asked to indicate the likelihood of their company taking up another partnership project with Massey in the next five years. The respondents were asked to give their answers based on their experience and satisfaction of the programme. Feedback from the mail survey (Table 4- 14) showed that six out of twenty-two respondents (27%) expressed a "Very Likely" interest while eight (36%) with "Likely" interest of another PDPP project with Massey.

Table 4- 14: Likelihood of Future Project Partnership with Massey University

Likelihood of Future Project Partnership with Massey	Frequency
Very Likely	6
Likely	8
Not Sure	5
Not At All Likely	3

Further analysis found that the respondent's interest of another partnership project with Massey were associated with the financial reward the project could bring to the company. Results given in Table 4-15 show the level of correlation between (i) the likelihood of future project, (ii) respondent's degree of satisfaction towards various aspects of the PDPP, and (iii) expectation ratings to the project's commercialisation status. As the correlation analysis shows, financial returns, publicity, and satisfaction rating of PDPP experience were the top three key factors in the respondents' showing interest in another partnership project with Massey. The correlation readings of these three factors and the likelihood of future projects were, 0.769, 0.681, and 0.670, respectively.

Table 4-15: Correlation Analysis between Likelihood of Future Project, Various Aspects of PDPP, Expectation Ratings, and Commercialisation Status

Project Likelihood Aspects	Correlationship to Likelihood of Future Project, r
Financial Returns	0.769
Publicity	0.681
Satisfaction Rating of PDPP experience	0.670
Progress Reports	0.611
Student's Overall Achievement	0.577
Supervision by Massey	0.501
Supervision by Company	0.495
Staff Liaison	0.458
Prototyping	0.417
Commercialisation Status	0.141

It is worth investing the time and resource to investigate the reasons why some companies lacked of enthusiasm to participate in a second or third project partnership even though they have had their product commercialised through the PDPP.

4.6 KEY FINDINGS

Product Development Process Overview

The respondent companies' Product Development process did not have any significant change as a result of their participation in the PDPP. Various reasons could be the cause for this: a) short project timeframe, b) Massey's understanding of the partnership project, and c) the student's understanding of the partnership project. It was generally thought that the project tended to be student-oriented rather than a joint project of company-student-Massey. Activities of the Product Development performance had improved quite extensively in the respondent companies. Among them, four activities, Preliminary Market Assessment, Detailed Market Research, Full-Scale Production Plan,

and Product Launch Plan, had excelled over the other nine Product Development activities listed in the survey. As previously stated, the PD activities improvement in client companies cannot be fully attributed to their participation in the PDPP. There is no evidence in the data gathered by this research showing that the PDPP impacted on their PD activities. Nor is there a question in the mail survey and interviews that asked if the PDPP helped improved the performance of their PD activities. Investigation of the PD process status and activities performance resulted by the PDPP participation is another research direction.

Benefits to Clients

- 95% of the respondents indicated that "Consumer Research Information" was the most useful information the student had provided to both the project and other on-going project at the company.
- With the average usefulness score of 2.5, "Technical Information" was selected by 86.4% respondents as the least useful information.
- The most expected benefit from the mail survey respondents was gaining fresh ideas. Ability to compete with larger competitors on the other hand was the least expected benefits. The occurrence rates for these two benefits were 56% and 100%, respectively.
- On the question of barriers to the progress of the partnership project, the student's ability to perform and communication with the student dominated the list by 77.3% and 72.7%, respectively. Other barriers listed by respondents included, "project time allocation", "student's Massey commitment", and "student's supervision at Massey".
- Ability and communication between company and student, which were highly correlated, were also recognised as factors inhibiting the progress of the partnership project.

Achieving Client's Expectations

- 82% of the respondents listed "Helping the student and university" as the main reason they had taken part in the partnership programme. Yet, this reason was only able to score 3.2 on the successful scale, compared to "to keep up with competitors" which had scored 3.8 on the scale.
- All twenty-two respondents selected "research availability" as an important factor to the Product Development project. The three factors with the highest importance scores were "student's performance", "clear project definition", and "communication with the student".
- Among the eight PDPP choices listed in the questionnaire, "supervision by company" was chosen by 95% of the respondent as their most satisfied aspect. "Progress reports produced by the student" and the "student's overall achievement" were the second most satisfied aspects, both scored at 3.0
- The client rated their experience of the PDPP based on the criteria of student's overall achievement and whether the student project led to commercialisation.
- Fourteen respondents had expressed interest of another partnership project with Massey in the next five years. The three factors influencing respondent's interest were the financial returns brought by the project, publicity and the level of satisfaction of the partnership experience.
- The fact that six of the seven projects that reached commercialisation were rated highly on the expectation scale, shows that the degree of satisfaction was very much dependent on whether the project reached commercialisation.

Discussions of the above findings will be done more meaningfully after the case study interviews. Therefore, the interviews had helped to provide information and insights for the interpretation of some of the responses and statistics.

Chapter 5

RESEARCH RESULTS AND ANALYSIS: CASE STUDY INTERVIEWS

5.1 INTRODUCTION

The case study was conducted following the mail survey. Interview methodology and strategy, sample selection, interview questions, and ethic protocol required by MUHEC were entailed in Chapter 3 Methodology. Objectives for the inclusion of case study interviews in this research include:

1. To gain more depth and clarification on some of the answers given in the survey, and
2. To get answers for questions raised as a result of the preliminary data analysis of the mail survey.

Generally, areas that need more depth and clarification from the mail survey were:

a. In-house project evaluation
   - Did the client company evaluate the student project (against their expectations) at its completion?
   - If they did, what measure did they use?
   - If they did not, what measure would they use if they were to evaluate the student project?

b. Factors influencing the project outcomes
   - What, in the client company's opinion, are the determinants of a successful product development project in general?

- What, if any, were the obstacles that the client company had encountered during the Partnership Programme?
- If the obstacles were overcome, would the project outcome be any different?
- Did the same obstacle occur in the development or production of their other product range?

c. Thought on the design and management of the PDPP

- Were there any other elements that the client company think are essential to the design and management of the Programme?
- What does the client company think of the concept of the Partnership Programme with Massey?

5.2 CASE STUDY ANALYSIS

5.2.1 CASE 1 - COMPANY A

Company Background

Company A is a multi-media software and programming company established in 1996. The founder of the company was previously working at Massey University as a programmer and started the business as a computer consultant before moving into the Multi-media/Information Technology (IT) domain. The four main products or services provided by the company include, (i) programming, (ii) web design/programming, (iii) educational training, which include corporate training and educational training for young people, and (iv) design and multi-media. Their primary business focuses are programming and web creation (70% of their time and resources) followed by educational multi-media products, which takes up 30% of their time and resources. The company is currently employs six full-time employees of which four are technology graduates with Product Development background. Company A's target markets include the Internet users, school children, governmental and regional organisations, and local businesses. Their export markets cover clients from Australia as well as the United States of America.

Company's Background to Product Development

Company A could be considered a veteran in the Product Development process as the company's project manager was a Product Development graduate from Massey University several years ago. Moreover, the company had, in recent years, employed four Product Development graduates. However, Company A has admitted that they are still very much a learner in product development process as every project they undertake is different and utilises a different combination of the Product Development process.

Project Background

The project brief was proposed and presented by Company A to the Product Development Partnership Programme Team at the Institute of Technology and Engineering who then assigned one of the fourth year PD students to the project. The student was chosen for the project based on his interest and abilities in graphic design as well as his computer literacy.

This PDPP student project aimed to develop a new educational multimedia product (ie. CD-ROM), which catered to the needs of New Zealand children. The reasons for targeting New Zealand children as the end users of the product were:

- Language (text and spoken) used in majority of educational multimedia software is American English. The differences in pronunciation and spelling can be confusing to New Zealand children.
- Products that are available on the market at present do not portray themes or issues that are relevant to New Zealand children.
- Research conducted by the student showed that very few existing products relate to the New Zealand environment, which New Zealand children are interested in, can relate to, and are involved in.

The identified market sectors of the education multimedia CD-ROM include: the primary school children who were the product end-user, schools that these children attended (ie. product purchasers), and the children's parents and/or grandparents who were also being referred to as the product purchasers.

Being a local company, the student was able to take the opportunity to spend the majority of the scheduled project time at the company to become familiarised with the process and tools used by the company. During the eight months, not only did the student create the product, but student and the company's project manager worked together to develop a marketing plan and distribution channels in order to launch this product into the marketplace. As disclosed by the project manager in the interview, this process had taken nearly another six months to accomplish.

Student Project Outcomes

The company was generally pleased with what the student had achieved considering the scope of the project and the limited timeframe. Company A did not evaluate the student project at its completion but was constantly monitoring the market success and financial return that the commercialisation may yield. Measures that the company would use to evaluate the student project include achieving project aim (ie. to develop an educational CD-ROM) and financial returns. The main obstacle that Company A thinks had affected the project progress was the other commitment (papers, reports and examinations to complete) that the student still had at Massey.

For this project, the client was looking for the student to provide as much information for their decision whether to continue or discontinue the project. During the eight months project timeline, the student was able to achieve what they set out to accomplish, i.e. to develop an educational CD-ROM targeted at the school children. As well as the production of the prototype the student also produced four progress reports, and the future plan of the project, to both the client and the supervisors at Massey University.

The sponsor company employed the student after he completed his bachelor degree study at Massey University to continue working on the project. The product was launched in the New Zealand market a year after the student joined the company.

Company's Opinion on the Product Development Partnership Programme

In the company's opinion, the project partnership was good practice for students to put their skill into use and was also an employment opportunity when they graduated. However, the company also agreed that it was difficult for a student to come to a company in a totally new environment and to achieve a commercially viable project in just eight months. As explained by the interviewee, in order to achieve that, the student would need to be very focused on the project with a solid eight hours of work per day. It was impossible for this project as the student still had other university commitments to attend to. The students had access to the assistance and resources made available at this company mainly because the client company was a local company within travelling distance. Company A thinks that the partnership programme is a very economical approach for a company to design and develop new products or to simply make the "Yes or No" decision for project continuation.

In terms of the project evaluation or assessment carried out by Massey University, Company A does not agree with the marking format where all the students were being assessed with the same set of criteria or requirements. Company A's argument was every project is different and unique in its one way, thus should not be assessed or measured by one common measurement.

Recommendations and Likelihood of Future Project Partnership

As well as the financial and resources sponsorship of the student project, Company A had also been involved extensively, along side the student, in the development and commercialisation of the product. From this PDPP involvement, they had gained valuable first-hand experience and information of the domestic market for educational software. When asked if he (the project manager) would recommend the partnership programme to others, he said he would, mainly because he had been a beneficiary of the

programme himself. Through his involvement of the PDPP programme firstly as a PD student and now as a PDPP sponsor, he had seen a mutual benefit to all the participants, i.e. the industry, the institute (ITE), and the student.

The interviewee expressed that as the company is expanding its business domain and job requirement and needs are changing, the company will not be looking for any PDPP project with Massey in the next few years. Nevertheless, the interviewee said should there be a need for a PD project, the company would certainly approach Massey to meet that need.

5.2.2 CASE 2 - COMPANY B

Company Background

Company B is a plastic rotational moulding company operating in the outskirt of Palmerston North. The current owner bought the business in 1993 and has been the sole owner ever since. The company's product line consists of farming equipments that can be fabricated from rotational moulding techniques with polyethylene, which is the principle material used. The initial product lines included different varieties of water and drinking troughs and liquid storage tanks. Other products that were produced at their four-worker production site included letterboxes (rural and urban), 2-Wheel Bike carriers, and 4-Wheel Bike carriers.

Company's Background to Product Development

Company B does not follow any particular process of Product Development. The majority of their product ideas were generated from variations on their opposition's products. Although they do not have any systematic process in developing new products, they constantly looked at all approaches that may be useful to them to improve their existing product lines as well as the manufacturing processes in order to be more a competitive market player. To achieve this, the company searches for new product innovations for the purposes of extending their product lines and increasing their market share.

Project Background

The overall aims of the student project with Company B were to research and develop two carrying devices for the front and/or rear end of all terrain vehicles (ATVs) (ie. 4-wheel motorcycles) predominantly for farming purposes. The proposed product was a plastic container with a tray integrated into the lid. The product is designed to fit on the rear frame of ATV's so the user can easily move and transport tools, materials and general farming equipment.

Before any concept was taken any further, the student researched and analysed similar products on the market. In this exercise, the student identified the limitations and problems in existing products. This was critical in designing a better product. The student also identified areas that required further research in the product feasibility study. The feasibility study consisted of two main sections, i.e. market research and concept development, and was defined by the student as a study concerning the systematic planning, research, analysis and synthesis of the proposed product. These areas were:

- Market analysis
- Financial analysis
- Materials/components, and production methods
- Identification of packaging requirements and existing methods
- Transportation methods to distributors
- Identification of Logo-type requirements
- Consumer information/instruction pamphlet

Other information collected from the feasibility study included the perceived target market, geographical market distribution, and the market size. Results of the market analysis research showed that there was currently only one known main competitor who manufactured ATV carry-case and tray products using plastic rotational moulding

techniques. It was suggested to the company to carry out on-going market research to raise the awareness of market competition.

Student Project Outcomes

An ATV carrier and tray prototype was developed at the completion of the project. The prototype was presented to the sponsor company and the advisory board for assessment and displayed at the Degree Show at the Manawatu Gallery in late 1999.

The product was commercialised in 1999 after much investigation into the product seasonal trends, financial trends and analysis. When asked about the financial returns of the student project, the company openly revealed the sales of the products and its annual turnover for the year before and after the student project. While there was an increase of the annual turnover, the owner-manager explained that the product commercialisation had only a small contribution to the increase of sales. Nevertheless, sales of the new product has been improving since its market introduction, and the manager believed that, in the future it will become a strong and competitive product in the market. This company evaluated the project by using the financial returns that the launched product had brought to the company. According to the manager, this was not a one-off evaluation, the company will continue evaluating the product with its market performance and competitiveness.

Company's Opinion on the Product Development Partnership Programme

The company's expectations of the partnership project included market sales, which subsequently result in making profit, and being competitive. Market sales and profit have increased, however it could take four to five years before the competitive impact on the market comes evident. Within the PDPP, the company considered student liaison, company's involvement in the programme, and student's level of technical skills/knowledge (in importance order) played important roles in the development of the product. When asked, student supervision at Massey and staff liaison were the two aspects that had only small contribution to the company's expectation and may need further improvement. The company expected more frequent communication with the

project supervisor and staffs at Massey to keep them up-to-date with the project progress and "what's new at Massey?". In the company's opinion, it is the student's responsibility to maintain and strengthen the liaison between Massey staff and the company. However, the company was expecting some level of contact at the end of the year from Massey to check if there was a vacancy for another partnership project. He was rather disappointed that Massey did not contact him last year after having two successful PDPP projects with Massey University.

Overall, the company is very pleased with the partnership programme, especially the prospect of going into a partnership with Massey to develop new products. Employing only four full time workers, Company B is a relatively small company, thus does not have adequate resources allocated for market research and the latest science and technology information that may be applicable to the product development operation.

Another aspect that the company would like to be improved is the project time frame, which currently is eight months from project brief to prototype and marketing plan presentation. The owner-manager's suggestion is to have a flexible project time frame according to the nature and requirement of the project. Company B was the only company in the case study interview sessions that did not think that having a student work at the company during the summer break prior to the project year is necessary in helping the student and/or the project. The reason was that having a student working at the company would require more attention, assistance and financial resources by way of salary.

Recommendations and Likelihood of Future Project Partnership

Company B had two PDPP project experiences with Massey over the years. Both Product Development projects have been commercialised and are gradually making progress in the competitive market. The interviewee told the researcher that the company is very impressed with the students' capabilities and the creative ideas that have been brought to the company.

The owner-manager said there are increasing needs and opportunities in New Product Development within the company and marketplace. This means that there are more project partnership with Massey in the future. In fact, as mentioned previously the owner-manager of Company B was rather disappointed for not being offered a project partnership with Massey last year (ie. year 2000). Investigation into the reason why Massey did not contact the company for another project partnership, found that Massey have different mix of projects and companies each year. His response to the likelihood of them recommending the partnership programme to others in the industry, was "certainly, but not to the opposition or competitors".

5.2.3 CASE 3 - COMPANY C

Company Background

Company C is a cleaning and packaging supplies agent for 3M in Manawatu region. The company was established in 1982 and has been privately owned by the current owner and manager since change of ownership in 1994. The number of employees has doubled since the changeover, and the company currently employs eleven full-time staff, with five involved in the sales department. Company C does not manufacture the product in-house, but is a representative for products manufactured overseas and domestically. Company C also specialises in safety products, cardboard cartons, brushware, rope, twine, cups and containers. The company's business principles are to supply whatever their customer requests, and to satisfy their customers' needs. Company C services businesses in the region between Ruapehu, Paraparaumu, Wanganui, Carterton, and Dannevirke. With the nature of products that they provide, they do not have a specific market but a diversified one. Ninety-five percent of the company sales come from attached customers in various industries. The remaining five percent of the sales are the casual sales over the counter. The primary export market lies in Belgium. Their main advantage in Belgium is competitive pricing.

Company's Background to Product Development

As Company C is a wholesaler and therefore not a manufacturer, Product Development is more of a market development and new ways of using existing opportunities. Thus

knowledge and usage of Product Development was limited. However, occasionally clients with specific needs will come to the company, and they will then contact its suppliers to arrange to have the new product designed or seek other alternatives from suppliers for its clients. They will approach Massey for a student to work on the Product Development project when the new product has to be designed and developed.

Project Background

The project was carried out in collaboration with the client company, the student, and Massey University in 1999. The project came as an opportunity when the cleaning supplies distributor wanted to increase the markets of Scotch-Brite™ scourers. The dairy industry was recognised and targeted as an industry that should be investigated for the cleaning of the exterior of the pipes and rails in milking sheds. There are two reasons why the company wanted to increase the scourer markets. Firstly, it would enable the company to increase their sales and profits, and secondly, the intended outcome could also bring a closer relationship between 3M, the manufacturer of the scourer, and the company. Company C is a small company by 3M's standard, however by showing that they are active in the industry, and have a quick response to the market needs, would improve the relationships and possibly lead to other opportunities in the future.

The student project aimed to:

- Investigate and evaluate the opportunities for the introduction of Scotch-Brite™ scourers for cleaning the exterior of pipe work in the dairy industry.
- Develop a product to solve problems that currently exist, to the requirement of the end users.

The student had carried out a series of market research and analysis in order to gain more knowledge of and be prepared for the project. The main objectives of the market research were to determine the need for a new product, to conduct a SWOT (Strength, Weakness, Opportunity and Threat) analysis of the proposed product, to determine the product and performance requirements, to investigate other industry applications, and

also to determine and identify the market size and potential competitors. The market research was divided into three specific areas of consumer, market and technical. Results of the market analysis included information of the perceived target market and user profile, market size, analysis of competition in the market, and product requirements and application in other industries or areas.

Student Project Outcomes

In the market research conducted, it was found that a considerable opportunity existed for scourers to be used with dairy sheds. As well as the exterior of pipes and rails, scourers could also be used on flat surfaces and other areas in and around the milking shed. Following the market research, the student also developed a commercialisation strategy and financial evaluation of the product's potential in the intended target market.

After much consideration of the recommendations presented by the student, the new product was commercialised in 1999 in New Zealand, the same year the project undertaken. Overall, all the initial aims established in the earlier stage of the project have been met. In terms of what had been achieved and what the student and project intended to achieve, the sponsor company was satisfied with the project outcomes and in a scale of one to five, rated the project successful (three on the scale). The company had sold 10 units of the scourers in the past 2 years after launch. The interviewee, who is also the company manager, revealed this was the maximum quantity that the company was selling at the moment. However, he was confident that the sales will pick up gradually over time and with recognition. Other benefits of getting the product commercialised, were the ability to obtain sales of other products from the lower South Island, where they had previously not been successful in gaining a market. This company did not evaluate the student project upon its completion but used the product sales and market performance as the mean of project evaluation.

Company's Opinion on the Product Development Partnership Programme

The company's expectations of the partnership project were to increase the sales and to make a profit from the product introduction. The PDPP project to the company was a

steady progress development project rather than a new invention. The scourer was already available for other applications but had not been recognised by the dairy industry as an important product in this sector.

On the discussion of project barriers, the manager responded that no particular barriers had been encountered relating to the student project. However, he did identify a weak link in the project, where he felt Massey staff had directly influenced the student in carrying out the project rather than a project partnership between Massey University and the sponsor company. In a way, he felt that Massey had dominated the project more than the company had. Consequently, the contact between Massey and the sponsor company was minimal. The company manager was particularly impressed with the student's attitude towards the project and ready willingness to become part of the team of employees. In the company's opinion, partnership between Massey University and Industry for Product Development should be strengthened by two – was good communication. Placing the student in the industry for first-hand experience gave the Product Development degree student a leading edge over his/her counterpart in the mainly theoretical Engineering Degree. Yet, the noticeable lack of communication between Massey and the industry was considered a major disadvantage to both student and sponsor, which may lead to a refusal for future sponsorship. Other factors that are crucial to a successful product development besides communication are teamwork and project planning.

Recommendations and Likelihood of Future Project Partnership

The only advantage Company C experienced as a result of the programme was an increase in sales of the product. The manager stressed that they would most likely undertake another Product Development partnership in the next five years as it is a good practical programme for both student and company, especially when it carries financial benefits. In terms of recommending the partnership project, he would recommend it to others in their industry, but would hesitate to encourage competitors in his field to participate.

5.2.4 CASE 4 - COMPANY D

Company Background

The sponsoring company of this project is a pet food company, who is also owned by a worldwide food manufacturer. The factory has had a number of owners since its establishment in 1956 and was purchased by the current owner in 1992. The parent company was founded in Switzerland in 1866, manufacturing mainly dairy products and the Palmerston North factory now manufactures seventeen different types of dried dog biscuit for both rural and urban markets. The factory currently employs thirty-three full-time employees.

Due to confidentiality reason, the name of the dog biscuit range will not be named in this report and will only be referred to as "Brand X". Brand X dog biscuit was first developed in Blenheim, New Zealand through the need for a healthy food product for working farm dogs. The biscuits have been proven to promote health and vitality in farm dogs, and have subsequently become the staple food for working farm dogs. This has resulted in broadening the market to accommodate almost all types of dogs. The company is also involved in producing other food products such as, milk product, beverages, confectionery, chocolate products, culinary products, and frozen foods.

Company's Background to Product Development

Being an internationally owned company and a market leader of the dog biscuit market, Company D has a systematic and formally documented process to guide its new product development process. Not only that, the company also has a cross-functional team playing critical roles in the development process. This has certainly helped the student project, which has to follow the systematic product development process. The stages of the product development which the company follows include: Preliminary Technical Brief (generated by both the marketing as well as the production teams); a formal product brief detailing the product ideas; target market; expected market share and nutritional claims which are written and circulated among the whole project team (i.e. the marketing, development, and production teams). Preliminary Market Assessment and Technical Assessment focusing on the project feasibility and costing are then

carried out followed by production trial and analysis if costing is acceptable. Teams in Australia and Missouri, USA provide technical and application support when developing product range for global markets. The product development stages are subject to change according to the nature of the product.

The majority of their R&D and scientific publications are produced in the group's Production Technology Centre (PTC) in Missouri, United States of America. The PTC facility provides most of the technical and product research and the development and scientific evidence to be able to manufacture recipe formulations for market.

The company's product development process is complex and multi-matrix as there are different levels of markets involved in the product.

Project Background

The overall aim of this project is to investigate methods of reducing the shortening effect of a high-energy dog biscuit. The shortening effect is measured by the amount of breakages occurring per unit of product. The under-investigated Brand X dog biscuit is an existing product sold in the New Zealand rural dried dog food market. The need for this project arose when complaints relating to product quality were growing. The problem was due to the crumbly appearance of the biscuit, caused by high fat level in the recipe. The fact that most of the parameters had already been established in the existing product was a benefit in conducting this development project.

Following are the initial project objectives set to achieve the aim,

- To improve Brand X farm dog biscuit by implementing the Product Development methodology,
- To define the parameters involved in each of the process stages of mixing, extruding and baking a high energy baked dog biscuit for the rural market,
- To determine which of these parameters or combination of parameters could contribute to reducing the "shortening" effect of the final product,

- To improve Brand X farm dog biscuit according to consumer requirements and/or preference.

Constraints to this student project included (i) the project time frame, which was less than twelve months, (ii) company requirements where the final-product retained the existing shape, size and manufacturing methods, (iii) cost of improvement could not incur more than 1% of existing cost of goods sold, (iv) consumer requirements, and (v) the available resources and facilities at the factory (ie. no extra investment for this project). Initial definition of the product characteristics were:

- Nutritional for the end user
- High energy and high fat content
- Convenience for consumer or purchaser in feeding
- Did not lose composition during transit and handling
- The biscuits were not brittle
- Improved palatability
- High digestibility low calcium levels

Areas that needed further investigation in order to carry out the feasibility study were consumer and market requirements, and technical researches. Technical research were the key research area of this student project and included investigation into the baking industry, ingredient effects, and machinery effects. One important market information collected by the student found that the dog biscuit buyers (ie. farmers) do not find dog biscuit a necessity, and that they had no problems with the dog biscuit they currently used.

Student Project Outcomes

The main objective of this student project was to investigate alternative methods of reducing the "shortening" effect of the biscuit. Throughout the project, various formulation methods were generated and screened using experimental design. Unlike

other consumer products developed by PDPP students, prototyping was necessary for this project to test the biscuit hardness, moisture level, and breakage of each concept.

Moisture and hardness were found to have affected the crumbling of the biscuits, therefore recommendations to improve the "shortening" effect of the biscuits were to lower the water level in the production and to continue investigating the cooling time, which was found to have produced harder biscuits. Recommendations presented by the student were considered by the company for ways to continuously improve the quality of the dog biscuit.

Measures that Company D used to evaluate the student project were the student's overall performance and understanding of the technical or manufacturing process.

Company's Opinion on the Product Development Partnership Programme

Company D has a product development process in-place. The interviewee and the company in general believe that the Partnership Programme is useful and practical for all parties involved and are fully supportive of the partnership project concept. The PDPP had allowed the company to gain a fresh and different perspective from the student's point of view. However, the student's skill and understanding of manufacturing process is the most important factor in the partnership project to achieve its objectives. Also, the student needed to thoroughly understand the working process, from office culture to production process and technical understanding before they can progress with practical activities. The interviewee explained, this process could take from a few weeks to a few months, especially if the student has not had any exposure to industrial operation.

One of the notable comments from the company on PDPP on this particular project was the lack of communication between the project supervisor at Massey and the company. Other aspects that the company thinks are important for the student and project to achieve their aims and objectives include 1) student's level of technical understanding and knowledge (the most important aspect to the company), 2) liaison between

company and student, and 3) company and Massey staff's involvement (to ensure that the student and project are on the same track as the company).

The reasons, which had encouraged the company to take on the programme, are the student's utilisation of potential technical skills and the opportunity to gain new perspectives on new and improved manufacturing processes. The level of achievement according to these reasons was relatively low due to the student's lack of knowledge/understanding of the processes. The factory manager suggested the student undertaking a project should spend the summer vacation, prior to the year of project working with the company. This would help both the student and the project by becoming familiar with the company and the manufacturing.

Recommendations and Likelihood of Future Project Partnership

The company's needs for product development had changed in the past years. Because of their background and operation, requirement for food technology student projects have grown and are now greater than new product development projects. However, if a suitable product development project arises, it is very likely (scale of 5) that the company will approach Massey for another Product Development student.

The likelihood of the company recommending the programme to others in the pet food manufacturing industry is likely with the understanding of Massey's capabilities further established. This however is dependent on the nature of the project and business.

5.3 KEY FINDINGS

1. Client's view and opinion of the Programme varies. There was, however, a shared view among the companies, that they were all very supportive of the idea of working with Massey University through the PDPP. They also agreed that putting a student in a business and industrial environment is a good practice for the student to their career advantage.

2. All the interviewed companies said they would appreciate it if there is a greater communication flow between Massey staff and the company which could help resolve some project issues and strengthen the university/industrial relationship.

Not all projects undertaken through the PDPP were commercialised, but product commercialisation is one of the project outcomes that all the concerned parties hoped to achieve.

Chapter 6

RESULTS COMPARISONS AND DISCUSSIONS

6.1 INTRODUCTION

The Product Development Process and Product Development Partnership Programme were the two main topics of discussion in both surveys.

Results from both the mail survey and case study interviews indicated that overall, PDPP had received good feedback on project's progress reports (produced by the student) and Massey having an industry-related product development programme. The areas of concern were student's capability in carrying a technical project, communications (with student and Massey staffs), and barrier(s) that inhibited the project progress.

6.2 PRODUCT DEVELOPMENT PRACTICE AND THE PROCESS WITHIN

Before going into the discussions of what benefits (either expected or unexpected) PDPP had brought to the company, and whether PDPP and the various aspects within had satisfied the clients' expectations, each respondent was asked to give an overview of their PD practice and activities by ranking their performance before and after the partnership project. This was to see if their PD status had changed since their participation in PDPP, and if it had, which part of their PD process were improved, hence benefiting the company.

6.2.1 PRODUCT DEVELOPMENT PRACTICE

Booz, Allen and Hamilton's research on the management of new products in 1968 found 86% of the best-known companies had formal new product departments. Later in 1982 (a follow-up study of their 1968 research), they found that almost half of the companies surveyed used more than one type of organisational structure (eg. cross-functional or multidisciplinary team) for their innovation activities. There had been a noteworthy change since the 1968 and 1982 reports by BAH. The study of the New Product Development practices and performance by Page (1993) found that 76% of the sample businesses used cross-functional or multidisciplinary teams (with formal product development process) to develop new products. In 1999, a study by Campbell reported that 52% (17 out of 33) of his survey companies used a formal product development process. Reasons given in Campbell's (1999) research for using a formal process were "quality systems require a process", "it provides consistency and reliability", and "the provision of a formal framework", while reasons for not using a formal process included "a process is only needed for product testing", and "only internal ideas are being used".

To find out the number of companies that utilise product development practice in their organisation, the mail survey respondents were asked to indicate which of the four forms of the product development status best describes the one used in their organisation. Feedback of the PD practice overview showed that 90.5% (19) of the responded companies have established and/or used some level of standard approach to product development (ie. formal product development process and cross-functional teams).

Comparing the number of companies in this research that utilise product development practice to those in studies by BAH in 1968 and 1982, Page (1993), and Campbell (1999), show that more businesses are using formal product development practice and/or multidisciplinary team for new product development activities. Though the geography of the samples varied between these studies, the increasing number of companies using formal or standard PD process is still noteworthy. It is also interesting to find where 73% of the

responded companies in this research are SMEs, and with some have employees as few as one person, that they follow a standard PD process.

6.2.2 STAGES WITHIN THE PRODUCT DEVELOPMENT PRACTICE

Following the PD practice overview, the respondents were asked to evaluate performance of the process or activities within the PD practice used. There are many concepts in the new product development process and they are presented as a number of stages or activities (Page, 1993). A PD model by Crawford (1991) consists of five stages with as many as sixty-seven specific activities, while Cooper and Kleinschmidt (1986) investigated a PD process with thirteen different steps. There were a number of studies, both overseas and New Zealand based, which have explored the organisational product development stages or activities based on Cooper and Kleinschmidt's 1986 model. These include Cooper and Kleinschmidt's own study of Canadian companies in 1986, Sanchez and Elola (1991) who conducted a study of the product development practices of Spanish companies, Kerr (1994) whose research was to study the product development practices of small manufacturing companies (food, electronic, and light engineering) in New Zealand, Campbell (1999) studied the knowledge creation in New Zealand manufacturing industry, and Ho (2001) investigated the impact of Technology New Zealand (TechNZ) scheme on SMEs in New Zealand. Comparisons of the usage (in percentage) of Product Development activities across studies by Cooper and Kleinschmidt (1986), Sanchez and Elola (1991), Kerr (1994), Campbell (1999), Ho (2001) and this present research are presented in Table 6-1 below. This present research had also used Cooper and Kleinschmidt's (1986) model with minor changes to the PD activities to suit the partnership programme evaluation. Changes to the model included the addition of "Idea Generation" to the front-end of the PD process and exclusion of "Trial Production" from the model. The inclusion or "Idea Generation" and exclusion of "Trial Production" were taken with the advice of the PDPP co-ordinator as the PD process use in PDPP include "Idea Generation" but does not include "Trial Production".

Feedback of PD activities showed that apart from the two respondent companies that do not use any standard approach for their product development purposes and one respondent company that refused to answer this particular question, the remaining 19 companies all reported using some or all of the PD activities.

Table 6-1: Comparison of Product Development Activities Usage

Activities	Cooper & Kleinschmidt (1986)	Sanchez & Elola (1991)	Kerr (1994)	Campbell (1999)	Ho (2001)	Current Research (2002)
a. Idea Generation	-	-	-	-	-	90%
b. Initial Idea Screening	92%	68%	77%	76%	94%	86%
c. Preliminary Market Assessment	78%	71%	75%	82%	62%	90%
d. Preliminary Technical Assessment	83%	75%	70%	85%	62%	90%
e. Detail Market Research	23%	46%	32%	55%	32%	86%
f. Business/Financial Analysis	61%	64%	56%	76%	53%	90%
g. Prototype Development	85%	88%	82%	88%	85%	90%
h. Prototype Testing (In-House)	85%	82%	77%	79%	79%	90%
i. Prototype Testing (Customer)	64%	59%	75%	70%	59%	86%
j. Trial Production	22%	30%	62%	69%	56%	-
k. Market Testing	45%	55%	42%	58%	32%	86%
l. Pre-Commercialisation Business Analysis	38%	39%	20%	46%	26%	86%
m. Full-Scale Production Plan	58%	55%	70%	85%	56%	90%
n. Product Launch (Plan)	65%	55%	72%	70%	56%	81%

**One respondent company in the current research did not answer the question.*
**NB: a dash (-) indicates the exclusion of the activities in the respective studies.*

Results of the six studies above suggested that the Canadian companies (Cooper & Kleinschmidt, 1986), Spanish companies (Sanchez & Elola, 1991), and New Zealand companies (Kerr, 1994; Campbell, 1999; Ho, 2001) tend to be more associated in the physical product design and development, and assessment of the feasibility of the product. Similar findings also found in the current study showed higher company involvement in these activities. It is only reasonable and fundamental for companies to study the product or concept feasibility before further development decisions are put forward. Percentage usage in "Detailed Market Research" and "Pre-Commercialisation Business Analysis" was relatively high compared to the Canadian, Spanish and New Zealand studies. Reason for

this maybe that the companies had seen the benefits in market research information and pre-commercialisation competitor analysis through the PDPP and thus had taken action in carrying out these two activities within their companies. Results from the mail survey indicated that more than 90% of the responses had commented highly on the usefulness of the market research and competitor information that the student had gathered.

Unlike studies of the Canadian (Cooper & Kleinschmidt, 1986), Spanish (Sanchez & Elola, 1991), and New Zealand (Kerr, 1994; Campbell, 1999; Ho, 2001) companies, the number of companies carrying out all the activities is reasonably high in the current study. Most companies in this current study use a relatively standard and systematic new product development procedure, though it may not be formally documented, the reasons being 64% do not have a specific team or person committed to the specific tasks and/or responsibilities. Rather, the tasks and/or responsibility were shared amongst the employees or taken by one person whose roles include owner-manager, product design, prototype testing, business analysis, and drawing up the product launch plan. This, however, is quite common in SMEs with limited financial and personnel resources. Overall, results of the current study are considered to be consistent with the research done by Cooper and Kleinschmidt (1986), Sanchez and Elola (1991), Kerr (1994), Campbell (1999) and Ho (2001) on activities *b. Initial Idea Screening, c. Preliminary Market Assessment, d. Preliminary Technical Assessment, g. Prototype Development, and h. Prototype Testing - In-House.*

One of the issues investigated was the performance of the product development activities at the client companies after the PDPP. It was found that there was very little improvement in the PD activities performance resulted from participating in the partnership programme. A note should be made that though there was no significant change of process status before and after the partnership programme (see Figure 4-1), there were improvements in the individual activities of the PD process of the companies. A comparison of the PD activities (ie. *Detailed Market Research, Preliminary Market Assessment, Full-Scale Production Plan,* and *Product Launch Plan*) that had a notable improvement is presented in Table 6-2

(refer to survey results in **4.2.1 Product Development Process and Stages Used,** p.94). These four activities were selected for discussion due to their outstanding performance in the mail survey.

Table 6-2: Comparison of Average Score of Product Development Activities Before/After Product Development Partnership Programme

PD Activities	Average Score Before PDPP	Average Score After PDPP	After – Before
Detailed Market Research	2.5	3.2	0.7
Preliminary Market Assessment	2.8	3.3	0.5
Full-Scale Production Plan	2.9	3.3	0.4
Product Launch Plan	3.1	3.5	0.4

Two of the four PD activities before PDPP were found to be market- or marketing-oriented. This may be due to the lack of marketing skill or knowledge of the respondent companies where 73% of them were SMEs. Marketing activities and practices, such as market research or consumer survey, require sufficient resources (both financial and people) and practices, which are lacking in small businesses. Though improving the companies' product development process or procedures was not the primary aim of the partnership project, it did indirectly help the companies to gain knowledge and/or skill on new product development.

6.3 PRODUCT DEVELOPMENT PARTNERSHIP PROGRAMME

The second part of the discussion and result comparisons focused on the Product Development Partnership Programme and the various aspects within. The main topics of discussion in this section are:

6.3.1 Benefits to Clients, and

6.3.2 Achieving Client Expectations

6.3.1 BENEFITS TO CLIENTS

Benefits, let it be a skill and/or information, gained by the client companies were diversified. These benefits range from market information or techniques to design skills, identification of new opportunities, and ultimately project commercialisation. Project barriers are also discussed in this chapter. There are three key areas of discussion in this sub-section,

6.3.1.1 Usefulness of Information Gained and Skill Learned,

6.3.1.2 Expected and Actual Occurrence of Benefits, and

6.3.1.3 Barriers that inhibit the progress of the Partnership Programme.

These three key areas were chosen due to their significant findings in the surveys.

6.3.1.1 USEFULNESS OF INFORMATION GAINED AND SKILL LEARNED

For almost all client companies, getting the partnership project commercialised and increasing their sales and revenue were their ultimate goals. Other skills and/or information were by-products gained through their participation in the partnership programme.

The mail survey results indicated that more than 90% of the respondent companies rated consumer research information, information of their competitors, knowledge of systematic procedures, and product development skills (in usefulness score order) as the four most useful benefits gained through their involvement in the PDPP. Research by Mahajan and Wind (1992) found that 36% of their respondents (28 out of 78) had suggested more formal and quantitative approaches to further complement and benefit the new product development process. As well as the need for more formal and quantitative approaches to new product development, market study for concept development and market study for market identification and positioning were also strongly suggested to further and better

enhance the new product models. The survey results indicated an increasing number of businesses favour the use of marketing research information in their new product development practices.

Despite the attention and claims of importance to new product development process, the new product failure rate has remained alarmingly high at 40% (Kyriazis & Patterson, 1996). While past studies on success and failure factors to new product development have identified the key sources of product failure, many of these were linked to the inappropriate use of marketing information, such as the formal market research and general marketing information in the new product development process. Results of Kyriazis & Patterson's research on the use of marketing research information in new product development in 1996 indicated that the most frequently used information types in New Product Development were sales-force, in-company competitor analysis, and customer visits. Among them, competitor analysis was featured highly as a key information source throughout, especially in the early stages of the new product development process. This is consistent with study conducted by Dwyer & Mellor (1989), which found that many firms were more inclined to focus upon competitors' circumstances than the customer needs. Findings of these research studies indicated that formal market research tends to be used later in the new product development process rather than the earlier stages to quantify consumer attitudes and behaviour. Lack of acceptance of the marketing concept (Kyriazis & Patterson, 1996) was identified as one of the four key reasons for new product failures. They claimed that many new products failed simply because market research information, understanding of customer needs, preferences and perceptions in particular, were ignored. In conclusion, based on the results of the research, they believed frequent use of formal market research techniques earlier in the new product development process could improve the new product success rate. The same conclusion was also made by Mahajan & Wind (1992) of the advantages and benefits of using formal and quantitative approaches in the earlier stages of the product development process. These stages were idea generation, concept screening, market identification and positioning and product development.

Results of the current research showing higher usefulness rating of **market research information** and **competitor information** illustrated that these respondent companies had clearly identified the critical role and usefulness of information pertaining to the new product development approaches. The other two benefits that had received the respondent companies' approval of usefulness were **systematic procedures** and **product development skills**. The same finding was supported by studies conducted by Grimes (1996) and Ho (2001) where responded companies of both studies had expressed the importance and usefulness of technological capability, innovation strategy, and product development procedures to maintain and have a growth in market share.

6.3.1.2 EXPECTED AND ACTUAL OCCURRENCE OF BENEFITS

The basic idea behind PDPP is to help the client company get the product idea or concept with market potential underway. At the same time, it offers them as much assistance as possible in obtaining information, skills, or knowledge that will benefit the project and/or the company. The project assigned to the student was carried out using the product development process as one of the requirements of the course. As a result, the company was being introduced for the first time to the formal product development process. Those already using the product development process, formally or informally, had reinforcement from the student.

Benefits of following a more effective product development process include a) better chance of increased revenue, b) improved product development productivity, and c) operational efficiencies (McGrath et al, 1992). Increasing product life-cycle revenue, improving market penetration, enabling success in time-sensitive markets, and creating more successful products can achieve increased revenue. Similarly, shortened development cycle times, reducing wasted development, improving resource utilisation, and attracting technical talent will uplift the product development productivity. Companies can improve their operational efficiencies by incorporating design for manufacturability and serviceability, encouraging product with higher quality, reducing engineering change or

modification orders, and improving the reliability of product launch date. In achieving all these together, the utmost benefit of an improved product development process will and can establish a significant advantage to the market competition (McGrath et al, 1992).

There were two main categories of benefits listed in the mail survey, financial and non-financial. Results of the current study on the expected and gained benefits showed a high percentage of respondents attaining **expected non-financial benefits** rather than the expected financial benefits. Of all the benefits listed in this current study, "ability to compete with larger competitors" and "design skills" held the highest occurrence rate of 100% and 89%, respectively. Compare that to Grimes' (1996) studies, whose study showed the TechNZ companies gained 100% occurrence rate on "R&D cost reduction" and "gaining knowledge on research partner's products/strategies" through their participation in the Technology for Business Growth (TBG) programme. While "money" and "ability to compete with larger and foreign competitors" were the two highest percentage in Ho's (2001) study. Table 6-3 shows the comparisons of the similar benefits listed in the current study, Ho's (2001), and Grimes' (1996) study. Percentage of companies in the current study that had gained the expected benefits of "technical information" ("access to technology" in Grimes' and Ho's study), "fresh ideas" ("cross-fertilisation of ideas" in Grimes' and Ho's study), and "reduction of development costs" ("reduction of R&D costs" in Grimes' and Ho's study), were, 86%, 56%, and 20%, respectively. Comparing these percentages, Grimes' (1996) research showed a higher percentage of respondents gained these benefits. In fact, her research results showed a high percentage across the gained expected benefits spectrum (70% to 100%). The result discrepancy can be explained by that the survey participants in Grimes' (1996) study involved collaborative projects with research partners, therefore, the benefits gained are based more towards the collaborative benefits.

Table 6-3: Comparisons of Results of Benefits Gained between the Current Study, Ho (2001), and Grimes (1996)

Benefits (Expected and Gained)	Current Study (2002)	Ho (2001)	Grime (1996)
Ability to compete with larger competitors	100%	90%	82%
Design skills	89%	-	-
Technical information	86%	45%	96%
Enhancement of market share	80%	32%	-
Fresh ideas	56%	39%	96%
Access to larger markets	50%	29%	83%
Faster time to market	43%	55%	70%
Reduction of development costs	20%	35%	100%
Make money	0%	100%	-

**NB: a dash (-) indicates that the benefits were not found in the respective studies.*

Ho's (2001) study of New Zealand companies which had participated TBG programme in the TechNZ scheme showed a high percentage of companies gained the benefits of the "ability to compete with larger and foreign competitors" (90%), and "shorter time for product development" (55%, or "faster time to market' in this current study). Comparing results of Ho's (2001) study and the current study on the similar benefits, the current study showed higher percentage of companies gained these benefits from participating in the partnership project with Massey (Table 6-3). These similar benefits were, the ability to compete with larger competitors, technical information, enhancement of market share, fresh ideas, access to larger markets, faster time to market, and reduction of development costs. It is also notable that 100% of Ho's respondent companies had indicated that money was their expected and gained benefit from TechNZ programme. Yet, there was only one respondent company from the current study listed "to make money" as one of the benefits that it expected to receive. Unfortunately, this benefit was not attained through the partnership programme participation. Possible reasons why this did not eventuate as expected could be due to changes in the market trends, timing to the market, increase in development costs, or changes in currency exchange rates.

The type of benefits that case study respondents expected to gain from the partnership programme were found to be more towards the financial benefits, which was to increase or

enhance sales and market share. The sales of the new products (designed and tested by the student) had yet to achieve the expected sales at the time the interviews were conducted, however, all four case study companies were confident that, given time, the sales of the new product will improve and be competitive.

An important finding of the mail survey was that one company indicated gaining benefits, which were not expected, namely design skills and information of its competitors. This finding was critical to the evaluation of PDPP but not significant enough to compare it to the similar studies.

Summary of the analysis of client's expectation from both the mail survey and case study interviews found that clients from large organisations (with full time employees of ninety-nine or more) were more realistic in terms of "return" on their investment and participation in the project. Realistic in a sense that they did not expect the student to develop and launch the new product in the short eight month timeframe. They understand that a successful product commercialisation takes more than eight months, more resources, and undivided attention of the project team. Which in this case, many companies claimed was infeasible as the students still have to complete their other study commitment at Massey. The main objectives and expectation of the large organisations were mostly non-financial related, which included: to help the student and Massey, to achieve project aims and objectives, to gain fresh ideas, and consumer and competitor information of their target market.

6.3.1.3 BARRIERS INHIBITING THE PROGRESS OF THE PARTNERSHIP PROJECT

Questions such as "How or why did the project fail to achieve the aims and objectives?" or "What inhibited the project from achieving the expected outcomes?" were asked to the client companies and the students in cases where their project failed to progress or to achieve the expectations. This section explores barriers that the client companies encountered during the design and development of the partnership project. Success or

failure of a development project can be assessed in many ways and at different level (Griffin & Page, 1996). The partnership project involved personnel from the client company, Massey staff, and the student, this makes identifying of barriers that inhibited progress difficult and multifaceted.

The barriers identified by the client companies can be classed into (a) people, (b) financial, (c) resources, (d) time, (e) skills, and (f) communication. Table 6- 4 shows the comparison of barriers reported in the current study and New Zealand and overseas studies. Student's ability to perform or lack of skills (77.3%) and communication with the student (72.7%) were rated as the two greatest barriers that had inhibited the development and outcomes of the partnership project. Student's ability in terms of project or product knowledge and skills required in machinery operation was a concern to the company considering he/she was playing the critical roles of project manager and designer in the project. Therefore, it was not without reason that student's ability was identified as one of the key influence in the project. Similar finding of lack of personnel skills was also found in Ho's (2001) study, but at a much lower frequency of 13%.

Table 6- 4: Barriers Inhibiting the Project Progress

Barriers	Current Study (2002)	Ho (2001)	Campbell (1999)	Kerr (1994)	Page (1993)
Lack of skills	√	√			
Communications	√				√
Lack of resources	√	√	√	√	√
Time	√	√			

Lack of resources was also identified as one of the key barriers with a high percentage of responses (68.2%). This finding is consistent with research conducted by Page (1993) and Campbell (1999), which identified resource constraints (ie. financial resources, human resources, and other resources such as engineering, marketing research, or design) to be the most frequently mentioned obstacle in their studies. "Resource constraints" was also

mentioned in studies by Kerr (1994) and Ho (2001), but at a much lower frequency. One vital constraint found in the current study that was not found in any of the studies mentioned above except Page's (1993) was communication. The communication channels in this study are between client company/student, company/Massey staff and student/Massey staff. Communication is especially crucial to projects with "out of town" companies. In cases like these, the student was only able to see very little of the company during the project. For projects with an in-town sponsor, the student was able to communicate with the project manager at the company on regular basis, daily or weekly. Besides regular communication, the student was also allowed to work on the project using the company's facilities, including machinery and human resources.

6.3.2 ACHIEVING CLIENT EXPECTATIONS

This sub-section discussed and compared results with other similar studies on meeting client companies' expectations, which range from competitive advantage to wanting to help the student and university. Other key areas of discussion include factors that are critical to product development projects and measures used to evaluate product performance. The sequence of discussion was:

6.3.2.1 Reasons for Participation and Level of Achievement,

6.3.2.2 Factors Important to Product Development Project, and

6.3.2.3 Measures of New Product Performance.

These three key areas were chosen due to their significant findings in the surveys.

6.3.2.1 REASONS FOR PARTICIPATION AND LEVEL OF ACHIEVEMENT

As well as measuring the type of benefits the clients had gained and the type of barriers they had encountered during the development of the partnership project, it is also imperative to measure the objectives or reasons that had encouraged them to participate in the programme and how successful that motivation had satisfied them. Contacting businesses for their interest in the partnership project is usually conducted during August-

September for projects in the next semester year. New clients join the programme for various reasons such as marketing or technical advantages, word-of-mouth or through periodic publications. For businesses that have worked with Massey before, it is not unusual for them to contact Massey staff in the first instance when a project suitable for a student becomes available.

In this evaluation, it has found that the most selected reason for the company's involvement in the PDPP was helping the student and university (82%). Economical reasons to get a new project underway and access to research expertise were the second and third most selected objectives, at 64% and 50% respectively. This indicated that the PDPP companies were more willing to invest in the partnership project for the student's and university's benefit than theirs. The least common reason for the company to join the partnership programme was found to be keeping up with competitors. This is consistent with the results from Ho's (2001) study where only a mere percentage of respondents indicated that competitive ability was their reason for new product development. The least common objectives found in Ho's (2001) study included preparation for emerging market segments and utilisation of by-products of existing products and excess capacity.

All of the twenty-two mail survey respondent companies and the four case study companies acknowledged their satisfaction of the student's overall achievement on the partnership project (refer to Table 4-11: Satisfaction of the Partnership Programme, p.117).

6.3.2.2 FACTORS IMPORTANT TO PRODUCT DEVELOPMENT PROJECT

Factors that are important to product development have been investigated both abroad and domestically for some time, yet, there is only limited literature and/or information available dedicated to product development at project-level. New product development is critical to the growth and survival of modern corporations (Kleinschmidt 1994), hence, it is only logical that the information for factors that contribute to their success are researched by many. Significant studies investigating success factors for new product development

included Project SAPPHO - the first comparative study of innovation success and failure (1972), Globe et al (1973), Rubenstein et al (1976), Kulvik (1977), Hopkins (1980), BAH (1982), Cooper (1980, 1984, 1999) Maidique and Zirger (1983), Stanford Innovation Project (1984), Project NewProd (1979a, 1980), Cooper and Kleinschmidt (1987a, 1987b, 1987c, 1990a, 1990b, 1993, 1995), and Kong (1998).

A high percentage of respondents (86% to 100%) from the current study rated a wide spectrum of factors that influenced product development highly in terms of importance. Factors with high importance rating (4.3 to 4.5) included, student performance, clear definition of agreed project aims, and communication with the student. Compare this to findings by Ho (2001), the three most import factor to NPD were "high product quality", "understanding of consumer needs", and "top management support & commitment", which scored 4.0 to 4.3 on the importance rating. The moderately important factors included communication within the company, resources availability, top management commitment, project supervision, and technology availability. Four of these factors, resource availability, project supervision, and top management commitment, were the most selected factors by the PDPP companies (95% to 100%). Other studies that had cited the importance of clear defined project aims include BAH (1968), Cooper & Kleinschmidt (1986), and Page (1993), and for top management commitment, it includes Rubenstein (1976), BAH (1982), Barclay (1992), Cooper & Kleinschmidt (1995), and Ho (2001). The reason remained unknown as to why in the previous study by Cooper & Kleinschmidt in 1987, it was found that top management commitment was insignificant to new product success but found otherwise in their 1995 study.

Research by Cooper and Kleinschmidt (1987a, 1993) found the following factors that are most influential to product development project leading to commercial success. These factors include **product advantage** (Utterback et al, 1976), **market environment** (Maidique and Hayes, 1984; Maidique and Zirger, 1984; Zirger and Maidique 1990), **synergies – marketing and technological** (Kulvik, 1977; Song and Parry, 1996), **project definition, and degree of top management support and commitment** (Barclay, 1992;

Song and Parry, 1996; Lester, 1998). Other factors cited in other research studies (Cooper and Kleinschmidt, 1996; Page, 1997; Curtis, 1998, Lester, 1998; Barclay, 1992; Allen 1993) that are important to commercial success of product development project included, **product/project strategy (includes goals and objectives), communication, and resource availability**. These findings are consistent with results from the current study indicating that the importance of factors to successful new product development is the same across companies in different industries and continents.

Market competitiveness was rated low as opposed to new product success in studies by Project NewProd (1979, 1979a, 1980), Cooper and Kleinschmidt (1987a, 1993), and Ho (2001). The same finding was supported by results of the current study. Yet, studies by Maidique and Zirger (1983), and Yap and Souder (1994) said otherwise. Both studies identified the competitive situation as a factor in product/project outcomes, but was not nearly so frequently or strongly cited as other factors. Market competitiveness was rated only moderately important in this current study (at 3.5 on the average importance rating).

6.3.2.3 MEASURES OF NEW PRODUCT PERFORMANCE

One way to know how a firm is progressing in the marketplace with respect to long-term survival is to measure its new product performance and its success or failure. Thus, metrics or criteria will need to be established before any product or project performance evaluations can take place. The participants of the case study interview were asked if they had evaluated the partnership project internally and if they had, what type of measures were used for the project evaluation. All four interviewees responded that they had evaluated the project through to commercialisation, and a combination of financial and non-financial measures were used. The financial measures included (a) sales growth, (b) profit, and (c) return on investment, whereas non-financial measures used included (d) meeting project aims and objectives, and (e) sales and market performance. Performance measures are a common control mechanism used to communicate the desired outcomes and to evaluate success in achieving goals (Hertenstein and Platt, 2000). It is generally believed that the

best performance measures are those linked to a firm's strategy (Kaplan and Norton, 1992, 1993; Nanni et al, 1992; Griffin and Page 1996; Langfield-Smith, 1997). However, there is little empirical evidence to support this claim explicitly.

PDMA has sponsored several studies (Griffin and Page, 1993; Page, 1993; Griffin and Page, 1996) investigating measures used in product development performance in recent years. The measures of project performance reported are market share, customer satisfaction, sales performance of new products, return on investment, profit goals being met, sales growth, profit, and technical performance. These results were very similar to those reported by BAH (1968, 1982) and Mahajan and Wind (1992). As indicated in Table 6- 5, the product development performance measures used by the PDPP companies in case study interview are similar to those identified in the above studies.

Table 6- 5: Product Performance Measures

Product Performance Measures	**BAH (1982)**	**Mahajan & Wind (1992)**	**Griffin & Page (1993)**	**Griffin & Page (1996)**	**Page (1993)**	**Griffin (1997)**	**Current Study – Interview Group (2002)**
Market Share		√	√	√	√		√
Return on Investment	√	√	√	√	√		√
Sales Growth/Performance	√		√		√		√
Market Performance					√		√
Product Performance			√			√	√
Competitiveness				√			√
Achieving project aims						√	√
Sales Volume		√					√

Respondents (both firms and researchers) from Griffin and Page's studies in 1993 indicated that measuring product development performance is multidimensional and can be done in different categories. The five independent dimensions of success/failure performance identified in Griffin and Page's (1993) research are firm-level measures, programme-level

measures, and product-level measures, and measures of financial performance and customer acceptance. It was also found that researchers focus more on overall firm impacts of success/failure, whereas companies focus on the performance of individual projects.

When asked about performance of the new product using the measures mentioned, all PDPP companies commented that it is a little premature to "label" the product as either successful or a failure. The time span used to evaluate the product performance by the PDPP companies is between three to five years after commercialisation. In this study, all the partnership projects were under three years in the marketplace at the time the interviews were conducted.

6.4 SUMMARY

Implications of the findings in this present research suggested that PDPP did, both directly and indirectly, provide the client companies benefits that were useful and much needed to their organisations. Such benefits included information gained, skills learned, and commercialisation of the student project. There is an undeniable fact that to have a much-enhanced partnership programme there are still opportunities (to the industry, the students, and Massey) to be discovered, barriers to be removed or minimised, and improvements that need to be made. The findings also acknowledge that a product development project can be influenced by a multitude of factors related to human and/or market factors. The overall research findings from the current research, coupled with findings from previous related studies (ie. New Zealand based studies – Kerr 1994; Grimes 1996; Kong 1998; Campbell 1999; Ho 2001; Overseas studies - BAH 1968, 1982; Project NewProd 1979, 1980; Maidique & Zirger 1983; Cooper & Kleinschmidt 1987, 1993, 1995, 1996; Mahajan & Wind 1992; Griffin & Page 1993, 1996; Page 1993; Kleinschmidt 1994; Yap & Souder (1994); Griffin 1997) suggest that the critical factors to product development are identical across projects, companies, industries, and/or countries.

Chapter 7

CONCLUSIONS AND RECOMMENDATIONS

7.1 OVERVIEW

The goals of this research study were to evaluate the Product Development Partnership Programme provided at Massey University from 1997 to 1999, and to explore issues and/or aspects of the Product Development process of the companies involved with the Partnership Programme.

The two main topics of discussion in this research were the Product Development Process at PDPP companies and feedback on Product Development Partnership Programme. The research objectives were:

i. To gain an overview of the Product Development process at the client company,

ii. To evaluate the PDPP in terms of

   (a) Benefits to client, and

   (b) Achieving client's expectations

iii. To present recommendations and future research directions to improve the deployment of the partnership programme.

The methodology used to gather the required data and information to help achieve research objectives was a tailored mail survey complemented by a series of case study interviews. The mail survey was conducted with the PDPP companies who had sponsored the

partnership projects in recent years. A total of twenty-two survey out of forty-six sent were returned, making a response rate of 48%. The case study interview participants were from the mail survey. The type of partnership projects that were the subject of this investigation were from the furniture, food, packaging enhancement, leisure products, and software industries. This research comprised six important preliminary stages before the full survey took place. They were (1) research planning and design, (2) sample selection and background check, (3) questionnaire design, (4) measurement and scales determination, (5) data analysis, and (6) pilot study.

This research was also anticipated to provide more New Zealand based research information on Product Development.

7.2 CONCLUSIONS

Both the mail survey respondents and case study interviewees showed an enthusiastic attitude towards taking part in the survey, gave comments and information on their Product Development process, and the Product Development Partnership Programme. There are five main messages emerging from this research study.

1. Product Development Process Overview of PDPP Companies

There were small changes on the PD process and activities from the returned survey. The returned survey showed only one company had indicated improvement on the PD process after the Product Development Partnership Programme. Likely reasons for this were,

i. As told by the case study companies, it takes longer than 8 months (the project timeframe) to introduce or upgrade a system, especially if,

- The company is not familiar with or has no knowledge about the system or discipline that involved,

- Student is not familiar with the procedure, and
- Student is not familiar with the operation system of the company.

ii. Company lacks the resources to follow up on the product development process that the student introduced, and

iii. Company did not appreciate the benefits of a systematic process and hence did not place commitment to utilise the process for their innovation purposes.

Although the overall PD practice and activities at the client company were only minimally affected by their involvement with the PDPP, it ought to take into account the number of respondent companies (averagely 88% companies) that carry out all the thirteen stages in the product development process. Idea Generation, Preliminary Market Assessment, Preliminary Technical Assessment, Business/Financial Analysis, Prototype Development, In-House Prototype Testing, and Full-Scale Production Plan were the seven product development activities with the highest (90%) company usage. These seven activities cover, (1) the front-end activities that both BAH (1968, 1982) and Cooper and Kleinschmidt (1990) had urged companies longing to success to utilise; (2) the marketing research activities that play critical roles in development successful product (Kyriazis & Patterson, 1996); and (3) the much needed analysis, testing, and plan before full scale market launch is proceed.

2. Benefits to PDPP Companies

Benefits gained by companies through the participation in partnership programme were gaining useful information and skills, ability to compete with larger competitors, enhancement of market share, and the subsequent project commercialisation.

Consumer research information was the most useful benefit to companies for both the project that the student was working on and their new and on-going projects. The number of businesses that appreciated marketing research and marketing research information was

high in this research at 95.5%, much higher than the previously reported by Campbell in 1999. This thus indicated that the respondent PDPP companies had recognised the importance and usefulness of marketing research information to new product development.

3. Project Barriers

The significant barriers that were identified and rated by the mail survey and case study interview participants can be classed into six categories. These were (i) people, (ii) financial, (iii) resources, (iv) time, (v) skills, and (vi) communication. The primary project barrier inhibiting the partnership project was found to be skill-oriented which consequently affects the project performance and outcomes. Communication between company and student was the second most selected and concerned project barrier.

The student's responsibilities in the partnership project were not just developing a prototype and completing the project but also to exercise and develop their communication skill with the client company and to play the role of an ambassador to strengthen the relationship between academic and the industrial sectors. To overcome the barriers inhibiting partnership projects, Massey must recognise the importance of student's skills required for the particular project by equipping the student with relevant technical/mechanical support, resources and skills.

4. Client's Expectations and Satisfaction

Both formal and informal analysis of the mail survey and case study interviews had indicated that the majority of the PDPP companies (above 80%) appreciated and supported the concept of working with Massey through the partnership projects. A foundation of good relations between Massey and the New Zealand manufacturing industry was being formed by the PDPP.

"To help students and university" was held by 82% of the client companies as their main reason for taking up the partnership projects with Massey. Yet, this reason was not rated as high on the level of achievement scales as "keeping up with competitors", "an economical way to get a project underway", and/or "getting fresh perspective on PD procedures".

All of the twenty-two respondents were satisfied with the student's overall achievement on the project with satisfaction score as high as 3.0. In contrast to this, the student's ability to perform was selected as the second most crucial barrier that had inhibited the development of the partnership project. This thus implied that, of the three parties (ie. the student, the client company, and Massey staffs) involved in the partnership project, the student and his/her capabilities and performance play the most important role.

Twelve out of twenty-two respondents (54.5%) rated their experience of the partnership project met their expectation and above in terms of benefits gained and/or skills learned. The main concerns for the ten respondents that rated their experience below their expectation were the assignments or tasks assigned by Massey to the students and time allocated to each assignment or task as opposed to what the client companies wanted the student to carry out and achieve. To minimise this concern, Massey will have to work with the client company in order to have a mutual understanding and agreement on assignments or tasks that the students have to complete before any project commencement.

5. Factors Important to PDPP Project

Factors important to PDPP project were multifaceted and involved student and personnel from Massey and client companies. The importance of these factors is the same in all sectors of the industrial industry, from a furniture project to a food or packaging project.

Student's skills and performance, clear project aims definition, communications between and within company and student, resources, and project supervision (in importance order) were recognised as important to the success of the partnership project. Resource

availability, with importance level as high as 3.7 was a common factor among the twenty-two responded PDPP companies. This proved its importance and the need to equip the student with relevant support and technical and mechanical resources and skills. It is also important to increase the funding for adequate resources made available to students to allow greater project performance and achievement.

7.3 RECOMMENDATIONS

The following are recommendations based on the findings of the mail survey, case study interviews, respondents' comments and suggestions to improve the Product Development Partnership Programme.

I. Carefully confining the project (with the agreement of the client) to suit the student's ability to reach commercialisation so that the company could see something concrete from the PDPP.

II. Better resources available to student from the client company and Massey. Resources such as technical/mechanical support, machinery facility, secondary market research data or information, and company staffs make available to assist the student when help or assistance is required.

III. A flexible product development process and report format that a student can adapt and adjust accordingly to the nature of the project and the client's expectations.

Two of the three elements listed above- student ability and resource availability were perceived to be important factors for the progress of the product development partnership project.

IV. More frequent staff visits or formal project progress meetings on milestones that involve the attendance of Massey staff and industrial representatives. One of many benefits for these visits or meetings is to build and maintain the communication and working relationship between Massey University and the industrial sector. Also, the regular meetings should help to motivate the student and client to problem solve, to remove any barriers to the project, and ensure steady progress to the milestones.

V. Before the project starts, the PDPP management staff need to clarify the expectations of the company's involvement, resource required, and anticipated project outcomes into the partnership project and make the company aware of the amount and type of work that the student is required to carry out and complete.

VI. Divide bigger projects into smaller projects (with the client's permission and agreement) and assigned them to a team of students. These students will be working on their part of the project individually with weekly or fortnightly meetings to ensure that smooth co-ordination of the overall project. Final project or product presentation will be the assembly of all the different project parts. This type of project working style helps to develop the teamwork spirit required by the Product Development process.

Chapter 8

RESEARCH LIMITATIONS AND FUTURE RESEARCH DIRECTIONS

8.1 INTRODUCTION

There are several limitations to this research that should be acknowledged when applying the results to built upon for future research directions. Several future research directions were also suggested based on the conclusions drawn in Chapter 7.

8.2 RESEARCH LIMITATIONS

1. Budget Constraint

Case study interviews were restricted to companies within the Manawatu region. Interviews with clients from other regions were not possible which meant the chances of collecting insightful input, comments, suggestions, and recommendations were missed.

2. Case Study Sampling

The fact that the research sample was not a random sample and that the results apply only to the sample of firms studied should be taken into consideration.

All the case study interview samples were commercialised projects. Thus the analysis of the case study interviews reflected only the perceptions of respondents companies with commercialised project. It was not intended that the case study sample be all with commercialised project but it happened that they were the only companies that were willing to participate in the case study interview within Manawatu region. This constraint was caused through budget restrictions. As a result it was not possible to assess the validity and reliability of the information provided by these key informants. Therefore, the results of this study should be viewed as tentative.

3. Small sample and low response rate

Only a low response rate of 48% (twenty-two) of the total sample of forty-six was received from the quantitative analysis. The group samples of business type and size, and project type were even smaller. The resulting small sample size has affected the accuracy of the analysis, particularly the correlation analysis and factor analysis. Even so, comments and feedback of the client company on the individual project were, by all means, useful to the programme evaluation to give some insight to the PDPP acceptance and benefits to companies.

4. Lack of Comparisons

Due to the lack of literature in this field of research, only limited information and facts relating to the evaluation of Product Development programme at project-level are available for comparisons to be made.

8.3 FUTURE RESEARCH DIRECTIONS

Considering the research findings and areas that need further investigation, following are some recommendations for future research directions with regard to the PDPP.

1. To evaluate the Partnership Programme from the Massey management and staff's perspectives in terms of project supervision, Massey-Industry relation, and programme performance in terms of effectiveness and efficiency.

2. To evaluate the Partnership Programme from former student's perspective in terms of skills learned, career opportunities and assistance as a result of experience gained during the PDPP, and programme efficiency.

3. Revisit the companies with successfully commercialised partnership project after a period of 5 years (as the interview companies had said to see significant market performance of the product would take four to five years) to determine the long-term effect of PDPP on the company's research and development process.

4. To conduct in-depth case studies to investigate the way new product development activities of the partnership project was managed.

5. Introduce the suggested improvements to the PDPP in terms of management and design of the partnership programme, and then re-evaluate the programme using the same measures established in this research.

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APPENDICES

APPENDIX I. COVERING LETTER FOR THE SURVEY

Massey University
COLLEGE OF SCIENCES

Institute of Technology
and Engineering
Private Bag 11 222,
Palmerston North,
New Zealand
Telephone: 64 6 350 5115
Facsimile: 64 6 350 5604

16 October 2000

«Title» «First_Name» «Family_Name»
«Company»
«Adress1»
«Address2»
«Address3»

Dear Sir/Madam,

RE: «ProjectArea»

I am a Masters student in the Institute of Technology and Engineering, currently working on a research project: "Evaluation of the Product Development Partnership Programme at Massey University". This survey aims to gather information about the performance of the Programme, and at the same time, to find out what opportunities it has or can offer the sponsor company.

In spite of being almost a decade since the Programme was first introduced, no comprehensive study has been taken to measure its performance. To my knowledge, this research study is also one of the first few studies, in New Zealand and overseas, which focuses Product Development on an educational front. Other notable values or benefits include improving the deployment of the Programme in terms of project design and management. With your input into the survey, valuable information on how to manage and achieve a programme with mutual benefits to the sponsoring company and Massey for future project partnership will also be collected. Therefore, your opinions and contributions are very important in helping me achieve these goals.

You are invited to participate in this survey because of your previous project partnership with Massey. You have the right not to participate or to leave any particular questions unanswered. To further assist my analysis, if you choose not to participate, could you please write down your reasons for withdrawal on the back of the survey and send it in. For any questions regarding the survey please do not hesitate to contact me.

I understand that your time is valuable, but it would certainly be appreciated and highly beneficial for my research, if you could spend 20 minutes to complete the survey. I would also appreciate the return of the survey in the enclosed freepost envelope by 30th October 2000.

Thank you very much for your time and assistance and I wish your business every success in the future.

Yours faithfully,

Shirley Lim
Product Development Masters Student
[redacted]
[redacted]n

APPENDIX II. MAIL SURVEY QUESTIONNAIRE

MASSEY UNIVERISTY
Institute of Technology and Engineering

Evaluation of the Product Development Partnership Programme at Massey University

Thank you for being involved in our Partnership programme. The objective of the survey is to evaluate the Product Development Partnership Programme in terms of (1) Benefits to Client, and (2) Achieving Client Expectations.

Please complete the survey and return it in the enclosed stamped envelope. If you are not the person most knowledgeable of the development aspects of the project, then please pass the survey to the person who was most responsible for the project during the Programme partnership. If that person is no longer available at your company, then please send the survey back with a remark of "NLA" (No Longer Available).

You are welcome to contact me via phone, fax or email for any questions regarding the survey or if more information about the survey is needed.

Thank you for agreeing to participate in this survey.

Statement of Confidentiality:

Before commencing, please be assured that all the information provided by you and/or your company will be held in the strictest confidence. You do not need to answer any questions if you do not wish to. Only summarised information will be released when publishing the research. Individuals and your company will be kept anonymous in the research result and data presentation. A copy of the research summary will be forwarded to your company on request.

Shirley Lim

Tel: [redacted]
Fax: [redacted]
Email: [redacted]

I. INTRODUCTION

The purpose of this survey is to measure the performance of the Cooperative Product Development Project Programme with your industry. We value your comments on the Programme so that we may be able to improve it to meet your future needs.

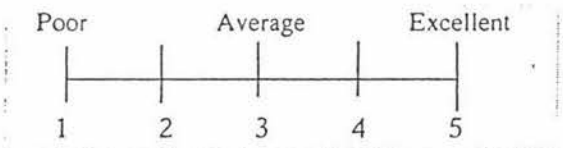
PLEASE TICK OR CIRCLE THE APPROPRIATE BOXES, AND/OR WRITE YOUR COMMENTS IN THE SPACE PROVIDED.

II. OVERVIEW OF PRODUCT DEVELOPMENT PRACTICE BEFORE & AFTER PROJECT

Q1. Which of the following best describes the Product Development process at your company BEFORE and AFTER undertaking the project with Massey University?
[*Product Development is the set of activities beginning with the perception of a market opportunity and ending in the production, sale, and delivery of a product*] [Please refer to glossary of terms at the back for detail]
(PLEASE TICK THE APPROPRIATE BOXES)

Product Development Process	BEFORE PROJECT [√]	AFTER PROJECT [√]
a. No standard approach		
b. Have a standard approach but no formally documented process		
c. Have a standard approach with formally documented process		
d. Have a formally documented process and a cross-functional team		

Q2. Please rate the performance of the Product Development activities at your company BEFORE and AFTER participating in the Cooperative Programme.
[Please refer to glossary of terms at the back for definitions of PD activities]
(PLEASE GIVE YOUR RATING USING THE SCALE BELOW)



PD Activities	BEFORE PROJECT		AFTER PROJECT
Example: Product Launch Plan	*2*		*4*
a. Idea Generation			
b. Initial Idea Screening			
c. Preliminary Market Assessment			
d. Preliminary Technical Assessment			
e. Detailed Market Research			
f. Business/Financial Analysis			
g. Prototype Development			
h. Prototype Testing - In-house			
i. Prototype Testing - Customer			
j. Market Testing			
k. Pre-Commercialisation Business Analysis			
l. Full-Scale Production Plan			
m. Product Launch Plan			

III. COOPERATIVE PRODUCT DEVELOPMENT PROJECT PROGRAMME

A. BENEFITS TO CLIENTS

A1. Please rate the Programme according to the **usefulness** of the following areas of information to your company.
(PLEASE CIRCLE YOUR RATINGS)

Areas of Information	Not At All Useful		Useful		Very Useful
Example: Systematic Procedures	*1*	*2*	*3*	*(4)*	*5*
a. Consumer Research Information	1	2	3	4	5
b. Information of Competitors	1	2	3	4	5
c. Identification of New Opportunities	1	2	3	4	5
d. Marketing Information	1	2	3	4	5
e. Fresh Ideas	1	2	3	4	5
f. Product Development Skills	1	2	3	4	5
g. Identification of New Material/Technology	1	2	3	4	5
h. Techniques Technical Information	1	2	3	4	5
i. Design Skills	1	2	3	4	5
j. Systematic Procedures	1	2	3	4	5
k. Others (Please specify)	1	2	3	4	5
l.	1	2	3	4	5
m.	1	2	3	4	5

Please rate and make comment on the overall usefulness of the areas of information rated above.

	Not At All Useful		Useful		Very Useful
Overall Usefulness	1	2	3	4	5
Comments for answer: _____					

A2. Which, if any, of the following **benefits** did you expect to gain from participating in the Programme, and did the expected benefits occur.
(PLEASE TICK ALL THAT APPLIES)

Benefits	Expected Benefit		Did it happen?	
	Yes		Yes	No
Example: Reduction of development costs	√			√
a. Ability to compete with larger competitors				
b. Access to larger markets				
c. Enhancement of market share				
d. Faster time to market				
e. Consumer research information				
f. Information of competitors				
g. Identification of new opportunities				
h. Marketing techniques				
i. Fresh ideas				
j. Developing Product Development techniques				
k. Identification of new material/technology				
l. Technical information				
m. Design skills				
n. Reduction of development costs				
o. Others (Please specify)				
p.				
q.				

A3. What **major barriers**, if any, did you face <u>during</u> the Product Development Project?
(PLEASE CIRCLE YOUR RATINGS)

Barriers	None		To Some Extent		Extreme
Example: Pricing Strategy	*1*	*2*	*3*	*(4)*	*5*
a. Lack of resources	1	2	3	4	5
b. Company's top management support	1	2	3	4	5
c. Company's internal problems	1	2	3	4	5
d. Competition in the market	1	2	3	4	5
e. Supplier problems	1	2	3	4	5
f. Pricing Strategy	1	2	3	4	5
g. Student's ability to perform	1	2	3	4	5
h. Communication with the student	1	2	3	4	5
i. Others (Please Specify)	1	2	3	4	5
j.	1	2	3	4	5
k.	1	2	3	4	5

A4. Was the product that was developed during the Cooperative Programme been commercialised?

Yes [ ] (PLEASE INDICATE WHEN AND WHERE)
When: _____ (Approx.)

Where: NZ [ ]
Overseas [ ]
Please Specify: _____

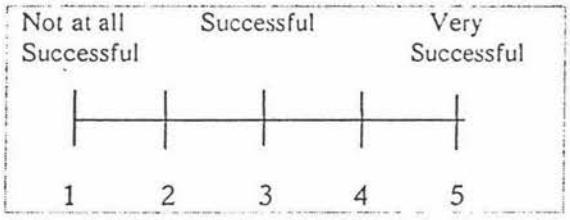
No [ ]
Reasons:

_____

_____

B. Achieving Client Expectations

B1. Please indicate which were the reasons that encouraged you to take on the Cooperative Programme with Massey and rate the level of achievement each motive had achieved using the scale below.
(PLEASE TICK ALL THAT APPLICABLE)

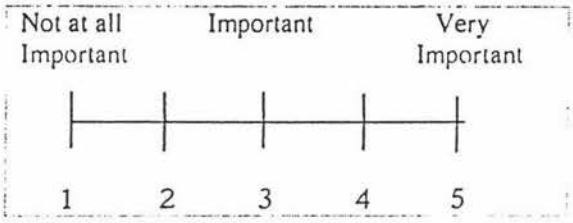


	[√] Reasons	Level of Achievement
a. To get fresh perspective on PD procedures		
b. To gain access to the latest science and technology		
c. To gain access to research expertise		
d. To keep up with competitors		
e. Economical way to get a good potential project started		
f. Good previous experience with Massey		
g. To help students and university		
h. Others (Please specify)		
i.		
j.		

Please comment on which was the main reason that encouraged you to take on the Programme with Massey?

_____

B2. Please rate the following factors in terms of **degree of importance** when applied to the Cooperative Project Programme.
(PLEASE CIRCLE YOUR RATINGS)



Factors	Level of Importance				
Example: Project Timeline	*1*	*2*	*3*	*(4)*	5
a. Clear Definition of agreed Project Aims	1	2	3	4	5
b. Detail Project Planning and Management	1	2	3	4	5
c. Company's Top Management commitment	1	2	3	4	5
d. Communication within the Company	1	2	3	4	5
e. Resource Availability	1	2	3	4	5
f. Technology Availability	1	2	3	4	5
g. Market Competitiveness	1	2	3	4	5
h. Student Performance	1	2	3	4	5
i. Communication with the Student	1	2	3	4	5
j. Communication with Massey's Staff	1	2	3	4	5
k. Supervision of Student by Massey	1	2	3	4	5
l. Supervision of Student by Company	1	2	3	4	5
m. Others (Please specify)	1	2	3	4	5
n.	1	2	3	4	5
o.	1	2	3	4	5

B3. Please indicate how satisfied was your company with the following aspects.
(PLEASE CIRCLE AND MAKE COMMENTS OF YOUR RATINGS)

	Not At All Satisfied		Satisfied		Very Satisfied
a. Cooperative Programme					
a1. Student's Overall Achievement (in reaching company expectation)	1	2	3	4	5
Comments: _____					
a2. Prototyping (if student was involved)	1	2	3	4	5
Comments: _____					
a3. Progress Reports (4 reports)	1	2	3	4	5
Comments: _____					
a4. Publicity (created as a result of the project)	1	2	3	4	5
Comments: _____					
a5. Supervision by Massey	1	2	3	4	5
Comments: _____					
a6. Staff Liaison	1	2	3	4	5
Comments: _____					
b. Supervision by Company	1	2	3	4	5
Comments: _____					
c. Financial returns on project	1	2	3	4	5
Comments: _____					

B4. Considering the benefits your company may have received, and meeting your expectation of the Programme, how would you rate your experience?

	[√]
a. Much Better Than Expected	
b. Better Than Expected	
c. Just As Expected	
d. A Little Below Expected	
e. Much Worse Than Expected	

C. Suggestions and Recommendations

C1. What areas of the Programme that you feel could be improved? Any suggestions on them?

_____

_____

_____

C2. Based on your experience and satisfaction, how likely would you be to take on the Product Development Programme again with Massey in the future?

		When?				
	[√]	2001	2002	2003	2004	2005
Very Likely						
Likely						
Not Sure						
Not At All Likely						

D. Demographics

(Optional but desirable so we can contact you shall there be a need to discuss your comments to help us improve the Programme)

D1. Your Name: _____

D2. Your position in the company: _____

D3. Company Name: _____

D4. Company Address: _____

_____

D5. Tel: _____

D6. Fax: _____

D7. Email: _____

D8. Number of employees (approx): _____

D9. Company's approximate annual turnover (before tax) for the last financial year: _____

D10. Would you like to receive a summary of the research results?

Yes [ ] No [ ]

D11. Would you like to participate in the face-to-face interview to further discuss your views about the handling of the Programme and the effects it has had on your company?

*The interview will last between 30minutes to 45minutes.

Yes [ ] No [ ]

THANK YOU VERY MUCH FOR YOUR VALUED OPINION!

Table 1: Key Activities in the New Product Development Process

a. Idea Generation	Approaches like: focus groups, brainstorming, employees' suggestions, managers ideas, observations, customer requests.
b. Initial Idea Screening	The first decision to go ahead with the project; the initial commitment of resources (people and money)
c. Preliminary Market Assessment	The initial market study: a "quick and dirty" assessment of the marketplace, possible market acceptance, and competitive situation; largely non-scientific and relying principally on in-house sources.
d. Preliminary Technical Assessment	An initial technical appraisal, addressing questions such as "can the product be developed" how? Can it be manufactured? Etc."; based largely on discussion, in-house sources, and some literature work.
e. Detailed Market Research	Marketing research: detailed market studies such as user needs-and-wants studies, concept tests, positioning studies and competitive analyses; involves considerable field work and interviews with customers.
f. Business/Financial Analysis	The decision to go to a full development programme; involves, for example, a financial analysis; risk assessment, and a qualitative business assessment, looking at market attractiveness, competitive advantage, etc.
g. Prototype Development	The actual development of the physical product.
h. Prototype Testing - In-house	Testing the product in-house under controlled or laboratory conditions; alpha tests.
i. Prototype Testing - Customer	Testing the product with the customer; field trials, beta tests, or preference tests: giving the product to customers and letting them try it under live field conditions.
j. Market Testing	A test market of the product: an attempt to sell the product to a limited number of customers or in a limited geographic area.
k. Pre-Commercialisation Business Analysis	The decision to commercialise: a final business and financial analysis prior to launch.
l. Full-Scale Production	Start-up of full-scale or commercial production.
m. Product Launch	The full market launch of the product: the implementation of the marketing plan.

Table 2: Product Development Process Categories

a. No standard approach to new product development
b. No formally documented process is followed, but we have a clearly understood path of the tasks to be completed in product development
c. We have a formally documented process where one function completes a set of tasks, then passes the results to the next function which completes another set of tasks
d. 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

APPENDIX III. CASE STUDY INTERVIEW TOPICS

Interview Topics

1. General Information

   Brief history of company
   Product range
   Company size and Philosophy

2. Product Development Partnership Programme

   Company's current PD practice
   In-house project evaluation
   Factors influencing the project outcomes
   Thought on the design and management of the Programme

1. General Info of Company

Brief history of your company

Company Structure
- R&D department?
- Multi-functional / PD team?

Company size
- SMEs? (6 ~ 99 employees)
- Large? (>100 employees)

Product Range
- Export?
- Who is your target market?

Approximate annual turnover (before tax) for the last financial year

2. Product Development Partnership Programme

2.1 Do you follow any particular process of Product Development?

- What is the process?

- (if no) Why not?

2.2 Did you evaluate the student project (against your expectations) at its completion?

- What measures did you use?
- What were your expectations?
- (if no) If you were to evaluate the project, what measures would you use?

2.3 What do you think are the determinants of a successful product development project (in general)?

- Which, in you opinion, was the one that played the most important role in general product development project?
- And which was the most important factor that applied to this particular project?

2.4 Did you encounter any obstacles during the project partnership?

- What were they?
- Which, in you opinion, was the most damaging to the outcome of this project?
- Do you think in overcoming the obstacle mentioned above, the outcome would have turned out to be what your company expected?
- Did the same obstacle occur to the development/production of your other product range?

2.5 What was your opinion of the design and management of the Programme?

- Was there any suggestion or recommendation you would like to raise?
- Besides the role of student in this project, what other element do you think is (are) essential to the design and management of the Programme? (ie. project timeframe, technical support (if applicable) at Massey, etc)
- Would you think having the student working at your company during the summer break prior to the project year helps him/her understanding the process better thus can perform better or more confidently?
- From your survey responses I noticed that the PD process at your company remained unaffected after the project partnership (ie. from "Have no std

approach" to "Have no std approach"), were you expecting the input from the partnership would assist your company in upgrading your PD process or implementing the PD process more effectively?

- If yes:
    - What do you think is the problem that prevented it from happening?
    - Do you think time play any part in it? (ie. too short to introduce or upgrade a system)
    - From your professional point of view, how much time is essential in introducing or upgrading a system such as PD process to an organisation like yours?

APPENDIX IV. ETHICS PROTOCOL

Note: The survey will be conducted according to Massey University's Code of Ethical Conduct. The following provides information to the respondent as required by the Code.

For this project, the relevant Massey University's ethics protocol will be followed.

1. *The identity of the researcher(s) and the supervisor(s)*
   Researcher: Shirley Lim
   Supervisors: Aruna Shekar
   Lionel Loo

2. *How to contact the researcher(s) and supervisor(s)*
   Contact detail:
   Researcher: Shirley Lim
   Tel: [redacted]
   Email: [redacted]

   Supervisors: Aruna Shekar Tel: [redacted]
   Lionel Loo Tel: [redacted]

3. *The nature and purpose of the study*
   The survey forms part of the assessment of the researcher's Masterate study. The findings of this study will be analysed and used as part of the researcher's Masterate thesis.

4. *How the researcher obtained their name to ask them to consider participating in the project*
   Details of the company were obtained through the private contact list of their previous Product Development Programme partnership with Massey University.

5. *How the information will be used*
   The findings of this study will be analysed and used as part of the researcher's Masterate thesis.

6. *What will happen to the information when it is obtained*
   The data collected will be stored in a locker, which is accessible only to the researcher and supervisors associated with the research.

7. *How confidentiality and anonymity will be protected*
   Only summarised information will be released when publishing the research. Individuals and your company will be kept anonymous in the research results and data presentation. Anonymity and confidentiality will remain of the utmost importance and we will undertake all reasonable measures to ensure them.

8. *What will happen to the data on completion of the project*
   On completion of the project and subsequent research, the responses of the questionnaires will be shredded.

9. *The participants of the survey have the right:*
   - to decline to participate;
   - to refuse to answer any particular questions;
   - to withdraw from the study at any time;
   - to ask any questions about the study at any time during participation;
   - to provide information on the understanding that your name will not be used unless you give permission to the researcher;
   - to be given access to a summary of the findings of the study when it is concluded.

It is assumed that filling in the questionnaire implies consent. You have the right to decline to answer any questions.

APPENDIX V. CONSENT FORM

Massey University
COLLEGE OF SCIENCES

Institute of Technology
and Engineering
Private Bag 11 222,
Palmerston North,
New Zealand
Telephone: 64 6 356 9099
Facsimile: 64 6 350 5604

AN INVESTIGATION OF THE EFFECTIVENESS OF THE PRODUCT DEVELOPMENT PARTNERSHIP PROGRAMME BETWEEN NEW ZEALAND BUSINESSES AND MASSEY UNIVERSITY

CONSENT FORM

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 understand I have the right to withdraw from the study at any time and to decline to answer any particular questions.

I agree to provide information to the researcher on the understanding that my name will not be used without my permission.
(The information will be used only for this research and publications arising from this research project).

I agree/do not agree to the interview being audio taped.

I also understand that I have the right to ask for the audiotape to be turned off at any time during the interview.

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

Signed:

Name:

Date:

APPENDIX VI. MASSEY UNIVERSITY CODE OF ETHICAL CONDUCT FOR RESEARCH AND TEACHING INVOLVING HUMAN SUBJECTS

The Code of Ethical Conduct for Teaching and Research involving Human Subjects

POINTS FOR CONSIDERATION

WEB CONTENT UNDER REVISION/DOWNLOADS REVISED

- Downloads *(Revised 16/2/00)*
  - Application Cover Word 1pg, 12K / RTF 1pg, 8K
  - Application Content Word 2pgs, 16K / RTF 2pgs, 12K
  - Complete Code Word 25pgs A4, 88K / RTF 25pgs A4, 184K

Problems downloading/formatting?, please email the Webmaster with the document name and your computer details (PC/Mac and wordprocessing package) for a copy

Ethical Implications

From time to time researcher(s) are faced with a number of issues that have ethical implications. The issues listed below represent some of the more common issues faced by researcher(s). The aim in this section of the code is to provide some background and some possible strategies for dealing with different issues. The aim is not to express these as a set of rules. How different issues are dealt with will change as we gather more experience and as the context within which research on human subjects changes. The points noted in this section should be seen as guidelines and boundaries. They are designed to provoke thoughtful consideration and should in most cases be brought to the MUHEC for discussion. This list is not exhaustive and will be added to from time to time as issues arise. In all cases where the researcher (s) has difficulty in resolving an ethical issue then this issue must be discussed with the MUHEC.

Issues of Anonymity and Confidentiality

The recent court decision permitting an outside agency to have access to cockpit voice recorders raises a number of issues concerning the assurances that researcher

(s) give to subjects regarding the protection of their identity and the confidentiality of data.

The Code makes it quite clear under "The Conduct of Teaching and Research", point 20, that "if potential participants cannot be guaranteed anonymity, this should be drawn to their attention in the Information Sheet." This point is reinforced under "Information Sheet", point 14 that, "if anonymity or confidentiality cannot be guaranteed this should be indicated."

The Code also states under "Information Sheet", points 10-12 that, the Information Sheet should contain a clear statement regarding the security of data, emphasising that particular care is needed when using audio or video tapes in which participants are easily recognisable. Further, procedures must be in place and specified in the Information Sheet as to the reviewing of audio or video tapes and the options available to the researcher and the participants as to the ownership of the data including the participants rights to the tapes, agreement that the tapes be destroyed or consent to their storage in a research archive.

The Code also requires researcher(s) to consider the implications for their research of different statutes including, for example, the Privacy Act 1993, the Human Rights Act 1993, the Accident Rehabilitation Compensation Insurance Act 1992 and the Employment Contracts Act 1991. While not specified, the protocols of the Code ask researchers to consider what it describes as "Other Legal Issues." It is now clear that under this heading researchers should think through the consequences for them and their subjects if the data, however collected, could be of interest to a third party such as the Police, Customs or the Inland Revenue Department.

Researcher(s) should now:

- recognise that it is not possible to give an *absolute* guarantee of anonymity and confidentiality where information is being recorded. The researcher should make it absolutely clear that he/she can only give an assurance of confidentiality and anonymity to the extent allowed by law, and ensure that subjects taking part in the research are informed that this is not an absolute protection;
- recognise that in any event there is a risk of inadvertent disclosure whenever information is needed;
- note that where an assurance of anonymity and/or confidentiality has been given as a condition for participating in the research, the researcher must be pro-active in protecting that anonymity and/or confidentiality. Practical steps to ensure the security of the data may include:
  - separation and storage of physical records at remote sites;
  - identification of participants through the use of key words or codenames;
  - separate storage of taped information from transcripts or other identifying material;
  - coded storage of information;
  - keeping the whereabouts of information, key words and codes secret;
  - arranging for the data to be destroyed as soon as it is no longer required for the particular research.

When considering anonymity and confidentiality researchers are directed to "Handling of Information Gathered" and if there is any doubt then the researcher must submit an application to the MUHEC for discussion and approval.

Recompense of Participants Involved in Research Study

The Code outlines a number of major principles that need to be considered and then implemented within the context of the proposed research. The major ethical principles involved include informed consent of the participants, confidentiality of information, the minimisation of harm, truthfulness and social sensitivity to all participants.

Within this framework members of Massey University may from time to time be requested to compensate students or members of the public for reasonable expenses which they may incur if participating as subjects in research. These expenses may include opportunity costs (e.g. for time) or other costs (e.g. for travel). For example when there is evidence for actual costs (e.g. receipts, bus tickets etc) reimbursement of these should be processed through normal departmental reimbursement procedures. However the case for payment of opportunity costs for participation in the research is less clear and some guidelines are detailed below. It is acknowledged that payment for participation in research is ethically acceptable and this is stated in the codes of ethics of a number of international learned bodies.

Because of the diverse nature of research within the University and the different research requirement expected from each participant, there are a number of conditions that must be taken into account when the research is being planned.

The conditions are:

- the payment must in general apply to all participants and all participants must be fully informed of the terms and conditions of the payment;
- the level of, and reason for, the payments should be clearly spelt out in the Proposal, the Information Sheet(s) and possibly any advertising or promotion of the research;
- the opportunity must be given for the participant to decline payment or seek recompense in an equivalent or alternative manner (e.g. Koha payment to an Iwi);
- at the onset of the research, investigators should make clear to participants their absolute right to withdraw from research at anytime, irrespective of whether or not payment is involved;
- where reimbursement is made other than by some payment (e.g. raffles) then this form of reimbursement should always be submitted to the MUHEC for approval;
- payments to participants must be not used;

  either as an inducement to participate in research;

  or to encourage participants to undertake dangerous or harmful acts which they would not perform in their normal lifestyle;
- payments to children must not be made without prior approval by their parents or guardians.

When considering a proposal requesting recompense to be paid to a participant, the MUHEC requests that the proposal come before the Committee for approval.

Action Research Procedure

- Any proposal for this type of research should come with a reasonable outline of how the (initial) researcher wants/is going to cope with a variety of possible scenarios. The MUHEC can make suggestions, changes as needed. The next step should be that the researcher(s) then submit a "confirmation proposal" to the MUHEC when the method/scope etc has been finalised. This second proposal may not need to come to the full MUHEC but be reviewed by the Readers that initially worked on the proposal and the Chairperson. Obviously if there is seen to be some difficulty with it, then it should be reviewed by a full MUHEC before final approval.
- We need to be mindful of the time frames involved, the workload for researcher and MUHEC. The fact that action research evolves over time creates particularly complex problems for researcher(s) and the MUHEC: The goal would be to work through the issues with the researcher(s) so that appropriate approvals are given at different stages of the research and the situation is avoided where approval is given to a research process that has yet to be fully identified.
- Potential participants must give their informed consent to all aspects of their participation in the research process. This poses particular difficulties for researchers undertaking action research. Action research requires the researcher to follow the primary consent process with a multistage consent process. The process used to obtain consent should be documented.

Consent Issues

Informed consent is fundamental to conducting research with human subjects in an ethical manner. Informed consent includes the following elements:

All prospective participants must know:

- the names of the people responsible for the research project;
- the procedures which they will be asked to agree to participate in, for example, interviews, testing, provision of source data, participation in a focus group etc;
- how the researcher obtained their name to ask them to consider participating in the project;
- how the information will be used, thesis, research publications etc;
- what will happen to the information when it is obtained, for example, aggregated with other information, used as case study etc. If the data is to be transcribed by another person (other than the researcher the Information Sheet should advise that this is planned and that the transcriber will be required to sign a confidentiality form;
- how confidentiality and anonymity will be protected. In instances where this protection cannot be guaranteed, participants should be advised of the reasons that it cannot be guaranteed and why this is so;
- what will happen to the data on completion of the project, archiving, returning data to participants, destruction of data are all possibilities.

In preparing an Information Sheet, researchers need to consider the possible level of literacy of potential participants, including familiarity with English. The Information Sheet should be adjusted to meet these requirements and should be translated where appropriate.

A suitable time period must be allowed for between provision of the Information Sheet and the formal signing of a Consent Form. This provides an opportunity for prospective participants to consider the request, ask questions that may occur to them and discuss the request with others before completing the Consent Form. The Code on contains a standard Consent Form which should be provided to participants for signing prior to the beginning of the research. This Consent Form provides for agreement to audio and/or video taping where this is part of the method to be used. This should be deleted if not required. If group meetings are to be used, the Consent Form should include a sentence agreeing that information obtained during the group meeting will remain confidential to group members.

Consent may be obtained orally where this is culturally appropriate. In such instances, the research process must include a procedure for obtaining consent and recording that consent has been actively obtained. A spoken statement on a tape or a list of participants at a hui would be appropriate in such circumstances.

If a participant is unable to provide written consent because of a disability, oral consent must be obtained. A spoken statement on a tape would be appropriate in such circumstances. An appropriate third party could also be used as a witness in these circumstances.

For research projects involving different stages and/or follow up interviews separate consents for each stage or follow up should be obtained. Thus, for example, if participation in an experiment is to be followed by a request to participate in an interview, a separate consent is required for each activity. In action research, consent should be obtained initially to enable exploration of the possible research work. This should then be followed by further consent as agreement is reached about specific research task.

Children and Research

All the above processes apply equally to children's participation in research. However, in undertaking research involving children additional requirements arise:

- the Information Sheet should be prepared at a level of language which reflects the reading age of the participants;
- children must be able to give their own consent if they are of an age to understand the nature of the project, this usually applies from around the age of seven;
- if the participation of children is being sought, their carers consent must also be obtained. Usually this will be necessary before the children are approached for their consent. In these instances, separate Information Sheet will be needed for the carer. Separate Information Sheets are also needed for other relevant parties such as school teachers and/or school principals and Board of Trustees;
- if children in a classroom or other group setting are being asked to participate in a research project, procedures must be put in place to protect the anonymity of those children who do not wish to participate, or whose carer do not wish them to do so. For example, if a questionnaire is being used all children should return the questionnaire, with non-participants returning a blank questionnaire. Where children are being asked to take part in interviews, steps such as interviewing out of school hours should be taken to protect their anonymity. Similarly, the Information Sheet should indicate what disruption, if any, will happen to the child's education programme; disruption should be avoided if at all possible.

Culturally Congruent Research Ethics

Dignity	Respect for cultural identity and ways of knowing;
Safety	Regard for physical, mental, personal and social wellbeing;
Mutuality	Mutual but not necessarily identical benefits to participants, iwi Maori, co-researchers, researchers;
Collaboration	Balance between individual and group rights and perspectives; joint ventures;
Control	Appropriate settlement of issues of authority and control over the direction, process and outcomes of the research;

ETHICAL CONCERNS

Ethics Committee	**Maori-individuals, communities**
Access to Participants	Consider context-culturally; Maori, Maori descent, Maori environment
Informed Consent	Individuals, identified spokespersons, elders, leaders, authorities, oral and written consents;
Anonymity & Confidentiality	Confidentiality, sharing and openness;
Potential Harm to Participants	Individual, whanau, extended whanau, tribal position, iwi Maori, takatakahi mana;
Participants Rights to Decline	Individual, group;
Uses of the Information	Participants and groups in feedback, loop (hui), allow for veto;
Conflicts of Interest/Roles	Insider/outsider;
Other Ethical Concerns	Intellectual property, oral traditions.

Notes for Applicants

Ethics Committees are obliged to ensure your research does not breach the HDC Code of Rights. To ensure this, the MUHEC will examine your application with considerable care.

MUHEC Members will wish to know for example:

- why you wish to do this research at this time with these participants;
- what you expect to be the outcome of this research;
- what the benefit(s) of participating in this research will be to participants;
- what hazards participants may encounter by participating in your research;
- how your research will be funded;
- how you plan to recruit participants;
- if you (and your supervisors) have the necessary qualifications and skills to conduct this research;
- when you are going to do this research;
- that your proposal is culturally appropriate;

- that the processes for obtaining informed consent are clearly stated and appropriate;
- the proposed methodology does not compromise the participants in any way - including the poor use of their time;
- that all legal requirements are met.

The chance of a successful application is enhanced if you remember the following:

- ascertain early in the process which other challenges you have to overcome to get permission to go ahead with your research e.g. other ethics committees, management's permission, funding applications;
- writing your proposal, ethics committee(s) applications and obtaining management permission all take time. (3 months is not unusual especially over Christmas, in some cases that may be rushing it!);
- complete the current ethics committee(s) application form(s) exactly as requested e.g. if you are asked for 'an abstract of no more than 300 words in lay person's language' do not give a 400 word abstract appropriate to a professional journal;
- state your qualifications with care. If they are uncommon, abbreviations may not be helpful;
- do not make flippant remarks or denigrate any person or institution;
- do not pursue 'hobby horses', if you have a 'bee in your bonnet' keep it to yourself;
- check and double check that you do not have a potential conflict of interest;
- sign and date the form;
- be conscious of the need to consider your consumption of participants (people and agency) resources. This may be knowledge, it may be petrol or it may be paper. Whatever it is it had or has cost to the participant;
- check that your methodology is appropriate for the study you wish to undertake;
- do not assume that native speakers of another language will automatically act as a translator for you. (It is generally not appropriate for research participants to act as translators);
- check your contact phone and fax numbers, spelling and grammar are correct;
- if you are asked to make amendments remember that this is in the best interests of your potential participants;
- if you are asked to talk to the MUHEC **DON'T PANIC**, this is quite normal. It usually just means they need some points clarified.

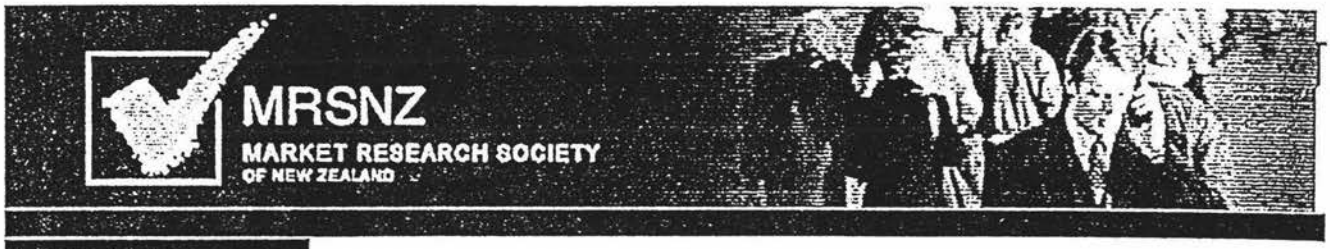
Please click on links below for further MUHEC information

Home | The Code | Auckland | Palmerston North | Useful Links

Home | Study at Massey | Student Life | Student Services | Enrolment | Research
Staff & Services | About Massey | Library | Site Map | Search | News & Vacancies

Comments to
Webmaster@massey.ac.nz
Massey University, New Zealand
URL: http://www.massey.ac.nz/

APPENDIX VII. MARKET RESEARCH SOCIETY OF NEW ZEALAND INC. CODE OF PRACTICE



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What is MRS?
Membership
News and Events
Research Company Profiles
Resources
Code of Practice
Employment Opportunities
Contact Us

CODE OF PRACTICE of the Market Research Society of NZ Inc.

1 INTRODUCTION

Effective communication between the suppliers and consumers of goods and service modern society. Growing international links make this even more essential. For a sup customers need in the most efficient way they must understand their differing require requirements; and how they can most effectively communicate the nature of the good offering.

Helping a business develop this understanding is the role of Marketing Research. It a public sectors of the economy Similar approaches are also used in other fields of stud measurement of the public's behaviour and attitudes in respect to social, political and and public bodies, the media and academic institutions. Marketing and Social Resear methods and problems in common although the subjects of study tend to be different

Such research depends upon public confidence: confidence that it is carried out hone unwelcome intrusion and without disadvantage to Respondents, and that it is based u This confidence must be supported by an appropriate professional Code of Practice g Marketing Research projects are conducted.

The latest 1994 ICC/ESOMAR Code forms the basis of this Code of Practice. This ne appropriate ethical and business principles as concisely as possible. It specifies the r in dealing with the general public and with the business community, including Clients profession.

The basic principles are relatively unchanging. There may be additional national Cod the application of this Code, which may go further in dealing with specific points of pr requirements should in such cases be followed. Research practice must of course in Zealand legislation and legal practice and in particular to the requirements of the 199

There are a number of specific ICC/ESOMAR and Market Research Society

Guidelines on various topics available from the Society's Secretary which give more d Code should be applied. These are not mandatory.

2 BASIC PRINCIPLES

This Code sets out the basic principles which must guide the actions of those who ca Research. No variation in the application of Rules is permissible without express auth Research Society of New Zealand. Individuals and organisations who subscribe to it but also the spirit of these rules.

No Code can be expected to provide a completely comprehensive set of rules which situation which might arise. Where there is any element of doubt people should there meanwhile follow the most conservative interpretation of these principles.

Individuals do not always have complete responsibility for, or absolute control over, a organisation to which they belong. They are however always responsible for ensuring organisation are aware of, and understand, the principles laid down in this Code. The endeavours to ensure that the organisation as a whole conforms to the Code.

3 DEFINITIONS

(a) Marketing Research is the function which links the consumer, customer and pub information - information used to identify and define marketing opportunities and prob evaluate marketing actions; improve understanding of marketing as a process and of marketing activities can be made more effective.

Marketing Research specifies the information required to address these issues; desig information; manages and implements the data collection process; analyses the resu

information; manages and implements the data collection process; analyses the resu findings and their implications.

Marketing Research includes such activities as **quantitative research; qualitative re advertising research; business-to-business and industrial research; research a groups** (such as those involved in pharmaceutical or financial research); and desk re these activities are concerned with collecting original data and not simply the second available data.

For the purposes of this Code the term Marketing Research also covers social and o these use similar approaches and techniques in the study of issues not directly conne goods and services.

Database marketing and any other activity where the names and addresses of the pe for individual selling, promotional, fund-raising or other non-research purposes can un regarded as marketing research since the latter is based on preserving the complete

(b) Researcher is defined as any individual, research agency, organisation, departme (or acts as a consultant on) a Marketing Research project or offers their services to d department etc, which belongs to the same organisation as that of the Client. Such a the same responsibilities under this Code vis-à-vis other sections of the Client organi completely independent of the Client organisation.

The term also covers responsibility of the procedures followed by any subcontractor f commissions any work (data collection or analysis, printing, professional consultancy the research project. In such cases the Researcher is responsible for ensuring that a conforms to the provisions of this Code.

(c) Client is defined as any individual, organisation, department or division (including organisation as the Researcher) which requests, commissions or subscribes to all or Research project.

(d) Respondent is defined as any individual, group or organisation from whom any inf Researcher for the purposes of a Marketing Research project, regardless of the type method or technique used to obtain it. The term therefore covers not only cases wher verbal interviewing techniques but also cases where other methods such as observat completion questionnaires, mechanical/electronic equipment, observation and any ot of the provider of the information may be recorded or otherwise traceable.

(e) Interview is defined as any form of direct or indirect contact (including the use of n those referred to above) with Respondents where the objective is to acquire data or i used in whole or in part for the purposes of a Marketing Research project.

(f) Record is defined as any brief, proposal, contact sheet, questionnaire, respondent record sheet, audio or audio-visual recording or film, tabulation or computer print-out, or other storage medium, formula, diagram, report, etc, in respect of any Marketing R whole or in part. It covers records produced by the Client as well as by the Researche

It includes not only original data records but also anything needed to evaluate those r documents.

4 RULES

A. General

Article 1 Marketing Research must always be carried out objectively and in accordan principles.

Article 2 Marketing Research must always conform to the national and international l protection and the privacy of the individual, which may apply in any of the countries in project.

B. The Rights of Respondents

All Respondents must be sure when they agree to take part in any Marketing Resear protected by the provisions of this Code and that the Researcher will conform to its re Respondents interviewed as private individuals and to those interviewed as represen

Article 3 Respondents' cooperation in a Marketing Research project is entirely volun not be misled when being asked for their cooperation.

Article 4 With the exception noted below, further interviews within the context of a pa survey with the same Respondents shall be carried out only if:

a) The Respondent's permission has already been obtained at a previous inte

b) It is pointed out to Respondents at the time they are re-contacted that this i one they have previously given and they then give their permission before the

The only exception to this procedure is in the case where it is an essential feature of involved that Respondents do not realise that this further interview is consequent upo given.

Article 5 If the Respondent is supplying information not in a private capacity but as a firm then it may be desirable to list the Respondent's organisation in the report. The r enable any particular piece of information to be related to any particular organisation explicit permission from the relevant Respondent, who shall be told of the extent to w This requirement does not apply in the case of secondary analysis of published data.

Article 6 The Researcher must avoid unnecessary intrusions on Respondents' privac

Article 7 Respondents' anonymity must always be strictly preserved unless they hav contrary. The Researcher must ensure that the information they provide cannot be lin organisations without such permission. It is the Researcher's responsibility to inform anonymity rights.

Article 8 In any case where Respondents are asked for permission to disclose their n anyone outside the research agency:

a) the Respondents must first be told to whom the information would be suppl it will be used, and also

b) the Researcher must ensure that:

(i) the information will not be used for any non-research activity

(ii) the information will not be published in a form that could reasonably be expected to identify the Respondents; and

(iii) the recipient of the information has agreed to conform to the requirements of this Code.

Article 9 The Researcher must take all reasonable precautions to ensure that Respo harmed or adversely affected as a result of their participation in a research project.

In the case of product trials, the Researcher must in particular ensure that arrangeme regarding the responsibilities for product safety and for dealing with any complaints o products or product misuse. Such responsibilities will normally rest with the Client, bu that products are correctly stored and handled while in the Researcher's charge and appropriate instructions for their use.

Article 10 Respondents must be told at the time of the interview when observation or be used, except where these are used in a public place. If a Respondent so wishes, t of it must be destroyed or deleted. Respondents' anonymity must not be infringed by

Article 11 Respondents must be able to check without difficulty the identity and bona obtain an answer to any reasonable query about the purposes and content of the res

Each interviewer must be able to be identified in a way that specifies his or her name and address/telephone number of the Research Company must be made available to the interview.

Article 12 The Researcher must take special care and precautions when interviewing under 15 years of age. The informed consent of the parent or responsible adult must with children. In obtaining this permission, the Interviewer shall describe the nature o detail to enable the responsible person to reach an informed decision. The responsib specifically informed if it is intended to ask children to test any products or samples.

C. The Professional Responsibilities of Researchers

This Code is not intended to restrict the rights of Researchers to undertake any legitim

This Code is not intended to restrict the rights of Researchers to undertake any legitim activity and to operate competitively in so doing. However, it is essential the general integrity of Marketing Research is not eroded in any way.

Article 13 Researchers must not knowingly or negligently act in any way which could Marketing Research profession or lead to a loss of public confidence in it.

Article 14 Researchers must not make false claims about their skills and experience organisation.

Article 15 Researchers must not unjustifiably criticise or disparage other Researcher

Article 16 Researchers must always strive to design research which is cost effective meet the Client's needs, and then to carry this out to the specifications agreed with th

Article 17 Researchers must at all times ensure the security of all research records i

Article 18 Researchers must not knowingly allow the dissemination of conclusions fr are not adequately supported by the data. They must always be prepared to make av information necessary to assess the validity of any published findings.

Article 19 No activity shall be deliberately or inadvertently mis-represented as Marke following activities shall in no way be associated, directly or indirectly or by implicatio interviewing or activities. Any such activities must always be clearly separated and di organisation and the conduct of Marketing Research.

(a) Enquiries whose objectives are to obtain personal information about privat for legal, political, supervisory, private or other purposes

(b) The compilation, updating or enhancement of lists, registers or databases research purposes

(c) The acquisition of information for use for credit-rating or similar services

(d) Sales or promotional approaches to Respondents

(e) The collection of debts

(f) Fund-raising

(g) Direct or indirect attempts to influence a Respondent's opinions, attitudes

D. The Mutual Rights and Responsibilities of Researchers and Cl

The Code is not intended to regulate the details of business relationships between Re insofar as these may involve principles of general interest and concern.

Article 20 These rights and responsibilities will normally be governed by a written co and the Client. By prior written agreement the parties may amend the provisions of A other requirements of this Code may not be altered in this way. Marketing Research m according to the principles of fair competition, as generally understood and accepted

Article 21 The Researcher must inform the Client in advance if the work to be carried combined or syndicated in the same project with work for other Clients, but does not clients. The Client shall not give any of the results of a multiclient study to other poten unless the Researcher's permission to do this has first been obtained.

Article 22 The Researcher must inform the Client as soon as possible in advance wh Client is to be subcontracted outside the Researcher's own organisation (including th consultants). On request the Client must be told the identity of any such subcontracto

Article 23 The Client does not have the right, without prior arrangement between the use of the Researcher's services or those of his organisation, whether in whole or in disclose the identity of any Client, or any confidential information about the latter's bu without the Client's permission.

Article 24 The following Records remain the property of the Client and the Research required to do so under the Privacy Act 1993) such data or findings to any third party

(a) Marketing Research briefs, specifications and other information provided b

(b) the research data and findings from a Marketing Research project (except multi-Client projects or services where the same data are available to more th

Respondents have a right of access, under the Privacy Act 1993, to personal informa refers to identifiable individuals and Researchers must disclose this information to Re access request. Respondents must also be allowed to correct identifiable information

The Client has however no right to know the names or addresses of Respondents un permission for this has first been obtained by the Researcher (this particular requirem Article 20).

Article 25 The research techniques and methods used in a Marketing Research proj of the Client, who has no exclusive right to their use. The following Records remain th

(a) Marketing Research proposals, discussion papers and quotations (unless the Client). They must not be disclosed by the Client to any third party, other t the Client on that project (with the exception of any consultant working also fo researcher). In particular, they must not be used by the Client to influence pro other Researchers.

(b) the contents of a report in the case of syndicated or multi-Client projects o data are available to more than one Client and where it is clearly understood available for general purchase or subscription. The Client may not disclose th any third party (other than to his own consultants and advisers for use in conn without the permission of the Researcher.

(c) all research records prepared by the Researcher (with the exception of the of non-syndicated projects and also the research design and questionnaire w these are covered by the charges paid by the Client).

Article 26 The Researcher must conform to currently agreed professional practice re Records for an appropriate period of time after the end of the project. The requiremen personal information not be kept longer than is properly required should be borne in m Researcher must supply the Client with duplicate copies of such records provided tha breach anonymity and confidentiality requirements; that the request is made within th the records; and that the Client pays the reasonable costs of providing the duplicates records does not apply in the case of a project or service where it is clearly understoo to be available for general purchase on a syndicated or subscription basis).

Original records must be kept for a minimum of six months and secondary records/sto minimum of two years after completion of the study, unless explicitly agreed with the exist, then the original records must be kept for a minimum of two years, unless expli

Article 27 The Researcher must not disclose the identity of the Client, or any confide latter's business to any third party without the Client's permission.

Article 28 The Researcher must on request allow the Client to arrange for checks on data preparation, provided that the Client pays any additional costs involved in this. A to Respondent anonymity requirements of Article 7. In the case of a multi-client study that the observer in charge of checking the quality of fieldwork (and/or data preparatio the Clients.

Article 29 The Researcher must always provide the Client with all appropriate techni project carried out for that Client. The Client is entitled to the following information ab project to which they have subscribed:

(1) Background

- organisation for whom and organisation by whom the study was conducted

- the purpose of the study

- names of subcontractors and consultants performing any substantial part of the work

(2) Sample

- a description of the intended and actual universe covered

- the size, nature and geographical distribution of the sample (both planned and achie extent to which any of the data collected were obtained from any part of the sample

- details of the sampling method, any weighting methods used and/or quota sampling

- where technically relevant, a statement of response rates and a discussion of any p response

(3) Data collection

- a description of the method by which the information was collected

- a description of the field staff, briefing and field quality control methods used

- the method of recruiting Respondents; and the general nature of any defrayment of their cooperation

- when the fieldwork was carried out

- (in the case of "desk research") a clear statement of the sources of the information a

(4) Presentation of results

- the relevant factual findings obtained

- bases of percentages (both weighted and unweighted, unless the results of weightin the report)

- general indications of the probable statistical margins of error to be attached to the m of statistical significance of differences between key figures

- questionnaires and other relevant documents and materials used (or, in the case of relating to the matter reported on).

The report on a project should normally cover the above points or provide a reference separate document which contains the information.

An exception to this Article is in the case where it is agreed in advance between the C it is unnecessary to include all the listed information in the formal report or other docu shall in no way remove the entitlement of the Client to receive any and all of the infor Also this exception shall not apply in the case where any or all of the research report or made available to recipients in addition to the original Client.

Article 30 When reporting on the results of a Marketing Research project the Resear distinction between the findings as such, the Researcher's interpretation of these and on them.

Article 31 Where any of the findings of a research project are published by the Clien to ensure these are not misleading. The Researcher must be consulted and agree in for publication. Where this does not happen the Researcher is entitled to:

(a) refuse permission for his/her name to be used in connection with the publi

(b) publish the appropriate technical details of the project

(c) correct any misleading aspects of the published presentation of the finding

Article 32 Researchers must not allow their names to be used in connection with any assurance that the latter has been carried out in conformity with this Code, unless the has in all respects met the Code's requirements.

Article 33 Researchers must ensure that Clients are fully aware of the existence of th comply with its requirements.

E. Implementation of the Code

E. Implementation of the Code

Article 34 Any person or organisations involved in, or associated with, a Marketing R proposal is responsible for actively applying the Rules and this Code in the spirit as w

Breaches of the Code may result in membership being withdrawn by the National Co

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APPENDIX VIII NUMBER OF ENTERPRISES & GEOGRAPHIC UNITS BY ANZSIC AND FTE SIZE GROUP

Number of Enterprises and Geographic Units[1] by ANZSIC and FTE[2] Size Group

February 2000

Economically Significant Enterprises[3]

ANZSIC Division		FTE Size Groups					
		0-5	6-9	10-49	50-99	100+	Total
Agriculture, forestry and fishing	Enterprises	10,154	483	590	32	11	11,270
	Geographic units	10,752	521	623	35	11	11,942
Mining	Enterprises	264	40	59	4	5	372
	Geographic units	355	72	87	7	3	524
Manufacturing	Enterprises	15,045	2,287	3,095	321	330	21,078
	Geographic units	15,912	2,538	3,596	428	380	22,854
Electricity, gas and water supply	Enterprises	94	6	23	8	18	149
	Geographic units	254	40	97	20	13	424
Construction	Enterprises	33,546	1,734	1,470	80	48	36,878
	Geographic units	33,855	1,826	1,681	123	39	37,524
Wholesale trade	Enterprises	13,560	1,447	1,608	135	91	16,841
	Geographic units	15,698	2,118	2,222	157	44	20,239
Retail trade	Enterprises	29,000	3,572	2,206	150	126	35,054
	Geographic units	32,609	4,371	2,839	242	109	40,170
Accommodation, cafes and restaurants	Enterprises	6,611	1,642	1,374	85	36	9,748
	Geographic units	7,270	1,763	1,659	87	27	10,806
Transport and storage	Enterprises	9,261	684	792	91	71	10,899
	Geographic units	10,059	902	1,121	99	60	12,241
Communication services	Enterprises	3,270	71	81	6	13	3,441
	Geographic units	3,444	167	215	26	44	3,896
Finance and insurance	Enterprises	9,239	234	204	33	48	9,758
	Geographic units	10,058	642	736	53	60	11,549
Property and business services	Enterprises	84,675	2,246	2,248	161	140	89,470
	Geographic units	86,886	2,597	2,697	234	166	92,580
Government administration and defence	Enterprises	27	9	54	29	85	204
	Geographic units	775	264	627	120	92	1,878
Education	Enterprises	3,052	847	1,834	186	105	6,024
	Geographic units	4,511	936	1,877	199	103	7,626
Health and community services	Enterprises	10,007	1,158	1,225	105	99	12,594
	Geographic units	11,334	1,418	1,633	179	110	14,674
Cultural and recreational services	Enterprises	8,874	452	391	31	22	9,770
	Geographic units	9,443	565	630	36	19	10,693
Personal and other services	Enterprises	10,639	722	448	23	22	11,854
	Geographic units	12,254	899	688	56	46	13,943
Total	Enterprises	247,318	17,634	17,702	1,480	1,270	285,404
	Geographic units	265,469	21,639	23,028	2,101	1,326	313,563

(1) Agriculture production (ANZSIC subdivision A01) is excluded from these statistics.
(2) Full-time Equivalent Persons Engaged (FTE) equals the sum of the full-time employees and working proprietors, plus half the part-time employees and working proprietors.
(3) Generally defined as enterprises with greater than $30,000 annual GST expenses or sales, or enterprises in a GST exempt industry.

Published by Statistics New Zealand

Commentary ...

- Coverage

Statistics New Zealand conducts an Annual Business Frame Update Survey (AFUS) in mid-February each year, primarily to update the information held on Statistics New Zealand's Business Frame. The frame provides a list of businesses used for selecting populations for Statistics New Zealand's business surveys. The survey results are also used to produce statistics on changes in the number, type and location of businesses in New Zealand, i.e. the 'demography' of New Zealand business. The reference date for the annual statistics is February. Analyses can be undertaken using a range of variables including geographic area, industry, institutional sector, business type, overseas ownership, and employment levels.

In order to understand what business demographic statistics measure, it is important to put into context the businesses covered in the analysis. An enterprise is defined as a legal entity engaged in the provision of goods and/or services, or set up with the intention of providing goods and/or services, which earns income and/or incurs expenses. Enterprises can range from a self-employed lawn-mowing contractor to large corporations such as Telecom or Fletcher Challenge.

The initial source of information about enterprises is the Inland Revenue Department client registration file. There are currently over 520,000 taxpayers registered for the Goods and Services Tax (GST).

The analysis of business demographics is limited for pragmatic reasons to those enterprises whose data is regularly maintained on Statistics New Zealand's Business Frame. These enterprises are termed 'economically significant'. At February 2000, there were 285,404 economically significant non-agricultural enterprises. Although they represent only 50 percent of enterprises on the IRD client registration file, they are estimated to represent over 99 percent of non-agricultural GST sales.

The Business Frame maintains data for enterprises that meet at least one of the following criteria:

- greater than $30,000 annual GST expenses or sales
- more than two full-time equivalent paid employees
- in a GST-exempt industry (except for residential property leasing and rental)
- part of a group of enterprises
- registered for GST and involved in agriculture or forestry.

Enterprises in agricultural production (ANZSIC A01) are not regularly maintained on the Business Frame and are therefore excluded from the business demographic statistics.

There are currently 72,000 enterprises in agricultural production held on the Business Frame.

All GST-registered enterprises recorded on the IRD client registration file are continually monitored to determine if they meet the 'economic significance' requirements for 'birth' onto the Business Frame. A buffer zone of $25,000 to $35,000 has been established to prevent enterprises switching excessively from 'economically significant' to 'economically insignificant'. The enterprises maintained on the Business Frame represent the target population from which Statistics New Zealand's economic surveys are selected.

- Limitations

There are a numbers of limitations with the business demographic data. These limitations include non-coverage of 'small' enterprises that fall below the $30,000 turnover threshold and exclusions of enterprises in agricultural production (as mentioned above), lags in recording businesses that have ceased trading or their activity has dropped below the $30,000 threshold, and difficulties in maintaining industrial and business classifications for smaller firms.

An enterprise which is outside the population scope for any of Statistics New Zealand's postal surveys is ceased on the Business Frame once it deregisters for GST or files 12-months of consecutive zero GST-returns.

Enterprises that are not part of a group of enterprises and have no paid employees are not covered by the postal AFUS. These enterprises do not currently have their industry and business classifications updated.

- Number of enterprises and geographic units

Excluding agricultural production, the number of economically significant enterprises at February 2000 was 285,404. The number of local or 'geographic units' attached to these enterprises was 313,563.

- Enterprises and geographic units by industry

There were 89,470 enterprises classified in property and business services at February 2000. This represents almost one third of all enterprises recorded in business demography, but accounts for only 13.0 percent of full-time equivalent persons engaged. By contrast, manufacturing accounts for 7.4 percent of all enterprises and 16.7 percent of full-time equivalent persons engaged. The smallest industry group in terms of the number of enterprises is electricity, gas and water supply with 149 enterprises.

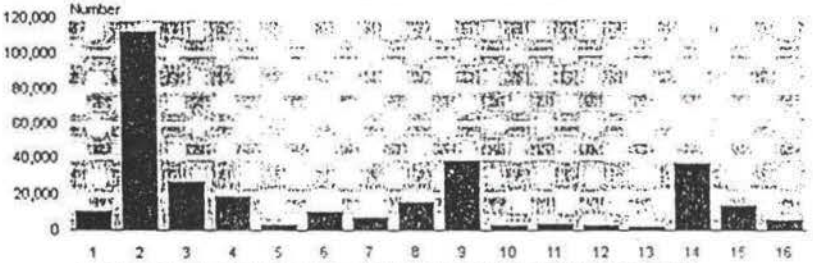
Number of Enterprises by Industry

A Agriculture, forestry & fishing, B Mining, C Manufacturing, D Electricity, gas & water supply, E Construction, F Wholesale trade, G Retail trade, H Accommodation, cafes & restaurants, I Transport & storage, J Communication services, K Finance & insurance, L Property & business services, M Government administration & defence, N Education, O Health & community services, P Cultural & recreational services, Q Personal & other services.

- Geographic units by region

There were 111,977 geographic units in Auckland at February 2000, which represents 35.7 percent of the total number of geographic units in New Zealand. Wellington and Canterbury recorded 38,552 and 37,329 geographic units respectively. The smallest region was the West Coast with only 2,428 geographic units.

Number of Geographic Units by Region



1 Northland, 2 Auckland, 3 Waikato, 4 Bay of Plenty, 5 Gisborne, 6 Hawke's Bay, 7 Taranaki, 8 Manawatu-Wanganui, 9 Wellington, 10 Tasman, 11 Nelson, 12 Marlborough, 13 West Coast, 14 Canterbury, 15 Otago, 16 Southland.

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APPENDIX IX DATA ANALYSIS

equency Table: PD Activities Overview - Before PDPP

Idea Generation

		Frequency	Percent	Valid Percent	Cumulative Percent
alid	Average	4	18.2	19.0	19.0
	Good	13	59.1	61.9	81.0
	Excellent	4	18.2	19.0	100.0
	Total	21	95.5	100.0	
lissing	System	1	4.5		
otal		22	100.0		

Initial Idea Screening

		Frequency	Percent	Valid Percent	Cumulative Percent
alid	Fair	5	22.7	23.8	23.8
	Average	10	45.5	47.6	71.4
	Good	4	18.2	19.0	90.5
	Excellent	2	9.1	9.5	100.0
	Total	21	95.5	100.0	
issing	System	1	4.5		
otal		22	100.0		

Preliminary Market Assessment

		Frequency	Percent	Valid Percent	Cumulative Percent
alid	Poor	1	4.5	4.8	4.8
	Fair	8	36.4	38.1	42.9
	Average	7	31.8	33.3	76.2
	Good	4	18.2	19.0	95.2
	Excellent	1	4.5	4.8	100.0
	Total	21	95.5	100.0	
ssing	System	1	4.5		
tal		22	100.0		

Preliminary Technical Assessment

		Frequency	Percent	Valid Percent	Cumulative Percent
lid	Poor	1	4.5	4.8	4.8
	Fair	2	9.1	9.5	14.3
	Average	9	40.9	42.9	57.1
	Good	6	27.3	28.6	85.7
	Excellent	3	13.6	14.3	100.0
	Total	21	95.5	100.0	
ssing	System	1	4.5		
tal		22	100.0		

Detailed Market Research

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Poor	3	13.6	14.3	14.3
	Fair	10	45.5	47.6	61.9
	Average	4	18.2	19.0	81.0
	Good	3	13.6	14.3	95.2
	Excellent	1	4.5	4.8	100.0
	Total	21	95.5	100.0	
Missing	System	1	4.5		
Total		22	100.0		

Business/Financial Analysis

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Poor	2	9.1	9.5	9.5
	Fair	6	27.3	28.6	38.1
	Average	6	27.3	28.6	66.7
	Good	5	22.7	23.8	90.5
	Excellent	2	9.1	9.5	100.0
	Total	21	95.5	100.0	
Missing	System	1	4.5		
Total		22	100.0		

Prototype Development

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Poor	1	4.5	4.8	4.8
	Average	10	45.5	47.6	52.4
	Good	5	22.7	23.8	76.2
	Excellent	5	22.7	23.8	100.0
	Total	21	95.5	100.0	
Missing	System	1	4.5		
Total		22	100.0		

Prototype Testing - In-House

		Frequency	Percent	Valid Percent	Cumulative Percent
alid	Poor	1	4.5	4.8	4.8
	Average	9	40.9	42.9	47.6
	Good	6	27.3	28.6	76.2
	Excellent	5	22.7	23.8	100.0
	Total	21	95.5	100.0	
issing	System	1	4.5		
otal		22	100.0		

Prototype Testing - Customer

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Poor	3	13.6	15.0	15.0
	Fair	2	9.1	10.0	25.0
	Average	8	36.4	40.0	65.0
	Good	3	13.6	15.0	80.0
	Excellent	4	18.2	20.0	100.0
	Total	20	90.9	100.0	
Missing	System	2	9.1		
Total		22	100.0		

Market Testing

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Poor	1	4.5	5.0	5.0
	Fair	6	27.3	30.0	35.0
	Average	9	40.9	45.0	80.0
	Good	1	4.5	5.0	85.0
	Excellent	3	13.6	15.0	100.0
	Total	20	90.9	100.0	
Missing	System	2	9.1		
Total		22	100.0		

Pre-Commercialisation Business Analysis

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Poor	2	9.1	10.0	10.0
	Fair	4	18.2	20.0	30.0
	Average	9	40.9	45.0	75.0
	Good	4	18.2	20.0	95.0
	Excellent	1	4.5	5.0	100.0
	Total	20	90.9	100.0	
Missing	System	2	9.1		
Total		22	100.0		

Full-Scale Production Plan

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Poor	1	4.5	5.0	5.0
	Fair	5	22.7	25.0	30.0
	Average	9	40.9	45.0	75.0
	Good	4	18.2	20.0	95.0
	Excellent	1	4.5	5.0	100.0
	Total	20	90.9	100.0	
Missing	System	2	9.1		
Total		22	100.0		

Product Launch Plan

		Frequency	Percent	Valid Percent	Cumulative Percent
alid	Poor	1	4.5	5.3	5.3
	Fair	3	13.6	15.8	21.1
	Average	9	40.9	47.4	68.4
	Good	5	22.7	26.3	94.7
	Excellent	1	4.5	5.3	100.0
	Total	19	86.4	100.0	
issing	System	3	13.6		
otal		22	100.0		

Company Size

		Frequency	Percent	Valid Percent	Cumulative Percent
alid	SMEs	16	72.7	72.7	72.7
	LOs	6	27.3	27.3	100.0
	Total	22	100.0	100.0	

Commercialisation Status

		Frequency	Percent	Valid Percent	Cumulative Percent
alid	Failed to Commercialise	14	63.6	66.7	66.7
	Commercialised	7	31.8	33.3	100.0
	Total	21	95.5	100.0	
issing	System	1	4.5		
otal		22	100.0		

equency Table: PD Activities Overview - After PDPP

Idea Generation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Average	3	13.6	14.3	14.3
	Good	13	59.1	61.9	76.2
	Excellent	5	22.7	23.8	100.0
	Total	21	95.5	100.0	
Missing	System	1	4.5		
Total		22	100.0		

Initial Idea Screening

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Fair	4	18.2	19.0	19.0
	Average	6	27.3	28.6	47.6
	Good	8	36.4	38.1	85.7
	Excellent	3	13.6	14.3	100.0
	Total	21	95.5	100.0	
Missing	System	1	4.5		
Total		22	100.0		

Preliminary Market Assessment

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Poor	1	4.5	4.8	4.8
	Fair	3	13.6	14.3	19.0
	Average	6	27.3	28.6	47.6
	Good	10	45.5	47.6	95.2
	Excellent	1	4.5	4.8	100.0
	Total	21	95.5	100.0	
Missing	System	1	4.5		
otal		22	100.0		

Preliminary Technical Assessment

		Frequency	Percent	Valid Percent	Cumulative Percent
alid	Fair	1	4.5	4.8	4.8
	Average	9	40.9	42.9	47.6
	Good	6	27.3	28.6	76.2
	Excellent	5	22.7	23.8	100.0
	Total	21	95.5	100.0	
issing	System	1	4.5		
otal		22	100.0		

Detailed Market Research

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Poor	1	4.5	4.8	4.8
	Fair	4	18.2	19.0	23.8
	Average	6	27.3	28.6	52.4
	Good	9	40.9	42.9	95.2
	Excellent	1	4.5	4.8	100.0
	Total	21	95.5	100.0	
Missing	System	1	4.5		
Total		22	100.0		

Business/Financial Analysis

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Poor	1	4.5	4.8	4.8
	Fair	3	13.6	14.3	19.0
	Average	8	36.4	38.1	57.1
	Good	7	31.8	33.3	90.5
	Excellent	2	9.1	9.5	100.0
	Total	21	95.5	100.0	
Missing	System	1	4.5		
Total		22	100.0		

Prototype Development

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Poor	1	4.5	4.8	4.8
	Average	8	36.4	38.1	42.9
	Good	7	31.8	33.3	76.2
	Excellent	5	22.7	23.8	100.0
	Total	21	95.5	100.0	
Missing	System	1	4.5		
Total		22	100.0		

Prototype Testing - In-House

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Poor	1	4.5	4.8	4.8
	Average	8	36.4	38.1	42.9
	Good	7	31.8	33.3	76.2
	Excellent	5	22.7	23.8	100.0
	Total	21	95.5	100.0	
Missing	System	1	4.5		
Total		22	100.0		

Prototype Testing - Customer

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Poor	3	13.6	15.0	15.0
	Fair	2	9.1	10.0	25.0
	Average	6	27.3	30.0	55.0
	Good	5	22.7	25.0	80.0
	Excellent	4	18.2	20.0	100.0
	Total	20	90.9	100.0	
Missing	System	2	9.1		
Total		22	100.0		

Market Testing

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Poor	1	4.5	5.0	5.0
	Fair	3	13.6	15.0	20.0
	Average	11	50.0	55.0	75.0
	Good	2	9.1	10.0	85.0
	Excellent	3	13.6	15.0	100.0
	Total	20	90.9	100.0	
Missing	System	2	9.1		
Total		22	100.0		

Pre-Commercialisation Business Analysis

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Poor	2	9.1	10.0	10.0
	Fair	4	18.2	20.0	30.0
	Average	8	36.4	40.0	70.0
	Good	4	18.2	20.0	90.0
	Excellent	2	9.1	10.0	100.0
	Total	20	90.9	100.0	
Missing	System	2	9.1		
Total		22	100.0		

Full-Scale Production Plan

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Fair	2	9.1	10.0	10.0
	Average	11	50.0	55.0	65.0
	Good	6	27.3	30.0	95.0
	Excellent	1	4.5	5.0	100.0
	Total	20	90.9	100.0	
Missing	System	2	9.1		
Total		22	100.0		

Product Launch Plan

		Frequency	Percent	Valid Percent	Cumulative Percent
alid	Fair	2	9.1	10.5	10.5
	Average	7	31.8	36.8	47.4
	Good	8	36.4	42.1	89.5
	Excellent	2	9.1	10.5	100.0
	Total	19	86.4	100.0	
ssing	System	3	13.6		
tal		22	100.0		

Company Size

		Frequency	Percent	Valid Percent	Cumulative Percent
lid	SMEs	16	72.7	72.7	72.7
	LOs	6	27.3	27.3	100.0
	Total	22	100.0	100.0	

Commercialisation Status

		Frequency	Percent	Valid Percent	Cumulative Percent
lid	Failed to Commercialise	13	59.1	61.9	61.9
	Commercialised	8	36.4	38.1	100.0
	Total	21	95.5	100.0	
ssing	System	1	4.5		
tal		22	100.0		

equency Table: Usefulness of Skill Learned and/or Information Gained

Consumer Research Information

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not At All Useful	2	9.1	9.5	9.5
	2	3	13.6	14.3	23.8
	Moderately Useful	3	13.6	14.3	38.1
	4	10	45.5	47.6	85.7
	Very Useful	3	13.6	14.3	100.0
	Total	21	95.5	100.0	
Missing	System	1	4.5		
Total		22	100.0		

Consumer Research Information

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not At All Useful	2	9.1	9.5	9.5
	2	3	13.6	14.3	23.8
	Moderately Useful	3	13.6	14.3	38.1
	4	10	45.5	47.6	85.7
	Very Useful	3	13.6	14.3	100.0
	Total	21	95.5	100.0	
Missing	System	1	4.5		
Total		22	100.0		

Information of Competitors

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not At All Useful	3	13.6	15.0	15.0
	2	1	4.5	5.0	20.0
	Moderately Useful	9	40.9	45.0	65.0
	4	2	9.1	10.0	75.0
	Very Useful	5	22.7	25.0	100.0
	Total	20	90.9	100.0	
Missing	System	2	9.1		
Total		22	100.0		

Identification of New Opportunities

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not At All Useful	3	13.6	14.3	14.3
	2	3	13.6	14.3	28.6
	Moderately Useful	9	40.9	42.9	71.4
	4	3	13.6	14.3	85.7
	Very Useful	3	13.6	14.3	100.0
	Total	21	95.5	100.0	
Missing	System	1	4.5		
Total		22	100.0		

Market Information

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not At All Useful	3	13.6	14.3	14.3
	2	4	18.2	19.0	33.3
	Moderately Useful	10	45.5	47.6	81.0
	4	4	18.2	19.0	100,0
	Total	21	95.5	100.0	
Missing	System	1	4.5		
Total		22	100.0		

Fresh Idea

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not At All Useful	2	9.1	9.5	9.5
	2	5	22.7	23.8	33.3
	Moderately Useful	7	31.8	33.3	66.7
	4	4	18.2	19.0	85.7
	Very Useful	3	13.6	14.3	100.0
	Total	21	95.5	100.0	
Missing	System	1	4.5		
Total		22	100.0		

Product Development Skills

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not At All Useful	2	9.1	9.5	9.5
	2	3	13.6	14.3	23.8
	Moderately Useful	8	36.4	38.1	61.9
	4	6	27.3	28.6	90.5
	Very Useful	2	9.1	9.5	100.0
	Total	21	95.5	100.0	
Missing	System	1	4.5		
Total		22	100.0		

Identification of New Material/Tech

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not At All Useful	4	18.2	20.0	20.0
	2	4	18.2	20.0	40.0
	Moderately Useful	9	40.9	45.0	85.0
	4	3	13.6	15.0	100.0
	Total	20	90.9	100.0	
Missing	System	2	9.1		
Total		22	100.0		

Techniques of Technical Information

		Frequency	Percent	Valid Percent	Cumulative Percent
alid	Not At All Useful	3	13.6	15.8	15.8
	2	7	31.8	36.8	52.6
	Moderately Useful	6	27.3	31.6	84.2
	4	2	9.1	10.5	94.7
	Very Useful	1	4.5	5.3	100.0
	Total	19	86.4	100.0	
issing	System	3	13.6		
otal		22	100.0		

Design Skills

		Frequency	Percent	Valid Percent	Cumulative Percent
alid	Not At All Useful	3	13.6	15.0	15.0
	2	6	27.3	30.0	45.0
	Moderately Useful	5	22.7	25.0	70.0
	4	4	18.2	20.0	90.0
	Very Useful	2	9.1	10.0	100.0
	Total	20	90.9	100.0	
sing	System	2	9.1		
tal		22	100.0		

Systematic Procedures

		Frequency	Percent	Valid Percent	Cumulative Percent
lid	MSMEs	2	9.1	9.5	9.5
	LOs	5	22.7	23.8	33.3
	3	9	40.9	42.9	76.2
	4	3	13.6	14.3	90.5
	5	2	9.1	9.5	100.0
	Total	21	95.5	100.0	
sing	System	1	4.5		
l		22	100.0		

Company Size

	Frequency	Percent	Valid Percent	Cumulative Percent
MSMEs	16	72.7	72.7	72.7
LOs	6	27.3	27.3	100.0
Total	22	100.0	100.0	

Correlations: Barriers Inhibiting the Product Development Partnership Project

Correlations

		Lack of Resources	Company's Top Management Support	Company's Internal Problems	Competition in the Market
ack of Resources	Pearson Correlation	1.000	.535	.319	.000
	Sig. (2-tailed)	.	.059	.312	1.000
	N	15	13	12	12
ompany's Top anagement Support	Pearson Correlation	.535	1.000	.631**	.478
	Sig. (2-tailed)	.059	.	.001	.116
	N	13	13	12	12
ompany's Internal roblems	Pearson Correlation	.319	.831**	1.000	.319
	Sig. (2-tailed)	.312	.001	.	.312
	N	12	12	12	12
ompetition in the Market	Pearson Correlation	.000	.478	.319	1.000
	Sig. (2-tailed)	1.000	.116	.312	.
	N	12	12	12	13
pplier Problems	Pearson Correlation	-.150	.017	-.017	-.159
	Sig. (2-tailed)	.626	.958	.958	.621
	N	13	12	12	12
icing Strategy	Pearson Correlation	-.057	-.265	-.503	-.086
	Sig. (2-tailed)	.860	.405	.096	.791
	N	12	12	12	12
tudent's Ability to Perform	Pearson Correlation	-.019	-.057	.432	.504
	Sig. (2-tailed)	.949	.854	.161	.079
	N	14	13	12	13
ommunication with the tudent	Pearson Correlation	.150	.189	.466	.543
	Sig. (2-tailed)	.624	.536	.127	.055
	N	13	13	12	13
ommercialisation Status	Pearson Correlation	-.046	.000	-.510	-.084
	Sig. (2-tailed)	.876	1.000	.109	.795
	N	14	12	11	12
her barriers	Pearson Correlation	.[a]	.[a]	.[a]	.[a]
	Sig. (2-tailed)	.	.	.	.
	N	1	1	1	2

Correlations

		Supplier Problems	Pricing Strategy	Student's Ability to Perform	Communication with the student
Lack of Resources	Pearson Correlation	-.150	-.057	-.019	.150
	Sig. (2-tailed)	.626	.860	.949	.624
	N	13	12	14	13
Company's Top Management Support	Pearson Correlation	.017	-.265	-.057	.189
	Sig. (2-tailed)	.958	.405	.854	.535
	N	12	12	13	13
Company's Internal Problems	Pearson Correlation	-.017	-.503	.432	.466
	Sig. (2-tailed)	.958	.096	.161	.127
	N	12	12	12	12
Competition in the Market	Pearson Correlation	-.159	-.086	.504	.543
	Sig. (2-tailed)	.621	.791	.079	.055
	N	12	12	13	13
Supplier Problems	Pearson Correlation	1.000	.594*	-.393	-.259
	Sig. (2-tailed)	.	.042	.207	.417
	N	13	12	12	12
Pricing Strategy	Pearson Correlation	.594*	1.000	-.466	-.363
	Sig. (2-tailed)	.042	.	.127	.247
	N	12	12	12	12
Student's Ability to Perform	Pearson Correlation	-.393	-.466	1.000	.859**
	Sig. (2-tailed)	.207	.127	.	.000
	N	12	12	17	16
Communication with the student	Pearson Correlation	-.259	-.363	.859**	1.000
	Sig. (2-tailed)	.417	.247	.000	.
	N	12	12	16	16
Commercialisation Status	Pearson Correlation	.553	.449	-.603*	-.477
	Sig. (2-tailed)	.062	.166	.013	.072
	N	12	11	16	15
Other barriers	Pearson Correlation	.[a]	.[a]	.[a]	.[a]
	Sig. (2-tailed)	.	.	.	.
	N	1	1	2	2

Correlations

		Commercialisation Status	Other barriers
Lack of Resources	Pearson Correlation	-.046	.[a]
	Sig. (2-tailed)	.876	.
	N	14	1
Company's Top Management Support	Pearson Correlation	.000	.[a]
	Sig. (2-tailed)	1.000	.
	N	12	1
Company's Internal Problems	Pearson Correlation	-.510	.[a]
	Sig. (2-tailed)	.109	.
	N	11	1
Competition in the Market	Pearson Correlation	-.084	.[a]
	Sig. (2-tailed)	.795	.
	N	12	2
Supplier Problems	Pearson Correlation	.553	.[a]
	Sig. (2-tailed)	.062	.
	N	12	1
Pricing Strategy	Pearson Correlation	.449	.[a]
	Sig. (2-tailed)	.166	.
	N	11	1
Student's Ability to Perform	Pearson Correlation	-.603*	.[a]
	Sig. (2-tailed)	.013	.
	N	16	2
Communication with the Student	Pearson Correlation	-.477	.[a]
	Sig. (2-tailed)	.072	.
	N	15	2
Commercialisation Status	Pearson Correlation	1.000	.[a]
	Sig. (2-tailed)	.	.
	N	21	3
Other barriers	Pearson Correlation	.[a]	1.000
	Sig. (2-tailed)	.	.
	N	3	3

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

a. Cannot be computed because at least one of the variables is constant.

Correlations: Various PDPP Aspects, Satisfaction Rating of PDPP Experience, and Commercialisatoin Status

Correlations

		Student's overall achievement	Prototyping	Progress reports	Publicity
Student's overall achievement	Pearson Correlation	1.000	.719**	.675**	.849**
	Sig. (2-tailed)	.	.001	.001	.000
	N	22	18	21	18
Prototyping	Pearson Correlation	.719**	1.000	.558*	.773**
	Sig. (2-tailed)	.001	.	.020	.001
	N	18	18	17	14
Progress reports	Pearson Correlation	.675**	.558*	1.000	.718**
	Sig. (2-tailed)	.001	.020	.	.001
	N	21	17	21	18
Publicity	Pearson Correlation	.849**	.773**	.718**	1.000
	Sig. (2-tailed)	.000	.001	.001	.
	N	18	14	18	18
Supervision by Massey	Pearson Correlation	.608**	.609*	.252	.655**
	Sig. (2-tailed)	.004	.012	.299	.004
	N	20	16	19	17
Staff liasion	Pearson Correlation	.535*	.630**	.205	.685**
	Sig. (2-tailed)	.015	.009	.400	.003
	N	20	16	19	16
Supervision by company	Pearson Correlation	.668**	.667**	.803**	.759**
	Sig. (2-tailed)	.001	.003	.000	.000
	N	21	17	20	18
Financial returns on project	Pearson Correlation	.821**	.598*	.616**	.803**
	Sig. (2-tailed)	.000	.018	.008	.000
	N	18	15	17	15
Satisfaction rating of PDPP experience	Pearson Correlation	.905**	.628**	.674**	.854**
	Sig. (2-tailed)	.000	.005	.001	.000
	N	22	18	21	18
Commercialisation Status	Pearson Correlation	.692**	.425	.655**	.874**
	Sig. (2-tailed)	.001	.079	.002	.000
	N	21	18	20	17
Experience rating	Pearson Correlation	.905**	.628**	.674**	.854**
	Sig. (2-tailed)	.000	.005	.001	.000
	N	22	18	21	18

Correlations

		Supervision by Massey	Staff liasion	Supervision by company	Financial returns on project
Student's overall achievement	Pearson Correlation	.608**	.535*	.668**	.821**
	Sig. (2-tailed)	.004	.015	.001	.000
	N	20	20	21	18
Prototyping	Pearson Correlation	.609*	.630**	.667**	.598*
	Sig. (2-tailed)	.012	.009	.003	.018
	N	16	16	17	15
Progress reports	Pearson Correlation	.252	.205	.803**	.616**
	Sig. (2-tailed)	.299	.400	.000	.008
	N	19	19	20	17
Publicity	Pearson Correlation	.655**	.685**	.759**	.803**
	Sig. (2-tailed)	.004	.003	.000	.000
	N	17	16	18	15
Supervision by Massey	Pearson Correlation	1.000	.879**	.418	.628**
	Sig. (2-tailed)	.	.000	.075	.007
	N	20	19	19	17
Staff liasion	Pearson Correlation	.879**	1.000	.398	.612**
	Sig. (2-tailed)	.000	.	.091	.009
	N	19	20	19	17
Supervision by company	Pearson Correlation	.418	.398	1.000	.685**
	Sig. (2-tailed)	.075	.091	.	.002
	N	19	19	21	18
Financial returns on project	Pearson Correlation	.628**	.612**	.685**	1.000
	Sig. (2-tailed)	.007	.009	.002	.
	N	17	17	18	18
Satisfaction rating of DPP experience	Pearson Correlation	.493*	.467*	.541*	.789**
	Sig. (2-tailed)	.027	.038	.011	.000
	N	20	20	21	18
Commercialisation Status	Pearson Correlation	.090	.120	.454*	.412
	Sig. (2-tailed)	.714	.625	.044	.089
	N	19	19	20	18
Experience rating	Pearson Correlation	.493*	.467*	.541*	.789**
	Sig. (2-tailed)	.027	.038	.011	.000
	N	20	20	21	18

Correlations

		Satisfaction rating of PDPP experience	Commercialisation Status	experience rating
Student's overall achievement	Pearson Correlation	.905**	.692**	.905**
	Sig. (2-tailed)	.000	.001	.000
	N	22	21	22
Prototyping	Pearson Correlation	.628**	.425	.628**
	Sig. (2-tailed)	.005	.079	.005
	N	18	18	18
Progress reports	Pearson Correlation	.674**	.655**	.674**
	Sig. (2-tailed)	.001	.002	.001
	N	21	20	21
Publicity	Pearson Correlation	.854**	.874**	.854**
	Sig. (2-tailed)	.000	.000	.000
	N	18	17	18
Supervision by Massey	Pearson Correlation	.493*	.090	.493*
	Sig. (2-tailed)	.027	.714	.027
	N	20	19	20
Staff liasion	Pearson Correlation	.467*	.120	.467*
	Sig. (2-tailed)	.038	.625	.038
	N	20	19	20
Supervision by company	Pearson Correlation	.541*	.454*	.541*
	Sig. (2-tailed)	.011	.044	.011
	N	21	20	21
Financial returns on project	Pearson Correlation	.789**	.412	.789**
	Sig. (2-tailed)	.000	.089	.000
	N	18	18	18
Satisfaction rating of PDPP experience	Pearson Correlation	1.000	.728**	1.000**
	Sig. (2-tailed)	.	.000	.000
	N	22	21	22
Commercialisation Status	Pearson Correlation	.728**	1.000	.728**
	Sig. (2-tailed)	.000	.	.000
	N	21	21	21
experience rating	Pearson Correlation	1.000**	.728**	1.000
	Sig. (2-tailed)	.000	.000	.
	N	22	21	22

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Correlations: Satisfaction Rating and Commercialisation Status

Correlations

		Satisfaction rating of PDPP experience	Commercialisation status
Satisfaction rating of PDPP experience	Pearson Correlation	1.000	.728**
	Sig. (2-tailed)	.	.000
	N	22	21
Commercialisation status	Pearson Correlation	.728**	1.000
	Sig. (2-tailed)	.000	.
	N	21	21

**. Correlation is significant at the 0.01 level (2-tailed).

rrelations: Likelihood of Future PD Project and Satisfaction Rating

Correlations

		Likelihood of future PD project	Satisfaction rating of PDPP experience
ikelihood of future D project	Pearson Correlation	1.000	.670**
	Sig. (2-tailed)	.	.001
	N	22	22
atisfaction rating of DPP experience	Pearson Correlation	.670**	1.000
	Sig. (2-tailed)	.001	.
	N	22	22

**. Correlation is significant at the 0.01 level (2-tailed).

ctor Analysis: Barriers Inhibiting the Product Development Partnership Project

Correlation Matrix

		Lack of Resources	Company's Top Management Support	Company's Internal Problems	Competition in the Market
Correlation	Lack of Resources	1.000	.270	.285	-.101
	Company's Top Management Support	.270	1.000	.824	.422
	Company's Internal Problems	.285	.824	1.000	.270
	Competition in the Market	-.101	.422	.270	1.000
	Supplier Problems	-.386	-.039	-.058	-.255
	Pricing Strategy	-.054	-.270	-.508	-.084
	Student's Ability to Perform	.082	.113	.411	.129
	Communication with the student	.022	.063	.432	.221
	Commercialisation Status	-.449	-.346	-.510	.070

Correlation Matrix

		Supplier Problems	Pricing Strategy	Student's Ability to Perform	Communication with the student	Commercialisation Status
Correlation	Lack of Resources	-.386	-.054	.082	.022	-.449
	Company's Top Management Support	-.039	-.270	.113	.063	-.346
	Company's Internal Problems	-.058	-.508	.411	.432	-.510
	Competition in the Market	-.255	-.084	.129	.221	.070
	Supplier Problems	1.000	.610	-.444	-.360	.425
	Pricing Strategy	.610	1.000	-.470	-.380	.449
	Student's Ability to Perform	-.444	-.470	1.000	.908	-.507
	Communication with the student	-.360	-.380	.908	1.000	-.514
	Commercialisation Status	.425	.449	-.507	-.514	1.000

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.284
Bartlett's Test of Sphericity	Approx. Chi-Square	55.503
	df	36
	Sig.	.020

Anti-image Matrices

		Lack of Resources	Company's Top Management Support	Company's Internal Problems
Anti-image Covariance	Lack of Resources	.111	4.927E-02	-3.731E-02
	Company's Top Management Support	4.927E-02	4.061E-02	-2.428E-02
	Company's Internal Problems	-3.731E-02	-2.428E-02	1.660E-02
	Competition in the Market	6.318E-02	-1.351E-02	-1.152E-02
	Supplier Problems	6.567E-02	3.236E-02	-2.513E-02
	Pricing Strategy	-6.480E-02	-3.518E-02	2.592E-02
	Student's Ability to Perform	-4.081E-02	-3.575E-02	1.998E-02
	Communication with the student	4.397E-02	3.223E-02	-1.987E-02
	Commercialisation Status	6.251E-02	4.827E-02	-2.070E-02
Anti-image Correlation	Lack of Resources	.121[a]	.734	-.869
	Company's Top Management Support	.734	.227[a]	-.935
	Company's Internal Problems	-.869	-.935	.281[a]
	Competition in the Market	.330	-.117	-.156
	Supplier Problems	.909	.740	-.899
	Pricing Strategy	-.902	-.810	.933
	Student's Ability to Perform	-.400	-.579	.505
	Communication with the student	.716	.867	-.836
	Commercialisation Status	.327	.417	-.280

Anti-image Matrices

		Competition in the Market	Supplier Problems	Pricing Strategy	Student's Ability to Perform
Anti-image Covariance	Lack of Resources	6.318E-02	6.567E-02	-6.480E-02	-4.081E-02
	Company's Top Management Support	-1.351E-02	3.236E-02	-3.518E-02	-3.575E-02
	Company's Internal Problems	-1.152E-02	-2.513E-02	2.592E-02	1.998E-02
	Competition in the Market	.330	5.252E-02	-3.590E-02	4.705E-02
	Supplier Problems	5.252E-02	4.705E-02	-4.417E-02	-2.160E-02
	Pricing Strategy	-3.590E-02	-4.417E-02	4.648E-02	3.097E-02
	Student's Ability to Perform	4.705E-02	-2.160E-02	3.097E-02	9.399E-02
	Communication with the student	-1.574E-02	2.679E-02	-3.030E-02	-4.771E-02
	Commercialisation Status	-.130	1.670E-02	-3.338E-02	-6.157E-02
Anti-image Correlation	Lack of Resources	.330	.909	-.902	-.400
	Company's Top Management Support	-.117	.740	-.810	-.579
	Company's Internal Problems	-.156	-.899	.933	.506
	Competition in the Market	.380[a]	.422	-.290	.267
	Supplier Problems	.422	.223[a]	-.945	-.325
	Pricing Strategy	-.290	-.945	.234[a]	.469
	Student's Ability to Perform	.267	-.325	.469	.462[a]
	Communication with the student	-.149	.670	-.762	-.844
	Commercialisation Status	-.395	.134	-.269	-.350

Anti-image Matrices

		Communication with the student	Commercialisation Status
Anti-image Covariance	Lack of Resources	4.397E-02	6.251E-02
	Company's Top Management Support	3.223E-02	4.827E-02
	Company's Internal Problems	-1.987E-02	-2.070E-02
	Competition in the Market	-1.574E-02	-.130
	Supplier Problems	2.679E-02	1.670E-02
	Pricing Strategy	-3.030E-02	-3.338E-02
	Student's Ability to Perform	-4.771E-02	-6.157E-02
	Communication with the student	3.400E-02	5.108E-02
	Commercialisation Status	5.108E-02	.330
Anti-image Correlation	Lack of Resources	.716	.327
	Company's Top Management Support	.867	.417
	Company's Internal Problems	-.836	-.280
	Competition in the Market	-.149	-.395
	Supplier Problems	.670	.134
	Pricing Strategy	-.762	-.269
	Student's Ability to Perform	-.844	-.350
	Communication with the student	.288[a]	.482
	Commercialisation Status	.482	.608[a]

a. Measures of Sampling Adequacy(MSA)

Communalities

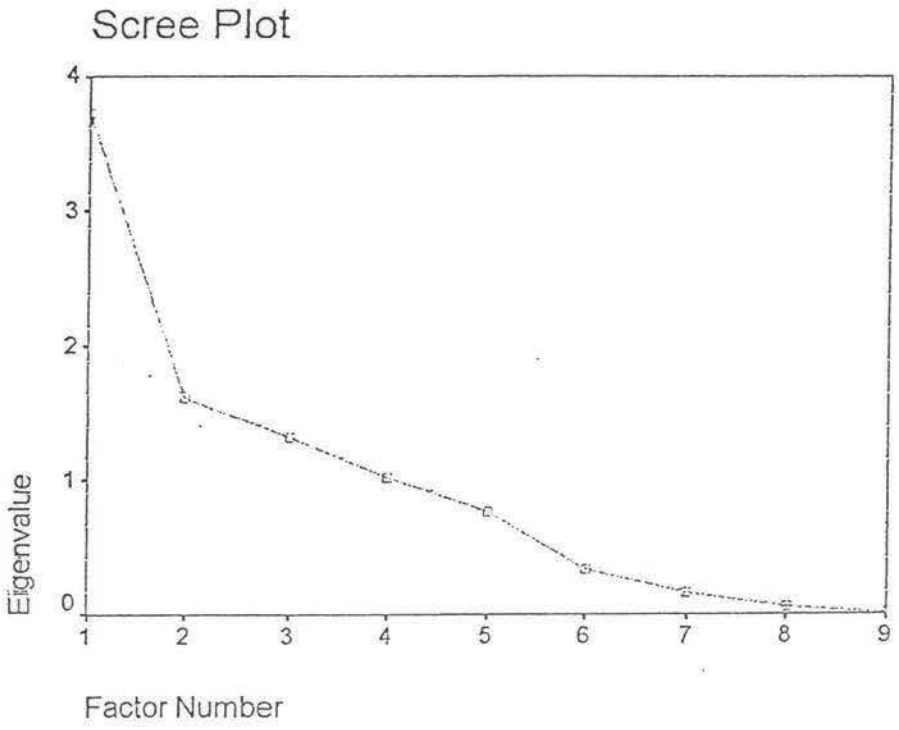
	Initial
Lack of Resources	.889
Company's Top Management Support	.959
Company's Internal Problems	.983
Competition in the Market	.670
Supplier Problems	.953
Pricing Strategy	.954
Student's Ability to Perform	.906
Communication with the student	.966
Commercialisation Status	.670

Extraction Method: Principal Axis Factoring.

Total Variance Explained

Factor	Initial Eigenvalues		
	Total	% of Variance	Cumulative %
1	3.720	41.331	41.331
2	1.612	17.907	59.238
3	1.323	14.705	73.943
4	1.019	11.318	85.261
5	.765	8.504	93.765
6	.338	3.753	97.517
7	.161	1.793	99.310
8	5.550E-02	.617	99.927
9	6.594E-03	7.327E-02	100.000

Extraction Method: Principal Axis Factoring.



Factor Matrix[a]

a. Attempted to extract 4 factors. In iteration 25, the communality of a variable exceeded 1.0. Extraction was terminated.

rrelations: Factors Important to Product Development Project

Correlations

		Clear Definition of Agreed Project Aims	Detail Project Planning and Management	Company's Top Management Commitment	Communication within the Company
lear Definition of greed Project Aims	Pearson Correlation	1.000	.331	.402	.487*
	Sig. (2-tailed)	.	.155	.071	.025
	N	21	20	21	21
etail Project Planning nd Management	Pearson Correlation	.331	1.000	.551*	.377
	Sig. (2-tailed)	.155	.	.012	.101
	N	20	20	20	20
ompany's Top anagement ommitment	Pearson Correlation	.402	.551*	1.000	.499*
	Sig. (2-tailed)	.071	.012	.	.021
	N	21	20	21	21
ommunication within the ompany	Pearson Correlation	.487*	.377	.499*	1.000
	Sig. (2-tailed)	.025	.101	.021	.
	N	21	20	21	21
esource Availability	Pearson Correlation	.079	.220	.457*	.506*
	Sig. (2-tailed)	.733	.352	.033	.019
	N	21	20	21	21
echnology Availability	Pearson Correlation	-.091	.097	.544*	.281
	Sig. (2-tailed)	.696	.684	.011	.218
	N	21	20	21	21
arket Competitiveness	Pearson Correlation	.366	.477*	.494*	.391
	Sig. (2-tailed)	.113	.039	.027	.089
	N	20	19	20	20
udent Performance	Pearson Correlation	.371	.112	.163	.526*
	Sig. (2-tailed)	.097	.637	.479	.014
	N	21	20	21	21
ommunication with the udent	Pearson Correlation	.454*	.336	.257	.522*
	Sig. (2-tailed)	.039	.147	.261	.015
	N	21	20	21	21
ommunication with assey's Staff	Pearson Correlation	.422	.034	.292	.200
	Sig. (2-tailed)	.057	.888	.199	.385
	N	21	20	21	21
pervision of Student by assey	Pearson Correlation	.735**	.238	.114	.275
	Sig. (2-tailed)	.000	.312	.623	.228
	N	21	20	21	21
pervision of Student by ompany	Pearson Correlation	.242	.248	.700**	.342
	Sig. (2-tailed)	.291	.292	.000	.129
	N	21	20	21	21
ompany Size	Pearson Correlation	-.269	.041	.078	-.312
	Sig. (2-tailed)	.266	.871	.752	.193
	N	19	18	19	19

Correlations

		Resource Availability	Technology Availability	Market Competitiveness	Student Performance
Clear Definition of Agreed Project Aims	Pearson Correlation	.079	-.091	.366	.371
	Sig. (2-tailed)	.733	.696	.113	.097
	N	21	21	20	21
Detail Project Planning and Management	Pearson Correlation	.220	.097	.477*	.112
	Sig. (2-tailed)	.352	.684	.039	.637
	N	20	20	19	20
Company's Top Management Commitment	Pearson Correlation	.467*	.544*	.494*	.163
	Sig. (2-tailed)	.033	.011	.027	.479
	N	21	21	20	21
Communication within the Company	Pearson Correlation	.506*	.281	.391	.526*
	Sig. (2-tailed)	.019	.218	.089	.014
	N	21	21	20	21
Resource Availability	Pearson Correlation	1.000	.804**	.368	.131
	Sig. (2-tailed)	.	.000	.110	.573
	N	21	21	20	21
Technology Availability	Pearson Correlation	.804**	1.000	.524*	-.011
	Sig. (2-tailed)	.000	.	.018	.962
	N	21	21	20	21
Market Competitiveness	Pearson Correlation	.368	.524*	1.000	.207
	Sig. (2-tailed)	.110	.018	.	.381
	N	20	20	20	20
Student Performance	Pearson Correlation	.131	-.011	.207	1.000
	Sig. (2-tailed)	.573	.962	.381	.
	N	21	21	20	21
Communication with the Student	Pearson Correlation	.408	.255	.302	.687**
	Sig. (2-tailed)	.066	.265	.195	.001
	N	21	21	20	21
Communication with Massey's Staff	Pearson Correlation	.371	.380	.392	.240
	Sig. (2-tailed)	.098	.089	.087	.294
	N	21	21	20	21
Supervision of Student by Massey	Pearson Correlation	.072	-.219	.045	.394
	Sig. (2-tailed)	.758	.340	.850	.077
	N	21	21	20	21
Supervision of Student by Company	Pearson Correlation	.722**	.739**	.500*	.057
	Sig. (2-tailed)	.000	.000	.025	.808
	N	21	21	20	21
Company Size	Pearson Correlation	-.057	.125	.058	.030
	Sig. (2-tailed)	.816	.609	.819	.903
	N	19	19	18	19

Correlations

		Communication with the Student	Communication with Massey's Staff	Supervision of Student by Massey
lear Definition of greed Project Aims	Pearson Correlation	.454*	.422	.735**
	Sig. (2-tailed)	.039	.057	.000
	N	21	21	21
etail Project Planning nd Management	Pearson Correlation	.336	.034	.238
	Sig. (2-tailed)	.147	.888	.312
	N	20	20	20
ompany's Top anagement ommitment	Pearson Correlation	.257	.292	.114
	Sig. (2-tailed)	.261	.199	.623
	N	21	21	21
ommunication within the ompany	Pearson Correlation	.522*	.200	.275
	Sig. (2-tailed)	.015	.385	.228
	N	21	21	21
esource Availability	Pearson Correlation	.408	.371	.072
	Sig. (2-tailed)	.066	.098	.758
	N	21	21	21
chnology Availability	Pearson Correlation	.255	.380	-.219
	Sig. (2-tailed)	.265	.089	.340
	N	21	21	21
arket Competitiveness	Pearson Correlation	.302	.392	.045
	Sig. (2-tailed)	.195	.087	.850
	N	20	20	20
ident Performance	Pearson Correlation	.687**	.240	.394
	Sig. (2-tailed)	.001	.294	.077
	N	21	21	21
mmunication with the ident	Pearson Correlation	1.000	.252	.481*
	Sig. (2-tailed)	.	.270	.027
	N	21	21	21
mmunication with ssey's Staff	Pearson Correlation	.252	1.000	.577**
	Sig. (2-tailed)	.270	.	.006
	N	21	21	21
pervision of Student by ssey	Pearson Correlation	.481*	.577**	1.000
	Sig. (2-tailed)	.027	.006	.
	N	21	21	21
pervision of Student by mpany	Pearson Correlation	.162	.501*	-.023
	Sig. (2-tailed)	.483	.021	.920
	N	21	21	21
mpany Size	Pearson Correlation	.016	-.207	-.431
	Sig. (2-tailed)	.947	.395	.065
	N	19	19	19

Correlations

		Supervision of Student by Company	Company Size
Clear Definition of Agreed Project Aims	Pearson Correlation	.242	-.269
	Sig. (2-tailed)	.291	.266
	N	21	19
Detail Project Planning and Management	Pearson Correlation	.248	.041
	Sig. (2-tailed)	.292	.871
	N	20	18
Company's Top Management Commitment	Pearson Correlation	.700**	.078
	Sig. (2-tailed)	.000	.752
	N	21	19
Communication within the Company	Pearson Correlation	.342	-.312
	Sig. (2-tailed)	.129	.193
	N	21	19
Resource Availability	Pearson Correlation	.722**	-.057
	Sig. (2-tailed)	.000	.816
	N	21	19
Technology Availability	Pearson Correlation	.739**	.125
	Sig. (2-tailed)	.000	.609
	N	21	19
Market Competitiveness	Pearson Correlation	.500*	.058
	Sig. (2-tailed)	.025	.819
	N	20	18
Student Performance	Pearson Correlation	.057	.030
	Sig. (2-tailed)	.808	.903
	N	21	19
Communication with the Student	Pearson Correlation	.162	.016
	Sig. (2-tailed)	.483	.947
	N	21	19
Communication with Massey's Staff	Pearson Correlation	.501*	-.207
	Sig. (2-tailed)	.021	.395
	N	21	19
Supervision of Student by Massey	Pearson Correlation	-.023	-.431
	Sig. (2-tailed)	.920	.065
	N	21	19
Supervision of Student by Company	Pearson Correlation	1.000	.231
	Sig. (2-tailed)	.	.341
	N	21	19
Company Size	Pearson Correlation	.231	1.000
	Sig. (2-tailed)	.341	.
	N	19	20

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).