Project portfolio management for product innovation in service and manufacturing industries

By

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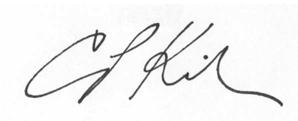
Certification

This thesis is submitted in fulfilment of the requirements of the degree of PhD, in the Macquarie Graduate School of Management, Macquarie University. This represents the original work and contribution of the author, except as acknowledged by general and specific references.

I hereby certify that this has not been submitted for a higher degree to any other university or institution.



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Abstract

This research examines the relationship between innovation project portfolio management (IPPM) capabilities and competitive advantage. Innovation projects – or projects for the development of new products – are of escalating importance in an increasingly competitive, globalised and deregulated environment characterised by shortening product lifecycles and dynamic markets. IPPM capabilities aim to improve the success rates for product innovation activities by providing a holistic and responsive decision-making environment to maximise the long-term value of innovation investments across the portfolio of innovation projects. This research takes a wide view and investigates the overall organisational capability for the management of the innovation project portfolio.

Successful product innovation is no longer primarily a concern of manufacturing-based industries – product development in service industries is a growing endeavour in an increasingly important industry. Therefore this research includes service product development environments and is the first to extend beyond the traditional manufacturing industry base for IPPM research. This is also the first study to investigate IPPM capabilities in Australia.

A pragmatic perspective guides a two-phase study encompassing a quantitative survey and a qualitative multiple-case study, the combination of methods providing a deeper level of understanding than could be achieved by either method alone. Findings support prior IPPM studies and suggest a positive relationship between structured IPPM capabilities and improved new product outcomes. The research highlights similarities and differences between service and manufacturing environments, and suggests future challenges will result from the increasing blurring of the boundaries between service and manufacturing industries. This research adopts a ‘dynamic capabilities’ perspective and draws on organisational learning theory to investigate the path-dependent nature of IPPM capability development. It adds to the understanding of how IPPM capabilities work with the resource base and contribute to competitive advantage. The findings of the research are presented in a maturity model and several conceptual models, and areas for future research are identified.

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Abbreviations used in thesis

CMM	Capability Maturity Model
DSS	Decision Support System
IMP	Importance (of IPPM)
IP	Intellectual Property
IPPM	Innovation Project Portfolio Management
IT	Information Technology
MAT	Maturity (of IPPM)
METH	Method (used in IPPM process)
NPD	New Product Development
NPP	New Product Performance
NSD	New Service Development
OLMM	Outcomes and Learning-based Maturity Model (for IPPM)
OPP	Opportunity (product opportunity effectiveness)
PM	Project Management
PMBOK	Project Management Body of Knowledge
PMI	Project Management Institute
PPM	Project Portfolio Management
PPO	Product Portfolio Outcome
PPP	Processes, Positions, Paths
PRB	Portfolio Review Board
R&D	Research and Development
RBV	Resource Based View
S-C-P	Structure-Conduct-Performance
SEI	Software Engineering Institute
SME	Small to Medium Enterprise
VRIN	Valuable, Rare, Inimitable, Non-substitutable
VRINE	Valuable, Rare, Inimitable, Non-substitutable, Exploitable
VRIO	Valuable, Rare, Inimitable, Organisational capability to exploit resources

Glossary

Ambidexterity

The ability of an organisations to perform both exploitation and exploration activities and to balance these types of activities effectively.

Capabilities

A specific type of organisational resource that enables the organisation to deploy other resources to perform activities that result in desired outcomes.

Competitive advantage

Competitive advantage is achieved through a capability to gain better returns than competitors (such as from investments in innovation projects) - creating more value than competitors are able to achieve.

Dynamic capability

A particular type of organisational capability that enables organisations to be responsive to the dynamic environment and is a source of sustainable competitive advantage through its ability to effectively deploy, integrate and build other organisational capabilities and resources in dynamic environments.

Effective IPPM capability

An IPPM capability that leads to improved product portfolio outcome (PPO) measures.

Establishment mode (of IPPM capability development)

The establishment mode is defined in this thesis as the type of capability development that occurs when an organisation explicitly recognises the need to acquire or re-design an IPPM capability and engages deliberate actions towards this end. Strong establishment activity often signifies the initial introduction of the capability to the organisation; however, it can also signify a major change in the capability that involves a rebuilding or replacement of the main elements of the capability.

Evolution mode (of IPPM capability development)

The evolution mode is defined in this thesis as the type of capability development that involves adjustments and improvements within an existing IPPM capability framework. The 'evolution mode' may involve unintentional capability evolution, or purposeful evolution where the capability is monitored, evaluated, modified and adjusted as required.

Experience accumulation

Tacit learning mechanism where experiences drive learning, often through trial and error.

Exploitation trap

See ‘Success trap’.

Exploitation / Exploitation projects

Exploitation processes use existing resources and processes. Exploitation projects are generally short-term projects that develop incremental changes to products. Exploitation projects are relatively low risk projects.

Exploration / Exploration projects

Exploration processes involve extending beyond established capabilities and developing new capabilities and processes to perform unfamiliar tasks. Exploration projects are generally long-term projects that develop radical or breakthrough innovation. Exploration projects are generally high risk, have lower levels of success than exploitation projects, but have the potential to gain high returns.

Industry type

Organisations are classified into two industry types for this research – either ‘service-based’ or ‘manufacturing-based’ industry types.

Innovation project

Projects for the development of any type of new product. These can be new manufactured products, new service products or new products that comprise a combination of manufactured and service elements.

Innovation project portfolio

An innovation project portfolio is defined in this thesis as a collection of innovation projects that are managed centrally to meet strategic business objectives.

IPPM capability

An IPPM capability is defined in this thesis as the overall organisational ability to manage the innovation project portfolio and maximise its contribution to the success of the organisation. The IPPM capability includes IPPM processes as well as organisational factors that contribute to the IPPM capability.

IPPM process

The policies, practices, activities, procedures, methods and tools that managers use for ongoing resource allocation and reallocation among a portfolio of innovation projects to maximise the contribution of projects to the overall welfare and success of the enterprise.

Knowledge articulation

Explicit learning mechanism where learning is enhanced by articulation activities such as meetings, discussions, seminars and training or educational sessions.

Knowledge codification

Explicit learning mechanism where learning is codified through documentation activities or through development of information capture and codification procedures.

Manufactured product

Manufactured products or physical goods that are primarily presented to customers in a tangible form.

Manufacturing-based organisation, manufacturing organisation, manufacturing industry

An organisation or industry that is primarily concerned with the development and delivery of manufactured products.

New product performance (NPP)

The performance of new products in the market, through measures such as profit, market share or success rates.

Product

Any developed offering that is available to customers. This includes both manufactured (or tangible) products and service-based (intangible) products, or products that include both tangible and intangible components.

Product portfolio outcome (PPO)

Product portfolio outcomes (PPO) are defined in this thesis as the product-based outcomes from the innovation project portfolio. PPO measures indicate the level of success of the new products resulting from the innovation portfolio. PPO measures include individual and portfolio-level measures of project success. Most PPO measures are based on meeting financial, market or technical objectives. Three types of PPO measures are included in this study: measures of performance on IPPM goals, measures of the effectiveness of the resulting products in exploiting market or technology-based opportunities (OPP measures), and measures of new product performance (NPP measures) in the market.

Service product or 'service'

Products that are service offerings, or services that consumers can purchase. Services are defined by intangibility and simultaneity of production and consumption.

Service-based organisation, service organisation, service industry

An organisation or industry that is primarily concerned with the development and delivery of service products.

Stage-Gate process

Product development or project management process with defined stages and decision points (or gates) between the stages (as shown in Figure 2-3).

Success factors (for NPD or IPPM capabilities)

The factors that are associated with the development of successful products or portfolios of products.

Success trap

The 'success trap' is a situation where exploitation project success leads to an imbalance in the project portfolio, with too many exploitation projects and too few exploration projects. The imbalance is caused by an unintentional evolution of decision-making processes due to the fact that decisions to allocate resources to exploitation projects provide more frequent and rapid positive feedback to decision-makers than decisions to allocate resources to exploration projects. As a result, decision-making tends to favour short-term, incremental or low-risk 'exploitation' projects, at the expense of the more radical, breakthrough longer-term 'exploration' projects.

Sustainable competitive advantage

Competitive advantage that is enduring (long-lasting) and is not copied by competitors or rendered obsolete.

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My supervisor, Associate Professor Bob Hunt has been a source of inspiration and motivation throughout this process – thank you, Bob for all your advice, and for encouraging me to explore and develop my ideas. I also want to thank my colleague and mentor Professor Elko Kleinschmidt whose interest and support has greatly assisted this project – Elko, you have been a much appreciated and valued sounding board throughout the process of this research. I am also grateful to Alison Basden for her efficient and expert assistance as a professional editor – many thanks, Alison, for so ably sharing the benefit of your experience to smooth this final path. I am fortunate to have had such a great supporting team.

Special thanks to the managers and organisations that have supported and contributed to this research – I have learned so much from you, and I greatly appreciate your interest and enthusiasm and the time you have invested in this project. To the members of the project portfolio management special interest group – thank you for your ongoing interest, feedback and support. Forming this community of practitioners has been an enjoyable, valuable and rewarding outcome of this research process.

Finally, I thank and acknowledge the family that has lived this process with me and supported me along the way: my husband Phil, and children Annabel and James. Thank you all for your patience and support – particularly Phil who has had to endure a household of students with their associated exams and deadlines. I also want to express my gratitude to my parents, William and Barbara Patterson, who taught me to value honesty and encouraged me in all my pursuits.

Publications based on this research

Dissemination of this research has followed a strategy designed to reach the wide range of audiences with interest in the topic and to gain their feedback to help shape the ongoing enquiry. Preliminary findings from this research have been disseminated in both academic and practitioner-oriented publications, as detailed below and through a number of practitioner-oriented conferences and seminars, outlined in section 7.4 in Chapter 7. The publications include two articles in refereed journals, a book chapter and several refereed conference proceedings.

Refereed journal articles

Killen, C P, Hunt, R A and Kleinschmidt, E J (2008) Project portfolio management for product innovation. *International Journal of Quality and Reliability Management* 25 (1), 24-38.

This journal article documents the first phase of the research, including analysis of the benchmark findings and differences between IPPM capabilities in Australia and North America and between service and manufacturing environments.

Killen, C P, Hunt, R A and Kleinschmidt, E J (2008) Learning investments and organisational capabilities: Case studies on the development of project portfolio management capabilities. *International Journal of Managing Projects in Business* 1 (3), 334-351.

This journal article presents findings from Phase 2 on learning investments and capability evolution and extends upon the work reported in this thesis.

Edited book chapter

Killen, C P, Hunt, R A and Kleinschmidt, E J (2008) The human factor in innovation project portfolio management, in *Inside the innovation matrix: finding the hidden human dimensions.* Australian Business Foundation (ed.), North Sydney, Australian Business Foundation Limited, pp. 158-176.

This book chapter in a practitioner-focused publication outlines the range of human factors that play a role in IPPM capabilities. As an extension of the work reported in this thesis, it addresses these aspects in detail.

Refereed conference papers

Killen, C P, Hunt, R A and Kleinschmidt, E J (2006) Benchmarking Innovation Portfolio Management Practices: Methods and Outcomes. *Proceedings of the International Association of the Management of Technology Conference*, Beijing, China, 22–26 May.

Findings of Phase 1 of the research detailing the comparison between North American and Australian findings from the quantitative survey.

Killen, C P, Hunt, R A and Kleinschmidt, E J (2006) Innovation Portfolio Management: Relating Practices to Outcomes. *Proceedings of the 13th International Product Development Management Conference*, Milan, Italy, European Institute for Advanced Studies in Management (EIASM), 11–13 June.

Findings of Phase 1 of the research, including the analysis of differences between IPPM capabilities in service and manufacturing product development environments.

Killen, C P, Hunt, R A and Kleinschmidt, E J (2006) Project Portfolio Management and Enterprise Decision Making: Benchmarking Practices and Outcomes. *Proceedings of the 11th Annual Conference of Asia Pacific Decision Sciences Institute*, Hong Kong, 14–18 June.

Findings of Phase 1 of the research, highlighting the decision-making aspects of IPPM capabilities and reviewing the literature related to IPPM and decision-making capabilities.

Killen, C P, Hunt, R A and Kleinschmidt, E J (2006) Project Portfolio Management in Australia. *Proceedings of the 3rd International Conference on Project Management (ProMAC2006),* Sydney, Australia, Project Management Institute, 27–29 September.

Findings of Phase 1 of the research, incorporating the project management perspective and highlighting the relevance of this IPPM study to project and portfolio management in a range of environments.

Killen, C P, Hunt, R A and Kleinschmidt, E J (2007) Managing the New Product Development Project Portfolio: A Review of the Literature and Empirical Evidence. *Proceedings of PICMET 2007, Portland, Oregon, Portland International Conference on Managing Engineering and Technology (PICMET),* 5–9 August.

Literature review on IPPM capabilities – the first comprehensive literature review to bring together the literature from multiple disciplines and sources that relate to IPPM capabilities.

Killen, C P, Hunt, R A and Kleinschmidt, E J (2007) Dynamic Capabilities: Innovation Project Portfolio Management. *Proceedings of ANZAM 2007, Sydney, Australia,* Australia and New Zealand Academy of Management, 4–7 December.

Literature and theory linking the dynamic capabilities framework with existing research on IPPM capabilities.

Killen, C P, Hunt, R A and Kleinschmidt, E J (2007) Strategic alignment for product innovation. *CINet, Gothenberg, Sweden, 8th International CINet Conference: Continuous Innovation - Opportunities and Challenges*, 7–11 September.

Initial findings for Phase 2, including findings from the first four case studies.

Killen, C P, Hunt, R A and Kleinschmidt, E J (2007) Project portfolio management: Learning investments and the establishment and evolution of organisational capabilities. *ICAN 2007*_Sydney Australia, ICAN Research Centre: Innovative Collaborations, Alliances and Networks, 29–30 November.

This conference paper was later expanded and published in *International Journal of Managing Projects in Business* (see details above).

Killen, C P, Hunt, R A and Kleinschmidt, E J (2008) New Product Project Portfolio Management and Competitive Advantage: Cases from Diverse Industries. *Proceedings of the International Association of the Management of Technology Conference*, Dubai, UAE, 6–10 April.

Findings for Phase 2 – initial case summaries and initial cross-case analysis – including all six case studies.

Chapter 1 Introduction

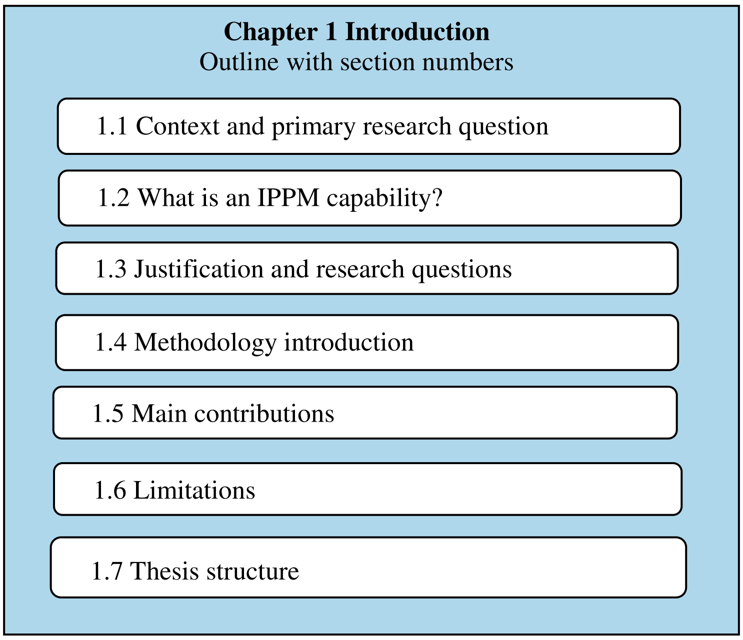

Figure 1-1: Chapter 1 outline

1.1 Context and primary research question

Innovation and new product development (NPD) are primary sources of competitive advantage for many organisations in both manufacturing and service industries (Wheelwright and Clark, 1992; Cooper and Edgett, 1999; Menor et al., 2002; Galende, 2006). More frequent product introductions and shorter product lifecycles are strengthening the impact of new products on organisational outcomes. In this dynamic environment gaining and maintaining organisational competitiveness through new products is a continual quest. As part of this quest, organisations are elevating the role of the NPD strategy within the overall business strategy to reflect the increasing investment and expectations from NPD activities (Edwards and Croker, 2001; Mikkola, 2001; Calantone et al., 2003; Hull, 2004).

To achieve strategic goals, these organisations strive to maximise the outcomes from their NPD investments by improving their organisational innovation capabilities (Lawson and Samson, 2001; Ernst, 2002). The push to improve innovation outcomes is reflected in the research and literature on organisations and competitiveness (Zaltman et al., 1973; Barney, 1991; Cormican and O'Sullivan, 2004; O'Regan and Ghobadian, 2004). Two central questions explored in this literature are "Why do some organisations compete more successfully than others?" and "What can organisations do to enhance and sustain their competitive advantage?" This thesis focuses on organisational innovation project portfolio management (IPPM) capabilities to address these questions.

The primary research question investigated in this thesis is:

> "What is the relationship between an organisation's IPPM capability and its ability to establish sustained competitive advantage through improved new product outcomes?"

This thesis addresses this question through a two-phase study of IPPM capabilities in Australia that includes both manufacturing- and service-based organisations. To set the context for the research this chapter first provides a brief introduction and definition of IPPM capabilities and related concepts, following the structure outlined in Figure 1-1. The research is justified through a summary of the literature on the importance of understanding and improving IPPM capabilities and an overview of the research questions. Next the two-phase methodology is introduced and briefly outlined. Finally, this introduction highlights the main contributions and limitations of the research and outlines the thesis structure.

1.2 What is an IPPM capability?

This section introduces IPPM and related concepts in order to set the context for the research. These definitions and their development based on the literature are covered in more detail in Chapter 2.

Briefly, an IPPM capability is defined in this thesis as 'the overall organisational ability to manage the innovation project portfolio and maximise its contribution to the success of the organisation'. The literature indicates that there is a growing emphasis on establishing and improving IPPM capabilities in organisations. This interest in IPPM capabilities is shown to be related to an intensified focus on improving NPD processes, as well as to the trends towards a more strategic perspective for the management of projects in general (Dye and Pennypacker, 1999; Cooper et al., 2001; Levine, 2005).

The IPPM capability includes IPPM processes as well as organisational factors. IPPM processes are the policies, practices, activities, procedures, methods and tools that managers use for ongoing resource allocation and reallocation among a portfolio of innovation projects to maximise the contribution of projects to the overall welfare and success of the enterprise (Cooper et al., 2001; McDonough and Spital, 2003; Levine, 2005). An organisation's IPPM capability is responsible for the effective deployment of the innovation strategy and provides a holistic perspective for ongoing decision-making to maintain the most effective combination of projects for new product and service development. The goals of the IPPM capability are: aligning projects with the innovation strategy, maintaining a balance of project types, and ensuring that the project portfolio fits with resource capability so that the organisation can gain the maximum value from the investment in NPD (Cooper et al., 2002a; Kendall and Rollins, 2003). In this way effective IPPM practices are proposed to enhance an organisation's competitive advantage.

Innovation projects are defined as projects for the development of any type of new product. These can be manufactured products, service products or products that comprise a combination of manufactured and service elements. An innovation project portfolio is defined in this thesis as a collection of innovation projects that are managed centrally to meet strategic business objectives. IPPM is related to the more general project portfolio management (PPM) processes that can be applied to many types of project-based environments, and derives from the project management (PM) discipline (Dye and Pennypacker, 1999; Levine, 2005). IPPM and PPM concepts and methods are very similar; however, there are some differences in emphasis and in the historical evolution of these capabilities, which are discussed in more detail in Chapter 2. While the research reported in this thesis focuses specifically on IPPM capabilities in product development project environments, the literature is drawn from both IPPM- and PPM-focused publications.

1.3 Justification and research questions

Competitive advantage, through the ability to create a successful stream of new products, is essential for the survival of many organisations in both manufacturing and service industries. These organisations compete in an increasingly deregulated and globalised environment, where rapid obsolescence is caused by continual technological advances and decreasing product and service life spans (Lawson and Samson, 2001; Calantone et al., 2003; Phaal et al., 2006; Kahn, 2007). These changes in the business and competitive environment are increasing the pace of product innovation (Wind and Mahajan, 1997).

To attract, satisfy and retain customers in this environment, organisations need to be able to introduce innovative products more and more frequently. One measure of this increasing frequency is the percentage of current sales that emanate from products that have been newly introduced within the last three years. This percentage has been steadily increasing and is estimated to be about 40% (Griffin, 1997; Cheskin and Fitch, 2003). New product development efforts are absorbing increasing levels of organisational resources in both manufacturing and service environments (Edwards and Croker, 2001), yet not all new product offerings are successful. Many projects do not reach the launch or delivery stage, and for those that do, the estimates of new product success are about 35–60% (Griffin, 1997; Cooper et al., 2001; Tidd et al., 2005). There is significant scope for improved success in new product outcomes, and organisations strive to improve new product success rates to boost the return on product development investments. Therefore the research presented in this thesis is valuable as it aims to improve understanding of IPPM practices and to provide guidance to organisations to ultimately improve their new product success rates.

Although new products have been traditionally thought of as manufactured items, a growing percentage of new products are service products (Edwards and Croker, 2001). These service products are increasingly important to the economic health of developed nations; however, research focused on service product development IPPM is scarce and no study compares IPPM practices across manufacturing and service industries (Easingwood, 1986; Cooper and Edgett, 1999; Menor et al., 2002). This thesis addresses this significant gap in the literature and investigates the IPPM practices for both manufacturing and service product development portfolios.

Organisations have always needed to make decisions about the best way to invest limited resources across a range of possible activities. However, the emergence of a distinct management capability or function for IPPM is a fairly recent phenomenon (Cooper et al., 1997a, b; Levine, 2005). As discussed further in Chapter 2, the past decade has seen an escalation in the amount of literature, research and practitioner activity focused on IPPM, reflecting the increasing importance placed on IPPM capabilities (Levine, 2005; Kwak and Anbari, forthcoming). The importance is highlighted by a Delphi study of 84 university and industry experts (Scott, 2001). The findings show that problems that are central to IPPM processes, such as the linking of technology and corporate strategies, and new product project selection were rated the most important management of technology problems along with strategic planning.

The swell of interest in IPPM can be attributed to two main trends. Both are essentially responses to the challenges presented by a globalised, information-rich, dynamic and competitive environment. First, IPPM capabilities are increasingly seen as instrumental for maximising outcomes from innovation activities as organisations are elevating their emphasis on innovation and organisational renewal (Cooper et al., 2001; Ernst, 2002). Product development is one of the primary avenues for organisational innovation, and a steady stream of successful new products is required for success in most manufacturing and service product industries. While exploitative innovation can sustain an organisation for a limited period of time, it is generally acknowledged that organisations must also employ exploratory innovation to succeed in the longer term (Danneels, 2002; Benner and Tushman, 2003). Therefore a sustainable NPD strategy requires a mix of new product projects that exploit current capabilities and develop new capabilities. The NPD strategy is also affected by many other factors that need to be addressed and balanced at the project portfolio level, such as the level and types of risks, the use of scarce resources and the long-term development of organisational innovation capabilities (Calantone et al., 2003). Competitive advantage is achieved by organisations with the capability to effectively manage their NPD strategy and processes in this dynamic environment (Eisenhardt and Martin, 2000). Processes for the management of individual NPD projects have become well established (Tatikonda and Rosenthal, 2000a; Krishnan and Ulrich, 2001). However, the focus on 'doing projects right' through effective PM capabilities is only part of the equation. 'Doing the right projects' is also essential to ensure that organisational resources are allocated to the best combination of projects to meet overall organisational goals (Cooper et al., 2001). Organisations therefore aim to develop their IPPM capabilities to manage decisions and priorities across the portfolio of projects in order to improve overall NPD outcomes.

The second trend prompting the increased attention to IPPM is the shift to 'management by projects' for organisational activities, many of which were previously viewed as operational (Walker et al., 2008). Therefore projects are often the main vehicle for delivering organisational strategy (Turner, 1999; Poskela et al., 2003; Artto et al., 2004). This 'projectisation' of organisations has many drivers, including competitive pressures, increased complexity of organisational activities and the increasing availability and success of PM tools (Webb, 1994; Cleland, 1999). There has been strong growth in the capability and skills of the PM community and in the prevalence of PM methods in organisational activity over the past two decades (Maylor et al., 2006). More recently PPM has gained attention among the PM community, primarily as a way of aligning projects with strategy and ensuring adequate resourcing for projects, and PPM capabilities are being extended throughout many project-based organisations in many industries (Crawford, 2006; Maylor et al., 2006). The surge of publications and interest from the PM community has led to increased attention to IPPM as well as PPM. The literature on PPM (from the perspective of the PM community) and IPPM (from that of the NPD community) includes a large degree of overlap, and the terminology and emphasis in the publications and research are beginning to merge.

The preceding discussion has emphasised the importance of IPPM capabilities to organisational success. There is a growing body of research aimed at improving organisational competitive advantage through better understanding and improved success rates for innovation projects (Brown and Eisenhardt, 1995; Ernst, 2002). The literature indicates that managing a portfolio of innovation projects presents a multi-dimensional challenge that is often addressed through an IPPM capability with a formal and structured process (Archer and Ghasemzadeh, 1999a; Cooper et al., 2001; Cauchick Miguel, 2008). A growing body of literature on IPPM outlines processes, methods and tools and identifies the 'best practices' associated with better outcomes (Loch, 2000; Cooper et al., 2001; Cormican and O'Sullivan, 2004; Jeffery and Leliveld, 2004). The IPPM literature suggests that a variety of methods and approaches can be applied to the problem; however, many of the IPPM-related publications do not provide empirical evidence on the use and outcomes of these methods (for example, O'Connor, 2004;

Wideman, 2004). A relatively new body of empirical research into IPPM practices is starting to generate findings related to IPPM practices and innovation outcomes. The literature review in Chapter 2 brings together and overviews the IPPM and PPM literature that is relevant to NPD, and aims to report on all of the empirical research and findings in the area. This is the first comprehensive review of the empirical findings on IPPM to be published. Prior research has been conducted primarily in North America and Europe. No IPPM-focused research has originated in Australia, and therefore the IPPM landscape in Australia is unknown. Research has been primarily atheoretical and has originated from multiple perspectives and disciplines. One of the primary contributions of the research reported in this thesis is the identification of the dynamic capabilities framework and the resource-based view as a theoretical base to unify previous research and guide future studies.

In summary, further research into understanding and improving IPPM capabilities is justified by the increased contribution of innovation projects to organisational outcomes and the strong level of interest in improving organisational innovation capabilities. IPPM capabilities provide a holistic perspective to optimising innovation project outcomes and enhancing competitive advantage. This thesis presents the first extensive literature review on the empirical research on IPPM capabilities, highlighting gaps in the literature to guide the investigations. Chapter 2 discusses the identification of research issues and the development of the research questions based on the review of the literature. The five research questions addressed in this thesis are:

RQ 1. What is the relationship between an organisation's IPPM capability and its new product outcomes?

RQ 2. How do IPPM capabilities in service and manufacturing NPD environments compare?

RQ 3. How do IPPM capabilities in Australia and North America compare?

RQ 4. Can theories or frameworks be developed or used to better understand the relationship between IPPM capabilities and competitive advantage? *As outlined in Section 5.5, this research question was adjusted for the second phase of research to read: "Can the dynamic capabilities framework be applied to assist in understanding the relationship between IPPM capabilities and competitive advantage?"*

RQ 5. How are IPPM capabilities developed?

1.4 Methodology introduction

The context for this research has been defined to address two of the major gaps in the literature: the lack of research on IPPM in Australia and the lack of IPPM research focusing on service industries. The research was therefore conducted in Australia and focussed on organisations that manage a portfolio of projects for the development of new products. These organisations represent both manufacturing-based and service-based product development environments.

This research adopted a pragmatic perspective and was conducted through a sequential two-phase mixed-method study. The research included a quantitative questionnaire-based survey and a qualitative multiple-case study to address the 'what' and the 'how' of the research questions. The use of the two methods enabled triangulation of the findings. This technique enhances the reliability of the findings by avoiding reliance on any single method and therefore limiting exposure to the particular limitations and biases of that method (Brewer and Hunter, 1989; Creswell, 2003). Another benefit of the sequential approach is the ability to incorporate the results from one method in the research design for a subsequent method, and to enhance the ability of each phase of research to build upon the prior phase (Greene et al., 1989; Creswell, 2003).

This section briefly introduces the two phases of the research. The methods are described in detail in Chapter 3 (methodology and Phase 1 research design) and Chapter 5 (Phase 2 research design).

Phase 1 employed a questionnaire-based survey designed to collect primarily quantitative data and test relationships between IPPM practices and outcomes in both manufacturing and service organisations. The survey included multiple-item constructs to test relationships proposed in a conceptual model on IPPM factors and outcomes presented in Chapter 2. The survey also explored alternative ways of measuring the outcomes of IPPM capabilities. Portions of the survey are similar to research conducted in North America (Cooper et al., 2001), allowing direct comparison between this study and the North American research. The findings highlight the strategic importance of IPPM capabilities and have produced a benchmark of IPPM practices and outcomes in Australia. The study is based on responses from 60 Australian organisations and provides the first comparable IPPM data for both service and manufacturing IPPM capabilities, as well as indications of relationships between practices and outcomes.

Phase 2 was designed using input from the findings of Phase 1 and an extended literature review. This qualitative phase comprised a multiple-case study focusing on six successful innovators in both manufacturing and service industries. The Phase 2 investigation allowed detail of the IPPM environment to be explored and compared across the two types of industries. It added an additional perspective to address the research questions to support and extend the relationships identified in Phase 1. Based on the findings of the extended literature review, RQ 4 on theories and frameworks was modified. The revised question focused on investigating the applicability of the dynamic capabilities strategic framework to improving understanding of the relationship between IPPM capabilities and competitive advantage. Phase 2 also provided new insight into the ongoing evolution and change in IPPM capabilities in response to the environment.

1.5 Main contributions

The main contributions of the research are highlighted in this section. Chapter 7 provides a more thorough discussion of the findings in relation to each of the research questions, drawing upon the quantitative Phase 1 findings from Chapter 4 and the qualitative Phase 2 findings from Chapter 6.

One of the most significant contributions of this research is the development of understanding of IPPM in service organisations. The findings on IPPM capabilities in service organisations address a major gap in the literature, given the significant and escalating importance of services to the economy of developed nations (Pilat, 2000; Edwards and Croker, 2001). The findings reveal that, although IPPM has been established more recently in service industries, the capabilities have developed relatively quickly and are at a similar level of maturity to the IPPM capabilities in manufacturing industries. IPPM processes are found to be similar overall, with unique challenges and drivers for the IPPM capabilities in each industry. The research also provides a valuable perspective on the service IPPM environment, and on the changing nature of products. The findings illustrate the blurring of the boundaries between service and manufactured products, highlighting the importance of understanding the similarities as well as differences in IPPM capabilities between the two environments in order to best tailor IPPM capabilities for hybrid environments.

The other primary contribution of this research is the identification of an IPPM capability as a 'dynamic capability' and the use of the dynamic capabilities perspective to improve understanding of how IPPM capabilities contribute to sustained organisational competitive advantage. The dynamic capabilities framework provides a perspective to explain the mechanisms through which IPPM capabilities draw upon and develop the resource base and contribute to competitive advantage. This research contributes empirical findings to illustrate and examine dynamic capabilities in action, thus strengthening the understanding of dynamic capabilities.

The research also contributes to the understanding of IPPM capabilities by illustrating stages of establishment and ongoing evolution in IPPM capabilities. Organisational investments in learning mechanisms for the development of the IPPM capability are observed in the case studies, and the dynamic capabilities perspective contributes to understanding the nature and processes of change and evolution in the IPPM capabilities. This research also embeds the findings on IPPM evolution and change in an initial version of an 'Outcome and Learning-based Maturity Model' (OLMM), designed specifically for IPPM capability evaluation and development in innovation project portfolio environments.

In addition, this research has developed the first Australian benchmark data on IPPM practices. Both phases of the research confirm links between positive NPD outcomes and established IPPM capabilities with strong management support. These findings align with previous 'best practice' research studies (Cooper et al., 2001; Jeffery and Leliveld, 2004) and reveal that Australian IPPM practices are similar to those in North America. Therefore the findings of this research may be applicable to North America and other culturally similar regions.

Finally, even though the literature on NPD has been summarised and reviewed regularly (see, for example, Montoya-Weiss and Calantone, 1994; Brown and Eisenhardt, 1995; Ernst, 2002), the empirical findings on IPPM or PPM have not been summarised in the literature. The comprehensive review of the literature related to IPPM capabilities presented in this thesis is an important contribution as it is the first review to bring the literature together and to highlight and summarise the empirical findings in this field.

1.6 Limitations

The findings of this research should be considered taking into account the limitations of the study. The findings are based on Australian organisations representing a diverse range of industries. The 60 organisations represented in the quantitative Phase 1 survey and the six organisations studied in the qualitative Phase 2 multiple-case study may not be representative of all organisations or all environments. The Australian-based findings are strengthened by comparability with similar North American research (Cooper et al., 2001); however, the findings may not be applicable across these or other regions. In addition, the data collection for this study was done over a short period of time at each organisation, and future research employing longitudinal studies would be required to capture in-depth information about learning processes and the evolution of the PPM capability over time. Further discussions on the limitations of the research are included in Chapter 3 (Section 3.6) and Chapter 5 (Subsection 5.6.5).

1.7 Thesis structure

This thesis contains seven chapters, with two methodology chapters and two findings chapters, one each for the quantitative and qualitative research phases (Figure 1-2). Chapter 2 presents a comprehensive review of the literature related to IPPM capabilities and provides the theoretical and empirical background for the identification of research issues and the development of the research questions. Chapter 3 justifies and outlines the sequential mixed methodology research design developed to investigate the five research questions posed in Chapter 2. Chapter 3 also includes the detail of the research design for Phase 1 of the study via a quantitative survey. The findings of the quantitative phase are presented and analysed in Chapter 4. Chapter 4 also discusses the impact of the findings for the subsequent phase of research. An extended literature review to explore emerging themes is presented in Chapter 5, along with the final research design for Phase 2, the qualitative multiple-case study. The qualitative findings are then presented in Chapter 6. Chapter 7 brings together the findings from both phases of the research to address each research question, as well as the primary research question. Conclusions, discussion and identification of future research opportunities indicated by this research are also included in this final chapter.

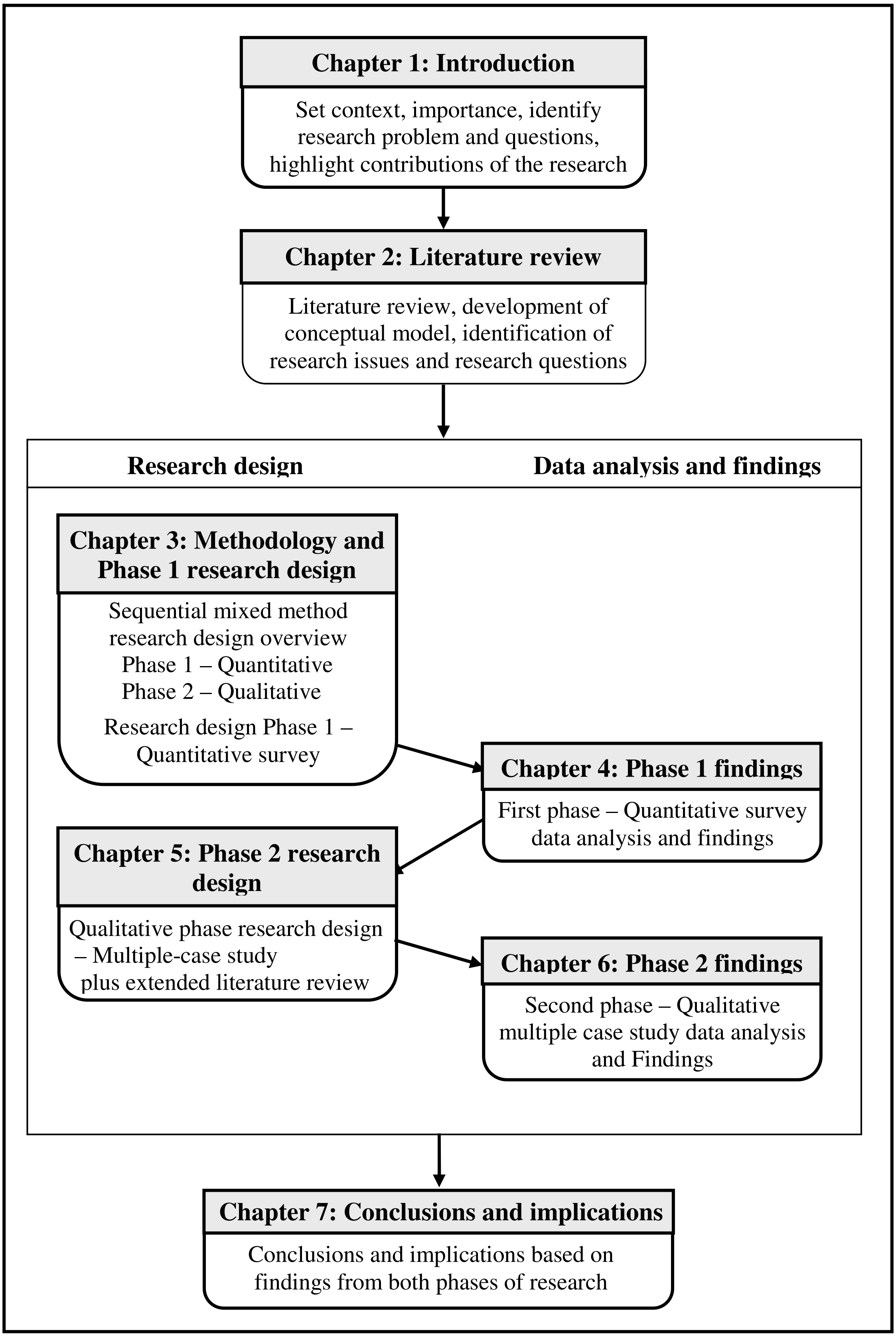

Figure 1-2: Thesis structure

Chapter 2 Literature review

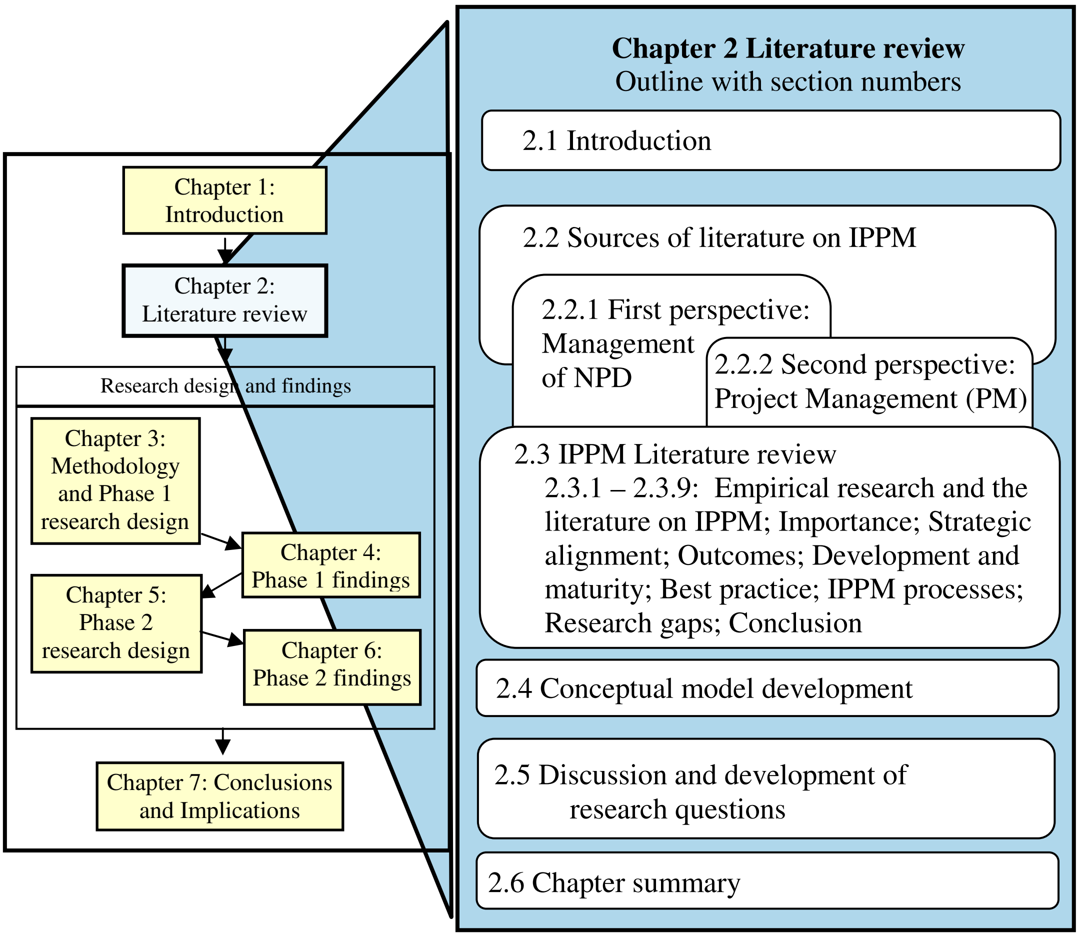

Figure 2-1: Chapter 2 outline within overall thesis structure

2.1 Introduction

Chapter 1 has established the context for research into IPPM capabilities, highlighted the escalating interest in this area and identified the research questions. This chapter draws together the literature on IPPM from a diverse range of sources and provides a base upon which to develop further research into IPPM capabilities. The literature review brings together the empirical research that focuses on IPPM as well as the closely related more general PPM literature. The findings of the literature review are used to develop a conceptual model (Figure 2-7, Section 2.4), while the five specific research questions discussed in Section 2.5 are based on five separate research issues identified from the literature.

Figure 2-1 outlines the structure of this chapter. This first section introduces the main concepts and clarifies the terminology used in this thesis. It also outlines the structure of the literature review and highlights the contributions of this review in furthering the understanding of IPPM practices.

2.1.1 What is Innovation Project Portfolio Management?

An 'Innovation Project Portfolio Management' (IPPM) capability is defined as 'the overall organisational ability to manage the innovation project portfolio and maximise its contribution to the success of the organisation'. It is an organisational decision-making capability that includes IPPM processes as well as organisational factors that contribute to the IPPM capability. The terms 'project portfolio', 'innovation project', and 'IPPM processes' are clarified here, followed by further discussion on the definition of an IPPM capability as used in this research.

Drawing from the definition of a 'portfolio' as a collection of investments, the Project Management Institute (PMI) defines a 'project portfolio' as "a collection of projects or programs or other work that are grouped together to facilitate effective management of that work to meet strategic business objectives. The projects or programs of the portfolio may not necessarily be interdependent or directly related" (PMI, 2006:78). A portfolio of projects is therefore a grouping of projects and programs to facilitate effective management to meet strategic business objectives (PMI, 2004). The 'project portfolio' differs from 'programs', which are a more tactical grouping of "related projects managed in a coordinated way to obtain benefits and control not available by managing them individually" (PMI, 2006:4). Programs may be included in a project portfolio along with other projects that are not part of a program.

'Innovation projects' are projects for the development of any type of new product, which can be new manufactured products, new service products or new products that comprise a combination of manufactured and service elements. The inclusion of service products in this definition reflects the growing importance of services in an area that has traditionally been associated primarily with manufactured products (Easingwood, 1986; Cooper and Edgett, 1999; Edwards and Croker, 2001). In fact, the blurring of the boundaries between manufactured products and service products is accelerating

(Andersson, 2000; Slack et al., 2004). The distinction between manufactured products and service products and the relative importance of the two is discussed below in Subsection 2.2.1. An innovation project portfolio is defined in this thesis, therefore, as ‘a collection of innovation projects that are managed centrally to meet strategic business objectives’.

‘IPPM processes’ are defined as ‘the practices, procedures, methods and tools that managers use for ongoing resource allocation and reallocation among a portfolio of innovation projects to maximise the contribution of projects to the overall welfare and success of the enterprise’. This definition is a combination of definitions in the literature (Cooper et al., 2001:3; McDonough and Spital, 2003:40; Levine, 2005:22), as outlined under the heading *Literature background for IPPM definition* below.

Some of the literature on IPPM focuses exclusively on these ‘IPPM processes’ (Iamratanakul and Milosevic, 2007; Hakkarainen and Talonen, 2008), while other literature also acknowledges the wider organisational factors that have a role to play (Elonen and Artto, 2003; Blomquist and Muller, 2006; Pellegrinelli et al., 2006; Christiansen and Varnes, 2008). Capability maturity models also provide a perspective on IPPM capabilities and include both process measures and other elements such as organisational structure, training and communication (PMI, 2003a; Crawford, 2007). A ‘capability’ in the IPPM context is an organisational capacity to deploy combinations of resources through organisational processes to produce a desired outcome, and it often involves the exchange and development of information (Amit and Schoemaker, 1993). The definition of an IPPM capability includes a wide scope to acknowledge the wider IPPM environment, and includes the ‘IPPM processes’ as a subcomponent of that capability.

The main goals of the IPPM capability are to maximise the value of the innovation project portfolio, align the portfolio with the strategy and balance the portfolio across important dimensions, such as between exploitation and exploration projects or across other dimensions like technology areas or product/market areas (Cooper et al., 2001; Levine, 2005). By managing the projects as a portfolio, an effective IPPM capability allows the holistic oversight that is required to meet these goals and to ensure that the number and types of projects are appropriate for the resources available. An effective IPPM capability is one that leads to improved product portfolio outcome (PPO) measures. PPO is used as a general term representing the performance of the products resulting from an IPPM portfolio. PPO measures are defined as 'measures that indicate the level of success of the new products resulting from the innovation portfolio'. A wide variety of measures can be used for PPO, and are often based on the ability of the product portfolio to meet financial, market or technical objectives.

As shown in Figure 2-1, the literature from the new product development (NPD) perspective overlaps with the literature from the project management (PM) perspective. Even though IPPM can be defined as a specific type of PPM, it is not a subset of PPM. In fact, much of the literature and research on IPPM developed earlier than the more general PPM literature, and it has been evolving since the 1960s from its base in the NPD discipline (Cooper et al., 2001). In contrast, attention to PPM from the PM community has been evident since the 1990s, and has become strong only in the past five or ten years (Levine, 2005). Furthermore, the PPM literature has drawn on research and publications focused on IPPM and extended the concepts to projects in general. As confirmed by the recent research findings (Cooper et al., 2004a; Jeffery and Leliveld, 2004; Center for Business Practices, 2005), similar portfolio management methods are used across the NPD and more general project environments. There are also indications, however, that IPPM capabilities need to be tailored for the individual environments and that each environment also has particular requirements that have prompted industry-specific methods, for example in the information technology (IT) industry (Maizlish and Handler, 2005) or the construction industry (Lowe, 2006). Although some of the research from other environments is drawn upon in this literature review, this study focuses on IPPM in NPD environments, and it is beyond the scope of this study to explore the differences between NPD and other environments.

Literature background for IPPM definition

Definitions of PPM and IPPM have been evolving as the discipline has become established since the late 1990s. While definitions originating in the NPD literature have a product focus and those based on PM have a project focus, in most respects the definitions agree on the essence of PPM or IPPM. A sample of definitions from both perspectives is presented here, followed by further explanation of the definitions adopted for this research.

A widely accepted and often cited definition of IPPM from the NPD literature, developed by Cooper et al. (2001:3) is: “Portfolio management for new products is a dynamic decision process wherein the list of active new products and R&D (research and development) projects is constantly revised. In this process, new projects are evaluated, selected, and prioritized. Existing projects may be accelerated, killed, or deprioritised and resources are allocated and reallocated to the active projects”. Artto (2001:9) recognises that each organisation develops a unique approach and defines IPPM as the “art and science of applying a set of knowledge, skills, tools, and techniques to a collection of projects to meet or exceed the needs and expectations of an organization’s investment strategy”. McDonough and Spital (2003:40) point out that IPPM is more than project portfolio selection as it also involves the “day to day management of the portfolio including the policies, practices, procedures, tools and actions that managers take to manage resources, make allocation decisions and ensure that the portfolio is balanced in such a way to ensure successful portfolio-wide new product performance”. Levine (2005:22) offers the following concise and generic definition of PPM: “Project portfolio management is the management of the project portfolio so as to maximize the contribution of projects to the overall welfare and success of the enterprise”, which forms the primary base for the definition of an IPPM capability used in this thesis.

The terms ‘IPPM capabilities’ and ‘IPPM processes’ used in this thesis are closely related, but have distinct meanings. ‘IPPM capability’ is used when referring to the overall organisational potential or capability that exists for the management of the innovation project portfolio. ‘IPPM process’ is used when referring to specific processes, procedures, methods and tools for IPPM.

This thesis uses the acronym IPPM, even though the term PPM is becoming standard in industry and is starting to be applied across all types of project environments including NPD environments. Because this thesis focuses on PPM for NPD, the non-standard acronym of IPPM has been adopted to refer to PPM in the ‘innovation project’ (or ‘NPD project’) environment. IPPM has been chosen for two reasons: (1) it is shorter and simpler than the other likely acronym of ‘NPD PPM’ or new product development project portfolio management; (2) it is a fresh term and does not invoke as many preconceived impressions as NPD PPM. Although NPD is defined in this thesis to include all products, whether manufactured or service-based, the term carries a strong association with manufactured products. The use of a fresh term like IPPM helps to reinforce the focus of this research on both manufactured and service product development projects. For this thesis, IPPM refers to the general fields of PPM and IPPM and the specific research in IPPM, while PPM is used only when quoting sources or when distinguishing research or findings related to general PPM environments from research or findings related to innovation project environments.

Although the term 'project portfolio management' (PPM) is becoming more standard, it is still not universally used in the literature or in practice (Milosevic and Srivannaboon, 2006). A range of terms are often used, particularly in literature that is more than 10 years old. For example, Hitt, Hoskisson and Nixon (1993) use the term 'commercialisation decision' to discuss the process of selecting the projects that will best achieve the organisation's strategy. In their influential book, *Revolutionizing Product Development: Quantum leaps in speed, efficiency and quality*, Wheelwright and Clark (1992a) proposed the Aggregate Project Plan (APP) as a key construct in a framework for product development. The APP is a form of IPPM process where one of the primary purposes is to establish the type and mix of projects that should comprise an organisation's product development portfolio over time. This type of aggregation of project resource requirements into a project planning and decision-making framework forms the basis for early IPPM processes; however, the term 'portfolio management' is not used by Wheelwright and Clark. In addition terms such as 'project pipeline management', 'project selection and prioritisation' or 'multi-project management' are often used to refer to processes that can be considered part of an IPPM process. Although the terminology in the literature is varied, when possible this thesis uses standard terminology as defined in this section and the glossary.

The initial foundation for IPPM and PPM derives from the financial portfolio management discipline. In its traditional financial sense, the term 'portfolio management' refers to the methods used to analyse portfolios of financial investments in order to select the best combination of investments to meet goals. Financial portfolio management, initially proposed by Markowitz in 1952 (1952), relies heavily on mathematical optimisation models and numerical financial data. Some PPM processes attempt to apply numerical models similar to those used for financial portfolio management. However, these models have not been successful due to the complexity of the project environment, and the necessity to incorporate multiple types of information and assist optimisation decisions along several dimensions (Coldrick et al., 2005). Therefore new approaches and methods have been developed, and PPM and IPPM have emerged as disciplines that are closely related to each other but quite distinct from financial portfolio management. Therefore, this literature review focuses on PPM and IPPM and does not address financial portfolio management further.

2.1.2 Introduction to IPPM processes

A typical process derived from those commonly outlined in the literature on IPPM is introduced here to provide a perspective on how IPPM processes are commonly structured. An established PM capability, consisting of a structured process with defined phases and decision points, is considered a prerequisite for an effective IPPM capability (Kleinschmidt, 2006). The combination of the PM and IPPM capabilities enables the organisation to gain the maximum value from project investments (Cooper et al., 2001; Dawidson, 2004; Pennypacker and Sepate, 2005). Figure 2-2 illustrates a typical IPPM process integrated with a PM process. A stage-gate style or process with defined stages and decision points (or gates) between the stages forms the backbone of a typical IPPM process (Cooper et al., 2001; O'Connor, 2004). The IPPM process provides portfolio level coordination so that decisions can be made to maximise the contribution of the overall portfolio rather than focus on projects individually for decision-making.

While there is no single process for IPPM, there are a set of commonly identified IPPM activities that involve "identifying, prioritizing, authorising, managing and controlling projects" (PMI, 2006:5). These activities include methods and tools such as checklists, financial models and portfolio maps, as well as processes for data collation and reporting, and portfolio review board formation. These activities are discussed in more detail in Subsection 2.3.7.

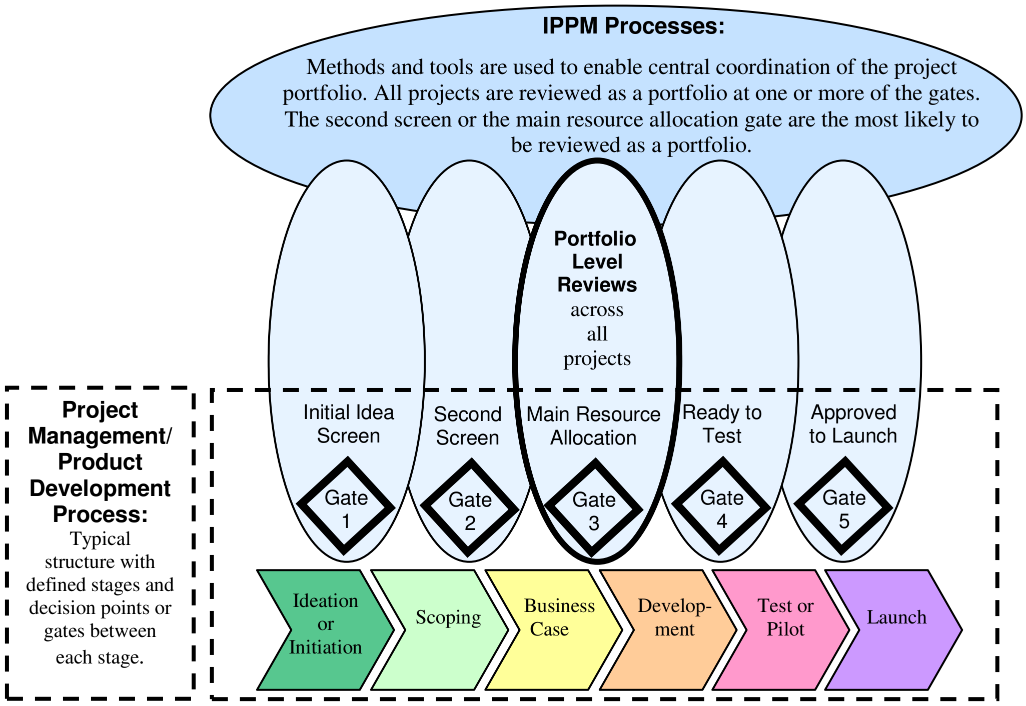

Figure 2-2: Typical integration of project and portfolio management processes
(built upon Cooper et al., 2001:291)

From a research perspective, the understanding of the IPPM processes is derived primarily from a study of practices or activities. For the purposes of this research, the terms ‘activities’ and ‘practices’ are used interchangeably. Some researchers (Cook and Brown, 1999; Chia and MacKay, 2007) draw a distinction between activities (behaviour or doing something that is imbued with meaning) and practice (“the coordinated activities of individuals and groups in doing their ‘ real work’ as it is informed by a particular organizational or group context” (Cook and Brown, 1999:386)). In short, practices can be defined as activities directed toward outcomes within an organisational or group context. The activities investigated as part of this research are studied as part of IPPM processes within specific organisational contexts, and therefore for this research it is appropriate to use these terms interchangeably.

2.1.3 Literature review overview

The literature on PPM and IPPM is published within a diverse set of disciplinary areas. There has been a surge of interest in IPPM since the late 1990s, resulting in increased research and publications. This literature review represents the first attempt to the author's knowledge to bring together the literature on IPPM and PPM and to report on all empirical research focused in the area or from associated areas with results relevant to IPPM.

The underlying goal for most of the publications and research on PPM and IPPM is to improve the outcomes from project investments. Some publications do this by proposing new methods and tools for PPM and IPPM, often with a case example or two outlining the application of the new methods. Other publications present the results of larger-scale research into PPM and IPPM methods and processes. Some of these studies attempt to identify the 'best practices' that are associated with improved outcomes. This literature review provides a summary of the progress in PPM and IPPM research to date.

Section 2.2 first outlines the two main perspectives that are responsible for most of the literature and research related to IPPM. Subsection 2.2.1 introduces the first perspective, the management of NPD. The section summarises the wide variety of disciplines that contribute to the literature on NPD, highlights the importance of service product NPD, provides an overview of NPD PM processes and IPPM processes from the NPD perspective, and finally reviews the literature on NPD and IPPM success factors and outcomes. Subsection 2.2.2 introduces the second perspective, the PM discipline and its perspective on PPM. This section highlights the strategic importance of PPM within the PM discipline and outlines the growth in publications and the evolution of PM standards to encompass PPM.

Section 2.3 includes the bulk of the literature review, drawing upon literature from both the NPD and the PM perspectives. This literature review highlights the main themes in the literature and identifies gaps in the literature. These gaps include the lack of a theoretical basis or explanation to underpin or unify the IPPM related research, the lack of studies investigating IPPM capabilities in service industries, and the lack of studies conducted in Australia. The literature review includes the first comprehensive overview of the empirical research related to IPPM capabilities. This research includes survey-based 'best practice' studies as well as other types of quantitative surveys and qualitative case studies.

Building on the main themes and relationships identified in the literature, Section 2.4 presents a conceptual model of the relationships between IPPM success factors and outcomes. This conceptual model and the gaps identified in the literature review are drawn upon in Section 2.5 to identify the main research issues and to develop the five research questions to drive the investigation. Section 2.6 provides a brief conclusion to the literature review and summarises the five research questions.

2.1.4 Contributions

This chapter provides an overview of literature and research related to IPPM and brings together the empirical research findings to date. There is no existing comprehensive review of the literature and research on IPPM. Therefore this chapter contributes to the field by providing a baseline for future research.

This literature review also brings service IPPM into perspective by highlighting the increasing importance of services to the economy of developed nations, and the increasing investments in projects for the development of service products. Despite the importance of service projects, this chapter shows that there is a lack of research focused on service-based IPPM and proposes that this is a major gap that needs to be addressed.

The lack of IPPM research in Australia is also highlighted in this literature review, signalling another gap to be addressed. In addition, a conceptual framework is proposed in this chapter illustrating relationships between the main success factors and outcomes reported in the literature.

The final contribution of this chapter is the identification of research issues and the development of the five research questions that drive this study.

2.2 Sources of the literature on IPPM

The literature related to IPPM derives from two main perspectives: the NPD perspective and the PM perspective.

The literature on IPPM and related resource allocation and portfolio planning capabilities has been developing within the NPD community for decades, initially focusing on R&D project prioritisation and technology selection activities in the 1960s. The identification of 'project portfolio management' terminology and concepts emerged during the late 1990s, although the related 'portfolio planning' terminology and mapping concepts had been around since the 1970s with the introduction of 'product portfolio planning matrices' (Wind and Mahajan, 1981; Hax and Majluf, 1983). More recently there has been a strong and growing interest in PPM from the PM community. Most of the existing research stems from the NPD environment, with strong growth in research and publications from the PM perspective. Therefore the empirical findings reported in this literature review derive primarily from the NPD perspective, although there are strong overlaps and contributions to IPPM from both the PM and NPD spheres. While the PM-based PPM literature is usually aimed at generic project environments rather than specifically focusing on NPD environments, the concepts are very similar.

This literature review first introduces the NPD and PM perspectives on IPPM and PPM. Then, due to the high level of overlap, the main themes and findings are presented together, drawing upon literature from both perspectives.

2.2.1 First perspective: management of NPD

The literature and research on NPD concentrates on understanding and improving the processes and the environment to improve outcomes from NPD projects. A stream of NPD literature focuses on identifying the factors that are associated with the development of successful products. These NPD success factors include inputs to the process such as the level of top management support, the skills and capabilities of staff and the use of certain tools or methods. IPPM processes, and elements of IPPM processes such as resource allocation methods, are among the success factors identified in NPD research (Brown and Eisenhardt, 1995; Ernst, 2002). The outputs of the NPD process are measured by evaluating the success of the resulting new products. This is often done by evaluating financial performance in the market, but can include other types of measures such as performance relative to goals, the level technology leadership or the ability to enter new markets. The measurement of new product performance is not straightforward, and for each environment the most appropriate measures must be determined before success factors can be identified. Figure 2-3 presents a schematic summary of the process, showing NPD success factors as an input to the NPD process leading to improved product performance.

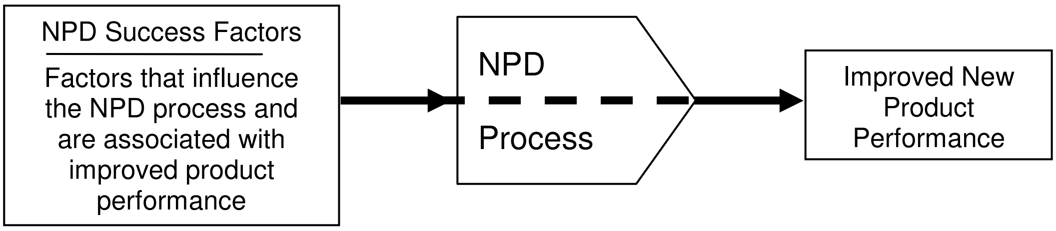

Figure 2-3: NPD success factors, NPD process and new product performance

This section initially presents an overview of the literature relating to the NPD environment, success factors and new product performance metrics for NPD. IPPM processes and activities are identified as important success factors for NPD, and IPPM-related considerations are included throughout this section. IPPM is therefore positioned within the NPD management discipline in this section before a general discussion of PPM literature from the PM perspective in the lead-up to a comprehensive review of IPPM literature.

Literature on NPD covers a wide territory and is found in several disciplines including marketing (Wind and Mahajan, 1997; Hauser et al., 2005), product development, engineering, operations management (Krishnan and Ulrich, 2001), technology management (Brady et al., 1997; Phaal et al., 2006) and strategy (Kim and Wilemon, 2002; Grimm et al., 2005). In addition, there are several niche areas of literature related to NPD, such as literature with a focus on PM (see, for example, Archer and Ghasemzadeh, 1999a; Thieme et al., 2003) or service product development (see, for example, Easingwood, 1986; Cooper and Edgett, 1999).

The cross-disciplinary nature of NPD research results in a difficult balance when attempting to limit and define the field while simultaneously including the many multidisciplinary considerations that impact this area (Drejer, 1997). In addition, because the literature is distributed through publications from many disciplines, there is not a consensus on the best avenue for publication of work in this field (Pilkington and Teichert, 2006). This literature review draws on publications from a variety of disciplines. Although the terminology used in the literature is not standard, this literature review adopts uniform terminology where practical (see glossary).

NPD for service products

Although NPD and IPPM research has traditionally focused on the processes involved with manufactured products, service innovation has become increasingly important and now makes a larger contribution to developed economies (Pilat, 2000). Services are generally distinguished from manufactured products by simultaneity of consumption and production of the service, and the intangible nature of services (Easingwood, 1986; Oden, 1997; Cooper and Edgett, 1999; Menor et al., 2002).

Many innovative sections of the service sectors are growing rapidly, and an increasing percentage of total organisational R&D expenditure is now dedicated to service innovation (OECD, 2000; Edwards and Croker, 2001). About two-thirds of GDP growth in OECD businesses between 1985 and 1997 was a result of the increases in the service sector (Pilat, 2000). In the manufactured product sector, ‘embedded’ services are a growing business with an estimated value of US$500 billion in 2006 (Auguste et al., 2006).

The research on NPD in services has escalated in recent years, reflecting the increasing importance of services. Most of this research focuses exclusively on service NPD; however, it is becoming increasingly clear that many organisations manage a portfolio of a mixture of both manufactured and service products (Andersson, 2000; Slack et al., 2004) and that the distinctions between manufactured product- and service product-based organisations are becoming blurred (Barras, 1990; Andersson, 2000; Slack et al., 2004; Teboul, 2006). For example, although General Electric is thought of as a ‘manufacturing’ company, GE now has a large business selling insurance and finance products. Another phenomenon involves the ‘service encapsulation’ of manufacturing products; for example, some aerospace engine manufacturers are providing engines as a ‘service’ based on hours of flight rather than selling engines (Howells, 2001). Strategic change is required to support the development and delivery of ‘embedded services’ by manufacturing-based organisations (Auguste et al., 2006), or ‘value-added’ services to support basic physical components (Gann and Salter, 2000), but strategy is often still focused on the tangible aspects of the businesses. This presents challenges as many organisations “find themselves grappling with strategic issues concerning the embedded services offered by them”, and the resulting confusion “seriously hampers the profitable pricing and delivery of embedded services” (Auguste et al., 2006:40).

The best approaches to studying service NPD are not agreed upon, although there is general agreement that current commonly used success measures for innovation may not be adequate. Some researchers believe that more ‘service focused’ studies are required (Menor et al., 2002), while others think that as the distinctions become blurred it will become more and more difficult to measure service and manufacturing product innovation separately, and that instead we need more comprehensive studies involving both service and manufactured products to capture the interactions (Edwards and Croker, 2001). The combination of service and manufacturing organisations in NPD research is supported by recent global NPD research that has found no significant differences between the two groups (De Brentani and Kleinschmidt, 2004; Kleinschmidt et al., 2007). In reality many products lie along a continuum between pure tangibility and pure intangibility (Shostack, 1982; Cooper and Edgett, 1999). Many typical manufactured products have an intangible or service component, for example a warranty and service agreement with a car. Toward the other end of the spectrum, many service products involve some tangible or manufactured elements, for example a service product of a ‘facial’ may also include the application of some cosmetic products. Nearer the centre of the tangible/intangible spectrum is a fast food restaurant or a mobile phone company. Some studies rate products on a ‘goods-services’ continuum to reflect the blending of the two ends of the spectrum (Shostack, 1982).

Although the bulk of NPD research has focused on manufacturing environments, there have been increasing efforts to investigate NPD for services and to define success factors for service-based NPD research during the past 15 years (Cooper and de Brentani, 1991; de Brentani, 1991; Griffin, 1997; Cooper and Edgett, 1999; Menor et al., 2002; Hull, 2004; Alam, 2005). NPD processes traditionally used in manufacturing industries are shown to be applicable to service operations with minor adjustments

(Hull, 2004). NPD research has indicated that service-based organisations are at a lower level of maturity with respect to NPD processes (Griffin, 1997). The lower level of maturity in service-based organisations is reported based on the fact that many have no NPD process at all – and those that do are likely to have an informal process with fewer steps than a typical NPD process in a manufacturing-based organisation. In addition, most traditional NPD methods and tools have been first developed for manufacturing environments, and established measurements of innovation success (such as patent rates) are often based on manufacturing and may not be relevant for most service products. There has been a continuing pattern of service companies adapting NPD process elements (designed for a manufactured product development) to the service development environment. This trend was identified by Easingwood (1986) in his observations of concept testing methods and it has continued with respect to other NPD tools such as Quality Function Deployment (QFD), Six Sigma and the Stage-Gate process (for examples, see Cooper and Edgett, 1999; Natarajan et al., 1999; Mader, 2002). The later application of many NPD tools to service development may explain the lower level of the maturity of the service-based NPD applications.

The NPD process

Models of the NPD process are abundant in the literature. The NPD processes for tangible or manufactured products are usually represented as a set of sequential phases or stages that progress an initial idea through design and development and then manufacturing (see, for example, Ulrich and Eppinger, 2000). Other models of the NPD process include extensions of the process through the launch or benefits realisation stages of the project (see, for example, Englert, 1990; Tidd et al., 2005). The most popular NPD processes are 'stage-gate' style of processes that includes sequential phases or 'stages' with checkpoints or 'gates' between each stage (Cooper, 1990). A research study involving 363 organisations showed that over half of the organisations used a structured gated process, with higher levels of adoption of gated processes associated with the higher performing organisations (Griffin, 1997) Gated development processes are also identified in service product development environments (Griffin, 1997; Cooper and Edgett, 1999; Milosevic and Srivannaboon, 2006; Cauchick Miguel, 2008), but at a lower level of use (about 40%) than in the manufacturing organisations (Griffin, 1997).

Figure 2-4 shows a typical stage-gate process for manufactured- or service-product development. Each stage of the process is followed by a 'gate' (represented in a decision diamond) where the status of the project is reviewed and a decision is made about whether the project satisfies criteria to move on to the next stage. Although NPD processes are often shown in sequential phases, concurrent engineering processes are often used to overlap the phases, improve cross-functional communication and reduce product development time (Clausing, 1994; Ranky, 1994), prompting variants of product development processes that support concurrent project operation to be proposed (Cooper, 1994; Lindkvist and Söderlund, 1998). Figure 2-4 also includes a final review step called a Post Implementation Review (PIR) which is not a standard part of most product development or stage-gate processes in the literature. The PIR is a final review of the outcomes of the project that is conducted long enough after project completion to determine whether the proposed benefits have been realised (von Zedtwitz, 2002; Labuschagne and Brent, 2005).

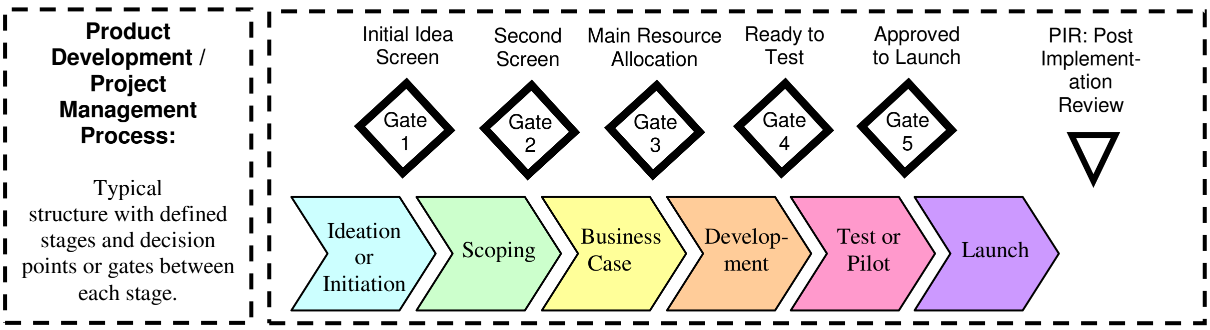

Figure 2-4: Typical stage-gate NPD process (derived from Cooper et al., 2001)

NPD literature highlights the fact that the early stages (sometimes referred to as 'front-end' stages or 'the fuzzy front-end') of the NPD process are much more important than an initial explanation of the process might indicate. Although most of the money is spent during the later stages of the NPD process, it is the early decisions that have the largest influence (Smith and Reinertsen, 1991; Wheelwright and Clark, 1992a; Khurana and Rosenthal, 1998). These early decisions are largely focused on project selection and resource allocation through the criteria applied at the early gates in the stage-gate process. In a typical stage-gate process, the early gates often are used for a two-stage idea review and idea selection process. Later gates are then used to monitor and evaluate the progress of projects and to kill projects that are not meeting requirements. The NPD process is a filtering process, where many ideas are encouraged to enter the process, and the gates are used to trim down the number of projects and to select the best ideas to continue the process. In some models this process of reducing the number of projects is viewed in the shape of a funnel (Wheelwright and Clark, 1992a; Ulrich and Eppinger, 2000).

The literature repeatedly emphasises that a single type of NPD process will not be suitable for all types of product development projects (Eisenhardt and Tabrizi, 1995; Coombs et al., 1998; Payne and Turner, 1999; Loch, 2000; Buijs, 2003; Koberg et al., 2003). Short-term incremental projects that exploit existing capabilities and longer-term more radical projects that explore new areas require different approaches (Khurana and Rosenthal, 1998; Benner and Tushman, 2003). Although there are some situations where specialisation in either exploitation or exploration may be an effective strategy, there is consensus in the literature that some form of balancing of exploitation and exploration activities is required for most organisations to achieve sustainable competitive advantage (Zaltman et al., 1973; Ali et al., 1993; Gupta et al., 2006). Linear, centralised and structured processes (such as a typical stage-gate processes) that focus on reliability and standardisation are appropriate for incremental innovation or 'exploitation', but may constrain the ability to create radical innovation through 'exploration' (Jansen et al., 2006; McCarthy et al., 2006). Therefore organisations must develop specific capabilities for ambidexterity to be able to effectively pursue both exploitation and exploration (Tushman and O'Reilly, 1996; Benner and Tushman, 2003; Jansen et al., 2006). Top management have a central role to play to ensure that organisations "engage in sufficient exploitation to ensure its current viability and, at the same time, to devote enough energy to exploration to ensure its future viability" (Levinthal and March, 1993:105). This often requires a segmentation of budgets, structures and processes for exploitation and exploration activities (Ettlie et al., 1984) and management involvement in planning and guiding exploratory innovation (Tripsas and Gavetti, 2000; Greve, 2007). IPPM capabilities provide the structures for top management involvement to influence the balance between exploitation and exploration projects and IPPM processes often include tools to manage budget segmentation, and to tailor the product development process to the project type (Cooper et al., 2001). Therefore IPPM capabilities have a strong role in helping organisations balance their project portfolio (Matheson and Menke, 1994; Tatikonda and Rosenthal, 2000a; Cooper et al., 2001).

NPD and IPPM outcomes: product portfolio outcome (PPO) measures

Organisations aim to gain competitive advantage through their NPD efforts by creating more value than competitors are able to achieve (Barney and Hesterly, 2006). A primary goal of NPD research is to help organisations improve new product success rates and therefore increase the value returned for innovation project investments. However, measuring the success of new products is not straightforward. As used in this thesis, the term ‘product portfolio outcome’ (PPO) refers to a range of measures of both individual and portfolio-level new product performance. Most measures of PPO are based on meeting financial, market or technical objectives. Financial and market objectives both measure success in commercial terms and their use is very widespread (Montoya-Weiss and Calantone, 1994).

Organisations generally use more than one measure of PPO in their IPPM processes to cater for the multiple dimensions of success and to increase their overall understanding of the new product success. There is no standard set of PPO measures to evaluate the success of product development projects. The best metrics for one type of development activity may not be appropriate for others (Hauser and Zettelmeyer, 1997) and the measurement of innovation success can be difficult due to the complexity of the environment and the unique set of challenges faced by each industry (Mikkola, 2001). This makes it difficult to generate confidence in the measures or to compare measures across different environments. Griffin and Page (1993) found 75 distinct measures of PPO reported in the literature, highlighting the difficulty that organisations and researchers have in determining which are the most appropriate.

PPO can be measured through metrics that measure individual product performance or through metrics of portfolio level NPD performance. Typical individual product metrics for PPO include financial measures (ROI, profit goals, margin), market-based measures (market share, customer satisfaction, number of customers), technical measures (performance, quality, technology innovation and leadership) and NPD process measures (speed to market, development cost) (Griffin and Page, 1996).

A comprehensive review of the literature has found that the use of a combination of measures is correlated with better overall new product success rates. The best combination was found to include both product effectiveness measures that represent a strategic perspective of product opportunities, and process performance parameters that measure the successful execution of the NPD process (Brown and Eisenhardt, 1995). These findings correlate with another study that found that the most commonly used PPO measures were related to strategy (measures of product advantage, technological synergy and marketing synergy) or to aspects of the development process (measures of process proficiencies and skills) (Montoya-Weiss and Calantone, 1994).

The challenge to find appropriate portfolio level measures of IPPM performance is compounded by the difficulty in identifying relevant cross-industry project level PPO measures. While there have been advances in the understanding of the IPPM process, links between the IPPM process and product success are still not well understood, and there is a need to improve understanding of IPPM process decisions and how they relate to performance outcomes (Hauser, et al 2005, (Menor et al., 2002). Portfolio level measures are often an aggregation of individual project measures for an overall portfolio view of performance on these measures. In addition, specific portfolio level measures for PPO include aspects that are particularly relevant at a portfolio level perspective, such as overall measures of the new product success rates, measures of strategic fit (fit with business strategy, meeting objectives, leads to future opportunities) and portfolio level technical measures (percentage of sales or profits under patent protection) (Griffin and Page, 1996).

While empirical studies attempt to find standard measures for PPO across several environments, the research indicates that the situation is too complex, and that each environment may lend itself to different measures that will best indicate the overall success of the NPD program (Mikkola, 2001). Several researchers have found that specific measures can be recommended for certain situations. One study of determinants of firm-level product portfolio outcome measures has suggested that the most appropriate measures can be determined based on the business strategy that the NPD effort is supporting (Griffin and Page, 1996). Other studies have suggested that many measures are focused on the short term, which can cause risk-averse behaviour and disadvantage the long-term success of the organisation. The type of environment and activity will determine the most appropriate measure for decision-making in the longer term (Hauser and Zettelmeyer, 1997). Some measures actively discourage the evaluation of a full range of possible ideas by measuring and rewarding internally developed technologies and not acknowledging the benefits from seeking out good ideas from outside the organisation. The research shows that the net results will be more productive development if all sources of ideas, both inside and outside the company, are measured and rewarded (Hauser and Zettelmeyer, 1997; Hauser, 1998).

Due to the difficulties involved with comparing performance across cases in different industries or different competitive environments, the best measures of PPO are often viewed relative to competitors. This makes the competitors the standard of comparison on the performance scale, which can, however, be more relevant than objective data used out of context (Matsuno et al., 2002; Joshi and Sharma, 2004). Self-reported measures of market share, the percentage of new product sales to total sales, and return on investment can be used to provide relative business performance indicators.

Services and product portfolio outcomes

The difficulties in determining appropriate success measures to study NPD and IPPM processes has been highlighted with respect to research primarily on manufactured product development environments. Appropriate outcome measures are even more difficult in a service development environment and, although some NPD studies include service products as well as manufactured products (Griffin and Page, 1996; Griffin, 1997), the measures used have largely been developed for manufactured products. Service product development studies and measurement of service product success rates are in their infancy relative to manufactured product studies (Menor et al., 2002). In addition, the use of metrics that are biased toward manufactured product attributes can make the results of studies of new service product development less relevant. The nature of the variation between and among services means that measuring against their own performance history may be more meaningful than measures against some external benchmark measure (Harmon et al., 2006). Yet the simultaneous nature of production and consumption of services makes it difficult to measure the costs associated with the delivery of the service product (Easingwood, 1986). Practitioners suggest extra care be taken to look for the deeper root causes of financial expenses associated with service products (Harmon et al., 2006).

NPD and IPPM success factors

The factors that are associated with superior new product outcomes have been the subject of numerous NPD research projects. A review of the empirical literature on success factors for NPD highlights the work of Cooper, Edgett and Kleinschmidt on success factors for NPD including IPPM (Ernst, 2002). Other empirical studies of front-end NPD processes reveal IPPM-related success factors (Murphy and Kumar, 1997) such as initial screening (Parry and Song, 1994), preliminary market and technical assessment (Dwyer and Mellor, 1991), business and financial analysis (Parry and Song, 1994) and careful project selection (Rothwell et al., 1974).

Many of the success factors repeatedly highlighted in NPD studies relate to IPPM processes or aspects of IPPM processes such as planning and resource allocation, and point to the need for better IPPM processes (Montoya-Weiss and Calantone, 1994; Brown and Eisenhardt, 1995; Ernst, 2002; Thieme et al., 2003). In addition to the process-based success factors, NPD research repeatedly identifies several environment-based success factors or 'soft resources' such as senior management support, cross-functional communication, teamwork and a supportive culture (Montoya-Weiss and Calantone, 1994; Nobeoka and Cusumano, 1997; Krishnan and Ulrich, 2001; Ernst, 2002; Thieme et al., 2003; Cooper et al., 2004b; De Brentani and Kleinschmidt, 2004). Similar environment-based success factors are also highlighted in the IPPM literature (Cooper et al., 2001; Kendall and Rollins, 2003; Levine, 2005). The level of importance placed on the IPPM capability and the level of support from senior management are repeatedly highlighted as success factors for IPPM (Cooper et al., 2001; Kendall and Rollins, 2003; Yelin, 2005).

Management styles and skills can also affect the success of NPD projects, with the management of project portfolios presenting additional challenges. Communication, experience, ownership and a flexible approach to management were all found to be more important for the management of portfolios of projects than for managing individual projects (Frick and Shenhar, 2000). An identified need for better understanding of the different managerial responsibilities between the project level and higher levels (Brown and Eisenhardt, 1995) is now being addressed in the literature. Different management skills are found to be required at the two levels (Khurana and Rosenthal, 1998; Pellegrinelli et al., 2006), and a recent study has helped to clarify the responsibilities of managers with respect to the IPPM process, as distinct from the responsibilities of the individual NPD project managers (Blomquist and Muller, 2006). The findings support a contingency approach suggesting that roles and responsibilities will depend upon the environment. Similarly, research has confirmed that there is no standard approach to the assignment of responsibility for the IPPM capability to specific departments or managerial positions, suggesting that these decisions are tailored for each environment (Center for Business Practices, 2005). The negative influence of politics and conflicting motivations on the outcomes of IPPM processes must be acknowledged and addressed by going "beyond resource allocation and … addressing incentive structures, accounting systems, and other deeply embedded features of the organisation" (Engwall and Jerbrant, 2003:408).

Summary of first perspective: management of NPD

Research and literature on managing the NPD process place emphasis on identifying the strategic, process and environmental factors that are related to improved outcomes. This literature is cross-disciplinary in nature and includes a relatively recent emphasis on NPD for services in response to the growth in activity and the level of importance of new products in the service sector.

Multiple measures are used to measure the outcomes from the NPD process and different measures are appropriate in different environments and industries, presenting a challenge for cross-industry research. Common PPO metrics include financial, strategic and process related measures at the individual and portfolio levels. The use of multiple measures of PPO provides a better picture of the situation than reliance on a single measure.

IPPM capabilities are one of the success factors that have been identified as associated with improved NPD process outcomes. There is a strong base of literature on IPPM from the NPD perspective reflecting the attention and importance paid to the role of IPPM in improving new product outcomes. The IPPM literature shows that success factors for IPPM and NPD include process- and environment-related factors.

2.2.2 Second perspective: project management (PM)

The PM discipline has been evolving and maturing over the years, although in recent years there has been a marked shift in PM circles to look more at multiple-project environments and the strategic impact of projects (see, for example, Söderlund, 2004; Martinsuo and Ikavalko, 2006; Artto et al., 2008). PPM has gained recognition and attention from the PM community because of its role in focusing efforts on organisational rather than project outcomes. The PM literature repeatedly puts forward the proposition that PPM will assist in maximising the organisational returns from project investments and improve the links between projects and strategy.

PM is associated with many types of projects (Pinto and Kharbanda, 1996; Pinto, 2007), and there are many definitions for the term ‘project’. Generally the definitions involve change, novelty and goals (Webb, 1994), and the fact that each project is a novel and unique undertaking. This thesis is concerned with innovation projects that fit into the definition of a project as “a temporary endeavour undertaken to create a unique product or service” (Wideman, 2004:14). PM involves the task of directing projects (Webb, 1994) and is usually viewed as a combination of systems, tools, people and skills applied to projects to help projects meet requirements (Wideman, 2004).

PM is therefore a very broad discipline, and publications in PM cover not only the many types of project environments, but also a range of topics such as project tools, project teams and governance (see, for example, Knutson, 2001; Englund and Graham, 1999; Hill, 2004; Wysocki, 2007; Crawford et al., 2008; and literature reviews such as Betts and Lansley, 1995; Söderlund, 2004; Artto et al., 2008; Kwak and Anbari, forthcoming). This literature review does not attempt to address the breadth of the PM discipline. This section of the literature review introduces very briefly the PM discipline and its relationship to PPM, and presents overviews of a few topics that provide background for the literature on IPPM presented in Section 2.3.

Project portfolios can be configured at many levels within the organisation, such as enterprise-wide, divisional or business unit levels (Cooper et al., 2001; Levine, 2005). Often decisions are made within a portfolio that contains certain types of project, such as basic research projects, innovation projects, corporate change projects, IT projects or infrastructure projects, however some project portfolios contain a mix of project types. Project portfolios represent a set of projects sponsored and coordinated centrally, drawing upon a shared set of resources. Problems arise when projects outside the portfolio decision-making process draw upon the same resources (Blichfeldt and Eskerod, 2008).

This section introduces the PM perspective on PPM, focusing on the PM literature that is relevant to IPPM. The term 'PPM' is primarily used in this section because the PM literature tends to be aimed at PPM in general and is not necessarily focused on innovation projects. It provides evidence of the increasing impact of PPM and shows how interest in PPM has escalated in recent years. The role of strategy and the mechanisms linking strategy to projects are also briefly reviewed in this section. Because of large areas of overlap, the PM-based literature that is related to IPPM, and findings from the NPD-based literature, are discussed together in Section 2.3.

Evidence of increasing interest in PPM in PM

Project portfolio management is a rapidly developing field for innovation research and practice, and awareness and application of PPM practices is growing. Chapter 1 established the importance of IPPM and noted that in recent years there has been a surge of interest in PPM, as innovation has become understood as the main driver of economic growth in developed nations and as organisations have become increasingly project-based. This section provides evidence, largely but not exclusively from the PM perspective, of the increasing importance of PPM. Evidence from published literature is outlined first, followed by evidence in the evolving PM standards.

The rise in PPM interest and research is shown in the increasing rate of publications focusing on ‘project portfolio management’ and related areas. For example, peer-reviewed citations that include ‘project portfolio management’ in the title, abstract or text have increased dramatically. In two major journal databases such citations have risen from eight in 2000–2001 to 72 in 2005–2006 (EBSCO, 2008; ProQuest, 2008). A review of PM-related publications in management journals over the past 50 years reveals that PPM and strategy topics represent the highest proportion and show a steady upward trend that is expected to continue (Kwak and Anbari, forthcoming). In addition, PPM is fast becoming a standard module for PM education, and management textbooks are starting to acknowledge PPM as one of the mechanisms linking projects to strategy. The latest editions of several PM textbooks have incorporated a chapter or section on PPM to address the role PPM plays in the management of projects (Knutson, 2001; Hill, 2004; Kerzner, 2004; Pinto, 2007; Wysocki, 2007; Gray and Larson., 2008).

PPM is becoming reflected in changes to PM standards and documentation as it becomes recognised as an important related discipline. In 2003, the Project Management Institute (PMI) released the Organisational Project Management Maturity Model (OPM3). OPM3 is focused on the relationship between project, program and portfolio management in implementing organisational strategy (PMI, 2003a). One of the major developments in PM as a discipline has been the definition of a ‘project management body of knowledge’ (PMBOK) by the Project Management Institute. The PMBOK was first released in 1996 and has been revised and updated in 2000 and 2004. PMI is working on incorporating PPM guidelines into the latest version of the PMBOK (PMI, 2003a, 2004).

These publications provide evidence of the increasing importance and visibility of PPM in the PM community, which is mirrored by other phenomena such as the increased numbers of seminars and conferences focusing on PPM and the increasing number of software packages available to assist with PPM. For example, the local chapter of PMI selected PPM as a theme for events during 2007 (PMI, 2007) and the PMI global research funding program identified PPM as one of the focus research areas for 2009. The request for proposals acknowledges that “project portfolio management has only become an important topic in the field of PM in recent years. There has been very little research on the topic outside of the field of new product development” (PMI, 2008).

Strategic importance of PM and PPM

For project-based organisations, PPM methods are an important link between strategy and organisational actions and an important part of strategic management process. Strategic management is a high level organisational function to develop policies and plans to achieve objectives over the long term (Hill and Jones, 1998; Johnson et al., 2005). The implementation of strategy involves putting the strategy into action by designing appropriate organisational structures and controls and managing change while ensuring fit with the strategy (Hill and Jones, 1998). Part of the strategic management process involves decisions about which activities an organisation should pursue to best realise strategic goals. In a project environment these decisions revolve largely around the resource allocation among projects in the portfolio. Whether it is done formally or informally these organisations need to set directions, make decisions and determine performance goals in order to achieve competitive advantage. However, even when there is a formal strategy in place, many organisations fail to effectively align their plans with the strategy and place top priority on improving this alignment (Dye, 2006).

One of the main reasons cited for the increased importance of PPM from the PM community is to improve the alignment of projects with strategy. Historically PM has been viewed as an operational rather than a strategic asset (Jugdev and Thomas, 2002) and success has been measured in operational terms such as budget and time metrics. More recently researchers and practitioners have begun to promote the measurement of the strategic impacts of project outcomes (Jugdev and Thomas, 2002; Dinsmore, 2006). It is increasingly emphasised that it is not enough to perform projects really well if the wrong projects are being completed (O'Connor, 2004; Levine, 2005). A popular distinction between PM and PPM is that PM focuses on "doing projects right" and PPM focuses on "doing the right projects" (Cooper et al., 2001). The rationale is that even when on budget, in time and to scope a project may not deliver the desired organisational benefits such as profit, market share or leadership. Furthermore, some projects that are viewed as a failure from an operational perspective (due to exceeding time or budget, for example) may actually be very successful in terms of their contribution to organisational revenue (Stander and Buys, 2008).

As the PM community has strengthened its focus on the strategic aspects of PM, it has also placed a higher level of importance on PPM. This recent attention to PPM from the

PM community has a particularly strong strategic focus. Pinto (2007:101) sums this focus up well by noting that "profitability often runs through the area of strategic project management. One of the most effective methods for aligning profit objectives and strategic plans is the development of a proactive project portfolio." The NPD literature also highlights the strategic goals and benefits of IPPM and the role of IPPM in the alignment of strategy and projects. Subsection 2.3.3 presents more detail on the strategic aspects of IPPM capabilities by drawing upon both NPD and PM literatures.

Summary of second perspective: PM

This section has outlined the PM perspective on PPM. PM has been presented as a broad practice-based discipline that is involved with a variety of project types, and is of increasing importance within organisations. There is a growing recognition of the strategic importance of not only doing projects 'right' but in 'doing the right projects'. The escalation of literature on PPM from the PM community is highlighted in this review to indicate the emergence of PPM as an important capability within that community.

2.3 IPPM literature review

As outlined in Section 2.2, the literature related to IPPM capabilities is generated from two overlapping perspectives: a perspective based on the management of NPD projects and processes with cross-disciplinary origins, and a perspective that is interested in the management of projects in general emanating from the PM community. As the main themes are common across both perspectives, this literature review combines findings from both perspectives within these main themes. The term IPPM is used throughout this literature review, with one exception. Subsection 2.3.6 contains a section on 'general' PPM benchmarking studies and maturity models from the PM perspective that are specifically *not* based on NPD environments, and so the acronym PPM is used.

2.3.1 Empirical research and the literature on IPPM

A growing body of literature on IPPM capabilities is available from both the NPD and PM perspectives. Much of this literature includes anecdotal reports and assumes that relationships exist between IPPM practices and outcomes. However, the empirical evidence on IPPM capabilities is limited. This literature review presents a comprehensive summary of the empirical findings that add to the understanding of IPPM. Some of these empirical studies focus on IPPM or PPM or multi-project management processes, while others focus on more general NPD or PM questions and include findings relevant to understanding IPPM.

A primary contribution of this thesis is the first comprehensive review of literature related to IPPM. This literature review includes a wide range of literature from multiple disciplines and includes papers with and without empirical research and evidence. Many of the IPPM publications focus on summarising and proposing IPPM methods and tools and may not include any empirical research. Empirical research studies are an important part of the IPPM literature collected for this review, and these have been collated and presented in an annotated reference list in Appendix 1. This list briefly summarises each empirical study and the main findings related to IPPM. Most of the empirical studies reported include quantitative surveys or multiple-case studies. Papers that present a single case example are not generally considered empirical research for the purposes of this review. Nonetheless, a few comprehensive single case studies have been selected for inclusion in the annotated list where the research methodology provides strong support for the findings presented.

The findings presented in the following sections include references to the empirical studies included in Appendix 1 as well as references to other literature relevant to IPPM capability understanding.

Underlying theory for IPPM research

There is no standard framework or theory behind most IPPM research other than a general proposition that some aspect of the IPPM methods used will have an effect on the resulting success of the innovation program. One exception is an empirical study that included IPPM within a theoretical framework that examines the links between business strategy and PM (Milosevic and Srivannaboon, 2006). The framework classified the business strategies in terms of the competitive strategies outlined by Porter (1980) and explored links with PM capabilities including project portfolio management processes. Portfolio management and strategic planning were found to mediate the relationship between strategy and projects. Several other authors have also proposed a variety of frameworks and processes for IPPM, outlining a series of steps and success factors for an IPPM process (see, for example, Archer and Ghasemzadeh, 1999a; Combe, 1999; Stummer and Heidenberger, 2003; Archer and Ghasemzadeh, 2004), although these were without further links to existing theories.

The empirical research on IPPM has focused largely on determining success factors or links between IPPM practices and successful outcomes. Almost all studies indicate that a standard IPPM process is not appropriate across different organisations, and that the process must be customised to suit the particular environment. While these findings represent a start in the development of understanding about IPPM practices and outcomes, the lack of a common theoretical grounding or framework limits their impact.

2.3.2 The importance of IPPM

The high and increasing level of attention and importance placed on IPPM stems from the increasing reliance on new products to organisational success and from findings that relate IPPM capabilities to improved new product outcomes. As highlighted in subsections 2.2.1 and 2.2.2, IPPM importance is strongly reflected in both the NPD and PM perspectives that form the bulk of IPPM literature. The literature regularly asserts that IPPM importance and senior management commitment and involvement are important success factors for IPPM (see, for example, Kendall and Rollins, 2003; Levine, 2005).

These assertions are supported by research findings that repeatedly reflect the high and increasing levels of importance placed on IPPM in organisations. The level of importance placed on IPPM in a particular environment is measured directly in some studies through responses related to the level of importance, or indirectly through proxy measures such as the level of support provided for the IPPM capability. Both direct and indirect measures of IPPM importance consistently reveal that better PPO measures show strong correlation with high levels of importance placed on IPPM, particularly from executive levels of the organisation (Cooper et al., 1997b, 1999, 2004a; Murphy and Kumar, 1997; Dye and Pennypacker, 1999; Center for Business Practices, 2005; Morris and Jamieson, 2005; Kapur et al., 2006; Pellegrinelli et al., 2006). One study has indicated that the level of importance placed on IPPM capabilities is a driving factor leading to improved outcomes (Cooper et al., 1999); however, causality has not been established in any of the studies relating IPPM importance to successful IPPM outcomes.

The level of importance placed on IPPM is also indicated by how organisations expect their IPPM capabilities to evolve in the future. The majority of survey respondents in several recent surveys plan to increase or improve their IPPM efforts in the near future (Center for Business Practices, 2005; Dye, 2006). These future plans emphasise the improvement of links with strategic plans through the IPPM capability.

In summary, the literature on IPPM consistently claims that the level of importance placed on the IPPM capability is related to improved outcomes from the portfolio of products. Organisational factors such as high levels of commitment and support, particularly from executive levels, are believed to contribute to the success of the IPPM capability in delivering improved new product outcomes. Several studies have produced empirical results supporting these assertions and revealing strong correlations between importance and success of IPPM capabilities.

2.3.3 IPPM and strategic alignment

The importance of IPPM, especially at the executive levels of the organisation, stems from the ability of the IPPM capability to align projects with strategy. This section highlights the literature and findings related to IPPM and strategy.

IPPM as a strategic decision-making process

The literature highlights that IPPM is primarily a strategic decision-making process which involves identifying, minimising and diversifying risk, and understanding, accepting and making trade-offs. IPPM decisions form an important part of the many decisions that are central to the NPD process (Krishnan and Ulrich, 2001). The importance of making decisions based on clearly defined goals and objectives and continually monitoring portfolio performance toward the achievement of the goals and objectives is repeated throughout the literature (see, for example, Matheson and Matheson, 1998; De Reyck et al., 2005). In fact, decision-making is viewed by some authors as the next frontier for quality improvement (Matheson and Menke, 1994).

The bulk of IPPM literature assumes that decisions are made on a rational basis within an IPPM process. However, some authors question this assumption and find that other influences on IPPM decisions can result in less than rational outcomes (Eskerod et al., 2004; Christiansen and Varnes, 2008). Influences from peers or managers, the level of complexity of the decisions, and the organisational learning processes that reinforce certain decision types all affect decision-making and are shown to lead to IPPM decisions that do not follow the rational calculative decision-making processes often assumed for IPPM. Humans also have a tendency for bias towards excessive optimism; however, an IPPM process can address such human shortcomings by improving transparency in the decision-making process (Lovallo and Sibony, 2006).

Linking strategy and projects through the project portfolio

In order to ensure that the projects in the portfolio are the best projects for the organisation, a particular focus of IPPM processes is on the alignment of projects with strategy. According to some authors, IPPM can act as a strategic hub at the centre of strategic, operations and project functions or as a bridge between corporate strategy and PM (Levine, 2005). This section presents an overview of the literature linking projects to strategy and highlights the central role of IPPM in this process. IPPM activities are shown to be ‘micro-strategising’ activities that implement strategy as well as influence strategic evolution.

Numerous models are presented in the literature to show the relationship between the project portfolio, corporate level strategy and PM. In some models the flow of information is one-way from top-down, and in other models a two-way relationship is shown between strategy and projects.

The cascade model (Turner, 1999) shows a one-way link between corporate strategy and projects. In the cascade model, the corporate strategy sets the objectives for the next level down in the cascade, which is used for strategy development at that level and objective setting for the next level down. In this way strategic aims are cascaded down through the project levels. Similar models linking strategy to projects (Bridges, 1999; Nelson et al., 1999; Dinsmore, 2006) use a cascade-style logic. These cascade models tend to stress the one-way flow of information from higher to lower organisational levels, as shown in Figure 2-5, and do not acknowledge feedback effects within the cascade.

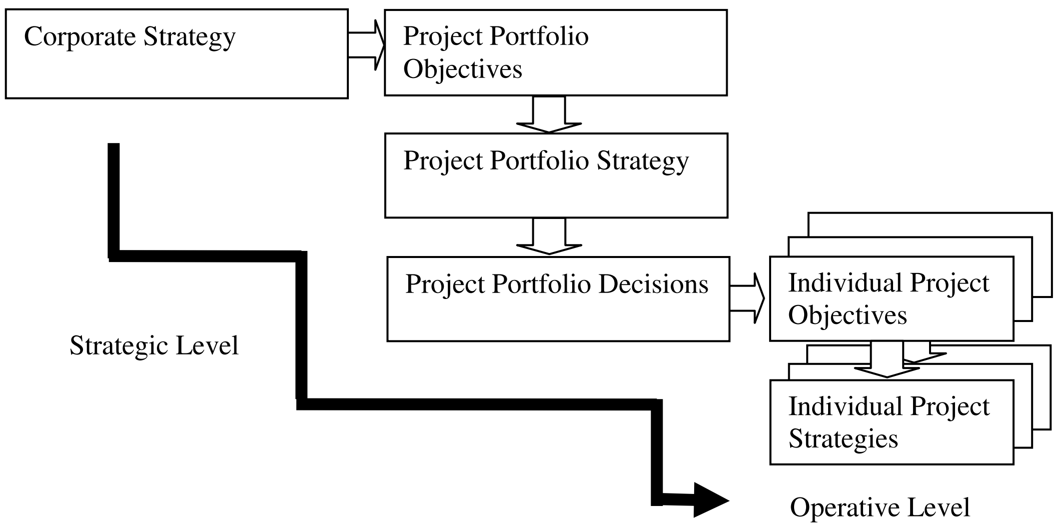

Figure 2-5: Cascade model of strategic objectives (built upon Turner, 1999:18)

An alternative model (Figure 2-6) shows the interaction between the levels and the two-way interaction between operative (PM) and strategic levels of the organisation that is not catered for in cascade-style models. This model is based on research that reveals that IPPM processes are central to the integration of strategic-level and operative-level activities in the front-end phase of innovation (Poskela et al., 2005). Empirical research has shown that a more participative strategy formulation process, including top-down as well as bottom-up strategy processes, improves the integration of the strategic and operative management. Portfolio management can improve links between strategy and the product development process, but the best ways to do this are shown to be moderated by the level of concreteness of business strategies, the emphasis on business-minded decision-making and the balance between control and creativity (Poskela et al., 2005). Supporting these findings on a two-way relationship between strategy and projects, bottom-up alignment mechanisms are presented as emergent strategic feedback mechanisms via the stage gate process in research on NPD projects in eight market-leading organisations (Milosevic and Srivannaboon, 2006). The effective combination of top-down strategic intent with bottom-up emergent strategy evolution through an intra-organisational ecology process was illustrated in a study of the Intel corporation (Burgelman, 1991). Similarly, research in a large complex business has shown that the shaping of strategy in new business areas is influenced through iterative resource allocation decisions such as IPPM decisions (Noda and Bower, 1996).

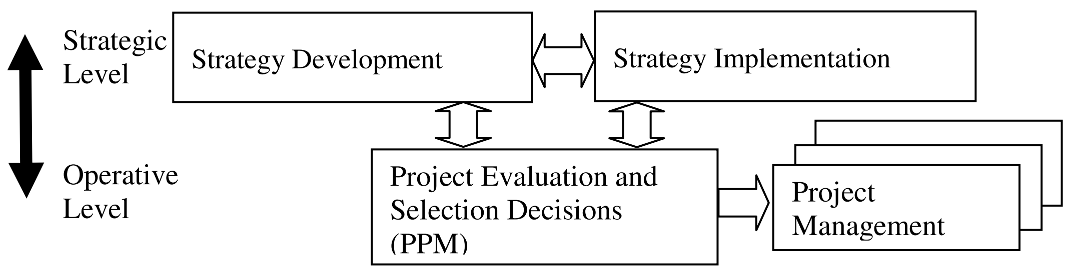

Figure 2-6: Two-way strategy project model (built upon Poskela et al., 2005)

Figure 2-5 and Figure 2-6 can be used to explain two possible mechanisms for the deployment of strategy to projects through IPPM practices. The 'best' approaches to link strategy and new projects depend upon the strategic innovation needs of the organisation (Loch, 2000). It has been shown that IPPM practices need to be tailored to the environment to be most effective. IPPM practice research illustrates a range of IPPM activities that drive top-down, bottom-up, emergent or iterative approaches, linking strategy activities at many levels of the organisation (Nelson and Winter, 1982).

These micro-strategising activities are attracting increasing attention in the literature (Cook and Brown, 1999; Johnson et al., 2003; Regner, 2003; Salvato, 2003).

A core micro-strategy is defined as “a relatively stable bundle of interconnected organizational routines and resources” that are a result of “past organizational experiences (both successful and unsuccessful), stratified over long periods of time” (Salvato, 2003:92). This definition of a core micro-strategy applies to IPPM activities and highlights the ways that these processes are path dependent and develop over time. In micro-strategy research, specific activities are identified as ‘micro-strategising’ activities and are studied to understand their impact on organisational outcomes.

2.3.4 Outcomes from IPPM: goals and organisational effects

Organisations implement an IPPM capability in order to achieve goals related to improved new product outcomes. Strategic alignment is one of the primary goals for an IPPM capability reflecting the strong strategic role outlined above.

In an early NPD study, Cooper, Edgett and Kleinschmidt (1997b) identified three primary goals for an IPPM capability: (1) maximise the value of the portfolio; (2) select the right balance of projects; and (3) link the portfolio to the business strategy. Much of the IPPM literature refers to these three goals for IPPM (see, for example, Dawidson, 2004; O’Connor, 2004; Cauchick Miguel, 2008). A fourth goal, “To select the right number of projects”, was identified by Cooper et al. (2002a). IPPM performance is often measured by how well these goals are met.

Other measures of IPPM portfolio outcomes include financial or market share measures or measures of the ability of the new product portfolio to exploit technical or market opportunities (Brown and Eisenhardt, 1995; Cooper and Kleinschmidt, 2000; McDonough III and Spital, 2003). Many of the tools that are highlighted in the IPPM literature are applied to meet one or more of the goals established for IPPM (Mikkola, 2001; Kendall and Rollins, 2003; Archer and Ghasemzadeh, 2004). Although the goals are generally agreed upon, research repeatedly shows relatively low performance in meeting these goals, suggesting that there is much room for improvement (Menke, 1997; Cooper et al., 2001; Pennypacker, 2005).

Decisions to terminate projects are essential for an IPPM capability to achieve desired outcomes. However these decisions can be difficult for managers to make and research shows that this is an area of poor portfolio performance (Cooper et al., 2001; Pennypacker, 2005). Emotional attachments to projects can overshadow the original objectives and cloud judgment (Kent, 2007), and optimism bias can result in distorted projections that keep poor projects alive (Lovallo and Sibony, 2006). Managers may also find it difficult to terminate projects due to concerns about damaging employee morale (Kent, 2007). In addition, managers may not view the investments as sunk costs and try to hold onto failing projects, while the costs continue to rise with little chance of recovery (Calantone et al., 1999).

In addition to project portfolio outcomes, the literature asserts that the introduction of a formal IPPM capability will result in organisational effects such as improved communication processes, increased confidence in the outcome, and the ability to make trade-offs (Cooper et al., 2001; De Reyck et al., 2005). Formal mechanisms for IPPM are abundant in the literature; however, some authors caution against too much control and bureaucracy and suggest that an improved management model will focus more on delegation and communication (Platje and Seidel, 1993). In addition to the expected formal communication mechanisms instituted as part of an IPPM capability, research shows that informal communication mechanisms evolve and play a valuable supporting role (Dietrich, 2006). In another study, management roles and governance structures at better performing organisations were shown to be adapted to suit the environment and the complexity of the projects (Blomquist and Muller, 2006; Muller and Blomquist, 2006). Research also indicates that organisational structure may be altered by the IPPM capability, and that portfolio decisions may take place at several levels of the hierarchy depending on the project size and type (Dawidson, 2004, 2005).

2.3.5 Development and maturity of IPPM capabilities

Organisations are increasingly looking to enhance their IPPM capabilities in their quest for better new product outcomes. The push to develop IPPM capabilities is supported by research and literature that shows correlation between established IPPM capabilities and improved outcomes (Cooper et al., 2001; Pennypacker, 2005). The research and literature also acknowledge that IPPM capabilities do not emerge fully formed and that they must be established and developed over time (O'Connor, 2004; Cauchick Miguel, 2008).

The term 'capability' implies some minimal or threshold level of functionality that assists with the achievement of results. In order to improve the understanding of capability development, Helfat and Peteraf (Helfat and Peteraf, 2003) have identified a capability lifecycle where capabilities follow a path from foundation through development to maturity. They have proposed that capabilities all follow a similar development path to reach maturity and have outlined possible further stages including decline and renewal stages. The capability lifecycle model acknowledges the dynamic nature of capabilities and helps to explain differing capabilities among organisations.

Organisational factors that influence or are influenced by the development and maturity of IPPM capabilities are highlighted in the literature. These organisational factors can be precursors to the establishment of IPPM capability, or they can be the result of the establishment and development of an IPPM capability. For example, the literature proposes that for a portfolio management approach to be applied in an organisation, the organisational structure must group projects centrally to allow a holistic view of the projects. Tools need to allow a portfolio view of the projects so that dynamic re-assessment of the entire portfolio can inform decision-makers about whether to fund projects or whether to terminate, delay or speed up projects by reallocating resources (Wheelwright and Clark, 1992a, b; McDonough and Spital, 2003).

In addition, as portfolio management must use strategy to drive the decisions and process, the existence and communication of a strategy is an important pre-condition for portfolio management (see, for example, Matheson and Matheson, 1998). Projects must also be managed well to enable integration with IPPM processes and facilitate effective data collection for IPPM decision-making (Wideman, 2004; Martinsuo and Lehtonen, 2007a). As mentioned earlier, assertions in the literature are supported by empirical findings that indicate that senior management commitment and involvement is an important precondition for successful IPPM implementation.

These organisational precursors and the concept of the capability lifecycle are evident in capability maturity models that have been developed based on empirical evidence. The following section presents a review of capability maturity models and the benchmarking studies on which they are based.

2.3.6 Best practice-based studies

PM, NPD and IPPM are practice-based disciplines and consequently there is a strong practice focus to much of the literature and research in this area. Benchmarking and 'best practice' studies are commonly used methods for practice-based research, and have been regularly applied to IPPM capability research. Based on the findings from such studies, capability maturity models have been developed to represent the stages of maturity in practices like PM and project portfolio management. Practice-focused studies are outlined in this section and summarised in Appendix 1.

This section first outlines the concepts behind benchmarking studies and the identification of 'best practices'. It then introduces capability maturity models and discusses their applications and shortcomings, before providing an overview of IPPM benchmarking studies and maturity models.

Benchmarking and best practices

Benchmarking is a process of identifying and adopting best practices – practices linked with improved business performance – to create sustainable competitive advantage (Camp, 1998). A benchmark study identifies the best of available methods so that managers can select the approach that is best suited to their situation (Karlof, 1995). Benchmarking and best practice studies have been widely used within PM, IPPM and related research areas (Cooper et al., 2004a; Jeffery and Leliveld, 2004; Notargiacomo, 2006). Best practice studies indicate correlations between practices and outcomes, but do not provide the depth to determine causality. Therefore there is a danger that organisations may rush to adopt 'best practices' that are not responsible for improved outcomes in the organisations studied (Reinertsen, 1997). In addition, identifying 'best practices' is counter to the repeated findings in IPPM studies that there are no best ways of doing things and that IPPM practices need to be tailored to the situation (Reinertsen, 1997; Loch, 2000). Several authors point out that the practices identified as 'best practices' are not uniform across industries, and that there are many examples of exceptions where successful organisations do not employ 'best' practices (Kahn et al., 2006; Peters, 2006). In a complex world, what is best will depend upon the situation, and people need tools to help them link appropriate practices with their context. Despite these concerns, best practice studies remain a popular vehicle for collecting and analysing data on IPPM practices. Although causality is not determined, many organisations and researchers consider these studies to be an effective way of identifying 'leading' practices.

Capability maturity models

While IPPM capabilities often have common elements, they cannot be easily transferred or acquired. There is an order of implementation to many aspects of a IPPM capability, and the capability must be developed over time (Eisenhardt and Martin, 2000). For example, establishing a foundational capability such as a gated NPD process is an antecedent to developing an effective IPPM capability, and data gathering capabilities must be developed before the capability to evaluate and adjust the portfolio mix can be established (O'Connor, 2004; Martinsuo and Lehtonen, 2007a). Therefore IPPM capabilities are thought to be developed along maturity paths that can be identified in 'capability maturity models'.

Capability maturity models (CMMs) have become a popular way for organisations to build capabilities ever since the Software Engineering Institute (SEI) CMM was developed (Paulk et al., 1991). Organisations can use CMMs to compare their capabilities with a standard and identify areas for improvement and development (Jugdev and Thomas, 2002). CMMs are applied to a range of capabilities from risk management and knowledge management to PM and IPPM (PMI, 2003b; Walker and Nogeste, 2008). CMMs are often derived from 'best practice' studies and are designed to reflect the practices that are in use, with practices at the higher levels of maturity generally thought of as the 'best practices' that successful organisations use. The proposition behind most maturity models is that organisations develop capabilities by achieving each level of capability in sequence across a range of capability dimensions (von Zedtwitz, 2002; PMI, 2003a; Crawford, 2007). At each level most maturity models include a list of criteria or activities that are undertaken by organisations operating at that maturity level. The SEI CMM contains five maturity levels: Level 1: Initial (ad hoc); Level 2: Repeatable; Level 3: Refined; Level 4: Managed; and Level 5: Optimised (adaptive and sustained).

CMMs for PM and IPPM identify levels of use, proficiency of various practices and the characteristics of the organisational environment that are associated with corresponding levels of improved outcomes. IPPM CMMs have been proposed for a variety of environments (PMI, 2003a; Jeffery and Leliveld, 2004; O'Connor, 2004; Rad and Levin, 2006; Crawford, 2007) and follow a similar four- or five-level approach. The only refereed publication outlining a CMM that covers IPPM in NPD environments is based on industry survey data and presents the IPPM capability as a component of NPD capability maturity (Kahn et al., 2006). This lower level of placement of the IPPM capability does not correspond with the more common view that IPPM is a higher level entity than PM or product development functions (Andersen and Jessen, 2003; PMI, 2003a). The NPD-focused CMM of Kahn et al. (2006) has also been challenged because the rigid hierarchies presented do not cater for the established need for portfolio management processes to be customised and tailored to the individual environment (Peters, 2006), and because interactions between elements are not adequately considered (Kleinschmidt, 2006). An un-refereed publication offers a CMM for IPPM in NPD using a 'spiral up' implementation approach with prescriptive steps for each capability stage (O'Connor, 2004). The source of data underlying the development of this IPPM is not specified, and the prescriptive nature of the model does not cater for the differing needs in a range of NPD environments.

These criticisms of the available IPPM CMMs highlight the challenge to representing complex organisational capabilities in a structured hierarchical form. Similarly, many of the available PM CMMs have shortcomings. One claim is that they are too simple, focusing only on a portion of the capability and ignoring the organisational environment and the development and management of the people in a PM environment (Kujala and Artto, 2000). In addition, maturity models usually focus on explicit codified practices and don't extend to cover the more intangible and knowledge-based elements of the capability (Jugdev and Thomas, 2002), and therefore do not help organisations manage unique environments and challenges of change (Kujala and Artto, 2000). Finally, although the research underpinning many maturity models identifies practices that are linked with successful outcomes, they do not establish a causal relationship between the practices and the outcomes. Based on these criticisms, CMMs may need to be developed to include more of the intangible aspects of the capabilities, including organisational learning capabilities (Jugdev and Thomas, 2002).

Benchmarking studies and maturity models

Benchmarking studies designed to identify 'best practices' form a major part of the empirical literature on IPPM. The following two sections present an overview of the literature on these benchmarking studies and the related maturity models. Studies that originate from the NPD perspective and focus on IPPM are outlined first. Studies from a general PM perspective that provide findings related to PPM in general are presented next. These empirical studies are also included in Appendix 1, along with other empirical literature relevant to IPPM.

IPPM benchmarking studies and maturity models

The most comprehensive empirical studies on IPPM are the best practices benchmark studies conducted in three phases by Robert Cooper, Scott Edgett and Elko Kleinschmidt between 1997 and 2000. The first phase of the IPPM studies was an exploratory work consisting of in-depth analysis of 35 companies (Cooper et al., 1997a, b). The first phase provided a view of the actual methods used and identified three goals for IPPM processes in practice, as outlined earlier. The second phase involved a quantitative benchmark of IPPM practices and performance in industry through a survey of 205 companies (Cooper et al., 1998, 1999). The performance of the IPPM process was evaluated through user-perceived measures and correlated with the detail on the methods used. Findings revealed a statistically significant relationship between more formal IPPM processes and the performance measures. Among the specific findings was the revelation that although financial measures are the most common method used, their use as a primary selection criteria is correlated with poor outcomes. Bubble diagrams or portfolio maps and strategic methods were shown to have stronger links to successful IPPM outcomes. The final phase of the IPPM study included 40 case studies (Cooper et al., 2000). This in-depth study of IPPM methods provided additional insights into the common challenges for portfolio management and the methods used to address the challenges. Although mathematical optimisation models are regularly reported in the literature, the IPPM benchmark studies did not find evidence of use of such methods in practice. The findings from all three phases of the research are comprehensively summarised in the book *Portfolio Management for New Products* (Cooper et al., 2001).

Cooper, Edgett and Kleinschmidt's empirical IPPM research forms a significant part of the NPD research that has been conducted by Cooper and colleagues since the 1970s. Early studies on NPD practices (see, for example, Cooper, 1979, 1992; Cooper and Kleinschmidt, 1987) led to identification of the IPPM process as an important success factor. More recent NPD research (Cooper et al., 2004a) has reinforced the importance of IPPM in the NPD process, and revealed that IPPM performance overall is low despite the increased attention to IPPM in recent years. Performance is highest on measures of alignment of projects with strategy. Significant challenges are highlighted in selecting a high-value portfolio of projects with the right balance and an appropriate number of projects.

Loch (2000) examined the effect of 'best practice' principles in NPD projects, based on a sample of 90 projects in a large, diversified European technology manufacturer. The study revealed that only one-third of the projects followed the formal approach, with the rest skipping the formal process through high-level sponsorship ('pet' projects) or by being conducted 'under the table'. Despite concerns based on previous research that the high level of informality may result in negative outcomes, the relative success between formal and less formal approaches in this study is not clear. Loch concluded that no 'best' approach is evident and proposed a process for developing a customised portfolio of NPD projects to achieve strategic alignment and ensure linkages between NPD projects and strategic positioning.

Miller and Floricel (2004) found that the best practices for managing innovation depend upon which 'game of innovation' is being played. Portfolio management practices are important for all of the identified 'games', but are most important in NPD 'games' (including R&D and service development). Coombs et al. (1998) developed three different variants of their audit model for R&D PM processes, based on field work in six business units in ICI and five companies from other industries. The three variants were designed to cater to the fact that R&D projects take place in different circumstances and have different objectives.

As mentioned earlier, the only refereed publication outlining a maturity model focused on IPPM is the NPD-focused study by Kahn et al. (2006), which proposes a best practices framework comprising six areas of NPD capability. IPPM is one of these six areas presented in the maturity level based framework.

General PPM benchmarking studies and maturity models

Several benchmarking studies have been conducted on PPM in general or IT-related environments. Although these studies did not focus on IPPM, they are briefly outlined here as they provide additional empirical evidence on the relationship between PPM and project success

A study of project portfolio management maturity among 64 PM practitioners identified five levels of maturity, and although about 60% of organisations were at the two lowest levels, almost all (97%) consider PPM important (Center for Business Practices, 2005). The study also revealed that there are no standardised processes or organisational models for PPM, and responsibility for the process does not lie in a particular area. Eighty-five per cent of respondents who use PPM have created the processes themselves. These results are in line with the results of a related study (Pennypacker, 2005) involving 54 PPM practitioners.

Jeffery and Leliveld (2004) surveyed 130 Fortune 1000 Chief Information Officers and conducted in-depth interviews with 16 selected respondents. A four-level IT PPM Maturity Model was developed based on the data. A statistical link was found between the highest level of IT PPM Maturity (labelled 'synchronised) and return-on-asset performance.

De Reyck et al. (2005) reported on a survey of 34 IT organisations and found a correlation between PPM adoption and improved outcomes. PPM processes clarified goals, enhanced the ability to make trade-off decisions, and improved the level of confidence in the decisions. The authors acknowledged that it was not necessary to implement all aspects of PPM to obtain benefits and that each organisation should identify and implement appropriate PPM methods.

Andersen and Jessen (2003) surveyed 59 managers and partially validated a model for project maturity in organisations. The model identifies progression from PM to program management and then to portfolio management.

Summary of best practice-based studies

The findings of best practice-based studies indicate practices associated with superior outcomes, and that organisations regularly seek to implement 'best practices'. However, the association of practices with outcomes does not show causality, and it is not known whether adopting 'best practices' will improve outcomes. This highlights the need for additional research to understand whether these best practices actually contribute to outcomes. Many findings of the empirical research (whether 'best practice' studies or other types of research) are related to the IPPM methods and processes. The following section summarises literature that focuses on methods and processes, in particular drawing from best practice-based as well as other empirical research (see Appendix 1 for a full annotated reference list of empirical research).

2.3.7 Review of literature on IPPM processes

Most of the IPPM literature focuses on the methods and processes for IPPM or for subsets of IPPM such as project selection. A common theme in the literature on IPPM methods is the assertion that adopting certain methods or establishing best practices in portfolio management will lead to success (Matheson and Matheson, 1998; Cooper et al., 2001). The measurement of innovation success can be difficult, due to the complexity of the environment and the unique set of challenges faced by each industry (Mikkola, 2001). A variety of methods have been used to evaluate the success of IPPM processes. For example, in benchmarking surveys, common measurements include respondents' satisfaction with the methods used, their perceptions of how well the resulting portfolio meets the main IPPM goals, measures of sales or profit or the percentage of successful products (Cooper et al., 2001; McDonough and Spital, 2003).

For a review of the literature on measurement of innovation processes, see Adams et al. (2006).

This section of the literature review starts with a brief overview of the evolution of the mathematical programming-based project selection literature. This is followed by an overview of more general management-oriented literature on IPPM. Literature on the specific methods that are commonly used for IPPM completes this section of the literature review.

The evolution of programming models for project selection

Project selection is one of the important considerations of an IPPM process. Literature on R&D project selection methods has been evolving since the 1960s and has traditionally had a strong focus on management science methods. There are hundreds of publications on R&D project selection (Henriksen and Traynor, 1999), many outlining mathematical programming and modelling approaches to R&D project selection; however, numerous studies have failed to find much application of mathematical programming and modelling in practice (Liberatore and Titus, 1983; Hall and Nauda, 1990; Farrukh et al., 2000; Cooper et al., 2001). Suggested reasons for this are related to the diversity of project types, resources and criteria (Liberatore and Titus, 1983), inability to incorporate interrelationships between projects and criteria, and perceptions that the models are difficult to use (Chien, 2002), the lack of available data and uncertainty in future projections and future opportunities (Martino, 1995), and management's preference for simple tools that are not so mathematically elaborate and do not require expert assistance (Henriksen and Traynor, 1999).

Published reviews of the literature on R&D project selection include comparisons or categorisations of methods (see, for example, Liberatore and Titus, 1983; Hall and Nauda, 1990; Schmidt and Freeland, 1992; Martino, 1995; Henriksen and Traynor, 1999; Poh et al., 2001; Chien, 2002). The shift from 'decision-event' or optimisation tools to 'decision-process' or 'systems' approaches was noted by Schmidt and Freeland (1992). Liberatore and Titus (1983) also highlighted a shift from approaches that attempt to optimise to approaches that support decision-making processes. However, as computing power and programming methods improve, decision-event optimisation models are continuing to be developed and enhanced to include more aspects of the problem. Some use techniques such as fuzzy set theory and options pricing models; however, there is still no evidence of these types of models being applied in practice (see, for example, Gustafsson and Salo, 2005; Medaglia et al., 2007; Wang and Hwang, 2007).

Decision support systems (DSSs) are growing in popularity and are used within some IPPM processes (Archer and Ghasemzadeh, 1999a; Henriksen and Traynor, 1999). DSSs use mathematical programming methods to produce information that will guide the decision-maker rather than attempting to produce a final solution. This allows decision-maker input and the ability to incorporate more flexibility than traditional optimisation programs. DSS programs still require significant amounts of data input, however, and many are not user friendly.

The literature on DSS is significant and continuing to evolve. Archer and Ghasemzadeh (1999a) developed a holistic framework for IPPM and proposed a structure for a DSS to support the framework. Specific examples of DSSs include the Project Analysis and Support System (PASS) (2000), which highlights the importance of a friendly user interface to support interactions between decision-makers and the data, a two-phase DSS including screening plus a mathematical optimisation programming tool (Bard et al., 1988), and a three-phase interactive approach (Stummer and Heidenberger, 2003).

Management-oriented methods for IPPM

Another common theme in IPPM literature is the need for different methods for different types of projects and environments to meet the needs of managers in practice. Differing types and levels of complexity of projects, industry and competitive situations, and resource constraints create unique environments for IPPM in each organisation (Archer and Ghasemzadeh, 1999a; Crawford et al., 2006). Many of the current methods that are more focused to the needs and preferences of management can be traced to Wheelwright and Clark's aggregate project plan (Wheelwright and Clark, 1992a, b). These methods often involve a structured IPPM process that incorporates several methods or tools. The management-oriented literature includes a range of methods, some that incorporate DSSs, such as the multi-phase interactive approaches outlined above.

There is a noted lack of use of the many methods available for project selection, prompting the development of guidelines and methods to assist organisations select appropriate methods (Martino, 1995; , 2000). The literature contains a number of case studies of specific applications of portfolio management processes that include a range of methods in a range of industries (see, for example, Sharpe and Keelin, 1998 for pharmaceutical; Combe, 1999 for insurance; Englund and Graham, 1999 for computers; Dickinson, 2001 for aerospace; Dawidson, 2005 for manufactured products).

Commonly applied methods to meet IPPM goals

This section presents a sampling of the literature that refers to some of the main methods that are common throughout IPPM literature. The empirical studies referred to in this section are outlined in Appendix 1.

- PM methods

Specific PM methods and tools often form the backbone of an IPPM process. For example, stage-gate methods can structure the NPD project process and create a framework for gate decisions to be conducted across the portfolio of projects (Cooper et al., 2002a; O'Connor, 2004). Before IPPM capabilities can be established, PM capabilities must be established (Eisenhardt and Martin, 2000; Kleinschmidt, 2006). PM systems are also relied upon to generate the data required for portfolio decision-making, and a consistent PM process is required for effective IPPM (Wideman, 2004). Empirical findings confirm the contribution of PM attributes to the efficiency of IPPM processes (Martinsuo and Lehtonen, 2007a).

- Scoring and ranking models

The IPPM literature discusses a variety of ranking and scoring methods based on specific criteria and importance weightings (see, for example, Cooper et al., 2001; Levine, 2005). Scoring and weightings can informal or determined by formal methods such as the Analytical Hierarchy Process (AHP) or the Delphi method (Henriksen and Traynor, 1999; Meredith and Mantel, 1999). Empirical findings illustrate the use of scoring models in practice (Cormican and O'Sullivan, 2004; Cauchick Miguel, 2008). Criteria for scoring and ranking models include a range of considerations such as customer and marketing (Hart et al., 2003), financial and strategic measures. The Balanced Scorecard scoring model (Kaplan, 1996; Olve et al., 1999) incorporates integrates multiple perspectives and has been shown to enhance strategic alignment when applied to project portfolio decision making (Norrie, 2006).

• Financial methods

Financial methods are the most commonly used methods for IPPM (Cooper et al., 2001). Traditional financial methods include discounted cash flow models, return on investment and payback analyses. Other financial methods include Earned Value Analysis (Hatfield, 2002), the Productivity Index, Expected Commercial Value, and Real Options (Cooper et al., 2001). By viewing projects as a series of investment decisions using Real Options methodology, the risk can be reduced by investing in each stage as the uncertainty reduces and more information is known (see, for example, Faulkner, 1996; Lint and Pennings, 2001; for a literature review see Newton et al., 2004). In another financially based method (Ringuest et al., 1999; Graves et al., 2000), Excel spreadsheets are used to develop a decision model that incorporates financial information with probability information to help manage risk in portfolio decision-making. Empirical findings show that although financial methods are the most commonly used methods, organisations that use financial measures as their primary decision-making criteria have lower levels of portfolio performance outcomes (Cooper et al., 2001). These findings are supported by a product development and management association (PDMA) study, which found that better performers had a strategic rather than a financial focus (Adams-Bigelow, 2006).

• Pipeline management and the 'right' number of projects

Tools to manage the pipeline of projects focus on limiting the number of projects to ensure that resources are not overstretched (Payne, 1995; Cooper and Edgett, 2003), and that the timing and flow of the projects through the development pipeline is managed. Models for pipeline management are presented by Ding and Eliashberg (2002) and

Bunch and Schacht (2002). Some optimisation models focus on selecting the 'right' number of projects (Lieb, 1998; Bordley, 2003).

• Portfolio maps

Portfolio level decision-making requires a central view of all projects in the portfolio. Portfolio maps (also called bubble diagrams) plot proposed projects on two axes and can assist with the selection of a balanced portfolio of projects. Decisions are often made in meetings, with methods that facilitate group decision-making including portfolio maps and other graphical and visual displays (De Maio et al., 1994). Commonly used portfolio maps balance risk versus return (Cooper et al., 2001) or benefits to the customer versus competitive advantage (Mikkola, 2001); however, the maps must be customised for effective portfolio decision-making (Phaal et al., 2006). Portfolio maps that identify derivative, platform and breakthrough projects on a grid of product change versus process change assist in balancing these aspects of the portfolio (Wheelwright and Clark, 1992a, b)

• Strategic alignment methods

A number of methods are proposed to align projects with strategy. For example 'strategic buckets' divide the overall budget to allocate funds to specific types of projects (Cooper et al., 2001). This ensures that the level of funding for areas of strategic importance is in line with strategy, and it can also help in identifying the appropriate type of IPPM approach for a particular type of project. In addition, strategic criteria are often used at gates or in scoring models or checklists, along with financial and other criteria (Cooper et al., 2001; Norrie, 2006), or are incorporated within 'strategy tables' to help decision-makers focus on identifying practical actions (Spradlin and Kutoloski, 1999). Platforms and product family planning are illustrated as tools to assist with the strategic planning for new products (Halman et al., 2003) and the Analytical Hierarchy Process (AHP) is useful in linking missions, objectives and strategies with project selection (1988). Scenarios are shown to be a useful tool for forecasting and portfolio planning (Ringland, 2003). Product and technology roadmapping tools are used for planning and communication of the timing of sequenced and linked development stages, and for assisting with the integration of business and technology strategy (Groenveld, 1997; Phaal et al., 2001; Albright and Nelson, 2004). A review of the roadmapping literature identifies four types of roadmaps, including the product portfolio roadmaps that are most useful for IPPM (Kostoff and Schaller, 2001).

- IPPM software applications

Specialised software applications are available to support IPPM processes, and a variety of vendors continue to improve their products. IPPM software tools range from programs that aid certain IPPM tasks to integrated tool-sets designed to support the entire IPPM process. For a review of IPPM software solutions (see Levine, 2005). As with many other types of software applications, there is a trend towards web-based IPPM applications with integrated team collaboration capabilities (Marcus and Coleman, 2007). IPPM is viewed as a software process in some literature (Wideman, 2004); however, empirical research indicates that the large majority of organisational IPPM processes do not use IPPM software (Center for Business Practices, 2005; Muller and Blomquist, 2006).

Summary of literature on IPPM processes

Much of the early literature on IPPM methods focuses on mathematical optimisation methods. However these methods do not seem to have been adopted by managers, despite 40 years of development. More commonly applied IPPM methods involve management-friendly interactive processes that support group decision-making. Computer-based support tools for IPPM continue to be developed, but the adoption of these methods remains low.

The often repeated claim that more formal IPPM processes will lead to improved outcomes is supported by some studies (Cooper et al., 2001; Jeffery and Leliveld, 2004; De Reyck et al., 2005) and challenged by others who find that the level of formality needs to be appropriate for the project types (Loch, 2000; Dietrich and Lehtonen, 2005).

The literature on IPPM processes outlines the main types of methods and processes used, and empirical findings provide indications of links between processes and outcomes. Strategy is shown to be an important consideration in IPPM decisions and a number of methods – such as strategic gate or checklist criteria, roadmaps, scenarios and strategic allocation of funding – can help link projects to strategy.

The path dependent nature of IPPM processes is confirmed by research that indicates important pre-conditions, such as the existence of a PM capability (Brown and Eisenhardt, 1997; Levine, 2005; Martinsuo and Lehtonen, 2007a). Path dependency is also indicated in findings that no single IPPM method is appropriate for all situations, and that organisations need to customise their IPPM process to suit their environment is reinforced by findings throughout the empirical literature (Coombs et al., 1998; Farrukh et al., 2000; Loch, 2000; Cooper et al., 2001; Phaal et al., 2001; McDonough III and Spital, 2003; Miller and Floricel, 2004; Blomquist and Muller, 2006; Crawford et al., 2006; Lawson et al., 2006; Vähäniitty, 2006).

Empirical studies report mixed findings regarding the links between particular IPPM methods and goals. For example financial methods, although the most commonly used, are shown not to be best as a primary selection method due to poor portfolio performance outcomes, particularly the financial value outcomes. The use of portfolio maps and some strategic methods is shown to enhance the balance and strategic alignment of the portfolio, as expected. Research reveals that most organisations feel that their project portfolio contains too many projects for the available resources; however, no research has demonstrated a significant empirical link between a IPPM method and better performance on the number of projects (Cooper et al., 2001).

In summary, the findings on IPPM processes provide a comprehensive picture of the types of processes and methods that are identified for IPPM. These processes and methods are shown to be applied in a customised fashion to suit individual organisations' requirements.

2.3.8 IPPM research gaps

This section outlines areas where IPPM literature and research are weak across both perspectives, and highlights these areas as gaps in IPPM understanding.

Service IPPM research

Although there is a growing body of research on NPD for service products, no research study reported in the literature concentrates specifically on IPPM for service products, although there are a few examples of research related to services and IPPM. A recent study investigated the implementation of PPM in a public sector service development environment (Martinsuo and Lehtonen, 2007b). The study found that the approach needs to be tailored for the public sector environment due to the different types of strategies, drivers and measurements in place. Another service-related PPM research area focuses on IT projects (see, for example, Jeffery and Leliveld, 2004; De Reyck et al., 2005). IT project portfolios generally concentrate on IT projects for operational services and do not have an NPD focus. In addition, there are a wide variety of service product development projects that go far beyond the scope of IT projects. Therefore there is a major gap in the research on IPPM related to service product development in industry. Studies that investigate IPPM for service product development or that include both service and manufactured product development projects are needed to fill this gap. Especially with the blurring of product boundaries between service products and manufactured products and the resulting difficulties in clearly distinguishing between the two (Andersson, 2000; Slack et al., 2004), studies that include the full spectrum of service and manufactured NPD project IPPM are required.

IPPM research in Australia

The research reported in this literature is mainly from North America and Europe, with a smaller proportion originating in Asia. To date there is no available empirical research conducted in Australia on IPPM, and therefore no benchmark of Australian findings in this area. It follows that there is also a lack of cross-cultural studies comparing Australian IPPM practices with other regions.

Cross-cultural studies reinforce the importance of nationality on organisational methods, and have produced evidence that different NPD and innovation management methods will produce the best outcomes in culturally different regions (Mishra et al., 1996; Khurana and Rosenthal, 1998; Lee et al., 2000).

However, cross-cultural studies define clusters of national cultural styles (Harzing and Hofstede, 1996; Hofstede, 1997; Garrett et al., 2006) and find that similar organisational styles are appropriate within clusters of similar cultures. Australia, New Zealand, the United States and Canada are all classified as ‘Western nations’ and are clustered together with other Anglo-Celtic nations in national cultural studies (Harzing and Hofstede, 1996). This cultural clustering indicates that management practices in Australia are likely to be similar to those in North America. A cross-cultural study of new service development (NSD) in financial industries in Australia and the United States found that while the main NSD practices are common across the two regions, there were significant differences in the emphasis placed on some stages of the NSD process (Alam, 2005). Although some differences were noted, these findings indicated that NPD management practices are likely to be largely common between these two countries with similar cultural profiles. In addition a study of NPD success factors in Australia presented similar findings to research conducted in North America (Cooper and Kleinschmidt, 2000).

The lack of existing Australian research into IPPM practices represents a gap in the literature. Cross-cultural research between Australia and other nations is required to address this gap. It would indicate how the existing research on IPPM relates to the Australian situation and whether any future research done in Australia will be of relevance and interest to other regions.

2.3.9 IPPM literature review conclusion

This literature review highlights the growing importance of IPPM and reveals a wide range of publications that originate primarily from either a perspective focused on the management of NPD or a PM perspective. Interest in IPPM is shown to have stimulated a relatively recent field of research that investigates the relationships between the IPPM capability and competitive advantage through new product outcomes. Much of the literature related to IPPM focuses on explaining or proposing methods, tools and processes, usually without including empirical findings beyond examples of the application of these methods and tools. This literature review is the first to bring together the empirical research related to IPPM. This empirical research and literature is summarised in Appendix 1. It includes quantitative survey-based research (including 'best practice' studies) as well as qualitative research studies focused on single or multiple case studies.

An IPPM capability's role in aligning the innovation project portfolio with the strategy is highlighted in the research findings. Research has improved the understanding of which front-end activities best link strategy to projects, and highlights the importance of the inclusion of business models in IPPM decision-making (Poskela et al., 2005; Reginato and Ibbs, 2006). In addition, in-depth analysis of the relationships between business strategy and projects reveals a two-way influence instead of the often cited one-way relationship where strategy flows downwards to drive IPPM decisions (Poskela et al., 2005; Milosevic and Srivannaboon, 2006).

Research indicates that the level of importance placed on the IPPM capability is an important success factor, with strong correlation to achievement of IPPM goals (Cooper et al., 1999). In recent studies, most survey respondents report that they consider IPPM important and that they plan to increase or improve their IPPM capability (Center for Business Practices, 2005; Dye, 2006; Kapur et al., 2006). One indicator of the level of importance placed on the IPPM capability, the level of management support for the IPPM capability, is also highlighted in the literature. Research indicates that management places importance on the IPPM capability with a primary goal of better alignment of projects with strategy.

Another strong theme throughout the IPPM literature is the level of maturity or establishment of the IPPM capability. The literature consistently acknowledges that IPPM capabilities develop over time and must be tailored to suit the individual environment. Development of the IPPM capability is often measured by 'maturity' levels or by evaluating the degree of formality, explicitness and consistency of the capability. A common proposition in the IPPM literature is that higher levels of IPPM formality or maturity will result in improved new product outcomes. The empirical findings show that IPPM maturity is low and that the phrases 'project portfolio management' or 'portfolio management' are not well understood or used in industry (Morris and Jamieson, 2005; Milosevic and Srivannaboon, 2006).

This review of the IPPM literature outlines several alternative approaches to measuring the outcomes of the IPPM capability's outcomes. Measures of 'product portfolio outcomes' (PPO) include financial or market share metrics as well as ratings for product or portfolio performance. Perceptions of performance of the resulting portfolio on IPPM goals − such as alignment with strategy, balance in the portfolio and high financial value − are commonly used in best-practice studies. The literature highlights that different measures may be appropriate in different industries and suggests that multiple measures of PPO are likely to produce more meaningful findings.

The goal of much of the IPPM literature is to help organisations improve and develop their IPPM capabilities. Given the strategic importance of IPPM capabilities and the evidence that organisations consider IPPM important and desire to improve their capabilities, this is an important area. The IPPM research and literature support the view that IPPM capabilities are developed along maturity paths. Indeed, research indicates that the establishment of PM capability is an important pre-condition for IPPM establishment. In addition, capability maturity models have been proposed that identify themes and maturity paths for IPPM capability development. These CMMs are usually based on best practice survey-based research findings, however, and there is a lack of research that shows how IPPM capabilities are actually established and evolve.

The literature on IPPM capability establishment repeatedly highlights the need for each implementation to be individually tailored to the environment. For example, the mixed findings reported in the literature with respect to IPPM formality and new product outcomes indicate that the level of formality may be one of the aspects of IPPM that needs to be tailored to suit the types of projects and the environment.

The literature focuses strongly on methods and processes for IPPM. The research supports the proposition that no single IPPM method will be appropriate for all situations and that customised IPPM processes need to be developed to suit the situation. Mixed findings are reported on the links between specific IPPM methods and outcomes, with financial methods shown not to be the best primary evaluation method to use. Empirical research also confirms that the use of business models is linked to successful IPPM outcomes. Although the adoption of computer-based decision support systems and integrated IPPM solutions is low, the continual developments in this area indicate that this is an area to monitor for effects on IPPM outcomes in the future.

The literature review also reveals three significant gaps in the literature on IPPM. First is the lack of research on IPPM in the increasingly important area of service product development. In addition, no research has focused on IPPM capabilities in Australia. Finally, although the empirical research on IPPM is starting to generate results and improve understanding, there is no theoretical basis to the majority of the research, and no theoretical basis or framework that unifies the research.

2.4 Conceptual model development

A large portion of the existing research on IPPM focuses on the relationship between the IPPM capability and new product outcomes. As these relationships are central to the research question, some of the main findings from the literature are used to create a conceptual model that can be used to further test the relationships between IPPM and product outcomes. The conceptual model presented in Figure 2-7 proposes relationships between three types of success factors and three types of outcome measures that are highlighted in the literature review.

The literature identifies several success factors that are thought to influence product portfolio outcomes (PPO). Three success factors are included in the conceptual model based on their particularly strong representation in the literature: the level of importance and support by management for the process, the maturity of the capability, and the IPPM processes or methods used. The level of importance placed on IPPM, particularly by senior management, is repeated throughout the literature (Cooper et al., 2001; Kendall and Rollins, 2003; Jeffery and Leliveld, 2004; PriceWaterhouseCoopers, 2004; Yelin, 2005). The proliferation of 'best practice' studies and maturity models highlights the relationship believed to exist between IPPM maturity and improved outcomes (PMI, 2003a; O'Connor, 2004; Pennypacker, 2005; Kahn et al., 2006). Similarly, the strong focus on processes and methods for IPPM indicates the belief that these processes and methods can improve IPPM outcomes (Archer and Ghasemzadeh, 1999a; Phaal et al., 2006; PMI, 2006; Cauchick Miguel, 2008), and empirical research provides evidence of some practices that are associated with improved outcomes (Cooper et al., 2001; Jeffery and Leliveld, 2004; De Reyck et al., 2005).

As outlined in the literature review, measuring outcomes (PPO) is not a simple task. There is not one best measure of PPO, and PPO measures are often not comparable across industries (Hauser and Zettelmeyer, 1997; Joshi and Sharma, 2004). The literature proposes the use of several measures of PPO to provide better understanding of actual new product outcomes (Brown and Eisenhardt, 1995; Mikkola, 2001). Common PPO measures outlined in the literature include measures of performance on IPPM goals, measures of the portfolio's effectiveness in exploiting technical and marketing opportunities, and measures of actual new product success (Montoya-Weiss and Calantone, 1994; Griffin and Page, 1996; Danneels and Kleinschmidt, 2001). As each of the outcome measures evaluates a different aspect of PPO, the conceptual model proposes separate potential relationships between the success factors and the three outcome measures.

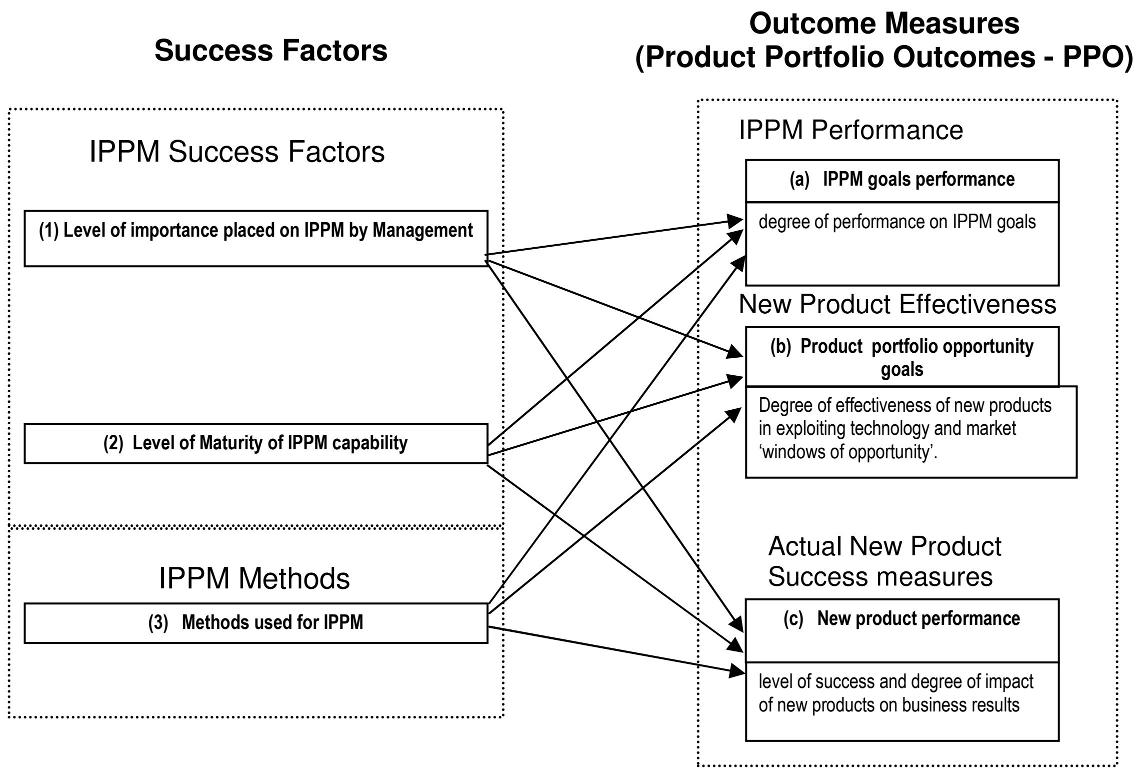

Figure 2-7: Conceptual model on IPPM success factors and product portfolio outcomes

Three types of success factors are shown on the conceptual model representing measurable multiple item constructs that are thought to be related to IPPM outcomes according to existing literature. These types of success factors are (1) the level of importance placed on IPPM by management, (2) the level of maturity of the IPPM capability, and (3) the processes and methods (practices) used for IPPM. In addition, three types of outcomes are shown on the conceptual model representing different constructs that measure the outcomes of an IPPM process. These outcome constructs are based on measuring the performance of the IPPM process with respect to (a) how well the project portfolio resulting from the IPPM process meets IPPM goals; or (b) the effectiveness of the products represented by the projects in the portfolio in exploiting technology and market windows of opportunity; or (c) the actual measures of new product success. The conceptual model and the constructs are discussed in greater detail in Chapter 3.

2.5 Discussion and development of research questions

The main research question unifying this research project is:

> “What is the relationship between an organisation’s IPPM capability and its ability to establish sustainable competitive advantage through improved new product outcomes?”

Competitive advantage is achieved through a capability to gain better returns than competitors from investments in innovation projects. Sustained competitive advantage requires that the capability provides enduring benefits and is not copied by competitors or rendered obsolete (Barney and Clark, 2007). Therefore the main research question aims to understand whether and how the IPPM capability influences new product outcomes – or the level of value created through investments in the innovation project portfolio – and whether this influence is enduring.

Analysis of the IPPM literature reveals several areas that suggest further study to address this main research question. This section identifies five main research issues derived from the literature review. The following five sections identify each of the research issues, summarise and discuss the literature that has led to the research issue, and outline the contribution of each research issue to understanding the main research question.

2.5.1 Research issue 1: The IPPM capability and its outcomes

The first research issue focuses directly on the IPPM capability and new product outcomes. The literature review has highlighted the importance of understanding what an IPPM capability is, what the outcomes are and how they can be measured. In addition, based on the main themes in the literature, the conceptual model presented in Figure 2-7 provides testable relationships between IPPM success factors and outcomes.

RQ 1 asks:

> "What is the relationship between an organisation's IPPM capability and its new product outcomes?"

This first research question aims to understand the IPPM capability and outcomes, test the relationships on the conceptual model and explore other potential relationships between IPPM capabilities and the resulting new product outcomes.

2.5.2 Research issue 2: IPPM capabilities in service industries

Service product development is of growing importance, based on steady increases in the level of effort and investment in this area and in the contribution of services to the economies of developed nations (Edwards and Croker, 2001). There is a small but growing field of research into service NPD; however, the literature review has revealed a major gap in the literature on IPPM. Existing empirical studies on IPPM focus primarily on manufacturing environments. Although some IPPM research focuses on service-related areas, none focuses on service product development, and no research includes both manufacturing and service-based NPD in the same study. Therefore the differences between IPPM capabilities in service and manufacturing environments are not known. In addition, the literature review has identified trends where the distinction between manufactured and service products is diminishing (Shostack, 1982; Andersson, 2000). Products increasingly include both manufactured and service aspects, providing additional incentive to understand how service and manufactured product IPPM capabilities compare. An understanding of IPPM capabilities in both environments will best assist the development of effective IPPM capabilities for products that span the manufacturing and service spectrum.

RQ 2 asks:

> "How do IPPM capabilities in service and manufacturing NPD environments compare?"

In the current environment, where the prevalence and importance of service product development is growing and large investments are being made in service product development, the management of innovation project portfolios in a service product development environment is an important and un-researched area. The second research question aims to address this gap in the literature by comparing the unknown area of IPPM capabilities, outcomes and their relationships in service product development environments with manufacturing product development environments.

2.5.3 Research issue 3: IPPM capabilities in Australia

The existing research on IPPM has been conducted overseas, primarily in North America and Europe, and no research has been conducted in Australia. Therefore there are no baseline data to build upon to enhance the understanding of IPPM practices in Australia and there is no available comparison between IPPM practices in Australia and other regions. Because differences in regional environments can influence innovation processes, they must be taken into consideration before findings from one country are applied to other regions. This makes it inappropriate to build upon the overseas research for an Australian study without first trying to better understand the relationships between the two regions.

An understanding of the relationship between Australian and overseas research will also indicate whether findings from Australian research are likely to be applicable to overseas environments. The third research question has been developed to address the gap in the literature on IPPM in Australia. Because North American data (Cooper et al.,

2001) are available for comparison with Australian findings, this research question focuses on comparing Australian IPPM practices with North American practices.

RQ 3 asks:

> "How do IPPM capabilities in Australia and North America compare?"

2.5.4 Research issue 4: Theory or frameworks for IPPM capabilities

The literature review highlights that empirical research on IPPM capabilities is fragmented and lacks a theoretical base. The fourth research question has been developed to address this lack, and to explore the possibilities of applying existing or developing new theories or frameworks as part of this research. Theories or frameworks may be able to improve understanding by identifying the mechanisms of a relationship between IPPM capabilities and competitive advantage. Such theories or frameworks may also be able to provide a unifying base for research focused on IPPM capabilities and to indicate directions for future research.

RQ 4 asks:

> "Can theories or frameworks be developed or used to better understand the relationship between IPPM capabilities and competitive advantage?"

2.5.5 Research issue 5: The development of IPPM capabilities

The literature reveals a pervasive view that an organisational IPPM capability cannot be 'bought' or instantaneously established and that it must be developed over time. Research supports the proposition that pre-conditions, such as the establishment of a PM capability, exist for the establishment of an IPPM capability. Research also supports the argument that each organisation's IPPM capability must be specially developed to suit each individual environment. In addition, maturity models and maturity paths proposed in the literature include a series of stages in the establishment and development of an IPPM capability with a proposition that higher levels of maturity will lead to improved outcomes. IPPM is thought to develop along the maturity paths represented in maturity models. These models can help identify gaps between current practices and reported 'best practice' but they do not help identify the methods or processes to fill the gaps (Adams-Bigelow, 2006). In addition, most maturity models have been developed based on cross-sectional studies of best practices and have not involved longitudinal study of the actual establishment and development of capabilities in organisations. Therefore it is unclear whether organisations actually pass through the maturity levels as indicated on the models, and the literature reveals much discussion and disagreement on how useful or applicable the maturity models are.

There are few studies that look at the development of IPPM capabilities in organisations, and none that include a mix of industries across the service and manufacturing areas. This research question addresses this gap in the literature. This research question aims to improve the understanding of how organisations with both manufacturing and service based product development environments develop IPPM capabilities.

RQ 5 asks:

> "How are IPPM capabilities developed?"

2.6 Chapter summary

This chapter has contributed to the field by bringing together the literature related to IPPM capabilities and outcomes from a wide variety of sources. These sources originate from two main perspectives: NPD and PM. The diverse body of literature on IPPM capabilities is fragmented and the terminology is not standard. This chapter has identified and defined terminology for use in this thesis. An IPPM capability has been defined as 'the overall organisational ability to manage the innovation project portfolio and maximise its contribution to the success of the organisation'.

The main research question, "What is the relationship between an organisation's IPPM capability and its ability to establish sustainable competitive advantage through improved new product outcomes?" has guided the literature review. A conceptual model has been proposed (Figure 2-7) to represent the main themes in the literature related to

IPPM success factors and outcomes. Five research questions have been developed based on the findings from the literature review. These questions are summarised in Figure 2-8 and are used to drive the research and address the main research question. Chapters 3 and 5 justify and describe the methodology used to investigate these research questions.

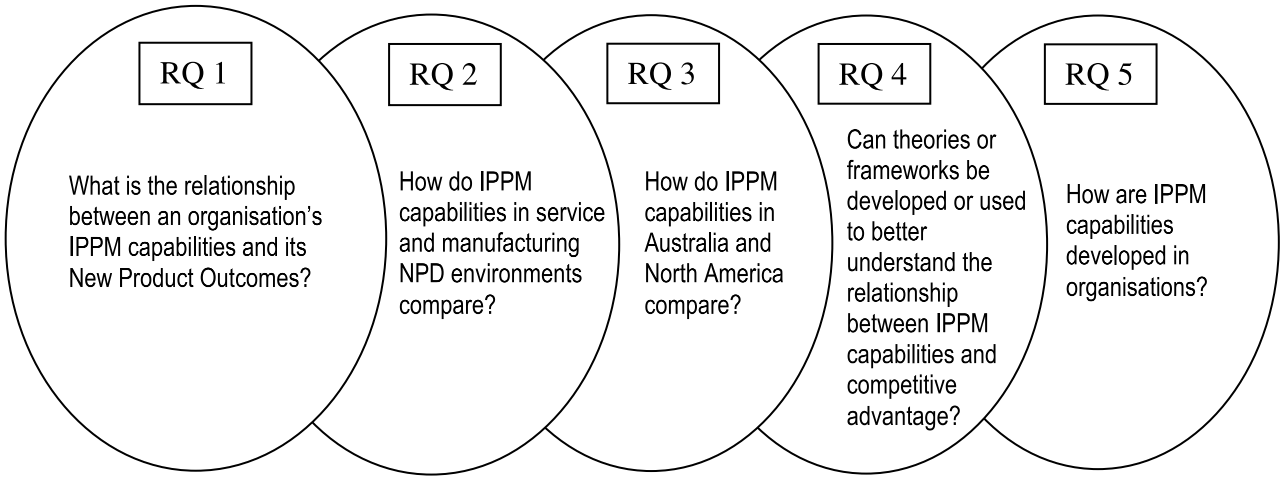

Figure 2-8: Five research questions summarised

Chapter 3 Methodology and Phase 1 research design

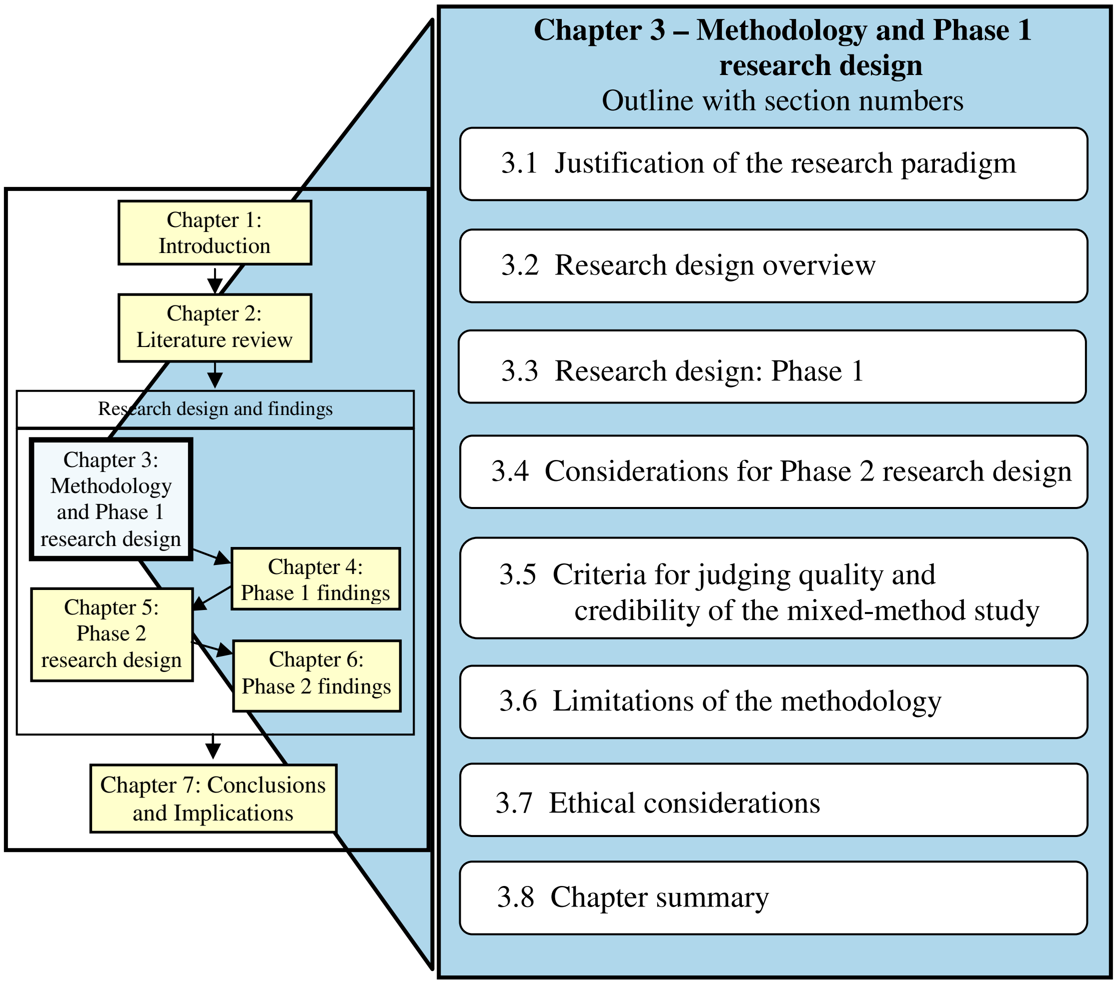

Figure 3-1: Chapter 3 outline within overall thesis structure

This research explores the relationship between an organisation's IPPM capability and its ability to establish sustained competitive advantage through improved new product outcomes. Five research questions have been identified from the literature review in Chapter 2 and a conceptual model has been proposed. This chapter justifies the research methodology and outlines the research design, both of which were selected to best address the research questions and to test the relationships in the conceptual model.

The chapter is organised as shown in Figure 3-1. Section 3.1 discusses the pragmatic research paradigm selected to drive the research study and identifies the 'strategy-as-practice' approach. Section 3.2 outlines the research design, which is justified based on the pragmatic paradigm, the subject area and the research questions. This section presents the benefits and applicability of a mixed methodology and justifies and explains the sequential two-phase mixed-method research strategy. Sections 3.3 and 3.4 expand upon the discussions in Section 3.2: Section 3.3 explains details of the research design for Phase 1, a quantitative questionnaire survey, and Section 3.4 discusses the case study method in general and presents literature used as a basis for the design of Phase 2, a qualitative multiple-case study. As Phase 2 incorporated findings from Phase 1, the design of Phase 2 is subsequently described fully in Chapter 5. This chapter concludes with a discussion of the criteria for evaluating quality and reliability of the findings (Section 3.5), a discussion of the limitations of the research design (Section 3.6) and an overview of the ethics considerations and approval (Section 3.7), before presenting a summary of the chapter in Section 3.8.

3.1 Justification of the research paradigm

The IPPM research reported in this thesis aims to improve understanding of IPPM capabilities and their relationship to competitive advantage. The aim of this research, in line with business research in general, is to produce findings that will ultimately provide guidance for improving organisational performance (Page and Meyer, 1999). In addition, in areas that are exploratory, the findings will provide a base that will assist future research. The understanding of IPPM capabilities is largely developed through studying the practices employed in organisations. These practices include activities used to plan, design and develop IPPM capabilities, as well as activities undertaken during IPPM processes. Chapter 2 has shown how IPPM practices and activities can be considered micro-level strategic activities due to their central role in the actioning of strategy and the development of competitive advantage through the NPD portfolio. Therefore a business and strategy perspective is appropriate for the research. This section justifies the use of a practice-based strategic perspective within a pragmatic research paradigm to study the relationship between IPPM capabilities and competitive advantage.

3.1.1 Overview of research paradigms

A series of core assumptions underlie the choice of research methodology and the research design. This section clarifies and articulates these assumptions, which form the basis for the philosophy underlying the research and are often referred to as the research paradigm (Collis and Hussey, 2003) or philosophical position (Easterby-Smith, 2002) or the knowledge claims (Creswell, 2003) for the research. This thesis will refer to this set of assumptions as the research paradigm.

The core ontological assumption defines the framework or type of theory behind the research and answers the questions: "What is knowledge?" or "What is the nature of reality?" (Collis and Hussey, 2003; Creswell, 2003; Denzin and Lincoln, 2003). The core epistemological assumptions determine the researcher's view on how we obtain knowledge and the relationship between the researcher and the researched (Collis and Hussey, 2003; Creswell, 2003). Other core assumptions explore the role of values in the process (axiological assumptions), how we write about the knowledge or what the language of the research is (rhetorical assumptions) (Collis and Hussey, 2003; Creswell, 2003), the primary logic used and beliefs about the nature and existence of causal linkages between phenomena (Tashakkori and Teddlie, 1998).

The two extremes of ontological assumptions are represented by a purely positivist approach (generally viewed as scientific, objective, experimentalist, traditional and quantitative) or a purely phenomenological approach (generally viewed as subjective, humanist, interpretivist and qualitative) (Collis and Hussey, 2003). Researchers who take a positivist perspective generally believe that there is a singular 'truth' that can be discovered through objective quantitative research. The researcher is not seen to influence or interact with the data. Positivist researchers most commonly use deductive logic and believe that real causes precede or coincide with effects (Tashakkori and Teddlie, 1998). In contrast, researchers who take a largely phenomenological view believe that the researcher and the research subject cannot be separated, and research is therefore biased by the researcher. These researchers believe that there is no single reality that can be discovered and that causes are indistinguishable from effects (Tashakkori and Teddlie, 1998).

Although some researchers use paradigms that fit close to either of these extremes, in reality most research is conducted along the range of ontological assumptions that can be represented as positions along a continuum between the two extremes (Morgan and Smircich, 1980). The pragmatic theoretical orientation sits closer to the middle of the positivist-phenomenologist continuum while providing a perspective to embrace elements from both ends of the spectrum.

3.1.2 The pragmatic paradigm

The pragmatic paradigm has been chosen from many possible theoretical orientations as the basis for the research presented in this thesis. This section outlines the main characteristics of the pragmatic paradigm, to set the base for the following sections that justify the relevance of the pragmatic paradigm for this research.

It is not practical to outline each major research paradigm; therefore Table 3-1 compares the pragmatic paradigm with the positivist and phenomenological paradigms that form the endpoints of the ontological spectrum (Morgan and Smircich, 1980). Table 3-1 draws upon information from several sources (Tashakkori and Teddlie, 1998; Collis and Hussey, 2003; Johnson et al., 2007).

Pragmatism is a part of the non-essentialist philosophy movement that is characterised by a distrust of rigid dualisms (Cherryholmes, 1992). Pragmatists bridge the divide between positivists and phenomenologists. In line with the positivists, pragmatists believe that an external reality exists separate from our minds but, like phenomenologists, they deny the fact that a singular and absolute truth can be determined (Cherryholmes, 1992; Powell, 2002, 2003). Pragmatism allows researchers to meet in the middle on some research issues. For example, while extreme positivists believe that ethics have no role to play, and extreme phenomenologists believe that human and ethical influences create bias that renders research useless, pragmatists accept that ethics have a role and also allow that research shaped by ethical (human) influence can be useful. Pragmatism allows researchers "to develop research that is focused on serving human purposes" (Wicks and Freeman, 1998:123). The pragmatic orientation guides researchers in management and practice-based studies (Wicks and Freeman, 1998; Johnson et al., 2003; Jarzabkowski, 2005). It values the day-to-day actions that can be considered micro-strategising and acknowledges that the practices and actions are conducted by people with varying degrees of 'human agency' (human autonomy and the ability to choose among a range of possible actions) (Powell, 2002).

Table 3-1: Research paradigms compared (derived from Tashakkori and Teddlie, 1998:23; Collis and Hussey, 2003:49; Johnson et al., 2007:31-34)

	Research Paradigm		
Theoretical orientation	**Positivism**	**Pragmatic**	**Phenomenological**
Primary methodology	Quantitative	Quantitative and Qualitative	Qualitative
Ontology – what is the nature of reality?	There exists a singular objective reality.	Accept external reality.	Reality is subjective and multiple realities may be seen by participants in a study.
Epistemology – what is the relationship between researcher and that researched?	Duality exists between knower and known. Researcher is independent from what is being researched.	Objective and subjective points of view are both considered.	Researcher interacts with that being researched; it is not possible to separate the two.
Axiology – what is the role of values?	Research is value free and unbiased.	Values play a large role in interpreting results.	Research is value-laden and biased.
Primary logic	Deductive	Deductive and Inductive	Inductive
Causal linkages	Real causes exist for subsequent or simultaneous effects.	There may be causal relationships but we do not expect to be able to pin them down.	All entities simultaneously shape each other therefore it is impossible to distinguish causes from effects.

From a pragmatic perspective, knowledge is not a search for absolute truths concerned with abstract generalisations and theories. Practitioners do not apply theories directly and the links between strategic theory and methods used in practice are often not clear (Jarzabkowski and Wilson, 2006). Pragmatists believe that knowledge is developed as a result of practical activities and it derives its value from its ability to influence future activities. The activities performed are therefore central to forming and evaluating knowledge (Johnson et al., 2007). Through recognising and valuing activity and human agency, pragmatism aims to generate findings that are useful for practitioners (Chia and MacKay, 2007). A pragmatic perspective allows the research to get "close enough to actors and their activities in order to help them be more effective in the field" (Johnson et al., 2007:33). Therefore practitioners have a central role in the research and in ensuring relevance and quality of the research.

A practice-focused perspective based on the pragmatic paradigm presents methodologies that link the qualitative and quantitative modes of enquiry (Evered and Louis, 1991; Creswell, 2003). Combining and linking methodologies improves the quality of the research. From the pragmatic perspective, the goal is to better understand reality even if the absolute truth is not obtainable. Multiple perspectives and methods allow for deeper understanding than is possible from a single method. Findings can be supported or challenged through methodological 'triangulation', enabling higher reliability and validity to findings (Brewer and Hunter, 1989; Denzin and Lincoln, 1998).

Researchers who subscribe to a particular theoretical style and the corresponding methodologies tend to ignore problems that are incompatible (Brewer and Hunter, 1989). Rather than align themselves exclusively with either quantitative or qualitative methodologies, researchers who can apply either method, or combine the methodologies, are best placed to address any research problems that arise (Onwuegbuzie and Leech, 2005).

3.1.3 Justification of the pragmatic paradigm to address the research questions

This section overviews the perspectives used for previous IPPM research and then justifies the use of a pragmatism-based 'strategy-as-practice' perspective for this research. The justification is based on the research question(s) and the strategy-based themes central to the research.

Traditionally IPPM research has focused primarily on the processes involved with the development of manufactured products, and the choice of paradigm has been aligned with a fairly positivist ontological perspective. Previous IPPM research has therefore employed largely quantitative methods (Cooper et al., 2001; Voss et al., 2002; Jeffery and Leliveld, 2004). However, increasingly researchers are looking into the phenomenological aspects of IPPM methods and incorporating more qualitative research methodology (Eskerod et al., 2004; Christiansen and Varnes, 2008). The wide range of approaches to the study of processes such as IPPM are appropriate given that IPPM involves both tangible and human elements of an organisation (Voss et al., 2002).

The main research question is:

> "What is the relationship between an organisation's IPPM capability and its ability to establish sustainable competitive advantage through improved new product outcomes?"

Yet analysis of the two extremes of positivist and phenomenological paradigms reveals that neither is appropriate for the study of IPPM capabilities. The research questions for this study aim to gain a deeper and broader perspective on IPPM capabilities and their relationship to competitive advantage in organisations. The literature review has shown that IPPM capabilities can be complex processes that involve individual motivations and are influenced by the social environment, and therefore a purely positivist view is not suitable for this research. In addition, according to Powell (2001), although positivist theories of truth are widely accepted epistemologies in organisational research, they are irrelevant in the search for sustainable competitive advantages. He points out that organisational elements that provide competitive advantage function properly only when they are not fully understood. Once fully understood, these elements are able to be imitated, rendering them ineffective in differentiating organisations from each other. Therefore empirical studies can neither prove nor disprove competitive advantage propositions (Powell, 2001). The search for truth is an inappropriate theoretical orientation for studies into organisational elements that lead to competitive advantage because "at the moment there appears to be no falsifiable, unfalsified theory of competitive advantage, nor any competitive advantage propositions defensible without resort to ideology, dogmatism or faith" (Powell, 2001:883).

A purely phenomenological approach is also unsuitable for this type of research because this approach puts forward a belief that reality is highly subjective and denies the existence of relationships between factors and outcomes. The research questions for this study and the focus on understanding IPPM capabilities and their relationship to competitive advantage therefore do not align with a phenomenological paradigm.

The strategic themes underlying the goals of the research are used to guide the selection of an appropriate paradigm for this research. A primary goal of this research is to provide guidance that can be applied to improve organisational performance. Sustainable competitive advantage is of interest because of its relationship to organisational performance. Leading strategic management theorists hypothesise that, in order to achieve sustained superior performance, organisations must possess one or more sources of sustainable competitive advantage (Grant, 1991; Powell, 2001; Barney and Clark, 2007). In most situations, improved new product outcomes will lead to superior organisational performance. Therefore organisations continually seek to develop capabilities that will improve their new product outcomes. If an organisation's IPPM capability leads to improved new product outcomes, the IPPM capability could be a source of competitive advantage.

Chapter 2 established that organisations consider IPPM capabilities important and that they invest in establishing and improving their capabilities with the goal that the IPPM capabilities will be a source of competitive advantage and improve organisational performance. Chapter 2 also showed that IPPM practices are used to deploy as well as influence strategy and identifies IPPM practices as micro-strategising activities.

Due to the role of IPPM practices in the deployment of strategy, strategic theories may be able to provide insight into this relationship. However, strategic theorising has often been criticised as not being relevant to the practice of strategy (Lowendahl and Revang, 1998; Baldridge et al., 2004; Jarzabkowski and Wilson, 2006). It can be argued that strategy research should concern itself with practical implications and applications (Pettigrew et al., 2002), especially as there is a positive correlation between judgments of academic quality and judgments of practical relevance in strategic publications (Baldridge et al., 2004). Therefore this research project looks towards practice-based strategic perspectives to support the research.

This project aims to maintain high academic quality while providing results with practical relevance by adopting the pragmatic paradigm and using a strategy and practice-based approach to studying IPPM practices. Such an approach can be seen in the 'practice epistemology' that has been identified for studies of 'strategy-as-practice'. This 'practice epistemology' draws upon a pragmatic perspective, values both objective and subjective views, and is grounded in the everyday practices used within organisations (Cook and Brown, 1999; Whittington, 2003; Jarzabkowski and Wilson, 2006; Johnson et al., 2007). Rather than viewing strategy as a property of an organisation, something the organisation 'has', the 'strategy-as-practice' perspective views strategy as an activity or something that managers within the organisation 'do' (Johnson et al., 2007). By studying the activities and micro-strategising activities that are distributed throughout an organisation, the study of 'strategy-as-practice' from a pragmatic perspective adds the important consideration of 'how' of strategies are implemented, whereas much strategy research and theory stop at the 'what and why' of strategy (Jarzabkowski, 2003; Johnson et al., 2007). IPPM activities align well with the pragmatic perspective and the study of micro-strategies. As Cook and Brown note, "Pragmatists have been centrally concerned with doing, particularly forms of doing that entail making or producing something (from technologies to ideas)" (1999:387). IPPM practices involve the production of new products, and the development of ideas and technologies. In addition, resource allocation processes have been identified as 'micro-strategies' (Jarzabkowski, 2003).

Therefore the pragmatic paradigm is appropriate to address the range of 'what, why and how' research questions identified in this study of the of IPPM capabilities. This approach supports both qualitative and quantitative research in the study of strategy practices, including the 'micro-strategising' activities such as IPPM activities.

3.1.4 Summary – pragmatic paradigm, 'strategy-as-practice' focus

The pragmatic perspective has been shown to be appropriate for research into strategic activities, including the micro-strategy activities that are best addressed through 'strategy-as-practice' research. IPPM practices are shown to be strategic 'micro-strategising' activities, and therefore pragmatism is an appropriate perspective with which to study IPPM and competitive advantage.

Table 3-2: IPPM research aligned with the pragmatic paradigm

Assumptions of the pragmatic paradigm	Comments and applicability to IPPM research
Methodological: Embraces both qualitative and quantitative methodologies	Quantitative and Qualitative methodologies have both been proven useful for IPPM research (Cooper et al., 2001; Blomquist and Muller, 2006; Blichfeldt and Eskerod, 2008; Cauchick Miguel, 2008), triangulation between findings based on different methodologies and different specific techniques can be used to improve understanding.
Ontological: Accept external reality.	Research methods assume that IPPM capabilities exist within organisations; it is up to the researchers to uncover the elements of the capabilities and the outcomes. The goals of the research are to improve business performance by understanding IPPM processes. This fits with the pragmatists' view that "the mandate of science is not to find truth or reality, the existence of which is always in dispute, but to facilitate human problem solving" (Powell, 2001:888).
Epistemological: Objective and subjective points of view are both considered.	Multiple perspectives and viewpoints are used through multiple research methodologies. Objective data are collected, as well as subjective measures. The researcher's role is to interact with the researched to best try to understand the organisational context for the IPPM process, and the ways in which it evolves. The researcher does not attempt to influence the environment and remains as objective as possible; however, in order to understand the nature of interaction and feedback between the elements, the researcher must develop an in-depth and holistic view of the environment (Morgan and Smircich, 1980). The research focus on IPPM practices fits within the 'strategy-as-practice' epistemology which is supported by the pragmatic paradigm.
Axiological: Values play a large role in interpreting results.	Pragmatism acknowledges that the values and experience of the researcher will influence their interpretation of the results, but believes that we cannot know the truth – we can only approximate it. In this process it is recognised that the researcher's values could cause bias in the research and that the methodology will need to be developed to minimise the potential bias.
Logical: Employs both deductive and inductive logic.	This research aims to employ both deductive and inductive logic as it builds upon existing research as well as explores new areas. Existing research has proposed relationships that can be tested in a deductive fashion, while improving the understanding in exploratory areas will benefit from the use of inductive logic.
Causal Linkages: There may be causal relationships but we do not expect to be able to pin them down.	This IPPM research aims to improve understanding of the relationships between IPPM capabilities and competitive advantage. The findings may indicate likely or possible causal relationships; however, due to the complexity of the environment this research does not expect to prove causality.
Rhetorical: Informal as well as formal writing styles are useful.	The impersonal voice and a relatively formal style is most often adopted in the NPD and IPPM literature, so the rhetorical assumption will be to align the writing style most closely with these styles.

The pragmatic paradigm fits with the research questions and supports the use of both quantitative and qualitative research. Pragmatism in management research is relatively new and the literature review has not found any explicit application of pragmatism to IPPM research. Therefore the applicability of pragmatism to the research problem is outlined in Table 3-2 before a discussion of the research design in Section 3.2.

In summary, this research project adopts the pragmatic paradigm and takes an ontological position near the centre of the positivist-phenomenological continuum (Morgan and Smircich, 1980). The pragmatic paradigm supports the use of mixed methodologies and encourages the involvement of practitioners in the research process, as well as in the evaluation of the usefulness of the research (Johnson et al., 2007). Therefore the pragmatic paradigm is well aligned with the study of 'micro-strategising' activities like IPPM practices in an organisational setting.

3.2 Research design overview

This section outlines the selection and design of a sequential mixed-method approach based on the underlying pragmatic paradigm and 'strategy-as-practice' epistemology chosen for this research. The choice of methodology for this research was guided by the subject area and the research questions as well as by the pragmatic research paradigm that underpins the research (Collis and Hussey, 2003; Creswell, 2003). Practical considerations such as time, access to organisations and data were also considered in the research design.

To provide a guide to the research design and the structure of the following chapters, Figure 3-2 graphically summarises the research design within the context of the overall research strategy. This section outlines the research design for the sequential mixed methodology and provides the structure for the remainder of this chapter as well as for chapters 4, 5 and 6.

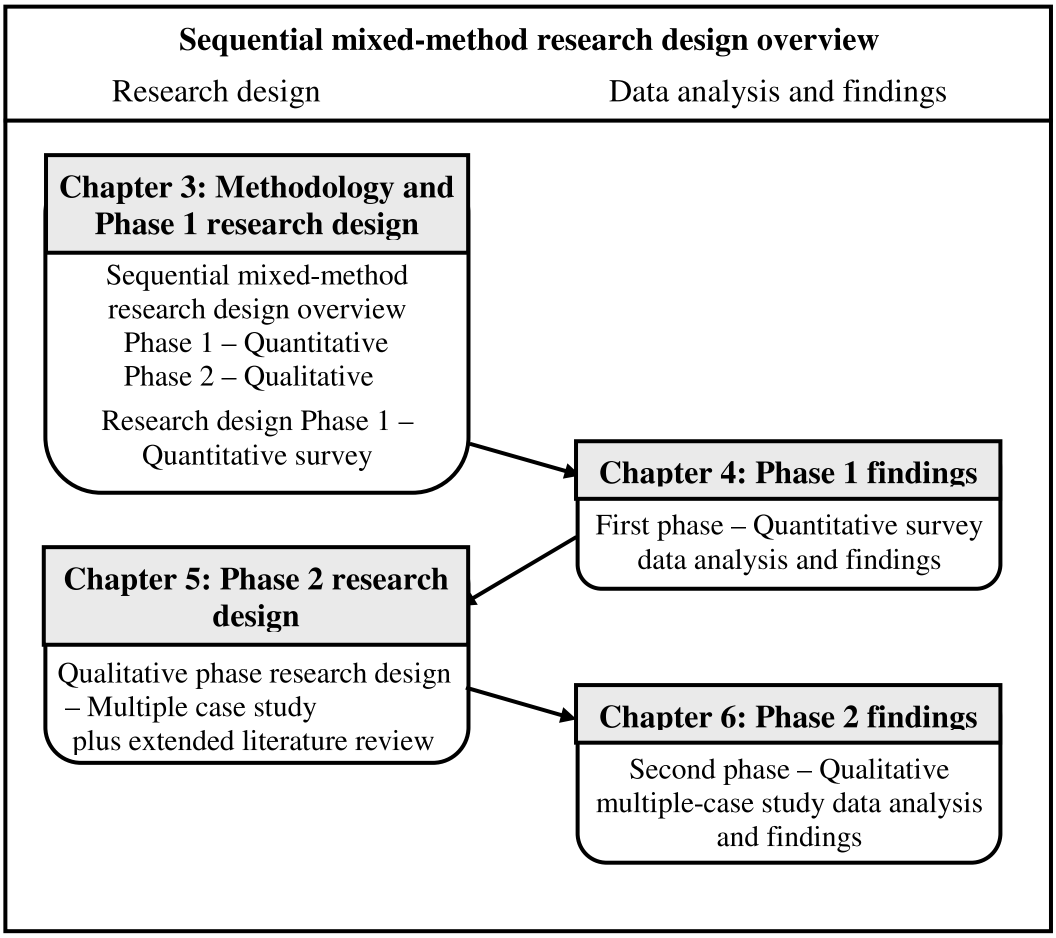

Figure 3-2: Sequential mixed-method research design overview

3.2.1 Justification of a mixed methodology

All methods have inherent biases and limitations that must be acknowledged and accounted for in order to appropriately analyse the findings. Mixed-method research aims to generate improved findings by avoiding reliance on any single method and therefore limiting exposure to the particular limitations and biases of that method (Tashakkori and Teddlie, 1998; Creswell, 2003). Other benefits of mixed methods include the ability for the results from one method to be incorporated in the research design for a subsequent method, and the ability to provide insight for different units of analysis (Greene et al., 1989; Creswell, 2003). However, mixed-method research presents its own set of challenges, such as the need to be able to use multiple perspectives and to apply a variety of research methods to the problem. Methods must be selected to complement each other and reduce rather than magnify any bias or limitation (Greene et al., 1989).

Support for mixed-methodology research has been growing; however, it is still not accepted by some sections of the research community. There is strong debate in the research methodology literature about the alignment of the research paradigm with the methodology. Some researchers who follow either the positivist or phenomenological approaches are 'paradigm purists' at the ends of the ontology spectrum. These 'paradigm purists' believe that only qualitative methodologies are appropriate for a phenomenological paradigm, only quantitative studies are appropriate for a positivist paradigm, and that the two perspectives and methodologies are not compatible. From the perspective of the 'paradigm purists', mixed methodologies cannot be successful due to the differences in the theoretical bases underpinning them (Tashakkori and Teddlie, 1998; Onwuegbuzie and Leech, 2005). However, others argue that researchers do not need to be limited to quantitative methodology for positivist research and qualitative methodologies for phenomenological approaches (Ticehurst and Veal, 1999; Creswell, 2003; Yin, 2003a; Onwuegbuzie and Leech, 2005). These authors argue that quantitative and qualitative methodologies both have strengths and weaknesses and that researchers can combine both to get the best understanding.

From a pragmatic perspective, research methodologies are just tools to get the job done and should be designed to aid understanding using the research questions to drive the selection of the research methods (Onwuegbuzie and Leech, 2005). The pragmatic paradigm supports mixed-methodology research as it allows the selection of the best method for the research question (Creswell, 2003). The researcher is able to zoom in or out to gain detail or broad perspective and therefore can study the micro as well as the macro levels of a research issue (Onwuegbuzie and Leech, 2005).

3.2.2 Justification for a sequential mixed-method research study

Mixed-method research takes many potential forms. This section explains and justifies the selection and design of a sequential mixed-method research study, in particular the relevance of this methodology to the five specific research questions introduced in Chapter 2 and repeated here for convenience:

> RQ 1: What is the relationship between IPPM capabilities and New Product Outcomes?

RQ 2: How do IPPM capabilities in service and manufacturing NPD environments compare?

RQ 3: How do IPPM capabilities in Australia and North America compare?

RQ 4: Can theories or frameworks be developed or used to better understand the relationship between IPPM capabilities and competitive advantage?

RQ 5: How are IPPM capabilities developed?

These questions, particularly RQ 1, 2 and 3, can be partially addressed through using a method that allows relationship testing and comparative analysis, such as a quantitative survey. However, in order to explore all of the research questions more fully and to gain a deeper understanding that gets beyond the ‘what’ to the ‘why and how’, an in-depth qualitative method is indicated. In addition, following a pragmatic perspective, the best understanding can be gained by using multiple research types and methods, in this case, a mixed-method approach involving both qualitative and quantitative methodologies.

In addition to the research questions and the research paradigm, other considerations and limitations driving the selection of the research methods include:

- Timeframe. The PhD research needs to be completed within a limited timeframe. For example, although longitudinal studies are suited to research into how IPPM practices are developed (RQ 5), they were not used in this research due to the time required. Instead the research was designed to capture as much temporal data as possible through questions about past evolution and future plans for the IPPM capability during semi-structured interviews.

- Data access. Management research usually requires participation from organisations and may require access to people, data and other artefacts within organisations. It is more difficult to gain access if a large amount of time or sensitive information is required. The research was designed to minimise the time investment required from research participants while ensuring that adequate data were collected. In addition, the research design was developed to ensure confidentiality, minimise the amount of sensitive information collected and reinforce the confidential nature of the research process to address potential concerns from participating organisations.

- Data availability. The research design was influenced by the availability of data from a North American survey of IPPM practices and outcomes. The Australian survey was designed to include questions that facilitated a comparison between Australian and North American findings (RQ 3).

Based on the research questions, the pragmatic paradigm and the other considerations, a sequential mixed-method design was chosen for the research. A sequential mixed-method research study involves qualitative research followed by quantitative research or, as in this study, quantitative research followed by qualitative research (Tashakkori and Teddlie, 1998). The sequential procedures allow the researcher to elaborate upon the findings of one method with another method (Creswell, 2003) and to enrich and cross-validate findings (Gillham, 2000a). The second phase of the study can be used to further test findings indicated in the first phase, to increase the level of understanding by using an additional perspective, or to provide further explanation for unexpected findings in the first phase. Alternatively the mixed methodology may uncover paradox or contradiction between findings (Greene et al., 1989). In a mixed-method study, the final analysis and conclusions are based on findings from both of the phases of the research (Tashakkori and Teddlie, 1998).

3.2.3 Selection of methods for the mixed-method study

The mixed-method approach adopted for this research involved a quantitative questionnaire survey followed by a multiple-case study in a sequential explanatory research strategy (Creswell, 2003). In this strategy the qualitative study in the second phase explained and expanded upon the findings of the first quantitative phase in addressing the research questions. The questionnaire survey and multiple-case study methods were selected to be complementary and to have non-overlapping weaknesses (Brewer and Hunter, 1989; Tashakkori and Teddlie, 1998). The use of multiple methods is supported by the pragmatic paradigm and by the ‘strategy-as-practice’ approach (Creswell, 2003; Johnson et al., 2007). The use of these complementary methods allowed cross-validation of findings through methodological and method triangulation (Greene et al., 1989). The pragmatic perspective asserts that we cannot discern a singular truth, but encourages us to use ‘what(ever) methods work’ to get closer to the truth (Cherryholmes, 1992; Creswell, 2003). The sequential mixed methodology was designed for this research to meet this aim.

A quantitative questionnaire survey was selected to conduct the first phase of the study. The survey was an effective method of capturing a wide range of information across samples on a comparable basis (Ticehurst and Veal, 1999). This enabled a baseline of IPPM data in Australia to be established, an important first step for this research because it is the first IPPM study conducted in Australia. Survey methods also enable the use of statistical analysis of the data, allowing researchers to establish cause and effect relationships (Page and Meyer, 1999). Therefore quantitative data obtained through the survey enabled the relationships on the conceptual model presented in Figure 2-7 in Chapter 2 to be tested, and also allowed the examination of other correlations between IPPM practices and outcomes to address RQ 1. Questionnaire surveys are also ideal for comparing responses across groups (Gillham, 2000a; Creswell, 2003). Therefore the survey provided a standard framework for initial exploration into IPPM practices in service product development-focused organisations. The survey allowed a comparison between manufacturing and service organisations' IPPM capabilities, and indicated specific areas of interest for further in-depth studies in this area to address RQ 2. In addition, RQ 3 was best tested through a questionnaire survey as this method provided an initial grounding for the first IPPM research in Australia and allowed comparison with North American survey-based data. The findings from the questionnaire provided a baseline for the subsequent in-depth study. The questionnaire findings on the IPPM factors and outcomes and the relationships between them provided a base from which to examine theories to explain the relationship and so obtain an answer to RQ 4. Data on the maturity of the IPPM capability provided a base for further research on how IPPM capabilities are developed, in response to RQ 5.

A qualitative methodology was selected for the second phase because, although the initial survey phase could establish a baseline of IPPM practice data, provide comparisons and test relationships on the conceptual model, it was not able to provide more in-depth understanding of IPPM practices. A quantitative methodology is appropriate for study of the 'what' but not the 'how' (Yin, 2003a). In-depth understanding of IPPM capabilities through qualitative research is required to understand how IPPM capabilities influence NPD outcomes or how IPPM capabilities are developed. The qualitative phase provided an extra perspective on the findings from the first phase, allowing these initial findings to be supported and strengthened, or challenged. In addition, the qualitative phase had the potential to explain unanticipated or exploratory findings from the first phase (Greene et al., 1989; Creswell, 2003). A multiple-case study method was chosen for the qualitative phase of the research in order to generate more robust findings (Yin, 2003b). As part of a sequential mixed-method study, the final design of the qualitative phase of research incorporated input from the findings of the first quantitative phase of research. The final design of the qualitative second phase of this study is discussed in Chapter 5.

Table 3-3 overleaf summarises the five research questions and the contributions expected from each phase of the research. As shown in the table, both the quantitative and the qualitative methodologies were designed to address RQ 1, 2, 4 and 5. RQ 3 was addressed only through the quantitative survey, due to the unavailability of comparable data for the qualitative phase of study.

Table 3-3 : Summary of two-phase approach and research questions

Research Question	Contribution from quantitative phase – questionnaire survey	Contribution from qualitative phase – multiple-case study
1- What is the relationship between IPPM capabilities and New Product Outcomes?	Empirical data collection focused on IPPM practices and outcomes, practice-based study resulting in benchmark of current IPPM practices in Australia, testing of relationships in the conceptual model.	In-depth data collection to better understand the activities and factors within the IPPM capability, further investigation into relationships indicated in the first phase seeking additional depth or explanation for relationships and possible emergence of additional relationships.
2- How do IPPM capabilities in service and manufacturing NPD environments compare?	Exploratory comparative study. Ability to directly compare responses to the questions between the two groups (service-based and manufacturing-based organisations).	Follow up and improve understanding, aim to confirm or disconfirm, and explain any findings from Phase 1. Explore multiple aspects of the IPPM capability with a view to generate additional insights
3- How do IPPM practices in Australia and North America compare?	Exploratory Comparative study. Ability to directly compare responses to the questions between the two groups (Australian data and existing North American data).	Not applicable to this research question. The qualitative study is unlikely to generate further understanding due to the lack of a similar study in North America for comparison.
4- Can theories or frameworks be developed or used to better understand the relationship between IPPM capabilities and competitive advantage?	Survey data will provide a baseline of factors, methods and outcomes. The findings will be used to help identify a direction or area of focus to address this research question.	Process-focused research to understand IPPM in more detail, see if there is any alignment with existing theories or frameworks, may suggest the development of a new theory or framework.
5- How are IPPM capabilities developed?	The survey will produce some data on maturity levels, providing a baseline on IPPM development.	In-depth questioning will develop understanding of the processes and the activities taken over time to develop IPPM processes.

3.3 Research design: Phase 1

The questionnaire survey was designed to address all five research questions and to provide an initial base for further research. The questionnaire was the first phase of a larger sequential mixed-method study, as outlined in Section 3.1, and provided a base for the second phase (Gillham, 2000a). This section outlines the design of the survey questionnaire.

The survey type chosen was a cross-sectional self-administered mail-in questionnaire. A self-administered mail-in survey is a good method for gaining information without taking much of the respondents' time, for enabling respondents to remain anonymous, and for cost effectiveness (Ticehurst and Veal, 1999). In addition, this was the format used for the previous data collection in North America (Cooper et al., 2001), and therefore the comparability of the Australian data was enhanced by adopting the same type of survey. A disadvantage of a self-administered survey, when compared with a survey completed by the interviewer, is the greater likelihood of incomplete responses or low response rates. The survey instrument and the data collection methods were designed to address these weaknesses.

A comprehensive survey instrument was developed to capture data on IPPM practices and outcomes. The design of the survey built upon the findings from the literature review on the methodologies, questions and methods used in existing IPPM research (Gillham, 2000a), particularly the North American research. The survey was designed to address the research questions and to collect data on several items for each of the factors in the conceptual model. A large portion of the Australian survey drew upon the earlier surveys used by Cooper et al. (2001) in North America so that the results from these portions of the Australian survey could be directly compared with the North American data. The Australian survey was also significantly extended to address IPPM for service-focused organisations and to explore alternative ways of measuring the effectiveness of IPPM methods.

The survey asked respondents whether their product portfolio contained service or manufactured products so that the IPPM capabilities could be compared between the two environments to address Research Question 2. In recognition of the fact that organisations produce products that are not necessarily purely service or manufactured products (Shostack, 1982; Cooper and Edgett, 1999; Andersson, 2000), this research asked respondents to indicate their project portfolio's position on a spectrum as shown in the survey extract in Figure 3-3. During the analysis phase, the responses at either end of the scale were used to classify organisations as 'primarily service-based' or 'primarily manufacturing-based' for comparison.

This survey will be looking at new product projects for **both goods (physical products) and service products**. Your portfolio of new product projects may relate to either goods or services or a mix of the two. Please indicate the approximate project mix that applies to your responses:

Our portfolio contains only physical product projects (goods)				Our portfolio contains a mix of goods and service product projects					Our portfolio contains service product projects only
[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]

Figure 3-3: Survey extract on the manufacturing and service mix of the project portfolio

As discussed in the literature review in Chapter 2, measuring the outcomes of an IPPM capability is difficult, particularly across different industries. The survey was designed to explore and compare alternative measures of new product portfolio outcomes (PPO) to better understand the outcome and therefore to improve the ability to understand the relationship between IPPM capabilities and outcomes. The survey incorporated three different types of outcome constructs with a total of thirteen different outcome items. Table 3-4 explains the three types of outcome measures (constructs) included in the survey. Appendix 2 lists the items that are used to measure the constructs in the conceptual model and Appendix 3 includes a copy of the survey.

The survey instrument was designed to balance the competing needs of completeness of data, ability to analyse the data, and obtaining a good return rate for the survey. The survey instrument was carefully formatted for clarity, as layout and presentation are important to gain completeness and accuracy in a self-administered survey (Ticehurst and Veal, 1999). An uncluttered layout with plenty of white space was chosen, resulting in a survey length of 12 pages, staying within the maximum recommended (Gillham, 2000a).

Table 3-4: Three types of product portfolio outcome (PPO) measures

Type of PPO measurement (and name of associated construct)	**Types of items for measurement**	**Type of response collected**	**Comments**
IPPM goal performance (PPM)	Six items measuring the level of performance on IPPM goals	Perceptions related to the portfolio of projects	These types of measures are used in previous IPPM research. Items are included for each of the main goals of an IPPM capability.
Product opportunity effectiveness (OPP)	Four items measuring the effectiveness of the new products in exploiting technology and market opportunities	Perceptions related to the new products produced by the portfolio of projects	These types of measures are generally used in NPD research. Two items measure market opportunities and two measure technology opportunities.
New Product Performance (NPP)	Three items measuring percentages of sales, profits, and success rates for new products	Reported rates of sales, profit and reported rates of the success of new products in the market	These new product performance items represent the most important outcomes of a new product program. These measures can be difficult to obtain from respondents and may not be comparable across industries.

To increase the reliability of findings, the survey used multiple-item constructs rather than single responses (Grimm and Yarnold, 1995; Hair et al., 2006). Multiple-item constructs allow a deeper analysis of the results, and reduce the likelihood of misinterpretation or errors skewing the survey results. The items used for multiple-item constructs for each of the success factors and outcome factors in the conceptual model are outlined in Appendix 2.

The survey questions were designed for a specific audience; however, attempts were made to explain terms and to limit assumptions about the knowledge of the audience

(Collis and Hussey, 2003). For example, the anchored endpoints for responses involving a Likert scale were defined by statements relevant to the particular question, as shown in the excerpt in Table 3-5. This technique ensured that the respondent clearly understood the meaning of the high and low Likert ratings, and provided an additional level of confidence that the question statement had been interpreted correctly. The examples in Table 3-5 also show how the questions were designed to use simple language to clarify terms such as 'resources' (people, time and money) and 'new product arenas' (product categories or types not offered three years ago).

Table 3-5: Sample survey questions

We have the right number of new product projects for our resources – people, time and money – available. 1 = no, we're spread far too thin; 5 = right number of projects for our resources.	[1]	[2]	[3]	[4]	[5]
Our new product program leads our company into new product arenas (product categories or types not offered 3 years ago). 1 = no; 5 = yes, our new products are often in new arenas.	[1]	[2]	[3]	[4]	[5]

The questionnaire was developed to include mostly closed questions, as these are easiest to collect and analyse with this method. However, two open questions were added to allow respondents to elaborate on their IPPM challenges and opportunities and add a greater level of discovery, and routing questions were used to expand the learning from simple closed questioning by allowing respondents to elaborate on their responses in a structured way (Gillham, 2000a). Questions that asked the users to rank a list of items were not included, as this has proven difficult for respondents and is likely to produce disappointing results (Collis and Hussey, 2003). The questions that required users to input data were minimised due to the difficulty in getting responses to this type of question.

The survey was extensively tested using three methods. First, 52 questions (about 60% of the questions in the survey) were drawn from an earlier survey conducted in North America by Cooper et al. (2001), and therefore these questions had already been tested.

In order to be able to compare the responses from the earlier survey and the current findings, these questions were included in the new survey unchanged. Second, the entire survey – including the new sections, the instructions and the overall design – was evaluated by the researcher and colleagues who are experts in the field, resulting in several pre-pilot iterations before the pilot testing phase. Third, a pilot test of the survey was conducted to test for ambiguity in the questions and the completeness of the data obtained through the survey, as well as whether the order of the questions was logical and easy to follow (Gillham, 2000a). A pilot test of the survey was conducted in late 2004 with five organisations. Respondents were asked to provide feedback on the covering letter and preamble to the survey, the survey layout and format, the content and wording used for questions, any difficulties they had in interpreting or answering the questions and any other comments. Feedback – via email and telephone – was positive overall. Slight adjustments were made to the preamble and instructions and one question was removed based on the comments.

The final survey questionnaire instrument contained 88 questions (some with sub-questions). Twenty-three of the questions related directly to the constructs for the conceptual model (the importance of IPPM, the maturity and formality of the IPPM capability, details of methods used, IPPM performance measures, new product effectiveness measures and new product success measures). The remaining questions provided organisational and demographic details and further information on the IPPM capability, including information on selection and evaluation criteria and self assessments of performance compared with competitors. The 52 questions from the North American survey enabled comparative analysis of the responses for the two groups (North American and Australian respondents). Most of the questions unique to the Australian survey were related to the service/manufacturing mix of the new product portfolio, enhanced measures of new product success and improved demographic measures. The questions on methods, importance and maturity, and some of the new product performance measures, were common to both the Australian and the North American surveys. See Appendix 2 for detail of the items and constructs related to the conceptual model and Appendix 3 for a copy of the full survey.

3.3.1 Sampling procedures and sample size

The questionnaire survey required that participants were screened extensively to ensure they had appropriate experience with the phenomena being studied. The survey targetted organisations that manage a program for developing new products in Australia – either service products or manufactured products or a combination of both. In order to address RQ 2 and compare the IPPM capabilities between manufacturing and service environments, the sample of respondents needed to be representative of both environments. The size of the new product program for responding organisations had to be large enough to regularly require decision-making to allocate funds among a number of competing projects.

Potential research participants were identified through a combination of judgmental and snowball sampling methods (Page and Meyer, 1999; Collis and Hussey, 2003). Some research participants were identified through the 'innovation index' developed by the Intellectual Property Research Institute of Australia (2003), and through searches based on industry codes and company size. Other sources of potential research participants included the industry advisory network at the University of Technology, Sydney (UTS) and alumni networks at the Macquarie Graduate School of Management and UTS. All organisations were assessed to determine whether they managed a portfolio of new product development projects, and some stratification was used to improve the representativeness of the sample by ensuring a spread of industry types (Page and Meyer, 1999). The sampling procedures were designed to maximise the usefulness of the responses rather than focussing on obtaining a fully representative sample. This type of sampling is appropriate when studying specialist experiences and phenomena (Collis and Hussey, 2003). The target sample size was primarily driven by the need to analyse the data (Collis and Hussey, 2003), but was also influenced by Australia's relatively small population size and the limited number of organisations with a new product project portfolio of sufficient size to benefit from an IPPM capability. A minimum sample size of 50 was targeted to enable sufficient statistical significance for correlation testing of the relationships in the conceptual model. This initial correlation testing was followed up by the second phase of research through in-depth qualitative research. Therefore the second phase of research helped to address the validity and generalisability of findings of this first phase.

One of the difficulties with the questionnaire/survey methodology is the low response rate and problems with data quality due to incomplete or inaccurate responses (Gillham, 2000a). Several methods were used to improve the return rate for the surveys. The importance of this research area and respondents' contribution were emphasised in both initial and follow-up contacts. In addition, since low response rates are often due to uncertainty about what would happen with the data and whether the respondent would obtain any direct benefit (Gillham, 2000a), each respondent was promised (and later delivered) a copy of the published results of the research.

Most of the surveys were sent by email directly to the person confirmed as the best contact for IPPM reporting. Surveys that were posted included a self-addressed return envelope to encourage and facilitate response. All surveys included a personalised covering letter.

Individual email and telephone contact was used as a follow-up to enhance the survey return rate. Follow-up for unreturned surveys was by email approximately two weeks and six weeks after the initial mailing. Telephone follow-up was then made with the remaining non-respondents.

3.3.2 Statistical methods for data analysis

The questionnaire survey response data were analysed using descriptive methods, comparative methods and explanatory methods. The statistical methods were selected based on the expected sample size and the type of analysis required, as outlined below.

Descriptive statistics were used to summarise the responses to create a benchmark of Australian IPPM practices. These descriptive statistics were presented primarily in the form of means and standard deviations for responses.

Comparative and explanatory statistics were used to address RQ 1. Comparative statistics using bivariate correlations were used to test for relationships between the factor and outcome constructs in the conceptual model, and to look for other relationships. Factor analysis was conducted to identify the groupings of items that 'go together' (Ticehurst and Veal, 1999) and to confirm the items that best supported the constructs in the conceptual model. The constructs were strengthened by removing items that did not load onto the construct or that weakened the overall construct by reducing the cronbach alpha. The process of factor analysis and strengthening of constructs provided a greater degree of confidence that the constructs represented the respondents' opinion accurately than would have been possible through a single response item. In addition, the use of constructs increased the statistical significance by reducing the number of items in the analysis (Ticehurst and Veal, 1999). The Pearson chi square correlation was used to indicate whether the items were related in a systematic way (Ticehurst and Veal, 1999) and indicated the slope of the linear relationship between the items (Page and Meyer, 1999). The Pearson correlation was appropriate for this data as there was a relatively normal distribution among the responses (see Appendix 4 for discussion of the tests for normal distribution). Two-tailed Pearson correlations were used on pairs of items and significant differences were identified at the 0.05 or higher level.

Explanatory statistics in the form of linear regressions and supporting factor analysis were used to clarify and strengthen the primary findings and to understand more detail of the relationships between a limited set of constructs. The regression analysis was conducted with three of the constructs, as appropriate for the sample size. Factor analysis of the set of constructs was conducted to clarify the appropriate composition of the constructs and to eliminate cross-loading (Hair et al., 2006).

In addition, comparative statistics using t-tests were employed to address part of RQ 1 as well as RQ 2 and 3. A comparison of means between two independent samples used the student's t-test to determine whether there was a significant difference between the means for the items and constructs in the survey. The student's t-test, normally referred to as the 't-test', is suited to the small sample sizes and relatively normal distribution of the samples in this survey (Collis and Hussey, 2003; Garson, 2006a). The results of Levine's test for equality of variance were used to confirm the applicability of the 'equal variance not assumed' or 'equal variance assumed' t-test values. The results presented represent two-tailed analysis and significance levels of 95% or better.

For RQ 1, the relationships involving IPPM methods and the OPP constructs and items were tested using t-tests comparing the means between independent samples. The two independent samples for each method were the sample where the method was used (coded 1) and the sample where the method was not used (coded 0). For RQ 2, each item and construct in the entire survey was tested for any significance between two sets of independent samples. In this case, the independent samples were the service product-focused organisations (n=24) and manufactured product-focused organisations (n=24) following a polar extremes approach (Hair et al., 2006). For RQ 3, the t-test was again used with the Australian data set (n=60) and the North American Data set (n=205) as the independent samples. Only the items and constructs common to both surveys were tested for any significance between the independent samples for RQ 3. The results of the comparative analyses for RQ 1, 2 and 3 are presented in Chapter 4, sections 4.2.2–4.2.4.

3.4 Considerations for Phase 2 research design

The second phase of this sequential mixed-method study built upon the findings from the survey questionnaire, and involved a multiple-case study methodology to gain in-depth knowledge about IPPM capabilities. As outlined in Table 3-3, this qualitative phase of the research focused on providing further explanation and understanding for four of the five research questions. Due to the lack of comparable case study research in North America, this qualitative phase was not able to address RQ 3. This section justifies the selection of the multiple-case study methodology and outlines the considerations for the research design. The final research design, which incorporated the findings from the quantitative survey, is presented in Chapter 5.

A case study method is appropriate for research into a process leading to results – where the focus is on the process rather than the outcomes (Gillham, 2000b). Case study interviews allow depth within the follow-up questions and provide a high degree of confidence in the data obtained (Collis and Hussey, 2003). Case studies conducted by qualitative (informal) interviews and observation provide the best opportunities to study processes (Gummesson, 1991). The case study design should employ several sources and types of data to achieve data triangulation to enhance the generalisability and validity of the outcomes (Collis and Hussey, 2003) and allow in-depth understanding (Denzin and Lincoln, 1998). The case study method also complements the initial quantitative survey and allows methodological triangulation (Greene et al., 1989; Collis and Hussey, 2003).

A comparative multiple-case study method was chosen for this research project to best address the research questions (Eisenhardt, 1989; Yin, 2003a). The multiple-case study method allows the possibility of general conclusions to be derived from a limited number of cases and enables the researcher to reach a fundamental understanding of the environment (Gummesson, 1991). This provided a complementary perspective to the more statistically significant but superficial correlations obtained from the quantitative survey (Greene et al., 1989).

Theoretical rather than random sampling allows the cases to be selected to optimise findings. For example, cases might be selected to illustrate extreme or contrasting conditions, or to extend or replicate findings (Eisenhardt, 1989; Johnson et al., 2007). There is no set number of cases to include in the multiple-case study analysis. The number of cases can depend on when the study reaches saturation, or when each case has a diminishing marginal contribution to the analysis and the likely contribution from additional cases does not justify continued research (Gummesson, 1991). Between four and ten cases are usually required to gain enough information while avoiding an overwhelming complexity and volume of data (Eisenhardt, 1989).

Addressing the research questions through a comparative multiple-case study makes several types of contribution possible. Descriptive findings can result in improved understanding of IPPM capabilities in Australian organisations. Comparisons between the cases can allow for variance and process theorising and also test relationships (Johnson et al., 2007). Exploratory and theory-building case study research is likely to adopt a recursive approach where the processes of theorising, data collection and data analysis overlap rather than occur completely sequentially (Eisenhardt, 1989; Ticehurst and Veal, 1999). The degree of overlap varies. Some research designs can be viewed as 'serial single cases', as each case incorporates the findings of the previous case to adjust the design for the next case, thus maximising the contribution to the relevant themes (Yin, 2003a; Dul and Hak, 2008).

Interviews are the main source of data for most case studies. Semi-structured interviews were appropriate for this multiple-case study, for two reasons (Collis and Hussey, 2003): the complexity and individuality of each organisation's IPPM processes meant that the step-by-step processes used were not standardised or easy to understand from a distance, and the subject matter was highly confidential. A high level of pre-design can enhance the internal validity of the findings and the generalisability to other cases and settings; however, such a design can amplify any researcher bias, so careful consideration and pilot testing of the pre-designed instruments is advised (Denzin and Lincoln, 1998). A more open and flexible interview structure allows exploration and the possibility of uncovering unanticipated findings (Yin, 2003a).

In order to conduct case study research through semi-structured interviews, the data should be collected in as complete and unbiased a manner as possible. The interviewer requires a level of pre-understanding through previous knowledge, insights and experience before engaging in the research area in order to get beyond simplistic answers and understand the complexity of the environment (Gummesson, 1991). The attributes of the researcher are important. The researcher must be prepared and should reflect upon each interview to prepare for subsequent interviews and research. During interviews the researcher must be able to establish rapport, keep an open mind and listen analytically. Questions need to be patiently probing, without directing or judging the responses (Glesne, 1999; Easterby-Smith, 2002). The researcher also needs to be aware of their own interests and assumptions, and to acknowledge the presence of power and political issues in the organisational environments (Easterby-Smith, 2002).

The collection of case study documents complements the data from semi-structured interviews by providing a written record and can provide material that is not captured during interviews (Creswell, 2003). These documents can be public documents such as annual reports, press releases, articles, product brochures and information from websites, as well as private documents such as internal procedure manuals, organisation charts, diagrams and flow charts.

This section has outlined some of the considerations for the selection and design of the multiple-case study method for the second phase of this sequential mixed-methodology research. The multiple-case study research design was not finalised at the outset so that it could incorporate the findings from the first phase of the study. Therefore the multiple-case study research design is presented in Chapter 5 after the findings from the first phase are presented in Chapter 4.

3.5 Criteria for judging quality and credibility of the mixed-method study

The quality and credibility of research is usually evaluated through the criteria of reliability, validity and generalisability. Considerations for both phases of the research are summarised here.

A reliable research methodology will be repeatable, indicated by the stability and consistency of responses. The reliability of the findings is enhanced by the triangulation of the findings (both methodological and method triangulation) offered by the use of a mixed methodology with non-overlapping methodological biases or weaknesses (Brewer and Hunter, 1989). Reliability is judged by the consistency of the findings and is further enhanced by transparency of analysis through the use of direct quotes to distinguish these from the researcher's interpretation (Flick, 2002).

The internal validity of the quantitative findings can be enhanced by careful design of the survey instrument and is determined by the ability of the data to test the intended relationships. Validity of the statistical conclusions is ensured by using statistical methods that are appropriate for the sample size and data types (Collis and Hussey, 2003). Statistical procedures and construct testing and validation methods were outlined in Section 3.3.2.

Internal validity of the qualitative findings was determined by using the two most common methods identified by Creswell (Creswell, 2003): triangulation of different data sources and checking accuracy with respondents through providing reports and obtaining feedback. Triangulation adds rigor, breadth and depth and therefore is viewed as an alternative to validation, rather than a tool of validation, by some authors (Denzin and Lincoln, 1998). In addition, negative or discrepant information can be presented along with the main themes in order to provide a full and realistic account of the findings. Pattern matching, where predicted patterns are compared with empirical findings, can be used to assess internal validity of the findings (Yin, 2003a). The multiple-method research strategy also enhances internal validity and can be judged by how well the findings of each method combine to address the research questions.

Generalisability of the findings (Easterby-Smith, 2002; Collis and Hussey, 2003) − also called external validity (Page and Meyer, 1999; Creswell, 2003) − determines how likely it is that the patterns observed in the sample will be generalisable to other members of the population. Generalisability is indicated by the strength and consistency of findings within and between methods. Generalisability of the findings can be determined by the level of confidence in the findings across industry groups and comparison of findings from phases 1 and 2.

From a pragmatist perspective, the value and quality of the research is judged by practitioners and the applicability of the research findings to practice (Chia and MacKay, 2007; Johnson et al., 2007). Therefore the research was designed to provide feedback and seek the opinions of practitioners as one method of evaluating the quality of the research. Phase 1 survey respondents were invited to a forum to present and discuss the findings after that phase of research was complete. Phase 2 included feedback sessions as part of the research process, as described in chapters 5 and 6.

3.6 Limitations of the methodology

Each of the methods in this sequential multi-method study has limitations. The combination of methods was designed to neutralise the effects of these limitations as much as possible. The two methods were chosen to provide complementary information and have largely non-overlapping weaknesses (Brewer and Hunter, 1989); however, the overall methodology still had some limitations.

The survey was largely quantitative and static, and was not good for revealing processes and time-based information. The self-response could have introduced bias. The low return rates, common with mail-administered surveys, could have introduced non-response bias. The statistical significance of findings depends sample size. The relatively small sample size for this study, as a result of the specialised nature of the required respondents, precluded the use of high-level statistical methods such as structural equation modelling. In addition, the survey method allowed no explanation or expansion of the findings.

The case study method allowed a much better understanding of processes, and also provided time-based information. Longitudinal case studies − best suited to providing temporal data − were not employed due to the need to complete this research in a practical timeframe. However, some time-based information was obtained through the nature of the questioning and the relatively long organisational experience and memory of most of the respondents. Case studies can introduce interviewer bias (Easterby-Smith, 2002), so the research was designed to clarify and reduce bias through self-reflection and transparency (Creswell, 2003). A final limitation is that only a small sample size is possible with a case study, possibly making it difficult to generalise the findings.

3.7 Ethical considerations

The research design included elements to ensure that high ethical standards were followed throughout all aspects of the research, such as ensuring that the research was conducted in a competent and responsible manner and that publications present accurate findings and are free of plagiarism. In addition, this research design took into account the fact that the research involves human research participants, who were not to be exposed to any harm (Ticehurst and Veal, 1999). Steps were included to ensure that both the qualitative and quantitative phases of this research met standards for ethical practice in both the research design and the ethical application of research methods. Both phases of the research process were evaluated and each received approval from the University ethics committee.

In order to ensure ethical conduct, the following aspects were incorporated in the research design (Ticehurst and Veal, 1999; Collis and Hussey, 2003; Creswell, 2003):

Informed consent and free choice: In advance of the research and data collection, all participants were provided with information about the purposes and design of the research, and the procedures for data collection and storage for both phases of the research. All participants were asked whether they agreed to participate in the research and signed a consent form witnessed by the researcher. In addition, separate explicit permission to record and transcribe interviews was requested from case study interview participants. It was made clear to participants that they were able to withdraw from the research at any time.

Anonymity and confidentiality. For both phases of the research, the anonymity of the research participants and their organisations was ensured. Data were stored without identifying information in a secure location and results have been presented in a non-identifying way.

Alternative contact for complaint or concern. Research participants were provided with contact details for the researcher's supervisor and the University research ethics committee, to provide them with an avenue for raising any complaints or concerns regarding the research. The researcher is not aware of any complaints or concerns arising from the research.

3.8 Chapter summary

This chapter has outlined and justified the selection of a sequential mixed methodology to address the five research questions identified in Chapter 2. A pragmatic perspective was analysed and selected to guide the research design. The pragmatic perspective has been shown to be appropriate for practice-based research and its applicability to IPPM research has been justified. The sequential mixed methodology selected for the study was supported by the pragmatic perspective. The methods were selected to be complementary and to reduce the bias or weakness associated with any individual method. A questionnaire-based survey was selected for the first phase, and a multiple-case study for the second phase of the study.

This chapter has provided the detail of the research design for the first phase, the quantitative survey. The findings from this first phase of research are presented in Chapter 4. The second phase research design is presented in Chapter 5, taking into consideration the findings from the first phase. This chapter has also included discussions of the criteria for judging the quality of the research, the limitations of the research, and an overview of the ethical considerations that have been taken into account during the research design. These final sections are applicable to both phases of the research.

Chapter 4 Phase 1 findings

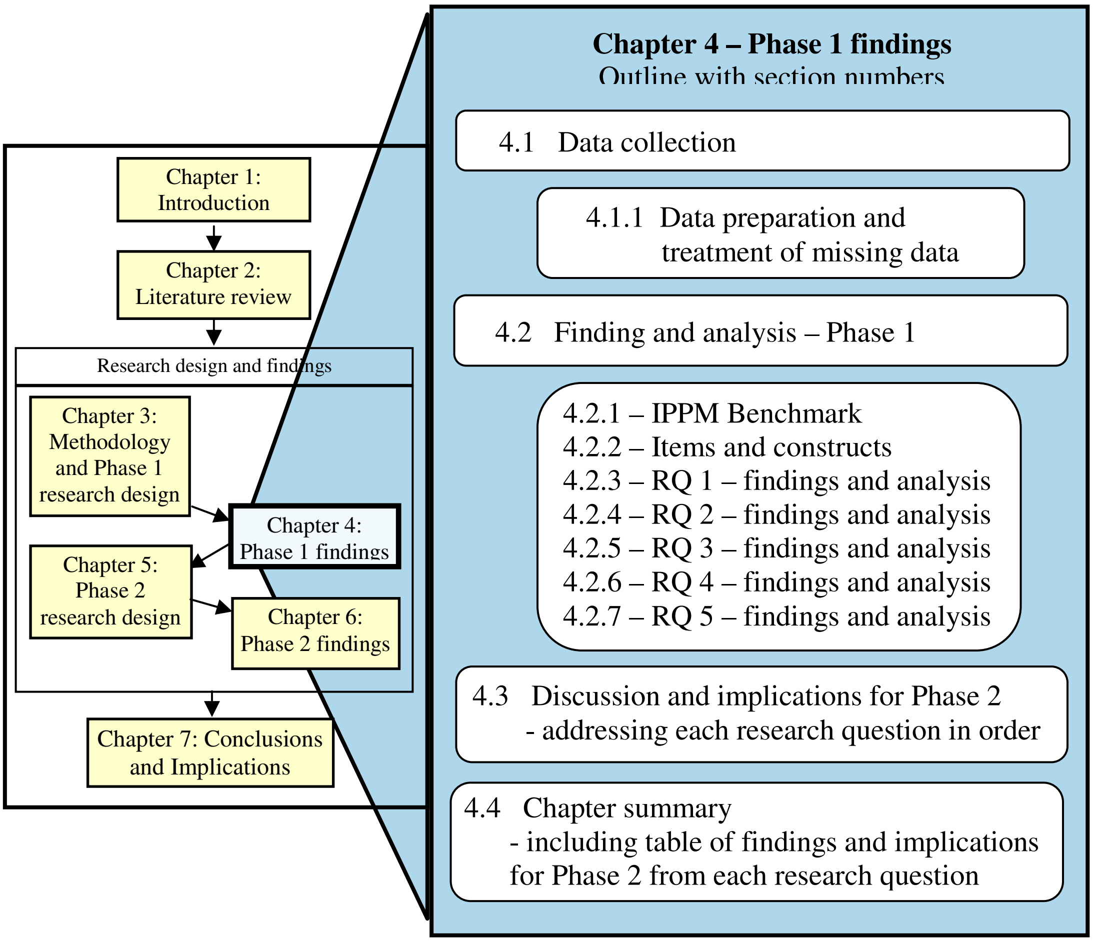

Figure 4-1: Chapter 4 outline within overall thesis structure

This chapter outlines the data collection, analysis and findings from the first phase of the sequential mixed methodology following the structure illustrated in Figure 4-1. The discussion of these findings leads to an outline of the implications for the design of the second phase of research at the end of this chapter.

4.1 Data collection

Chapter 3 outlined the research design process and presented the final design of the research instrument. That chapter also described the methods designed for respondent selection and the administration of the survey questionnaire. This section outlines the resulting return rate and presents an overview of the sample of respondents.

The main phase of data collection was completed during 2005. Survey instruments were mailed out to 166 organisations who manage a portfolio of NPD products. These organisations were identified using the methods and sources outlined in Chapter 3, Subsection 3.3.1. Individual email and telephone contact was used to follow up and to enhance the survey return rate as planned, with the addition of a final telephone contact towards the end of the data collection phase. The final return of 60 valid responses represented a 36% return rate.

The sample of respondents represented an even balance between service and manufacturing-focused organisations and included a diverse set of industries. Responding organisations indicated the degree to which their product portfolio consisted of manufactured products or service products on a scale of 1–10. Three clusters of responses indicated three distinct groups of organisations. Twenty-four primarily manufacturing-based organisations responded with a mean rating of 1.9 on the scale (standard deviation of 1.0), and an equal number of primarily service-based organisations responded with a mean rating of 8.8 on the scale (standard deviation 1.2). Twelve organisations responded with a rating of 5 of the scale, indicating that their product portfolio was evenly spit between manufactured and service products.

The responding organisations represented a wide range of industries in 21 separate industrial classifications. The median size of responding organisation was A$125 million (approximately US$94 million at the time of data collection). Seventy per cent of respondents fell within nine classifications: Finance and Insurance; Basic Products, Agriculture; Computer and related; Communications and Telecomm; Health and Community Services; Electrical and Electronics; Food and Beverage; Petroleum, Coal and Chemical; and Construction. On average the businesses spent 7.5% of annual sales revenue on the development of new products. Appendix 4, Section 1 gives a full listing of industries and frequencies and a more complete profile of the survey respondents.

4.1.1 Data preparation and treatment of missing data

Survey data from the 60 usable responses were separated from identifying data to protect the anonymity of the respondents and then coded into a statistical software package for analysis (SPSS, version 12, updated to version 15 before final analysis). The responses for most of the questions were directly entered or involved simple coding (for example '1' for 'yes' or '2' for 'no'). For open-ended or constructed response questions, most of the data were captured using content analysis, keywords and codes (Gillham, 2000a); however, the answers to these questions were also read in full by the researcher to gain the depth of meaning within the context of the answer.

Non-response bias may occur where non-respondents and respondents represent different views. It has been shown that samples with non-response bias show differences between the responses of early and late responders (Armstrong and Overton, 1977; Collis and Hussey, 2003; Garson, 2006b). Non-response bias was tested by comparing the responses and the organisational profiles (size, industry type, etc) for the first 10 and last 10 surveys received using an independent samples t-test. An additional test was performed using the first and last 20 surveys received. No non-response bias was indicated as no significant differences were found in either of these comparisons – thus increasing the confidence that the responding sample represented the entire sample (Collis and Hussey, 2003).

Before analysis, the data were analysed to identify missing data or outlying responses that could skew the analysis. Outlying answers, answers that seem unexpected, or missing responses were followed up to increase the number of valid and complete surveys available for the analysis (Page and Meyer, 1999; Gillham, 2000a). First, the entered data were rechecked against the returned questionnaires, and errors in data entry were corrected. Then phone and email follow-up was used to obtain any remaining missing data and to assess the accuracy of any outlying data. After this process was completed, some surveys still did not contain the full set of data to analyse. With the aim of maximising the usefulness of the data collected, missing data were analysed and were found to cluster in two areas, with the remainder occurring randomly.

The largest cluster of missing data was in the area of new product performance (NPP) measurement, as data on hard measures like revenue or profit are often difficult to obtain. Some of the respondents did not have access to or were not allowed to disclose all of the requested data on the levels of success of their new product portfolios. Several of the organisations were not able to supply data for one or more of the NPP data items. The questions relating to NPP measurement were answered by 70−80% of respondents, and only 38 cases (63%) were able to supply data for all three NPP measures. Due to the exploratory nature of the NPP measurement and the varied responses, it was not considered appropriate to impute values for these missing data points. However, deleting these cases would have reduced the sample size (Garson, 2006c; Meyers et al., 2006), and so the cases were deleted only for analyses that involved the NPP construct. Therefore the correlations and analyses that involved the items within the NPP construct were conducted using 38−48 cases.

Missing data were also found in respondents' demographic information, with data supplied by 86–90% of respondents. Because these data were not central to the statistical analysis they did not require rectification.

Other than these areas, the missing data were random and involved 2.3% of responses overall and less than 5% of responses for a single item. To correct for the missing data a few options were considered. Rather than remove the cases with missing data from the complete analysis, these cases were deleted only from analyses that concerned the missing data. This decision meant that the bulk of the analysis involved 95−100% of the sample.

As a test to see if it would strengthen the analysis, the missing data points were imputed using mean substitution, using the group mean among the items in the construct as these items correlated more closely with the missing data points (Garson, 2006c). This augmented data set was then analysed and the results were compared with the analysis of the original data set. Because only a small influence was achieved from the imputation and there were no differences in the conclusions and results, the analysis reported in this chapter is based on the original data set without imputed data points.

4.2 Findings and analysis – Phase 1

This section presents and analyses the findings from the questionnaire survey. Subsection 4.2.1 provides a brief summary of the benchmark findings on IPPM practices in Australia. Appendix 4, Section 2 contains further detail on the benchmark findings. Subsection 4.2.2 presents findings on the constructs used to test the relationships on the conceptual model. Specific findings related to each of the five research questions are addressed in subsections 4.2.3–4.2.7, along with some analysis of these findings in relation to each research question. The implications of the findings for Phase 2 of the research are then discussed in Section 4.3.

4.2.1 IPPM benchmark – findings and analysis

The benchmark of Australian practices presented in this section provides a summary of the types of methods and processes used for IPPM, the level of importance placed on the IPPM capability, the level of performance on IPPM goals, the level of product opportunity effectiveness and success in the market and other information about the organisations and their IPPM environments.

IPPM success factors

Importance and maturity of IPPM

Table 4-1 presents the findings for the IPPM success factor items and shows that IPPM was considered most important at the corporate executive and senior management levels of the organisation. In addition, the highest maturity measure was the level of management buy-in and support for the IPPM capability. Except for the importance placed on IPPM by higher management, the responses showed mid-range levels of importance and maturity overall on average, with a wide spread of responses across a relatively normal distribution. (See Appendix 4 Section 3 for a discussion of the tests for normal distribution.)

Table 4-1: IPPM success factor items and descriptive statistics

Name	Short Description	Mean	Std dev.
Level of Importance placed on IPPM		(5 point Likert scale)	
IMP_exec	Importance - Corporate Executives	3.7	1.0
IMP_sman	Importance - Senior Management	3.6	1.1
IMP_techman	Importance - Technology Management People	3.3	1.1
IMP_mkt	Importance - Marketing/Sales Management	3.1	1.4
IMP_opman	Importance - Opn or Production Management	2.9	1.4
Level of Maturity of the IPPM capability		(5 point Likert scale)	
MAT_supp	Management buy-in and support	3.1	1.2
MAT_est	Established, explicit method	3.0	1.2
MAT_port	All projects evaluated as a portfolio	2.8	1.3
MAT_rules	rules and procedures clear, well-defined	2.7	1.3
MAT_cons	method is consistently applied	2.7	1.2

Methods for IPPM

Data were collected on which IPPM methods were used, how these methods were applied to the IPPM process, and which methods were dominant. A brief summary of the findings on IPPM methods is presented here, with additional detail in Appendix 4, Section 2.

Nearly half (45%) of the Australian organisations surveyed used a formal method for new product portfolio management. On average, respondents used two of the five methods listed in detail in the survey. As shown in Table 4-2 and Figure 4-2, the two most common methods used were financial (used by 77% of respondents) and business strategy (56%). Although financial methods were used much more commonly within the IPPM process, strategic methods were nearly as likely as financial methods to dominate the decision-making process. Strategic methods were dominant in 36% of organisations, and financial methods dominated in 39%. Appendix 4 Section 2 includes a discussion of the confidence interval for these findings.

Table 4-2: IPPM method items and findings

Item Name	Question on the use of the IPPM method	Use of method (percentage)
METH_fin	Do you use a financial method for project selection?	77
METH_check	Do you use a checklist method?	14
METH_score	Do you use a scoring model method?	27
METH_strat	Do you use the business strategy as a basis for allocation of money for different types of new product projects?	56
METH_map	Do you plot projects on a bubble diagram or portfolio map and look for projects in certain zones or quadrants of the bubble diagram?	25

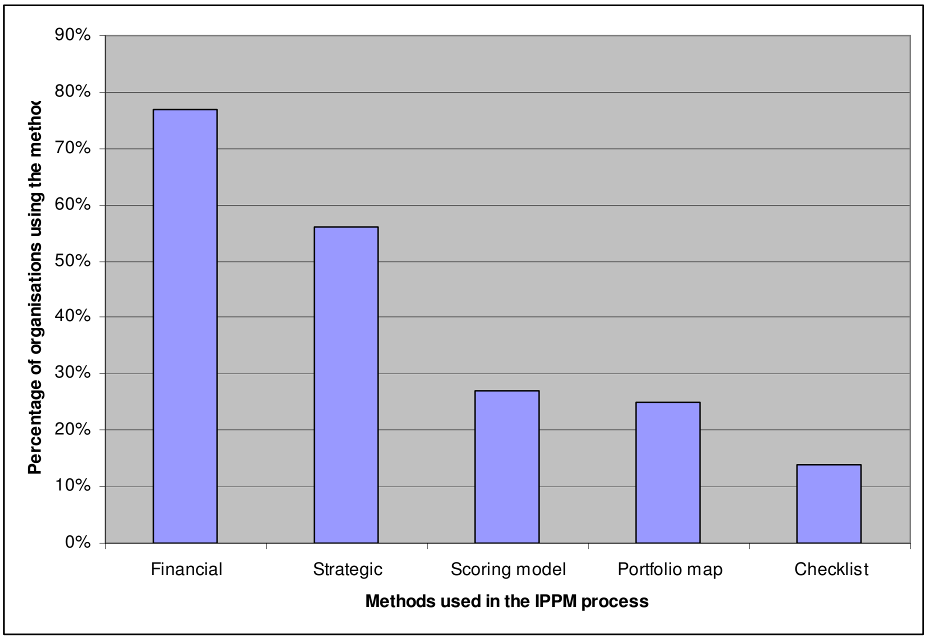

Figure 4-2: Use of five common IPPM methods

(NOTE: on average each organisation uses two methods)

PPO measures

IPPM goal performance and product opportunity effectiveness

Table 4-3 shows that the highest level of performance on PPM goals was the alignment of the portfolio with objectives and strategy. Performance on this goal stood out above the more average levels of performance on the other PPM goals. The highest performance on product opportunity effectiveness was in the portfolio's ability to develop existing technologies. The relatively large standard deviations indicate a wide range in outcome measures among the responding organisations.

Table 4-3: PPO items and descriptive statistics

Name	Short Description	Mean	Std dev.
Level of performance on IPPM Goals	(5 point Likert scale)		
PPM_alignstrat	Portfolio aligned with objectives and strategy	3.7	1.1
PPM_value	High value portfolio of new product projects	3.3	1.1
PPM_spendstrat	Spending reflects business strategy.	3.2	1.1
PPM_time	Projects done on time	3.0	1.1
PPM_balance	Excellent balance in project portfolio	2.9	1.0
PPM_number	Right number of projects for resources	2.6	1.1
Level of Product Opportunity Effectiveness	(5 point Likert scale)		
OPP_develtech	Develops our existing technologies	3.8	1.1
OPP_newtech	Brings new technologies to our business.	3.6	1.0
OPP_newmkt	Enables our business to enter new markets.	3.3	1.2
OPP_newarena	Leads our company into new product arenas	3.3	1.2

NPP measures

Data were also collected for the actual market success of the new products from the portfolio through the NPP measures as reported in Table 4-4.

Table 4-4: NPP items and descriptive statistics

Name	Short Description	Mean	Std dev.
New Product Performance (NPP) Measures	(percentage of total)		
NPP_sales	Percentage of Sales from New Products	27	26
NPP_profit	Percentage of Profit generated by New Products	25	28
NPP_success	Percentage of launched new products that are successful	59	19

Average levels of sales and profits from new products reported by survey respondents were around 25% and the average success rate for new products was 59%. These findings are consistent with findings reported in the literature (Griffin, 1997; Tidd et al., 2005). The wide range of responses received indicated that some organisations were experiencing much higher and much lower levels of sales, profit and success.

4.2.2 Success factor and outcome measure constructs

Three success factors and three types of outcome measures were identified in the conceptual model on IPPM presented in Chapter 2. A revised version of the model is presented below in Figure 4-3 including the names of the constructs that were used to represent two of the success factors and two of the outcome measures.

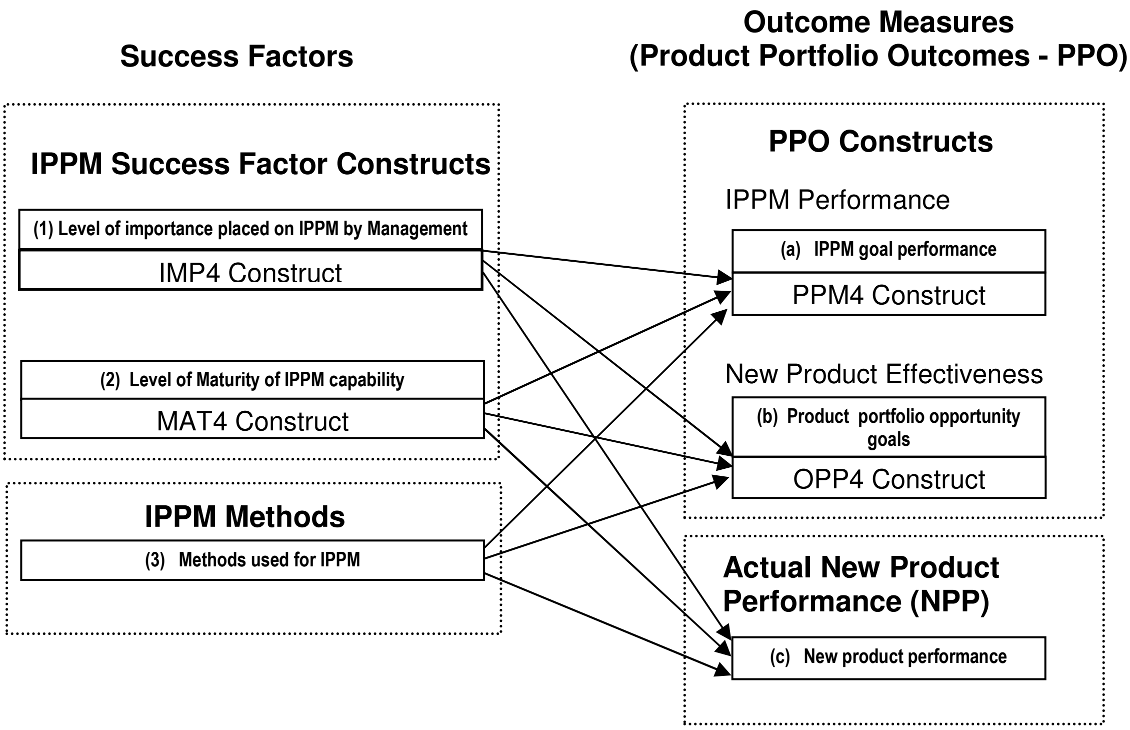

Figure 4-3: Conceptual model with constructs

This section outlines the findings on the development of constructs to test the relationships between success factors and PPO measures in the conceptual model. Each success factor and outcome measure was assessed through multiple items, as outlined in tables 4-1 through 4-4. Constructs were developed for two of the success factors and two of the outcomes measures as detailed in Appendix 4, Section 3. Factor and reliability analysis were performed to determine whether the items loaded onto the desired construct. The confirmed constructs (IMP4, MAT4, PPM4 and OPP4) each included the best selection of items to represent the construct and to provide the strongest results. Factor and reliability analysis confirmed that the IPPM method items and the NPP items were not suitable for representation by a construct.

Using the methods outlined in Chapter 3, correlations were performed between individual items and between constructs to test the relationships in the conceptual model. The details of the analysis and results are presented in Appendix 4, Section 4. In short, simple Pearson Chi-square correlations were conducted to test most of the relationships, with the exception of relationships involving IPPM methods, where t-tests were used to compare the means between independent samples. While the correlations between constructs provides more robust findings than the correlations between individual items, the item level correlations add to the overall understanding by indicating specific 'best practices' for IPPM.

4.2.3 RQ 1 – findings and analysis

RQ 1 asked "*What is the relationship between an organisation's IPPM capability and its new product outcomes?*" This research question was addressed by the quantitative survey through testing the relationships presented in the conceptual model of IPPM success factors and outcomes. These relationships and the relationships between the multiple methods of measuring outcomes are analysed in this section.

Table 4-5 summarises the findings from the analysis of the relationships between constructs shown on the conceptual model (see Figure 4-3). The strongest correlation between success and outcome factors was the relationship between the level of maturity construct (MAT4) and the performance on IPPM goals construct (PPM4), with a Pearson correlation of 0.547 (significance of 0.000).

Table 4-5: Constructs and correlations

Construct	Mean	Std dev	1. IMP4	2. MAT4	3. PPM4	4. OPP4
1. IMP4	3.3	0.9	–			
2. MAT4	2.8	1.1	0.568 (0.000)	–		
3. PPM4	3.1	0.8	0.316 (0.018)	0.547 (0.000)	–	
4. OPP4	3.5	0.9	0.146 (0.282)	0.319 (0.015)	0.426 (0.001)	–

In addition to the relationships indicated in Table 4-5, relationships were tested to determine how the use of each of the five main types of IPPM methods correlated with the PPO measures (using t-tests as outlined in Chapter 3). The use of strategic and portfolio mapping methods showed the strongest performance, with significant correlation to improved outcomes on many of the PPO measures as listed in Table A4-8 in Appendix 4, Section 4. In contrast, financial methods related only to positive difference in one PPO measure. In addition, a negative relationship was shown between the use of financial methods and the item OPP_newarena. This was the only significant negative correlation found between the use of a portfolio management method and one of the performance measures.

Regression analysis

Linear regression analysis was conducted on a limited number of constructs to strengthen and clarify the strongest correlations between constructs. In keeping within the limits of the sample size, three constructs were included in the regression analysis. The full factor analysis and regression analysis are detailed in Appendix 4, Section 5.

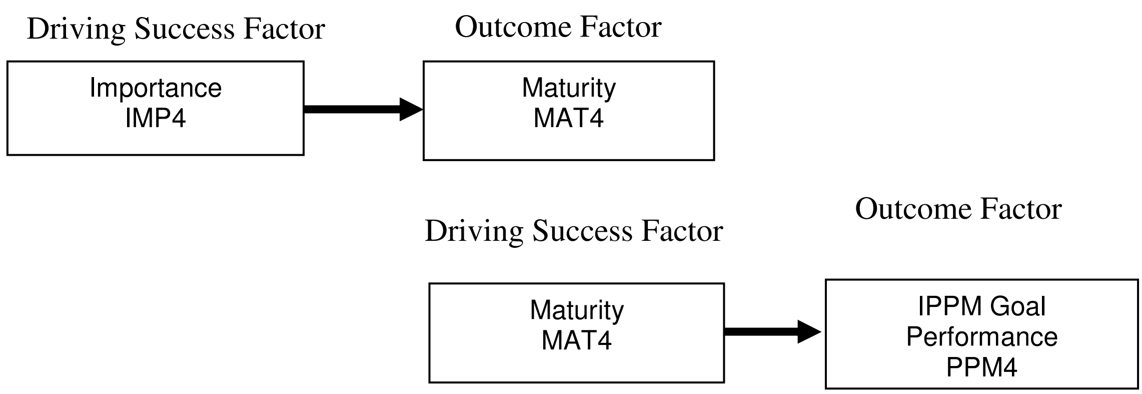

Figure 4-4: Regression results – explanatory relationships between IMP4, MAT4 and PPM4

Regression analysis showed the strongest explanatory relationship between the importance of IPPM (IPM4) and the maturity of the IPPM capability (MAT4), and an explanatory relationship between the maturity of the IPPM capability (MAT4) and the performance on IPPM goals (PPM4), as illustrated in Figure 4-4. The relationship between IMP4 and PPM4 (not illustrated) was close to non-significant (marginal in the t-test and not significant in regression analysis whether direct or in multiple regression when IMP4 and MAT4 were regressed simultaneously on PPM4).

This analysis suggests that the level of importance placed on IPPM may explain the maturity level of the IPPM capability and that the maturity of the IPPM capability may explain the level of performance on IPPM performance goals. Each of these relationships was positive: higher importance was related to higher maturity, higher maturity was related to higher performance on IPPM performance goals.

The findings indicate that MAT4 may act as an intervening (or fully mediating) construct between IMP4 and PPM4; however, the relatively small sample size did not allow more advanced statistical analysis such as structural equation modelling (SEM) that could be used to verify such a relationship.

Product portfolio outcome (PPO) measures

An important part of this study was to better understand and improve the PPO measures for an IPPM capability, as outlined in Chapter 3. Understanding the relationships between the three different outcome measures used in the quantitative survey led to a better understanding of the relationships between IPPM capabilities and new product outcomes, which was relevant to addressing RQ 1.

The three types of measures are outlined in Table 4-6, with an overview of the use of constructs to represent two of these measures. Appendix 4, Section 3 provides more detail on the individual items and the development of constructs.

Table 4-6: Constructs and items used for three types of PPO measures

Name	Description	Construct development
PPM4	Construct measuring the level of performance on IPPM goals	Four of the six items from the survey are included in this construct.
OPP4	Construct measuring the level of effectiveness in exploiting product opportunities	All four items from the survey are included in this construct.
NPP_sales NPP_profit NPP_success	Items measuring percentages of sales, profits, and success rates for new products	These three NPP (New Product Performance) items are not suitable for reduction into a construct.

Both PPM4 and OPP4 constructs were expected to relate to the desired end result of a new product project portfolio. This end result, the regular introduction of successful and profitable new products, was measured using actual new product results in the market through the three NPP items (percentage of sales and profits from new products and the success rates for launched products). Details of the correlation testing between these outcome measures are presented in Appendix 4, Section 6, and the main findings are summarised here.

As discussed in the literature review, measuring performance on IPPM goals is a common method of assessing an IPPM capability; however, whether these measures correspond to actual new product portfolio success in the market has not been tested in previous studies (Cooper et al., 2001). Therefore the solid and significant relationship found between the IPPM goal construct (PPM4) and the measure of new product success rates (NPP_success) (r=0.609, sig=0.000) in this study is an important finding. This finding helps to validate the use of the IPPM goal performance measures to assess an IPPM capability, as it indicates that IPPM goal performance does relate to new product success. However, there was no significant relationship between the IPPM goal performance measures and the sales or profit percentage measures. Interestingly, significant but more moderate correlations were found between the OPP4 construct and all three NPP items, as well as the PPM4 construct, indicating that the OPP4 construct may also be a useful measure to assess IPPM capabilities and outcomes.

Although there was a fairly good level of correlation among most of the PPO measures, the variety of relationships indicated that the different outcome measures are not fully interchangeable, and that each may measure different aspects of the IPPM outcomes. For example, there was a difference in the time frame between the PPM4 and the OPP4 constructs which may have affected the findings. PPM4 measures impressions of the project portfolio today, and OPP4 measures the effectiveness of current products (produced from a previous project portfolio) in exploiting opportunities. In addition, the complexity of the NPD environment suggests that many factors may influence these relationships.

These findings and indications must also be evaluated in the light of the study's relatively small sample size spread across several industries, with the possibility that the measures may not be comparable across the sample. This is particularly true for the NPP measures where only 70–80% of respondents were able to supply data on each item, and only 63% supplied data for all three NPP items.

RQ1: summary

In summary, the quantitative survey provided some support for most of the relationships on the conceptual model of IPPM success factors and outcomes (PPO). Many of the relationships were not very strong and could not be used to predict or explain the relationships. However, explanatory relationships between the level of importance of the IPPM capability and the maturity of the IPPM capability, and between the level of maturity and the level of performance on IPPM goals, are presented in Figure 4-4. This relationship and the relationships on the conceptual model merited further investigation in the second phase of research. Analysis of the different methods used to measure IPPM outcomes provided support for the use of the OPP4 measures and the PPM4 measures as indicators of success in the new product portfolio. The relationship between the outcome measures is complex and better understanding would require further analysis that is beyond the scope of this investigation.

4.2.4 RQ 2 – findings and analysis

RQ 2 asked "*What is the relationship between IPPM capabilities in service and manufacturing NPD environments?*" This section presents and analyses findings from the quantitative survey on the differences between service product-based and manufactured product-based organisations. All items in the survey were tested to determine whether any significant differences existed between the samples of organisations that were service-focused and those that were manufacturing-focused, as outlined in Chapter 3. The responses to the majority of the questionnaire items did not show any significant difference between the two samples. The few areas of significant difference are highlighted in this section.

There were some significant differences in the project portfolio profiles. Service product-based organisations invested a higher percentage of their revenue in the development of new products (8.7% of turnover compared with 5.3% for manufactured product development). Manufactured product-based organisations reported significantly more profit generated from new products (28% compared with 13% for service product-based organisations). Manufactured products took longer to develop than service products (17 months versus eight months).

Despite these differences in the project portfolio profiles, the number and types of methods used and correlations between methods and performance were very similar for both manufactured product- and service product-based organisations. The only statistically significant areas of difference in the IPPM practices reported relate to decision-making processes and the use of portfolio maps. Decision-making processes were more likely to be performed in a group or management meeting for manufacturing product-based organisations than for service product organisations, where an individual was more likely to make decisions. Both group meetings and individual decision-making methods were used by 43% of respondents. Of the remaining 57% of organisations that specified use of either group or individual decision making, 72% of manufactured product businesses and only 27% of service product businesses used group decision-making methods (significance 0.029). Decision-making processes were also more likely to involve the use of portfolio maps in manufactured product-based organisations.

Portfolio management methods are still fairly new to most of the responding organisations. Nearly 50% of organisations had only established their portfolio management methods within the previous two years; however, manufactured product-based organisations had longer-established IPPM methods than service-based organisations, as shown in Figure 4-5. Evidence from this study suggests that, despite their more recent establishment, the IPPM capabilities in service-product focused organisations are just as mature as in the manufacturing focused organisations. No significant differences were found between manufacturing and service-based organisations for the IPPM maturity items and construct, or for other measures that can be used to indicate maturity such as the performance on IPPM goals, and the number and types of methods used (Kahn et al., 2006; Notargiacomo, 2006).

In summary, the questionnaire survey revealed a high level of similarity in the IPPM capabilities between the service and manufacturing-focused organisations. Interestingly, the maturity level indicators showed no differences between the two groups, even though the service-focused organisations had established their IPPM capabilities more recently. An exploration of all responses found differences related only to a higher use of group decision-making and portfolio maps in the manufacturing-based organisations.

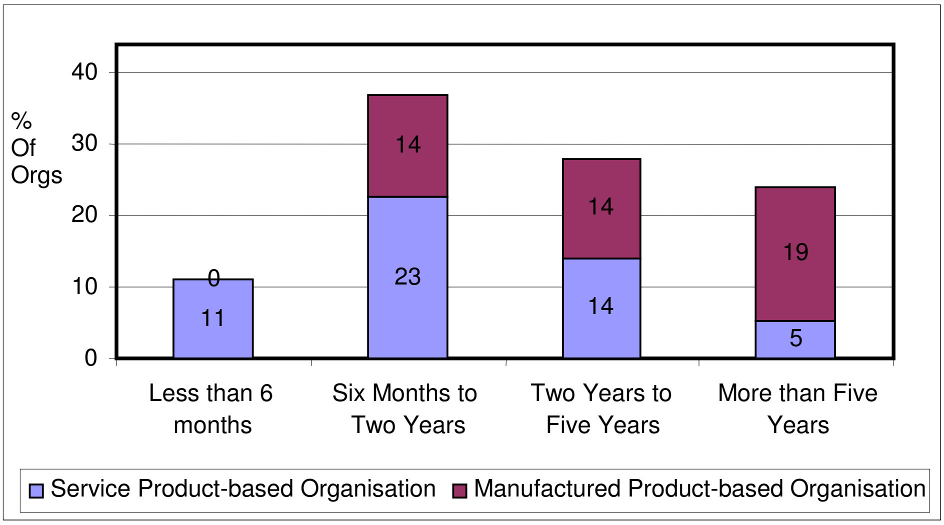

Figure 4-5: Length of time the portfolio management method has been established

(Approx 75% of respondents indicated that they had established an IPPM method for a length of time)

4.2.5 RQ 3 – findings and analysis

RQ 3 asked "*How do IPPM capabilities in Australia and North America compare?*" This section presents and analyses findings related to the differences between the Australian responses to the survey and the responses from a similar North American survey (Cooper et al., 2001). The common portions of the surveys from the two regions were tested to determine whether any significant differences existed between the two samples, as outlined in Chapter 3. Where no difference is reported, the responses showed no significant difference at the 95% confidence level between the two samples.

Table 4-7: Profile of respondents to the Australian and North American IPPM surveys

Region	Number	Average and Median size of organisation (in US$)	Organisation size range (in US$)	Innovation investment −% of turnover (average)
Australia	60	Average 1.77 billion Median 94 million	225,000 – 22 billion	7.5% (all respondents) 5.3% (manufacturing-based) 8.7 % (service-based)
North America	205	Average 1.89 billion Median 400 million	3 million – 22 billion	4.9% (all manufacturing-based)

The Australian data have been extensively analysed in comparison with the North American data. A summary of the profile of responding organisations to both surveys is shown in Table 4-7. All of the organisations in the North American study (n=205) were manufactured product producers, so the North American data did not include service organisation data, while the Australian data were evenly spread between service and manufacturing-focused organisations. Several sets of correlations were performed to determine whether the difference in the manufactured/service product profiles in the two regions affected the relationship between responses in the two regions. There were no significant differences between the correlations performed using only manufactured products from the Australian sample and the correlation using the entire Australian sample. This suggests that the difference in product profiles does not affect differences in responses between the two regions, so the correlation using the entire Australian sample is reported. The analysis included the 52 questions on the Australian survey

(60%) that overlapped with the North American data, using a comparison of the mean responses from the two samples as outlined in Chapter 3.

There was no significant difference between the North American and Australian data for the large majority of responses. Areas with differences did not affect the findings of the analysis of relationships between success factors and outcomes. These areas of difference are detailed under the following three points.

(1) North American organisations believed their portfolio contained more high value projects than Australian organisations and that their spending was more consistent with strategy than reported by Australian organisations. North American responses averaged 3.78 on the 5-point Likert scale for "Our portfolio of new product projects contains only high value ones to our business – profitable, high return projects with solid commercial prospects" (item PPM_value), whereas Australian responses averaged 3.30 (0.005 significance level). North American responses averaged 3.68 on the 5-point scale for "The breakdown of spending (resources) in our portfolio of projects truly reflects our business's strategy" (item PPM_spendstrat), whereas Australian responses averaged 3.25 (0.015 significance level). There was no significant difference between the two samples for the construct PPM4 (which included the item PPM_value) that was used for the main analysis of relationships in the conceptual model of IPPM success factors and outcomes.

(2) When using financial models for portfolio management, North American organisations were less likely to use hurdles than Australian organisations. Criteria were measured against a required level or 'hurdle' in 50% of North American organisations compared with 67% in Australia (0.034 significance level). North American organisations were more likely to rank projects against each other – 60% of North American organisations reported ranking methods compared with 41% in Australia (0.029 significance level). When using business strategy models, Australian organisations were more likely to have a member of senior management alone make decisions than North American organisations, which tended to use a team.

(3) Finally, the North American organisations used more types of assessment criteria on average to compare projects (average 4.9) than reported by Australian organisations (average 4.0). In both regions the most commonly used criterion to assess and compare

projects was the level of alignment with strategy and core competence. These criteria are listed in Appendix 4, Section 2, Figure A4-2.

In summary, a high level of similarity was found between responses to IPPM survey questions in Australia and North America, indicating that the IPPM capabilities and outcomes in these two regions are largely comparable.

4.2.6 RQ 4 – findings and analysis

RQ 4 asked "*Can theories or frameworks be developed or used to better understand the relationship between IPPM capabilities and competitive advantage?*" This was an exploratory in-depth question requiring analysis of existing theories and frameworks, as well as a deep level of analysis of the relationship between IPPM capabilities and competitive advantage. The first phase of this research has provided an initial analysis of the relationship between IPPM capabilities and competitive advantage, as reported in Subsection 4.2.3. This first phase has also emphasised the importance of the relationship between strategy, IPPM capabilities and outcomes, which supports the use of theories and frameworks of strategy and competitive advantage to better understand IPPM capabilities.

The emphasis on strategy has been highlighted by two points: (i) the highest level of performance on any of the IPPM goals was for the alignment of the project portfolio to the objectives and strategy, and (ii) 83% of organisations used measures of strategic fit to evaluate and compare projects, the highest incidence of any one measure (see Table A4-2 in Appendix 4). Strategic fit measures were used as a component of IPPM methods such as checklists and scoring models, as well as within strategy-focused IPPM methods. These strategy-focused methods were used in the IPPM capabilities of 56% of organisations, and 36% of organisations used a strategy-focused method as the dominant method for IPPM decision-making. Strategy methods and criteria were therefore strongly represented in IPPM capabilities studied.

Analysis of the correlation between the use of strategy methods and the outcome measures shows that strategy methods had a higher positive impact on outcomes than the use of any other methods (see Table A4-9 in Appendix 4, Section 4). The use of strategy methods showed significant correlation to improved outcomes on both the PPM4 and OPP4 constructs, as well as on 8 of the 13 individual items used to measure IPPM outcomes.

Strategy is generally considered a high-level activity (Hill and Jones, 1998; Johnson et al., 2005), and therefore the high level of performance and importance of strategic methods and considerations in the IPPM capabilities in the responding organisations may be aligned with the high level of importance placed on IPPM by the executive and senior managers in the organisations.

Therefore the findings of the first phase of research indicated the need for further investigation of theories of strategy and competitive advantage, to determine whether they can be used to improve understanding of the relationship between IPPM capabilities and competitive advantage.

In summary, the research has highlighted the importance of strategic alignment in the project portfolio and the role of the IPPM capability in achieving this alignment. The relationship between the use of strategic methods and improved outcomes suggests a strong link between the use of strategic methods in an IPPM capability and achieving competitive advantage through the new product portfolio. These findings indicate that theories of strategy and competitive advantage may be useful for improving understanding of IPPM capabilities. Section 4.3 provides further discussion on the implications of these findings.

4.2.7 RQ 5 – findings and analysis

RQ 5 asked *"How are IPPM capabilities developed?"* The findings from the first phase provided a base and emphasised the importance of this question. Although the quantitative survey method was not suitable to assess how IPPM capabilities develop over time, the survey captured the level of maturity of the capabilities and their length of establishment. The findings presented in Subsection 4.2.2 indicated that the maturity of the IPPM capability was central to the relationship between the level of importance placed on IPPM and the level of performance on IPPM goals (see Figure 4-4). This finding emphasises the importance of understanding IPPM maturity and how it can be developed. Capability maturity studies propose that maturity develops over time; however, this study did not find any significant relationship between the IPPM capability maturity and the length of establishment of the capability. In addition, no significant difference was found between the levels of maturity of the IPPM capabilities in service-focused organisations and manufacturing organisations, even though the service organisations' IPPM capabilities had been established more recently.

Open-ended questions in the questionnaire survey highlighted the challenges that several respondents found in developing their IPPM capability. The lack of resources devoted to IPPM was cited as a factor inhibiting the development of the capability and the ability to conduct IPPM activities at several responding organisations. In addition, many respondents highlighted goals to improve their IPPM capabilities in the future, with the goal to gain buy-in and support most commonly mentioned.

In summary, the first phase findings emphasised the importance of maturity in the relationship between IPPM success factors and outcomes. However, the findings did not indicate a relationship between the length of time the IPPM capability had been established and its maturity. Organisations indicated that they required resources to develop their IPPM capabilities, and desired increased buy-in and support for the capability. The implications of these findings are discussed in the following section.

4.3 Discussion and implications for Phase 2

The first phase of this sequential mixed methodology research study was conducted through a quantitative questionnaire survey. The previous section has presented and analysed the findings from the quantitative survey with respect to each of the five research questions. Addressing each research question separately, this section summarises the contribution of these survey findings related to the research questions and discusses the implications of these findings for the second phase of research via an in-depth multiple-case study.

RQ 1 asked "*What is the relationship between an organisation's IPPM capability and its new product outcomes?*" The findings from the quantitative survey were used to test the relationships between specific IPPM success factors, including IPPM practices and methods and measures of IPPM outcomes as represented in the conceptual model of IPPM success factors and outcomes. Correlations between the IPPM success factors and outcomes provided some support for most of the relationships shown in the conceptual model as outlined in Subsection 4.2.2. Relationships between IPPM methods and outcomes showed that strategic and portfolio mapping methods correlated with positive outcomes on several measures. The use of financial methods correlated positively with only one outcome measure and was negatively correlated to OPP_newarena (the ability of the new product program to bring the company into new product arenas).

Further analysis of the relationship and the actual methods used may reveal more about this relationship. It is possible that the design of established financial methods undervalues opportunities in new product arenas, and therefore the resulting decisions negatively affect performance in this area. Although financial measures are a part of most PM processes, this research supports findings from previous research (Cooper et al., 2001) and indicates that financial methods alone produce the weakest portfolio outcomes.

The strongest relationships indicated by this study suggest that the level of importance placed on IPPM may be a driving factor in improving IPPM maturity, and IPPM maturity may in turn be a driving factor in improving performance on IPPM goals, as illustrated in Figure 4-4. The findings suggest that IPPM maturity may act as an intervening (or fully mediating) factor between the level of importance placed on the IPPM capability and the performance on IPPM goals, although the relatively small sample size does not enable this to be confirmed. In order to build upon these findings and understand more about 'how' IPPM capabilities relate to outcomes, Phase 2 needed to be designed to further explore and understand the relationships in the conceptual model, as well as to investigate the existence of the relationships shown in Figure 4-4. A specific aim of Phase 2 was to determine if the relationship in Figure 4-4 exists, and if so to try to understand 'how' the driving and intervening factors work together to improve IPPM outcomes.

In addition to testing the relationships shown in the conceptual model in Figure 4-3, RQ 1 also encompassed any other relationships between IPPM capabilities and outcomes. Phase 2 included an exploratory component to identify other success factors that may lead to improved IPPM outcomes.

RQ 2 asked "*What is the relationship between IPPM capabilities in service and manufacturing NPD environments?*" The quantitative survey provided a first chance to compare and explore the differences between these two environments, and produced the first benchmark of IPPM capabilities in the increasingly important area of service product development. Chapter 2 outlined several differences in service and NPD environments. In contrast, the comparative analysis revealed a surprising level of similarity between the IPPM capabilities and outcomes, with only a few areas of significant differences identified between service and manufacturing-focused environments. As this is a new area for IPPM research, Phase 2 was especially important for exploring and comparing the two environments, and in particular for understanding IPPM in a service product development environment.

Areas of focus for Phase 2 were indicated by the two main areas of difference highlighted. First, there were differences in the amount of group and individual decision-making between the service and manufacturing IPPM environments studied. Manufacturing environments were more likely to use group decision-making processes and to employ portfolio mapping techniques in their IPPM capabilities. These differences may have been influenced by the development of manufactured products often requiring input from more disciplines than required by service product development. One of the primary aims of portfolio maps is to aid group decision-making by displaying the relationships between attributes of the projects that need to be balanced, such as risk or market type. Therefore it follows that when more decisions are made in groups, as they are in manufactured product organisations, it would be appropriate for portfolio maps to be used more often. Phase 2 needed to explore the decision-making environments more closely and determine whether this difference exists among the multiple cases studied. If so, Phase 2 needed to investigate the reasons for the difference – those discussed above or other reasons.

Second, although the survey responses revealed that service product-oriented organisations had established an IPPM capability more recently than manufactured organisations, their capabilities on average were just as mature. Phase 2 needed to confirm or disconfirm and explain this finding. If confirmed, Phase 2 had the potential to reveal additional differences about the two environments that may help to explain how more recently established IPPM capabilities can reach similar maturity.

In addition to these two areas for follow-up indicated by the first phase of research, the second phase needed to emphasise the importance of exploring and understanding all aspects of IPPM capabilities in service product environments, and comparing these with manufacturing environments. This is one of the most important areas of contribution of this research as it is the first study to focus on IPPM in services and also the first to directly compare both environments. Finally, although environments may be labelled primarily service or primarily manufacturing product-focused, the literature and the first phase of research indicated that many product portfolios represent a mix of service- and manufacturing-based products. Therefore, another exploratory area of research for this study was to understand the nature of the service/manufacturing product split and to see how this relates to the IPPM capability.

RQ 3 asked "*How do IPPM capabilities in Australia and North America compare?*" The analysis of the quantitative survey addressed this relationship directly through comparison with common questions in a similar survey conducted in North America. The findings presented showed no significant differences between the IPPM capabilities in the two regions for most of the questions and no significant differences in the relationships between success factors and outcomes. Because influences specific to individual countries can affect innovation processes (Mishra et al., 1996; Lee et al., 2000), they must be taken into consideration before findings from one country are applied to other regions. The high level of similarity between IPPM survey responses in the two regions reinforces the cultural clustering of Australian and North American countries with respect to IPPM practices. This confirms the relevance of previous IPPM research to the current Australian research, and indicates that other findings from the Australian IPPM research may be relevant in North America and possibly also in other countries in the Anglo-Celtic cultural cluster (Harzing and Hofstede, 1996).

Phase 2 included only Australian organisations and did not add further insights to compare IPPM capabilities between the two regions. Therefore RQ 3 was not included in the research design for the second phase.

RQ 4 asked "*Can theories or frameworks be developed or used to better understand the relationship between IPPM capabilities and competitive advantage?*" and was based on the analysis of the literature and the recognition that existing research on IPPM is fragmented and lacks a unifying theoretical base. The strategic nature of IPPM capabilities in organisations was highlighted in the literature review, supporting the use of the pragmatic paradigm for this research. The findings of the first phase of research also highlighted the strategic nature of IPPM capabilities, reinforcing the justification of this strategy oriented research paradigm. The findings indicated that IPPM has an especially important role in the alignment of strategy with the project portfolio and in achieving competitive advantage through improved new product portfolio outcomes. The strong focus on strategy in the findings of the first phase of this research indicated that theories of strategy and competitive advantage and associated frameworks may assist in understanding the relationship between IPPM capabilities and competitive advantage. These findings suggested that the second phase of research needed to include an exploratory investigation into whether theories of strategy and competitive advantage can be applied to improve this understanding. In addition, the second phase of research needed to develop a deeper understanding of the relationship between IPPM capabilities and competitive advantage in order to support this investigation.

RQ 5 asked "*How are IPPM capabilities developed?*" The literature review outlined best practice studies and maturity models that have been proposed to identify the practices linked with improved outcomes. Maturity models propose that capabilities develop along maturity paths; however, the literature has emphasised that maturity is not well understood, especially whether and how organisations move along the proposed maturity paths. RQ 5 aimed to better understand the development of IPPM capabilities. Phase 1 of the research highlighted the importance of maturity in the relationship between IPPM capabilities and improved outcomes. Open-ended questions indicated challenges for organisations in obtaining resources for their IPPM capabilities. Although most models of maturity development suggest that maturity increases over time, the first phase of this study found no significant relationship between maturity and length of time the IPPM capability had been established. Investigation into the literature on capability development supported a second phase of research to explore how organisations establish and develop their IPPM capabilities and whether they develop along similar maturity paths. To extend the findings of the first phase, the second phase of research included an investigation into the relationship between the length of time the IPPM capability had been established and the level of maturity. Findings from the first phase also suggested further investigation to understand how IPPM capabilities develop, such as the level of resources allocated and the activities used to develop the capability.

4.4 Chapter summary

The first phase of this sequential mixed methodology research was conducted using a quantitative questionnaire. The findings from the 60 responding organisations provided the first benchmark of IPPM practices in Australia and addressed all five research questions in order to better understand the relationship between an organisation's IPPM capability and its ability to establish sustainable competitive advantage through improved new product outcomes. This first phase built a necessary foundation upon which to continue the investigation through a multiple-case study in the second phase.

The first phase of research has improved the understanding of the relationship between IPPM capabilities and new product outcomes and provided partial support for the relationships shown in the conceptual model of IPPM success factors and outcomes. In addition, explanatory relationships have been suggested between the level of importance placed on the IPPM capability and the level of maturity of the IPPM capability, and between the level of maturity and the level of performance on IPPM goals. A baseline has been established for the investigation into the relationship between IPPM capabilities in service and manufacturing environments. IPPM capabilities are shown to be largely similar in this first comparison of the two environments.

In addition, the benchmark of Australian IPPM practices has been compared with results from North American research, and the high levels of similarity indicate the applicability of research from one region to the other. Through the strong emphasis on strategy that has emerged through the study, the first phase of research has supported the investigation of theories of strategy and competitive advantage to help explain the relationship between IPPM capabilities and competitive advantage. Finally, the first phase has revealed the importance of improving the understanding of how IPPM capabilities develop, through highlighting the importance of IPPM maturity and exposing the limited understanding of how IPPM capabilities develop.

As discussed in Chapter 3, the final research design for the Phase 2 multiple-case study drew upon the findings from Phase 1. The implications of the first phase of research on the design of the second phase of research have been outlined in Section 4.3 and are summarised in Table 4-8. In brief, the second phase of research focussed on gaining a deeper level of understanding of the relationships between IPPM capabilities and outcomes, with a particular emphasis on understanding the differences between service product development environments and manufacturing product development environments. The findings from this first phase suggested further literature analysis in order to support the second phase investigations into the theories and frameworks that may help improve understanding of IPPM capabilities and their relationship to competitive advantage. Additional literature analysis was also suggested to support the understanding of the development of organisational capabilities, such as IPPM capabilities. Therefore Chapter 5 presents an extended literature review before the presentation of the final design of the second phase.

Table 4-8: Implications of Phase 1 findings on Phase 2 research design

Research Question	Implication for Phase 2 research design based on Phase 1 findings
1- What is the relationship between PPM capabilities and New Product Outcomes?	Phase 1 findings provide support for some of the relationships in the conceptual model proposed in Chapter 2. Further investigation is indicated to confirm or disconfirm these Phase 1 findings and to develop a deeper understanding of the mechanisms of the relationships if they exist. In addition, an exploratory component in Phase 2 will allow identification and exploration of other IPPM factors that may be related to improved new product outcomes.
2- What is the relationship between PPM in service and manufacturing NPD environments?	Phase 1 findings indicate that IPPM capabilities are very similar across the two environments, while identifying some areas of IPPM difference. Phase 2 aims to develop in-depth understanding of both environments and continue exploration of this question. Phase 1 findings also reveal that many product portfolios include a mix of service and manufacturing products. Phase 2 will explore the nature of this service/manufacturing mix.
3- How do PPM practices in Australia and North America compare?	Phase 1 findings indicate that IPPM capabilities are very similar in the two regions. This suggests that it is appropriate to draw upon previous North American research for the Australian study, and that IPPM findings from the Australian study may also be applicable to North American environments. Phase 2 will not investigate this relationship further as there has not been a comparable study conducted in North America.
4- Can theories or frameworks be developed or used to better understand the relationship between IPPM capabilities and competitive advantage?	Phase 1 findings reveal strong strategy themes. The findings show a strong link between the use of strategic methods and improved outcomes, and highlight the role of strategic alignment in the IPPM capability. An extended literature review of theories and frameworks of strategy and competitive advantage will guide Phase 2 investigations to address this research question.
5- How are IPPM capabilities developed?	Phase 1 findings highlight the importance of maturity in the relationship between IPPM capability factors and outcomes. Although it is generally believed that capability maturity increases over time, the findings show no significant relationship between the length of time the IPPM capability has been established and its level of maturity. This raises additional questions and suggests further exploration of the literature on the development of organisational capabilities and further exploration of the establishment and evolution of IPPM capabilities.

Chapter 5 Phase 2 research design

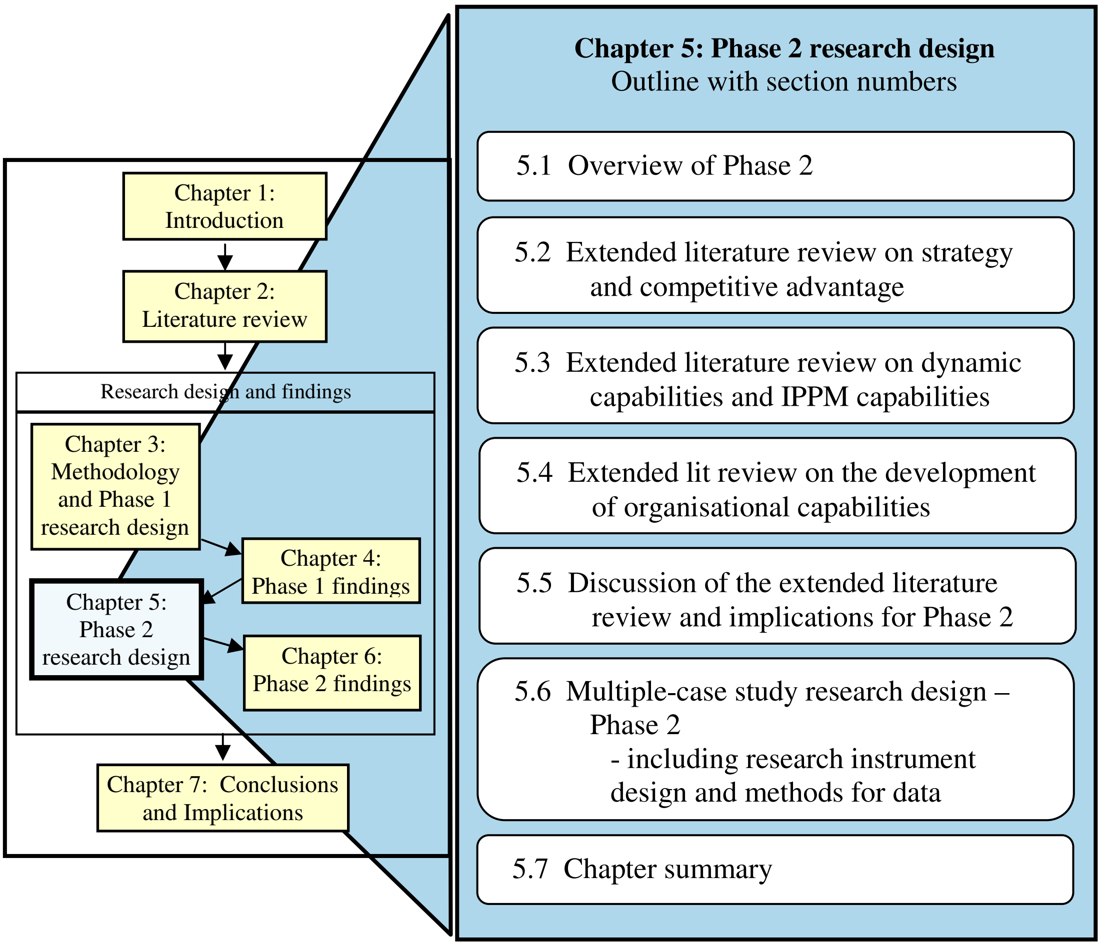

Figure 5-1: Chapter 5 outline within overall thesis structure

This chapter presents the research design for the second (qualitative) phase of the sequential mixed-method study. The selection of a multiple-case study methodology for Phase 2 and the considerations for the multiple-case study research design were presented in Chapter 3. The sequential mixed methodology was designed so that Phase 2 (the multiple-case study) elaborated on and extended the findings from Phase 1 (the questionnaire survey). Chapter 4 presented the findings of Phase 1 and outlined implications for Phase 2 of the research. These findings included indications of the need for an extended literature review to support in-depth investigations to address RQ 4 and RQ 5. Therefore, following the structure outlined in Figure 5-1, this presents an extended literature review followed by the research design for the second and final phase of the research.

5.1 Overview of Phase 2

This second qualitative phase of this sequential mixed-method study was designed to address four research questions − RQ 1, RQ 2, RQ 4 and RQ 5 − by incorporating findings from the quantitative questionnaire survey that formed Phase 1. RQ 3 was excluded from Phase 2 because the Australian-based multiple-case study was not expected to provide any additional insight for comparing IPPM capabilities in Australia and North America. For each research question, the implications of the Phase 1 findings helped to identify areas for further elaboration or exploration during Phase 2, as summarised at the end of Chapter 4 in Table 4-8.

In order to build upon the existing literature and Phase 1 findings and to allow in-depth exploration, Phase 2 required a mix of targeted and exploratory in-depth investigation. In addition, RQ 4 and RQ 5 required further investigation of the literature on theories of strategy and competitive advantage and on the development of organisational capabilities.

Due to the exploratory nature of many of the research considerations, the identified need for an extended literature review and the desire to incorporate any emerging themes, the research design adopted for the multiple-case study phase of this project included overlapping phases of investigation, analysis and literature review. As shown in Figure 5-2, the literature review commenced before the design and testing of the interview guide and continued throughout the case study. The directions for the literature review were influenced by the findings emerging during the case study process, and the understanding and analysis of the case study findings were influenced by the literature review. The final analysis for the multiple-case study was conducted with input from the findings of both the case studies and the literature review.

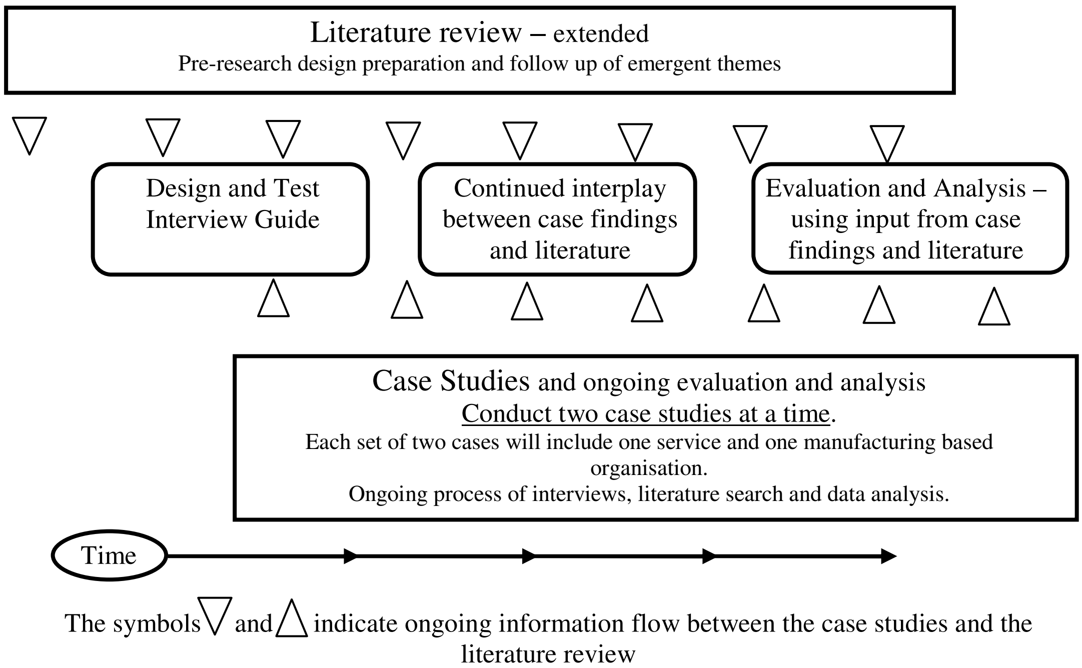

Figure 5-2: Phase 2 research design overview

The literature review, research design and case study were conducted concurrently and developed complex interconnections. For simplicity, the research design is presented here in two separate parts. The extended literature review is presented first. The literature review focused on the areas where an additional selective review of the literature was suggested in Phase 1 (see Table 4-8 in Chapter 4): theories and frameworks of strategy and competitive advantage, particularly relevant to RQ 4 and RQ 5 (Section 5.2), dynamic capabilities and IPPM capabilities (Section 5.3) and the development of organisational capabilities (Section 5.4). Section 5.5 summarises the extended literature review and introduces a revision to RQ4 for Phase 2 of the research. The case study research design and conduct, including the development of the main research instrument – the interview guide – are then presented in Section 5.6. This section also explains the methods used for analysis of the case study findings.

5.2 Extended literature review on strategy and competitive advantage

As outlined in Chapter 2, the existing literature and empirical research are starting to generate results and improve the overall understanding of the relationship between IPPM capabilities and competitive advantage. However, there is no theoretical basis to the majority of the research, and no theoretical basis or framework that unifies the research. RQ 4 was developed to address this situation. This section presents a selected – rather than comprehensive – review of the literature on theories and frameworks of strategy and competitive advantage, and suggests that the RBV and the dynamic capabilities perspectives may help improve understanding. This section concludes by adjusting RQ 4 to better focus the Phase 2 investigation.

The central role and importance of IPPM in strategy and decision-making related to the innovation project portfolio are highlighted by the findings of Phase 1 presented in Chapter 4 and summarised in Table 4-8. The strategic importance of IPPM is also supported by the literature review in Chapter 2, which highlights the role of IPPM in the two-way relationship between strategy and projects, and suggests that IPPM can be considered a 'micro strategising' activity.

Based on this strategic emphasis, this section focuses on strategic frameworks and theories that may provide a basis for unifying IPPM research and improving understanding of the relationships between IPPM capabilities and competitive advantage. It examines the links between IPPM and strategy, and reviews the general strategy and strategic management literature, highlighting the literature on strategy and competitive advantage that is most relevant to IPPM. It discusses the external competitive positioning and the internal resource and capability-building perspectives on strategy and competitive advantage, including a sample of popular theories and frameworks and their relationship to IPPM capabilities. The literature on the dynamic capabilities framework of the RBV is reviewed in more detail and the existing IPPM literature is structured following the 'processes, positions and paths' dynamic capabilities framework. This section of the literature review concludes with a revision of RQ 4 to ask whether the dynamic capabilities perspective can improve understanding of the relationship between IPPM capabilities and competitive advantage.

5.2.1 IPPM and strategy

One of the goals of strategy research is to determine why some organisations are more successful than others, and to understand the mechanisms that help some organisations achieve a competitive advantage. Competitive advantage is the ability of an organisation to create more value than its rivals, and therefore achieve superior return on investment (Barney and Hesterly, 2006). Strategic decisions about how to spend or invest resources, such as decisions made as part of the IPPM process, are central to organisational strategy (Teece et al., 1997). The IPPM process aims to deliver strategic goals and maximum return on project investment through the NPD project portfolio by allocating and monitoring resource allocation, ensuring alignment with strategy, and balancing the portfolio of projects (Dye and Pennypacker, 1999; Cooper et al., 2001). If an IPPM capability is effective in meeting these aims, it can be a source of competitive advantage to the organisation.

Strategic management is a high-level organisational function to develop policies and plans to achieve objectives over the long term (Hill and Jones, 1998; Johnson et al., 2005). The implementation of strategy involves putting strategy into action by designing appropriate organisational structures and controls and managing change, while ensuring fit with the strategy (Hill and Jones, 1998). Part of the strategic management process involves decisions about which activities an organisation should pursue to best realise strategic goals. In an NPD environment these decisions revolve largely around the resource allocation among projects in the NPD project portfolio. Marketing, financial and technical people all make input to the IPPM process, but it needs to be driven from high levels in the organisation (Levine, 2005). Whether it is developed formally or emerges informally, the NPD strategy sets the direction, directs decisions and sets performance goals that will help the organisation achieve competitive advantage. However, even when there is a formal strategy in place, many organisations fail to effectively align their plans with the strategy (Dye, 2006). Improving alignment with strategic plans is a top priority for improving the strategic process (Dye, 2006) and is also a primary goal for IPPM (Cooper et al., 2001; Wideman, 2004). For organisations focused on new products, IPPM methods are an important link between strategy and organisational actions and an important part of the strategic management process (Krishnan and Ulrich, 2001).

Despite the strong links between strategy and IPPM capabilities, strategic frameworks have not generally been used for IPPM capability research. The research is largely atheoretical and draws upon an assumption that identifying and implementing ‘best practice’ IPPM methods will improve organisational outcomes. Some studies also adopt a contingency approach that is based on the proposition that there is not one best method, and that the IPPM capability must be tailored to fit the environment.

5.2.2 Strategy literature background

Strategy is “considered to be the high point of managerial activity” (Mintzberg et al., 1998:9). As the study of strategy has been evolving, researchers have identified divergent and conflicting perspectives for the formulation and implementation of strategy (Mintzberg, 1994; Mintzberg et al., 1998; Whittington, 2001). In addition, knowledge about strategic management has evolved with the changing environment and the new challenges presented. New strategic frameworks have continued to be developed in response to these changes (Greiner et al., 2003). Core logical foundations that change in response to the environment are proposed to underlie the existence and evolution of multiple strategic perspectives and frameworks (Lengnick-Hall and Wolff, 1999; Jarzabkowski and Wilson, 2006).

Examples of the diversity of strategic theories and perspectives were given by Mintzberg et al. (1998), where ten different ‘schools’ or approaches to strategic management were identified, in Whittington’s (2001) grid model outlining four strategic approaches, and in the seven phases of of strategic management approaches presented by Greiner et al. (2003). Several dimensions distinguish the different strategic perspectives and approaches identified in the literature: variations of perspectives (such as political, analytical, cultural), goals for the strategy process (for example, singular profit-making goals or multiple goals), organisational focus (central or decentralised), levels of prescriptive or descriptive focus, and the amount of deliberate planning and formality verus learning and emergence. Strategic perspectives on organisations and competitive advantage also vary between perspectives focused on an internal organisational capability or on external competitive positioning. These internal and external perspectives are particularly relevant to this research and are explored in more detail in Subsection 5.2.3.

In response to changes in organisational and industry environments, there has been a continual evolution of strategic approaches. This dynamic situation has prompted some researchers to propose a dynamic evolutionary perspective for strategy (Nelson and Winter, 1982; Barnett and Burgelman, 1996; Schendel, 1996). In practice most strategy formulation methods adopt a wide view of strategy that incorporates more than one perspective or approach (Greiner et al., 2003). The 'strategy-as-practice' movement proposes that studying strategy as a 'practice-based' activity is an important and under-researched area that has the potential to provide a unifying strategic perspective (Johnson et al., 2007).

One of the distinctions between strategy types that is relevant to the study of IPPM capabilities is the contrast between deliberate and emergent strategic perspectives. Deliberate strategy is more formal and rigid and is usually represented as a pre-planned one-way dissemination of strategy from above to be implemented below. Emergent strategy becomes clearer as decisions are made and events unfold, and the strategy can evolve as it is being implemented to incrementally adjust to the environment (Mintzberg and Quinn, 2003). In this way organisational practices and activities that enact strategy can be considered micro-strategising activities. A 'strategy-as-practice' research perspective is particularly useful for understanding the development of emergent strategy through these 'activity-based' strategic processes. There is a lack of strategy literature covering the deployment of strategic aims down to the IPPM level (Morris and Jamieson, 2005). The 'strategy-as-practice' approach is able to address this gap in the literature by investigating the actual practices and activities involved in strategising from high levels right down to the micro-level, revealing what actually happens rather than being limited to superficial understanding restricted to traditional strategic planning perspectives (Johnson et al., 2007).

5.2.3 External and internal strategy perspectives

In order to identify the most appropriate strategic theory or framework to apply to research on IPPM capabilities, this subsection focuses on the two main perspectives that are commonly applied to research on strategy and competitive advantage. The distinctions between externally-focused and internally-focused strategic perspectives have been compared and debated as organisations search for ways to develop strategies to improve competitive advantage. External strategy perspectives can be considered 'outside-in', and focus on the organisation's position and competitive strategies within the external environments (Antonacopoulou et al., 2005; Wang and Ahmed, 2007). Mitzberg's 'positioning school' is an example of a strategy framework with an external perspective (Mintzberg et al., 1998; Jarzabkowski and Wilson, 2006). External strategy frameworks concentrate on how organisations can improve competitive advantage through competitive positioning within the industry. Much of the strategic literature in the past few decades has been dominated by approaches focused on this external competitive environment and strategic conflict and positioning, such as Porter's competitive forces approach (Porter, 1980) or Miles and Snow's typologies of organisational strategies and structure (Miles and Snow, 1978).

In contrast, the resource-based theory of competitive advantage provides an internally focused strategic perspective, viewing competitive advantage from the 'inside out' (Antonacopoulou et al., 2005; Wang and Ahmed, 2007). Despite the popularity and prevalence of the 'outside-in' external environment-based strategic perspectives, they are criticised because they do not fully explain why some organisations are more successful in the same market than others (Teece et al., 1997). To better understand the organisational basis for competitive success, the internally focused resource-based view (RBV) (Wernerfelt, 1984, 1995; Smith et al., 1996) or core competency models (Prahalad and Hamel, 1990) of organisational advantage view success in the external market as consequence of an organisation's superior internal resources, capabilities and competences. This internal perspective is also referred to as a 'capability-building' perspective (Jarzabkowski and Wilson, 2006).

While acknowledging that both the internal and external considerations are relevant, strategy theorists present differing views and arguments about which view is most appropriate to help organisations create and sustain strategic advantage (see, for example, Nelson, 1991; Porter, 1991). Others debate the most appropriate level of attention to internal and external considerations. For example, some authors point out that the RBV can be quite limited by focusing too much on the internal side of the strategy equation without proper consideration of the external environment and the importance of balance and fit (Mintzberg et al., 1998). In one model resources are shown to directly provide the ability to pursue competitive strategies to achieve competitive advantage (Grant, 1991). In practice the internal RBV approach and the externally focused competitive strategy models complement each other to provide a rich picture of the organisation within its environment. For example, popular strategy tools such as the SWOT (strengths, weaknesses, opportunities and threats) analysis (Mintzberg, 1994) or the environment, strategy and capability (ESC) gap framework (Hubbard, 1996) incorporate considerations from both perspectives.

These three subsections have provided a brief overview of selected literature on strategy and competitive advantage to provide a base for an investigation of strategic frameworks or theories to address RQ 4. The following two subsections overview some popular external and internal perspectives on strategy and competitive advantage that may be useful to address the relationship between IPPM and competitive advantage.

5.2.4 Strategy - the external perspective

Two popular externally focused frameworks of strategy and competitive advantage are Porter's competitive strategies and Miles and Snow's typology of strategic orientation. These external strategy frameworks are based on the Structure-Conduct-Performance (S-C-P) theory, whereby organisations can position themselves to gain sustainable competitive advantage by understanding the industry structure and the conduct of the firms within the industry (Barney and Hesterly, 2006). This subsection outlines these two frameworks and discusses their potential application to the study of IPPM capabilities.

Porter's competitive strategies

Porter (1980) proposed three generic strategies used by organisations to compete in their markets: cost leadership, differentiation and focus strategies. Porter asserts that organisations need to adopt one of these generic strategies to gain competitive advantage, and his work on competitive strategies is widely referred to and applied to business research. Porter's competitive strategies framework is based on the S-C-P paradigm (Barney, 2002; Barney and Hesterly, 2006), an economic theory that focuses on the structure of the industry and the conduct of the organisations within the industry to explain organisations' choice of positioning and resulting performance. Application of Porter's competitive strategies framework to the study of IPPM capabilities could investigate which aspects of effective IPPM capabilities are aligned with particular competitive strategies, although the framework neither predicts nor explains this relationship. Only one IPPM-related study has applied Porter's competitive strategies, in an evaluation of the links between business strategy and project management (Milosevic and Srivannaboon, 2006). The study classified business strategies in terms of the competitive strategies outlined by Porter (1980) and explored links with project management capabilities. The findings of this research indicated that IPPM is a mediating process that aligns the business strategy to the relevant project management approach. However, the details of the IPPM capability were not evaluated so it is not clear whether different IPPM approaches were indicated for different competitive strategies. No other IPPM-related study has been identified that applies this framework – or any other strategic framework – to better understand IPPM capabilities.

Miles and Snow's typology of strategic orientation

Miles and Snow's typology of strategic organisational orientation proposes four main organisational typologies and outlines the types of strategic approaches that fit with each (Miles and Snow, 1978; Miles et al., 1978). The typology framework draws upon strategic choice theory and is based on the proposition that over time successful organisations develop a "systematic and identifiable approach to environmental adaptation" (Zahra and Pearce II, 1990:751). These approaches to adaptation result in the identification of the four organisational typologies: Defenders, Prospectors, Analysers and Reactors. The first three of these are identified as successful models of organisational structure and style, whereas the fourth, the Reactors, do not have a clear approach or strategy and are not successful. The framework outlines the levels of formality and structure and the types of strategies that are associated with each of the successful typologies.

The existence of the Miles and Snow typologies has been confirmed by several studies (Zahra and Pearce II, 1990). High levels of centralisation and formalisation characterise the organisational structures and processes at Defender organisations, where Prospectors operate with low levels of formality and decentralised structures. Analysers have a mix of both formal and informal processes and structures.

No study has been found that applies the Miles and Snow typology to IPPM capability-related research. The main aspect of the Miles and Snow typology that may be relevant to understanding IPPM capabilities is the differing levels of formality and centralisation associated with each of the typologies. These differing levels may be evident in the IPPM capabilities in accordance with the typology of strategic orientation used by that organisation. The strategic orientation is best determined by measuring multiple dimensions of the Miles and Snow's typologies, such as the level of dynamism in the industry as well as strategic responses to identify the type of organisational typology (Zahra and Pearce II, 1990).

5.2.5 Strategy – the internal 'Capability Building' perspective

This section expands on the discussion of the internally focused strategic perspective of the RBV and introduces the dynamic capabilities framework. A significant aspect of organisational strategy is the identification, development and maintenance of the important organisational resources that underpin competitive advantage (O'Regan and Ghobadian, 2004). The RBV assumes that resources are not uniform across competing organisations and uses this heterogeneity to explain the differing organisational success rates. As briefly mentioned in Chapter 2, according to the RBV, resources that are valuable, rare, inimitable and non-substitutable (VRIN) form the best basis for sustainable competitive advantage by being difficult for other organisations to copy or acquire (Barney, 1991). Further evolution of the VRIN framework has produced the VRIO (Barney and Hesterly, 2006:93) and the VRINE (Carpenter and Sanders, 2007) frameworks – each of these frameworks has been adjusted to include an additional criterion to evaluate whether the resource is exploitable. These frameworks establish criteria for the identification and development of resources and capabilities that will generate sustainable competitive advantage.

Organisational resources include cognitive competencies as well as physical and technical assets. The RBV approach focuses on identifying and measuring organisational resources such as tangible assets, a loyal customer base, or experience and knowledge within the organisation, in order to shape appropriate strategies. From the RBV perspective the overall ability of an organisation is "what it can do as a result of resources working together" (Grant, 1991:120). Some of the RBV literature refers to resources and capabilities interchangeably, while others distinguish between them (Ethiraj et al., 2005). Helfat and Peteraf's (2003:999) definition of capabilities as the "ability of an organisation to perform a coordinated set of tasks, utilising organisational resources, for the purposes of achieving a particular end result" distinguishes between capabilities and the resources that underpin these capabilities. Capabilities may depend upon underlying resources, but they are also resources. This thesis defines 'capabilities' as a specific type of organisational resource that enables the organisation to deploy other resources to perform activities that result in desired outcomes (Amit and Schoemaker, 1993; Teece et al., 1997). While some types of resources can be bought and sold, valuable resources like capabilities cannot easily be transferred from one organisation to another (Makadok, 2001). Capabilities therefore need to be developed within an organisation and tailored specifically for that organisation.

The RBV has gathered support over the past two decades, and is now an influential, popular and fruitful area of strategy research (Verona, 1999; Hoopes et al., 2003). However, the RBV also attracts criticism because the path-dependent and evolutionary nature of the perspective is suited to relatively stable environments and requires both internal organisational stability and external environmental stability to be applied in practice (Lengnick-Hall and Wolff, 1999). Therefore a major addition or extension to the RBV is the identification of 'dynamic capabilities' as a class of organisational capabilities that enable organisations to effectively respond to changes in the dynamic environments in which they compete (Teece et al., 1997). The dynamic capabilities approach focuses on the processes used in organisations to integrate, build and reconfigure their resources to compete in dynamic environments.

The RBV and dynamic capabilities framework are increasingly being used to understand the relationship between organisational capabilities and competitive advantage. Through the RBV and the VRIO framework, project management capabilities have been shown to be a strategic asset through a combination of tangible and intangible aspects (Jugdev, 2004, 2007; Jugdev et al., 2007). The RBV and the dynamic capabilities frameworks have also been used to understand learning and capability building processes in project management environments (Davies and Brady, 2000; Brady and Davies, 2004; Söderlund et al., 2008). Path-dependent learning processes are part of a dynamic capability that helps organisations develop 'economies of repetition' in rapidly changing complex environments (Davies and Brady, 2000).

Drawing upon the dynamic capabilities framework, Söderlund et al. (2008) identified three learning mechanisms for project management capability building in a large-scale railway development project: relating or networking to develop the resources such as 'social capital', reflecting to learn from experiences and exploration to improve capabilities, and routinising to exploit knowledge and experiences from one project to the next. In another study, a process for project capability building was shown to be triggered by a 'vanguard' or 'first of its kind' project, with the process building a new organisational resource for project management by capturing learning to be applied in subsequent projects through coevolution of project-led and business-led learning (Brady and Davies, 2004).

The RBV has also been applied to project-based, service-enhanced construction project environments to highlight the role of feedback and the interaction between technical project resources and business processes in learning processes and capability development (Gann and Salter, 2000). In addition, numerous recent studies have employed the dynamic capabilities framework to understand the relationship between other organisational capabilities and competitive advantage. For example, the dynamic capabilities framework has been applied to studies on organisational learning capabilities, strategic alliancing capabilities and new venture creation strategies (Helfat, 2000; Zollo and Winter, 2002; Antonacopoulou et al., 2005; Prieto and Easterby-Smith, 2006).

As the dynamic capabilities framework is relatively new, more empirical research is required to strengthen and develop the field (Eisenhardt and Martin, 2000; Zahra et al., 2006; Martinsuo and Lehtonen, 2007a). Although the dynamic capabilities framework has not been applied to the study of IPPM capabilities, it should be noted that a central aspect of IPPM capabilities are resource allocation processes, and there is support in the literature for treating resource allocation processes as dynamic capabilities (Eisenhardt and Martin, 2000). Processes for resource allocation are said to be "clearly relevant to dynamic capabilities because they directly deal with changes to the resource position of an organisation" (Helfat et al., 2007:32). In addition, product development capabilities are also cited as dynamic capabilities by some authors (Eisenhardt and Martin, 2000; Danneels, 2002; Helfat et al., 2007), although others believe that product development capabilities are largely operational capabilities and that a dynamic capability must be a higher-order capability that directs the development and evolution of the operational capability (Winter, 2003). The proposition that IPPM is a dynamic capability fits with this. IPPM capability can be considered a higher-order capability through its role in customising the product development capability to suit the changing environment and to cater for different project types (De Maio et al., 1994; Loch, 2000; Cooper et al., 2001).

Criticisms of the RBV and the dynamic capability concept

The growing body of research and literature on RBV and dynamic capabilities includes an ongoing debate about whether the RBV is a valid theoretical perspective. Some authors believe that the premise behind the RBV is flawed due to tautological definitions. A main argument is that the definition that resources and capabilities must be valuable to contribute to competitive advantage is tautological when combined with the proposition that the creation of competitive advantage helps to define whether contributing resources or capabilities are valuable. This circular reasoning invalidates the RBV as a theory according to these authors (Priem and Butler, 2001).

Another criticism points out the lack of empirical research and argues that the RBV cannot be empirically tested (Bacharach, 1989; Priem and Butler, 2001). Other authors argue that, although the RBV can be defined tautologically, the theory is not tautological in essence. These authors also suggest better ways of defining capabilities and resources that allow empirical testing of the theories (Barney, 2001; Peteraf and Barney, 2003; Helfat et al., 2007). When capabilities are described based on their functional relationship to the underlying organisational resources, their value can be determined without considering the organisation's performance (Eisenhardt and Martin, 2000). In addition, in response to concerns that the use of the words 'ability' or 'capability' to define a 'dynamic capability' can be tautological, some definitions of dynamic capabilities are constructed specifically to avoid tautology (Zollo and Winter, 2002). The identification of specific organisational processes as dynamic capabilities and the generation of empirical research is important for the continued development and validation of the dynamic capabilities framework (Eisenhardt and Martin, 2000; Helfat et al., 2007).

5.2.6 Summary and implications

This section has briefly introduced some existing theories and frameworks that have been applied to the study of organisational strategy and competitive advantage. Porter's competitive strategies, Miles and Snow's typologies of strategic orientation, and the RBV and the dynamic capabilities framework have been outlined and their applicability to IPPM capability research has been discussed. Based on these discussions the dynamic capability framework has been selected as the most suitable framework to consider for application to the research on IPPM capabilities and competitive advantage. This selection has been made because resource allocation is a central aspect of IPPM capabilities, and the dynamic capabilities framework focuses on the relationship between capabilities and resources. In addition, although the dynamic capabilities framework has not been directly applied to the study of IPPM capabilities, there is strong support for its application to the study of resource allocation capabilities. The likely alignment of the externally focused strategic frameworks with the study of IPPM capabilities is much more limited in scope and focuses mainly on the degree of formality and centralisation of the IPPM capability. Therefore the external strategy frameworks are not considered further and the literature on the dynamic capabilities framework is more thoroughly explored and reviewed in the following section.

5.3 Extended literature review on dynamic capabilities and IPPM capabilities

Ever since the concept of dynamic capabilities was introduced (Teece and Pisano, 1994; Teece et al., 1997), researchers have been exploring the concept and proposing alternate definitions. Dynamic capabilities were initially defined as "the firm's ability to integrate, build, and reconfigure internal and external competencies to address rapidly changing environments" (Teece et al., 1997:516). As the concept has been explored and extended, the definition has evolved to consider dynamic capabilities as "the capacity of an organisation to purposefully create, extend, or modify its resource base" (Helfat et al., 2007:4). Some authors discuss aspects of the dynamic capabilities such as the 'patterned elements' (Winter, 2003), 'routinised activities' (Zollo and Winter, 2002) or 'core micro-strategies', the relatively stable sets of routines that are involved with shaping strategy (Salvato, 2003). Some definitions focus on the relationship of the dynamic capabilities with lower-order capabilities (Winter, 2003) or operating routines. One such definition defines a dynamic capability as a "learned and stable pattern of collective activity through which the organisation systematically generates and modifies its operating routines in pursuit of competitive advantage" (Zollo and Winter, 2002:340).

An alternative view of dynamic capabilities focuses on the "behavioural orientation constantly to integrate, reconfigure, renew and recreate its resources and capabilities and, most importantly, upgrade and reconstruct its core capabilities in response to the changing environment to attain and sustain competitive advantage" (Wang and Ahmed, 2007:35). Similarly, a dynamic capability can be viewed as a particular type of organisational capability that focuses on learning processes provides organisations with the ability to reconfigure resources and routines to adapt to changing environments (Jarzabkowski and Wilson, 2006). Organisational learning aspects are highlighted in a growing segment of the literature on dynamic capabilities (Antonacopoulou et al., 2005; Prieto and Easterby-Smith, 2006; Cepeda and Vera, 2007; Easterby-Smith and Prieto, 2007). Three component factors of dynamic capabilities that emphasise learning-based behavioural orientations are adaptive capacity (the ability to identify and capitalise on emerging market opportunities), absorptive capacity (the ability to identify and integrate new external knowledge with existing internal knowledge for competitive gain) (Cohen and Levinthal, 1990) and innovative capacity (the ability to develop new products and/or markets) (Wang and Ahmed, 2007).

By definition, dynamic capabilities must be dynamic and adaptive in order to provide sustainable benefits in a dynamic environment. Dynamic capabilities that possess a learning orientation with a strong absorptive capacity are well placed to ensure that the capability remains dynamic by continually evolving in response to changes in the environment. Absorptive capacity and the learning aspects of dynamic capabilities are discussed further in Section 5.4.

Dynamic capabilities provide resource-based competitive advantage, but they are different from the standard organisational resources in several ways. While resource-based competencies must be difficult to copy or imitate to provide lasting competitive advantage, dynamic capabilities are often easy to copy and acquire (Eisenhardt and Martin, 2000). Dynamic capabilities often show strong commonalities across organisations and industries, allowing the identification of 'best practices'. These practices may have evolved from different paths and may be transferred or acquired more easily than other firm resources. Dynamic capabilities enhance organisational competitive advantage (Teece et al., 1997). However, they cannot add value alone; they do this through reconfiguration of the existing resource-base (Eisenhardt and Martin, 2000) and therefore can be considered an enabling resource (Smith et al., 1996). In addition, the relative ease by which dynamic capabilities may be copied or acquired limits their ability to independently provide lasting value. Dynamic capabilities also require the prior establishment of supporting capabilities through a sequential order of implementation (Eisenhardt and Martin, 2000) and play an important role in allocating resources, as well as in identifying the desired development and direction of resources and capabilities in line with strategy (Wang and Ahmed, 2007). Therefore, the presence of both dynamic capabilities, as well as underlying resource advantages that are VRIN, is required for long-term competitive advantage in dynamic environments (Teece et al., 1997).

5.3.1 Dynamic capabilities – examples including IPPM capabilities

Dynamic capabilities are "specific strategic and organizational processes like product development, strategic alliancing and strategic decision-making that create value for firms within dynamic markets by manipulating resources into new value-creating strategies" (Eisenhardt and Martin, 2000:1106). Processes like NPD have not been considered as traditional areas for strategic research (Nelson, 1991); however, there is a large amount of empirical research into NPD that has been conducted outside the strategy field (Griffin, 1997; Ernst, 2002). The identification of particular processes as dynamic capabilities enables these processes to be better understood by evaluating their role in altering an organisation's resource base and the resultant effect on organisational performance (Eisenhardt and Martin, 2000). In addition, the existing research on these processes will add to the empirical grounding of the RBV and dynamic capabilities approach. Although the RBV and dynamic capabilities approaches were initially developed from an economic modelling perspective (Barney, 1991), an organisational activity-based or practice-based perspective is most appropriate for the study of specific dynamic capabilities through empirical research (Eisenhardt and Martin, 2000).

IPPM capabilities can be viewed as a dynamic capability for a number of reasons. An organisation's IPPM capability is one of the internal organisational capabilities or resources that an organisation uses to gain competitive advantage. IPPM decisions are responsible for the alignment of projects with strategy, maintaining a balance of project types, and ensuring that the project portfolio fits with resource capability so that the organisation can gain the maximum value from the investment in NPD (Cooper et al., 2001; Dawidson, 2004). Therefore, the RBV of strategy presents a theoretical framework that is relevant to the study of IPPM capabilities. Classic RBV perspectives offer a model of organisational resources and advantages that is applicable to a fairly static environment; however, innovation is by nature a dynamic organisational activity. Even in slow-moving industries, innovation is unpredictable and dynamic and requires an ever-changing mix of resources (Tatikonda and Rosenthal, 2000a; Danneels, 2002; Zollo and Winter, 2002). The dynamic capabilities concept provides a framework within the RBV that addresses such dynamic environments. Figure 5-3 illustrates the relationship between the RBV, the dynamic capabilities framework and organisational capabilities such as IPPM capabilities. The RBV is the underlying theoretical perspective to support the dynamic capabilities framework, and IPPM capabilities can be viewed as a type of dynamic capability.

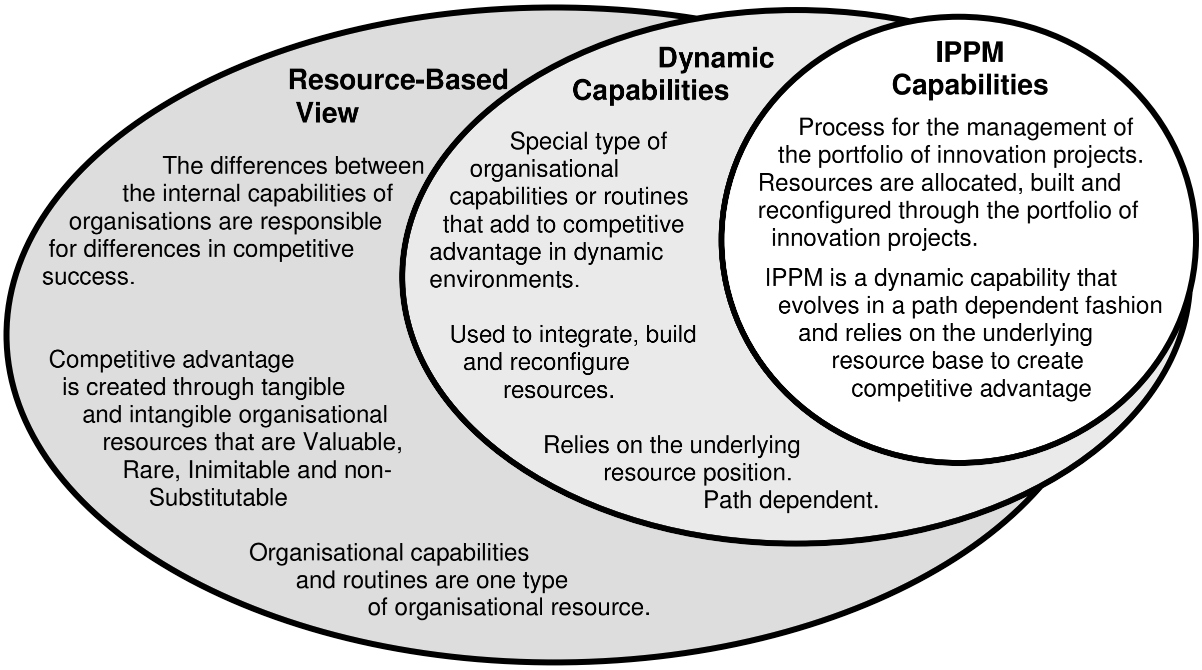

Figure 5-3: Relationship between the RBV, dynamic capabilities and IPPM capabilities

5.3.2 IPPM capabilities: processes, positions and paths

Teece, Pisano and Shuen's 'processes, positions and paths' (PPP) framework (Teece et al., 1997) provides an overview of the mechanisms in the relationship between resources, dynamic capabilities, learning and performance. As shown in Figure 5-4, although dynamic capabilities such as IPPM capabilities are essentially organisational routines or processes, they depend strongly on the resource position of the organisation or the underlying resource base to generate sustainable competitive advantage. In addition, historical and future paths are important to the organisational decisions and learnings that form the basis for dynamic capabilities.

By using the PPP dynamic capabilities framework to structure the existing IPPM research, this section uses that existing research to strengthen the empirical base of dynamic capabilities research (Eisenhardt and Martin, 2000). This structuring aims to add clarity by illuminating the relationships between the processes used for IPPM, the resource position of the organisation, and the historical paths and future options available.

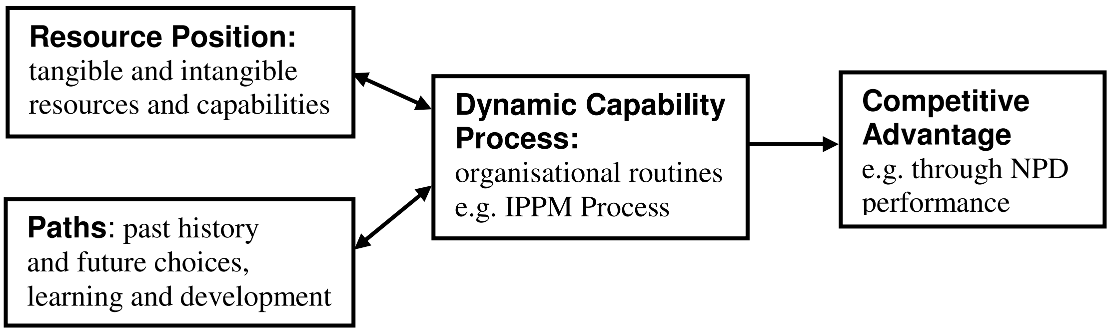

Figure 5-4: Dynamic capabilities and the 'processes, positions and paths' framework
(built on Teece et al., 1997)

Processes

Most of the existing IPPM literature focuses on specific processes and methods, as outlined in Chapter 2. Only a brief overview of this literature is presented here. These are largely decision-making processes that are tailored to the individual organisation, supported by a set of processes involving specific tools, methods and procedures (a sample of the literature on IPPM processes includes Archer and Ghasemzadeh, 1999b; Nelson et al., 1999; Cooper et al., 2001; McDonough and Spital, 2003; Archer and Ghasemzadeh, 2004; O'Connor, 2004; Cauchick Miguel, 2008).

The identification of 'best practices' is a strong theme in IPPM literature and a number of benchmarking studies have identified practices that are linked with improved business performance and the creation of sustainable competitive advantage (Cooper et al., 2001; Jeffery and Leliveld, 2004; Center for Business Practices, 2005). The often repeated claim that more formal IPPM processes will lead to improved outcomes is supported by some studies (Cooper et al., 2001; Jeffery and Leliveld, 2004) and challenged by others (Loch, 2000; Dietrich, 2006). Other IPPM process-focused studies have identified the front-end activities that best link strategy to projects and have highlighted the importance of including business models in IPPM decision-making (Poskela et al., 2005; Reginato and Ibbs, 2006).

The processes for the management of single projects form an important part of the IPPM capability (Martinsuo and Lehtonen, 2007a). Empirical studies report mixed findings regarding the links between particular IPPM methods and goals. For example, financial methods, although the most commonly used, are shown not to be best as a primary selection method, due to poor portfolio performance outcomes (Cooper et al., 2001). This finding is aligned with the view that the internal resource base of an organisation comprises a range of capabilities, and that a “balance sheet is a poor shadow of the firm’s competencies” (Teece et al., 1997:517). As a large volume of IPPM literature focuses on the process aspects of IPPM capabilities, only a brief summary has been presented here.

Positions

The PPP framework acknowledges the two-way relationship between the resource positions and the processes that underpin the creation of competitive advantage through dynamic capabilities. The resource position includes the organisation’s full set of resources and capabilities. This includes resources that can be explicitly allocated to projects (such as money, equipment and people, and their skills and knowledge), as well as other underlying resources and capabilities, some of which support project activities less directly (such as the customer base, the culture and management capabilities).

One of the main roles of strategic management is to allocate resources in order to implement plans that fulfil the objectives of the company while also considering the effect of the resource allocation decisions on the future development of the larger set of organisational capabilities and resources. The IPPM literature repeatedly shows that the allocation of resources is a core function of an IPPM capability. The literature identifies the ‘resource allocation syndrome’ (Engwall and Jerbrant, 2003), where organisations struggle with setting priorities, managing competing demands for limited resources and interdependencies between projects. Organisations regularly report that their resources are stretched and that they are completing too many projects for the available resources (Cooper et al., 2001; Elonen and Artto, 2003; Engwall and Jerbrant, 2003; McDonough and Spital, 2003).

The ‘chasm’ between ambitions and resources (Hamel and Prahalad, 1994) or the gap between the number of projects attempted and the limitations of the available resources is well recognised in the literature (Cooper et al., 2001; Cooper and Edgett, 2003; Burgelman et al., 2004). The methods to bridge this gap vary in focus. Some authors explicitly acknowledge that project selection processes have a large role in both the allocation of existing resources and the development of capabilities and resources for the future of the organisation (Engwall and Jerbrant, 2003; Burgelman et al., 2004). Some literature focuses on accumulating and leveraging resources more effectively (Hamel and Prahalad, 1994) or on improving methods for measuring resources (Engwall and Jerbrant, 2003), while most IPPM literature emphasises the processes for allocation of existing resources and the necessity to limit the number of projects (see, for example, Heidenberger and Stummer, 1999; Cooper et al., 2001; Ding and Eliashberg, 2002; Milosevic, 2004; O'Connor, 2004).

The IPPM literature clearly shows the strong relationship between the resource position of the organisation and the IPPM capability and processes. This literature focuses primarily on the allocation of fixed resources across competing projects, leaving largely unexplored the influence of the IPPM capability on the development of the resource position.

Paths

Dynamic capabilities steer the organisation on future-oriented paths, but they are also path-dependent. Path dependency occurs when the nature of the capability depends on the process through which it is acquired (Andreu and Ciborra, 1996). A path-dependent process is one in which "events early in the evolution of the process have significant effects on subsequent events" (Barney and Hesterly, 2006:89). Path dependency in dynamic capabilities is a function of the previous decisions made, knowledge gained and competencies developed that affect the current choices available. Current and future choices and paths are formed and altered by dynamic capabilities as an organisation moves forward in a dynamic environment (Teece et al., 1997; Lavie, 2006). The dynamic capabilities themselves evolve in a path-dependent evolutionary fashion (Lavie, 2006). For example, organisational learning theory shows how decision-making processes evolve in response to the feedback and outcomes from previous decisions (March, 1991). This type of tacit accumulation of experiences (previous paths), together with the more deliberate learning mechanisms of knowledge articulation and codification, are responsible for the evolution of dynamic capabilities (Zollo and Winter, 2002).

Strategic choices, future paths and path dependency are evident in two themes within the literature on IPPM capabilities. One theme of research focuses on the evolution of the IPPM capabilities themselves, and the other looks at the role IPPM capabilities play in shaping organisational paths. Past organisational experiences and previous choices and decisions influence both of these themes.

Research into IPPM capabilities regularly acknowledges the stages of establishment and development of these practices within an organisation. IPPM processes are shown to be on an evolutionary path through maturity models developed based on empirical 'best practice'-focused research studies (PMI, 2003b; Jeffery and Leliveld, 2004; Pennypacker, 2005; Kahn et al., 2006). In addition, a majority of recent survey respondents placed importance on IPPM and planned to increase or improve their IPPM efforts (Center for Business Practices, 2005; Dye, 2006; Kapur et al., 2006). The evolution paths for IPPM capabilities are also highlighted in literature that emphasises the need for IPPM capabilities to be tailored to suit the particular environment (see, for example, Loch, 2000; Cooper et al., 2001; McDonough and Spital, 2003; Crawford et al., 2006).

Existing research results also reveal the necessary 'order of implementation' or sequential implementation paths for the establishment of successful IPPM capabilities. For example, several studies have confirmed the relationship between project management practices and IPPM performance, and the requirement for project management practices to be established before IPPM implementations can be successful (Brown and Eisenhardt, 1997; Dietrich, 2006; Martinsuo and Lehtonen, 2007a). The presence of top management support is also a prerequisite for successful IPPM implementation (Cooper et al., 2001; Poskela et al., 2004).

The role of IPPM capabilities in shaping organisational paths is reflected in some of the existing empirical research. The literature highlights how obtaining a balance in the project portfolio is difficult to achieve and that the balance between incremental and radical or short- and long-term projects is one of the most problematic areas (Matheson et al., 1994; Cooper et al., 2001). A majority of organisations report that they have too many short-term and incremental projects in their project portfolio (Cooper et al., 2001, 2004). Organisational learning theory is used to explore decisions related to short-term or incremental projects that ‘exploit’ existing capabilities, compared with decisions related to longer-term or radical projects that ‘explore’ less established areas (March, 1991). Decisions to allocate resources to exploitation projects provide more frequent and rapid positive feedback to decision-makers than decisions to allocate resources to exploration projects, and therefore research has revealed that a natural evolution of such decision-making processes will tend towards allocating resources to an increasingly higher percentage of exploitative or incremental and short-term projects (March, 1991). Deliberate learning mechanisms such as knowledge articulation and codification can be employed to build the IPPM capability (Zollo and Winter, 2002), while addressing the need to balance the portfolio.

The path dependence of IPPM capabilities is strongly represented in the literature. Path dependence is demonstrated in research that indicates a necessary order of implementation of IPPM capabilities and their development along maturity paths, as well as in findings that show how IPPM decisions and the resulting project portfolio evolves in response to the accumulation of past decisions and experiences.

5.3.3 Summary and implications for design of the research instrument

In summary, the literature provides strong support for the identification of IPPM as a dynamic capability. IPPM capabilities fit well with the descriptions and criteria proposed for dynamic capabilities and, although IPPM capabilities have not previously been identified as dynamic capabilities in the literature, related capabilities such as NPD capabilities and resource allocation processes are cited as examples of dynamic capabilities. Improved understanding of the mechanisms responsible for competitive advantage through the IPPM capability is found in existing research on processes (the methods and procedures used), positions (how IPPM processes draw upon and contribute to the underlying resource position) and paths (the role of past decisions and organisational paths in shaping IPPM processes, as well as future options and decisions).

Based on the strong support in the literature for identifying IPPM capabilities as dynamic capabilities, Phase 2 of this study set out to explore this relationship further. RQ 4, therefore, was adjusted based on this extended literature review to ask "*Can the dynamic capabilities framework be applied to assist in understanding the relationship between IPPM capabilities and competitive advantage?*" In order to investigate the relationship using a dynamic capabilities perspective, Phase 2 was designed to gather information on the levels of change and evolution in the case organisations' environments, the past history and future plans related to the IPPM capability, and the role of the IPPM capability in configuring, deploying and developing the resource position.

5.4 Extended literature review on the development of organisational capabilities

This section of the extended literature review focuses on literature to help address RQ 5, 'How do IPPM capabilities develop?' The IPPM literature in Chapter 2 and the findings from Phase 1 both indicate that organisations go through a process of establishing and developing their IPPM capabilities over time. The previous sections have explored the RBV and the dynamic capabilities perspective and indicate that understanding of the relationship between IPPM capabilities and competitive advantage may be improved by viewing IPPM as a dynamic capability. This section presents an overview of the literature on the establishment and evolution of organisational capabilities, drawing upon literature on organisational learning as well as on the literature that links learning and the dynamic capabilities framework.

As outlined previously, the RBV focuses on resources and capabilities and their role in organisational outcomes. Capabilities are defined in this thesis as a specific type of organisational resource that enables the organisation to deploy other resources to perform activities that result in desired outcomes. Research shows that creating and improving capabilities is essential for the effective management of product innovation in order to make NPD a competitive advantage over the long term (Ayas, 1999). In addition, the ability to learn and apply new knowledge is a source of competitive advantage (Zack, 1996). Capabilities are not something the organisation buys; they are developed over time (Makadok, 2001) and often evolve through learning from repeated trial and error (Cohen and Levinthal, 1990). Investment in learning and capability development will influence the level of establishment and improvement of organisational capabilities (Ethiraj et al., 2005). However, not all capabilities are equally valuable. Optimising investment in the establishment and development or maintenance of organisational capabilities requires an understanding of how valuable these organisational capabilities are (Ethiraj et al., 2005).

The capability lifecycle model identifies general patterns that organisational capabilities follow from establishment, through development to maturity and beyond (Helfat and Peteraf, 2003). Organisational learning processes enable organisational capabilities to develop through the lifecycle stages. Without this ability to learn, organisational capabilities will remain static and unresponsive to changes in the environment. An organisational learning capability enables the organisation to obtain, process, interpret and respond to information, and to change organisational behaviours to generate opportunities and improve organisational outcomes (Senge, 1990; Easterby-Smith and Araujo, 1999). Organisational learning allows organisations to correct errors and adapt to changes in the environment, and so both internal feedback and information on the external environment are required for effective capability development (Huysman, 1999). In order for such learning to take place, the structures and systems within the organisation must support information and learning (Field and Ford, 1995). These structures often include social networks and teams where individuals can engage in dialogue and learning can be shared (Nonaka, 1991). Organisational learning is also enhanced through structures and systems for capturing historical paths and experiences through project histories (Maqsood et al., 2006).

In order to develop organisational capabilities, the learning within individuals must be captured and transformed into organisational knowledge. Most organisational learning is first embedded in individuals through their experiences. Effective organisational learning structures mobilise this tacit (unarticulated) knowledge that resides within individuals into organisational knowledge through a ‘knowledge spiral’ (Nonaka, 1994). In this way tacit experience is used to develop and improve organisational capabilities (Nonaka, 1991).

Research into IPPM capabilities regularly acknowledges the evolution and development of these capabilities. Organisations invest in developing organisational capabilities – such as IPPM capabilities – to enhance their organisation's competitive advantage (Amit and Schoemaker, 1993; Ethiraj et al., 2005). Investments usually take the form of time, money and managerial effort (Ethiraj et al., 2005), and are designed to create an environment that encourages organisational learning and enhances absorptive capacity by providing mechanisms for the capture of that learning. Absorptive capacity enables the organisation to identify, assimilate and apply knowledge and is developed through experience and access to knowledge (Cohen and Levinthal, 1990; Zahra and George, 2002). Investments in the creation of organisational structures for the amplification, capture and codification of knowledge help to embed and institutionalise organisational knowledge and experiences in organisational capabilities (Nonaka, 1994). Learning activities can also be targeted to improve tacit learning mechanisms, for example by creating an environment conducive to the socialisation of ideas and development of knowledge (Nonaka, 1994). Investments in learning activities can also improve knowledge flows which may otherwise be restricted by the tendency of tacit knowledge that is internalised within individuals to be 'sticky', that is, difficult to transfer within organisations (Szulanski, 1996).

In addition to their effect on capability development and maturity, organisational learning processes have been shown to affect decision-making processes and outcomes. IPPM decisions that involve choices between short-term or incremental projects that 'exploit' existing capabilities and longer-term or radical projects that 'explore' less established areas evolve through experience accumulation (March, 1991). A primary goal of an IPPM capability is to balance the project portfolio, with the balance between the exploitation and exploration projects highlighted as one of most difficult and weakest areas of performance in both Phase 1 and the literature (Matheson and Menke, 1994; Cooper et al., 1999). According to organisational learning theory, decisions to allocate resources to exploitation projects provide more frequent and rapid positive feedback to decision-makers than decisions to allocate resources to exploration projects. Therefore a natural evolution of such decision-making processes will tend towards allocating resources to an increasingly higher percentage of exploitative or incremental and short-term projects (March, 1991; March, 1994). This tendency may explain the often reported imbalance in project portfolios, where too many exploitation projects are approved at the expense of the exploration projects.

5.4.1 Organisational learning and dynamic capabilities

Organisational learning capabilities can be considered a type of dynamic capability due to their role in shaping other organisational capabilities (Zollo and Winter, 2002). From a capability hierarchy perspective, organisational learning capabilities can be viewed as ‘second-order’ dynamic capabilities through their role in the creation and evolution of other dynamic capabilities that are considered ‘first-order’ because they can change other operational capabilities (Winter, 2003). This hierarchy is evident in recent research, where a knowledge management capability (a ‘second-order’ dynamic capability) is shown to support the development of other (‘first-order’) dynamic capabilities in the IT industry (Cepeda and Vera, 2007).

The identification of IPPM capabilities as dynamic capabilities therefore suggests that an organisational learning capability is a pre-condition for the development and evolution of a sustainable IPPM capability, as it enables an organisation to learn and adapt. Organisational learning has an important role to play in the establishment and evolution of dynamic capabilities, as they need to be updated repeatedly in order to respond to changes in the environment (Zollo and Winter, 2002). Without an organisational learning capability, the IPPM processes would become static routines. Dynamic capability development follows a ‘knowledge spiral’ (Nonaka, 1994) in the ways that these capabilities are continually developed and refined through mechanisms where individual knowledge is explicitly articulated, amplified, codified and re-codified on an ongoing basis.

The organisational learning processes that support the development of dynamic capabilities are beginning to attract the attention of researchers (see, for example, Zollo and Winter, 2002; Cepeda and Vera, 2007; Easterby-Smith and Prieto, 2007). Zollo and Winter (2002) proposed that dynamic capabilities co-evolve through three types of learning mechanisms: tacit experience accumulation, explicit knowledge articulation and explicit knowledge codification. Organisational routines and capabilities have traditionally been thought to develop mainly through tacit experience accumulation learning mechanisms such as trial and error and the selection and retention of past behaviours (Zollo and Winter, 2002). Experience accumulation will occur without specific investment in the learning process; however, learning investments can enhance the effectiveness of the experience accumulation process and can serve to ‘enlarge’ the individual’s ability to develop knowledge (Nonaka, 1994). For example, investments in organisational restructuring to create a place within the organisation where experience can accumulate, or in creating incentives for stability in the workforce, will enhance the experience accumulation process.

In addition to tacit experience accumulation, explicit learning mechanisms such as knowledge articulation and codification mechanisms contribute to the development of dynamic capabilities (Nonaka, 1994; Zollo and Winter, 2002). These types of learning are theorised to be especially valuable when the tasks are infrequent, highly variable or when the links between the decisions or actions taken and the desired performance outcomes are obscured (Zollo and Winter, 2002). An example of a deliberate learning investment to enhance knowledge articulation is the allocation of time and effort for meetings and knowledge-sharing sessions. Deliberate learning investments to enhance knowledge codification involve activities like the development of a procedures manual or a software application.

Figure 5-5 illustrates the relationship between learning investments and the effectiveness of IPPM capabilities. Learning investments are used to enhance the effectiveness of the three types of learning mechanisms that develop the dynamic capability for IPPM (Zollo and Winter, 2002). Learning investments also develop the project management capability that supports the IPPM capability (Ethiraj et al., 2005). The outcomes from effective learning investments will be an aligned, high-value, balanced and adequately resourced project portfolio that will provide the highest return on both the learning investment and the project investment.

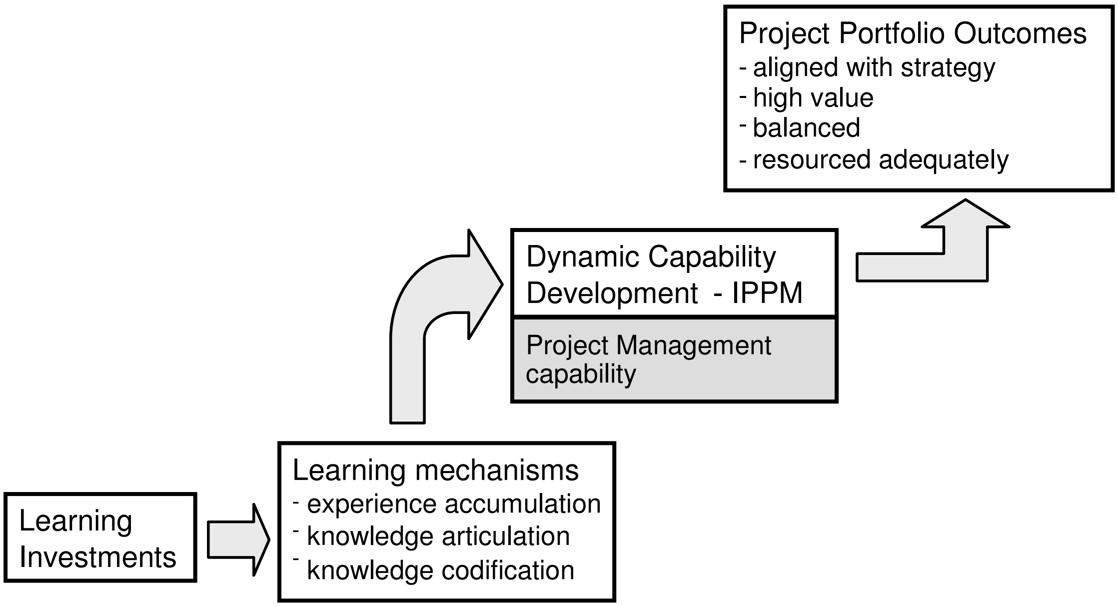

Figure 5-5: Learning investments, capability development and outcomes

5.4.2 Summary and implications for design of the research instrument

In summary, the literature highlights the role of organisational learning in the development of organisational capabilities. The literature suggests that investments in organisational learning activities can enhance the development of knowledge within individuals and the capture of that knowledge in organisational capabilities. The identification of IPPM capabilities as dynamic capabilities leads to the relatively new area of literature that focuses on organisational learning and the development of dynamic capabilities to further the understanding of the development of IPPM capabilities.

The implications for Phase 2 of the research were that data needed to be gathered on the evolution paths of the IPPM capabilities. The in-depth study needed to look for evidence of organisational learning capabilities and details of the activities involved in the establishment and evolution of IPPM capabilities over time, in order to better understand the processes of capability development. The research also needed to investigate the role of organisational learning in the evolution of decision-making processes over time, by evaluating the effect of the IPPM capability on the balance between exploitation and exploration projects in the case study organisations (March, 1991).

5.5 Discussion of extended literature review and implications for Phase 2

The previous sections have explored selected areas of the strategy and organisational learning literature to support RQ 4 and RQ 5 in Phase 2 of this research.

As the field of strategy is broad and deep, the review in Section 5.2 of 'strategy and competitive advantage' presented a brief overview of selected strategic perspectives before identifying the dynamic capabilities framework of the RBV as an appropriate perspective for research into IPPM capabilities. Although the existing IPPM research has been conducted largely without a unifying theoretical basis, the dynamic capabilities framework was used to structure this research *post hoc.* Analysis of the literature on IPPM from a 'processes, paths and positions' perspective indicates that IPPM capabilities follow the patterns identified for dynamic capabilities framework. This analysis reinforces the justification of using the dynamic capabilities framework to analyse IPPM capabilities in future research. RQ 4 was therefore adjusted based on this extended literature review to ask "*Can the dynamic capabilities framework be applied to assist in understanding the relationship between IPPM capabilities and competitive advantage?*"

The selected review of the literature on the development of organisational capabilities reveals a strong organisational learning focus. While RQ 5 remained unchanged as *"How are IPPM capabilities developed?"*, the findings of the extended literature review provided additional guidance for the Phase 2 investigations. The literature on the development of dynamic capabilities provided an additional perspective on the establishment, evolution and development of organisation capabilities to guide the research and improve understanding. The literature emphasises the role of organisational learning as a dynamic capability that enables other dynamic capabilities to respond to changes in the environment. Learning activities are shown to enhance both tacit and explicit learning mechanisms to assist with organisational capability development.

The findings of the extended literature review suggested several areas to explore in Phase 2:

- the case organisations' environments, noting areas of change and evolution
- the relationship between the IPPM capability and other organisational resources
- the past history, future plans and evolution paths of the IPPM capability
- the organisational learning activities involved in the establishment and evolution of IPPM capabilities over time
- the balance between exploitation and exploration projects in the portfolios over time.

These areas are purposefully general to avoid guiding the responses, so that information was collected on 'what really happens'. The findings of the extended literature review were also used to evaluate and analyse the findings from the case study research.

5.6 Multiple-case study research design – Phase 2

Chapter 3 justified the selection of a multiple-case study method for Phase 2 of this sequential mixed methodology research project. The case study methodology, considerations for research design and limitations of the method were discussed in Chapter 3. This section outlines the research design for the multiple-case study including the design of the main research instrument, the semi-structured interview guide.

The research design for Phase 2 drew upon five main inputs based on the previous stages of the research process:

- the five research questions identified based on the review of the literature (see Chapter 2, Section 2.5)
- considerations based on the pragmatic perspective and the sequential mixed methodology chosen for this research (see Chapter 3, Sections 3.1 and 3.2)
- considerations for multiple-case study research design (Chapter 3, Section 3.4)

- the findings of the Phase 1 quantitative questionnaire survey and the implications for Phase 2 (see Chapter 4, Section 4.3 and Table 4-8 in Section 4.4)
- the findings of the extended literature review and the implications for the research design, including the revision of RQ 4 (this chapter, Section 5.5).

This section outlines the research design for Phase 2. An overview of the case study design and conduct is followed by detail of the research instrument design and the methods for analysis of the findings.

5.6.1 Multiple-case study design overview

Phase 2 of this research used a multiple-case study design using a theoretical sampling method to strengthen the empirical analysis by maximising the ability to compare and contrast the findings. Semi-structured interviews were the primary means of data collection, augmented by the review of documents obtained from the case organisations and from independent research. Figure 5-2 outlined the basic approach to Phase 2, illustrating a design that addressed emerging themes in the case studies through an extended and ongoing literature review process and ongoing analysis of the case findings. The extended literature review was conducted initially to support the design of the interview guide, and continued throughout the conduct of the case studies to assist with analysis of the case study findings and to address emerging issues. This section outlines the units of analysis for the case studies and the criteria for selection of the cases, and gives an overview of the methods used in the cases.

Unit of analysis for the case studies

The units of analysis for the case studies were the precise objects of the research and thus needed to be bounded, defined and understood (Yin, 2003a; Johnson et al., 2007). The comparative multiple-case study design involved two different units of analysis within each case organisation, as illustrated in Figure 5-6.

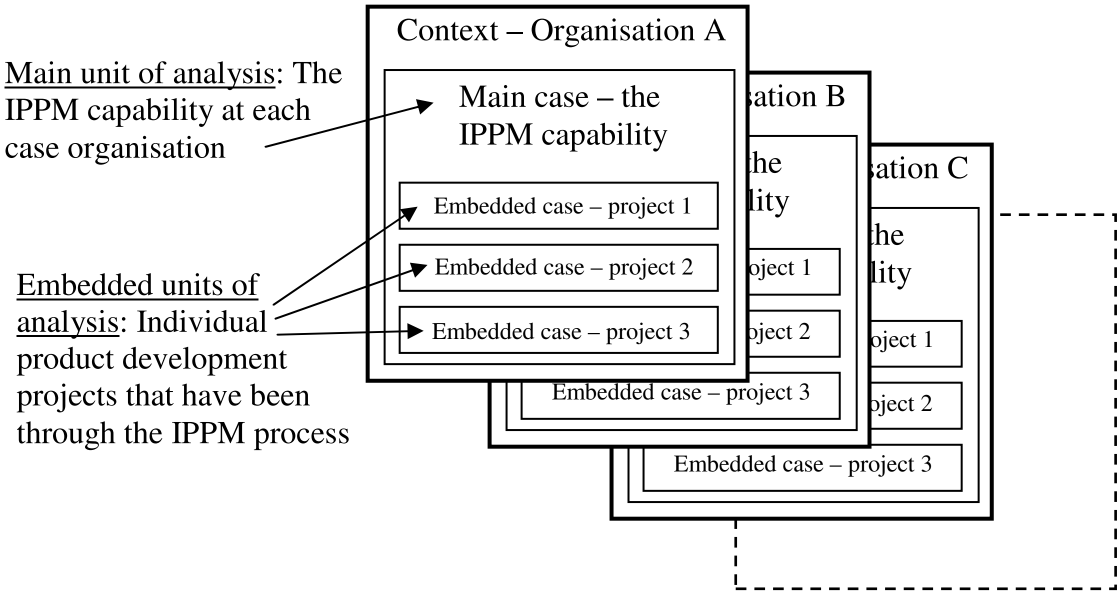

Figure 5-6: Embedded case research design

Each case study organisation included a main unit of analysis and three or four embedded units of analysis. The main unit of analysis was the IPPM capability within the organisation. The IPPM capability was defined as "the overall organisational ability to manage the innovation project portfolio". This definition was purposely broad to allow the investigation to include all aspects of the environment that contribute to the IPPM capability. These include the commonly referred-to aspects of an IPPM capability such as the processes and methods used within the IPPM capability, as well as emergent themes that explore the bounds of the IPPM capability.

The research design also included an embedded unit of analysis within the main unit of analysis. The embedded unit of analysis is an individual project that has been through the IPPM process. Each of these projects is referred to as an 'embedded case' or an 'embedded case project', as illustrated in Figure 5-6. The findings from the embedded cases also formed part of the main case findings (Yin, 2003a).

Case study sample selection

A theoretical sampling method (also called a purposeful sampling method) was used to select organisations for the case study (Gummesson, 1991; Yin, 2003a). Selected organisations had a sustained record of new product success across a wide range of industries in both service and manufacturing areas. A diverse range of organisations across manufacturing and service industries were chosen in order to understand how IPPM capabilities in service and manufacturing-focused organisations compare. Rather than focus on any one industry within each of these areas, the cases were purposely selected to represent a diverse range of industries in order to enhance the generalisability of the findings for this exploratory aspect of the research. Only one organisation was selected from each industry in order to minimise any potential influence of a particular industry and to facilitate free and open discussions since the research did not involve competing organisations.

Successful organisations were selected to gain the most value from a limited number of cases in Phase 2. The 60 organisations that participated in Phase 1 of this study represented a mix of IPPM outcomes levels. The Phase 1 study was therefore able to compare IPPM practices with outcomes, and the findings suggested a relationship between established IPPM capabilities and improved product portfolio outcomes. This finding supports those of previous studies and indicates that organisations with sustained records of new product success are more likely to have an established IPPM capability that can be studied in depth. However, it is acknowledged that new product outcomes are difficult to compare across industries, and that success relative to the particular industry may be a more reliable indicator (Matsuno et al., 2002; Joshi and Sharma, 2004). Therefore, Phase 2 focused on organisations which are industry leaders in their record of sustained competitive advantage from new products. These cases complemented the more general set of organisations represented in Phase 1's quantitative survey, and were more likely to include established IPPM capabilities that could provide a rich set of information. As only organisations with successful innovation product outcomes were chosen for the research, Phase 2 did not analyse the level of success, but focused on developing in-depth understanding of the IPPM capabilities and the organisational and environmental elements that comprise the IPPM capability.

Cases were selected to represent innovation leadership and sustained growth measured relative to their industry. The case organisations have achieved better than average industry growth over the past 10 years. In addition, the organisations each have a strong new product profile and reputation established through publications and industry recognition. Many have received government or industry 'innovation' awards. All of the organisations were purposefully selected based on independent research into publicly available information, and without prior knowledge of their IPPM capabilities in order to avoid bias.

Access to the selected organisations was required at a deep enough level to support the research (Gummesson, 1991). This access was obtained by identifying the appropriate person (usually at vice president or general manager level) and making initial telephone contact. Professionally conducted phone and email follow-up initiated a dialogue with each contact person to provide further information on the project, obtain the consent and identify and gain access to managers at the appropriate levels. Each of the selected organisations agreed to participate in the research. This high level of support indicates the high level of interest in the subject area and increases the confidence in the results, as there is no bias that could be attributed to organisations that declined to participate compared with those that agreed.

The cases were conducted using overlapping data collection and analysis phases, allowing incorporation of emerging themes during the process (Eisenhardt, 1989). Case comparisons and initial evaluations of the findings were conducted after each two cases, while the ongoing literature review addressed the emerging issues. As the final cases exhibited a diminishing marginal contribution to the analysis, the number of cases was limited to six (Gummesson, 1991).

Table 5-1 outlines the six case study organisations. To maintain confidentiality of the organisations, details of company performance are not provided, and the specific industry sector is omitted when it would be too likely to reveal the participant's identity. The six organisations studied are well-known high profile successful Australian industry leaders. All also have a strong international presence.

Table 5-1: Profile of the case study organisations

Type of project portfolio	Service product-focused			Manufactured product-focused		
Industry type	Professional Services	Tele-communi-cations	Finance	Heavy Industrial Machinery	Medical Equipment	Building materials
Organisation code name	SERV	TELE	FIN	IND	MED	MAT
Organisation revenue	Annual revenues range from A$800 million to several billion dollars. Organisation size is not related to industry type, with both manufacturing and service organisations at the top as well as the bottom of the revenue ranges. Four of the organisations studied are independent organisations and two are self contained and locally managed entities that are part of a global group. The revenue reported for these two is for the local entity only.					

The primary unit of analysis at each of these organisations is the main IPPM capability for the organisation. In four of the cases, the innovation project portfolio is a central portfolio for the entire organisation. In the two largest case organisations, where divisions manage separate innovation project portfolios, the IPPM capability studied represents the division with the largest or most prominent new product project development portfolio.

Embedded case selection

The embedded cases (embedded units of analysis) were a selection of projects that have been through the IPPM process. The embedded cases studied the progress of these projects through the IPPM process as well as the success level of the launched new products resulting from the process. The purpose of including embedded cases in the analysis was to improve the understanding of how the IPPM process is used in practice and how the IPPM processes relate to product success, and to explore whether the IPPM process differs for different project types, as suggested in some of the literature (Loch, 2000; Cleland, 2006).

These projects were selected to represent a variety of project outcome levels and project types. Projects were rated on three project outcome levels: high success (exceeding expectations), success (meeting expectations), or below expectations. Projects types were categorised with respect to the degree of 'newness': Radical, New (but not radically new), and Incremental. Appendix 5 gives more detail of the criteria for categorisation of the embedded case projects. Three or four projects were studied at each of the case organisations as embedded cases within the main case analysis. A range of project types, from incremental to radically new projects, were studied at each organisation. Attempts were made to study at least one unsuccessful (below expectations) project at each organisation; however, the IPPM processes in many organisations successfully filtered projects so that very few unsuccessful products were launched using the current IPPM processes.

Case study conduct

The case study method was designed to incorporate multiple sources of evidence to provide additional depth to the understanding and to allow triangulation of the findings (Denzin and Lincoln, 1998). Semi-structured interviews were chosen as the primary means of data collection for the multiple-case studies. A minimum of three and a maximum of five interviewees representing different functions and different management levels at each organisation were included in the study. Data were collected for the main case (the IPPM capability) as well as the embedded cases (individual projects) during the interviews. In addition, other sources of information both publicly available (annual reports, press releases, publications and websites) and internal organisational documents (graphs and charts, internal procedure manuals, computer output examples, some confidential material) were sought and reviewed. These multiple perspectives and data types allowed within-case triangulation between different data sources and perspectives to increase confidence in the findings (Denzin and Lincoln, 1998).

Interviews were conducted on location at each case study organisation from February through to December 2007. As outlined in Chapter 3, consent forms including the confidentiality agreements were signed at the beginning of each interview. In addition, the researcher also signed company-specific confidentiality agreements when requested at two of the organisations.

The case study interviews were conducted with an open mind, allowing the researcher to expand on issues or follow additional paths and to develop thick descriptions of the IPPM processes being studied (Gillham, 2000b). The increased depth of the interviews also helped to reduce bias (Collis and Hussey, 2003). The researcher is well qualified to conduct the interviews, with 20 years of experience working with organisations in multiple industries and a practical understanding of processes involved in NPD decision-making, as well as a thorough understanding of the literature in this area. In addition, the researcher is aware of sources of bias and took steps to minimise the introduction of bias into the interview process. These steps included avoiding the use of leading questions and avoiding making judgments or analysis of findings during interviews (Rubin and Rubin, 1995; Glesne, 1999; Easterby-Smith, 2002).

Except on two occasions where two interviews were conducted in a single day, all other interviews were conducted at the rate of one per day. Five of the six organisations agreed to have their interviews audio-recorded. Audio-recorded interviews were transcribed by the researcher, usually within 24 hours of the interview. Summaries of the interviews that were not audio-recorded were entered into the computer directly after the interview to enable as much of the data as possible to be captured, using notes taken during the interview. During the interviews documents, presentations, graphs and tables were reviewed and discussed in relation to the IPPM capability. When possible, copies of these documents were obtained for later analysis. Follow-up emails or phone calls were used to clarify information or fill in gaps as required.

5.6.2 Research instrument design

Figure 5-7 outlines the process used to design and test the interview guide.

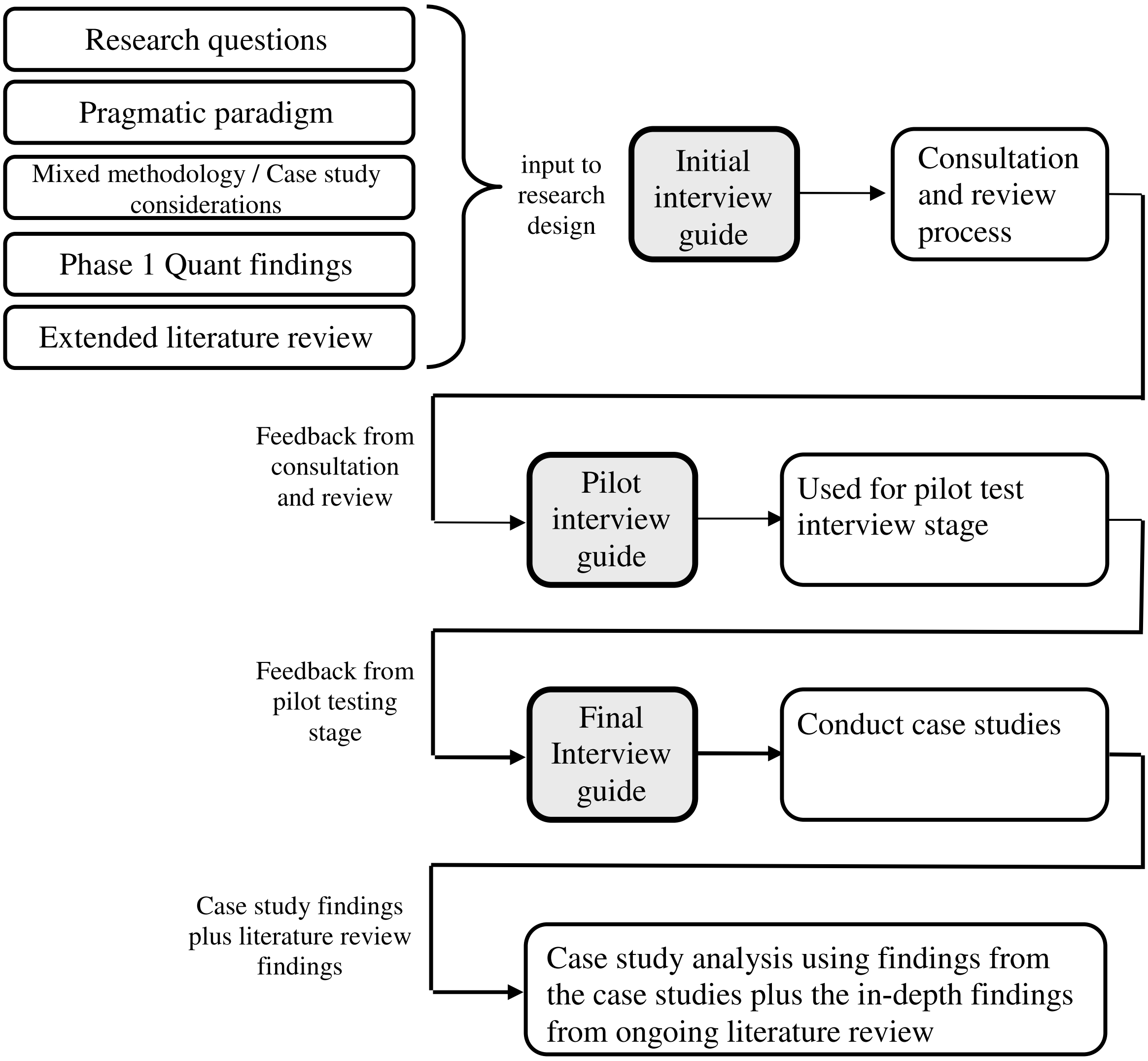

Figure 5-7: Flow diagram of interview guide development and use

The research questions, considerations based on the research paradigm and the research methodology, and the findings from the initial phase of research (quantitative survey) and the extended literature review provided the background for developing the semi-structured case study interview guide. In addition, the preparation of the semi-structured interview design was enhanced by familiarity with the IPPM capabilities at other organisations (Gummesson, 1991).

The interview guide design was accompanied by the development of an information letter that was sent to research participants along with copies of the consent forms prior to the interviews. This pre-interview information was designed to enable each research participant to understand the purpose of the research and the conditions of confidentiality. Participants received copies of the consent forms to review and so they could consider in advance whether they were willing to allow audio recording of the interview. The pre-interview information invited participants to contact the researcher if anything needed clarifying, or to contact the ethics approval body at any time if there were any questions or concerns about the ethics approval or compliance.

During the research design process, the pre-interview information and the interview guide were first shared with colleagues for comment, then revised and pilot-tested before case organisations were approached. Revisions incorporated into the research design based on the feedback included changes to the order of questioning and improvements to the information letter and consent forms, primarily to reduce duplication and streamline the process. The data collected during the pilot interview were not used.

As the research questions include a mixed level of exploration in the questioning, the semi-structured interview format used for this research was designed with a high level of structure in some areas, and a fairly open format in others. For example, the semi-structured interview format was highly structured in the section designed to capture data on the perceptions of IPPM performance that are comparable with the Likert scale responses in the survey, but with additional depth added through the respondents' elaborations and explanations of their ratings. To encourage exploration, the semi-structured interview format was quite open in many other areas, such as when seeking explanations of the evolution of IPPM capabilities or enquiring about the main challenges related to the IPPM capability (Yin, 2003a).

The interview guide started with an introductory statement in order to guide the researcher in explaining the research and the interview process. Because the terms related to IPPM are not uniformly understood, an explanation of IPPM processes and capabilities was included in the introductory statement for each participant at the beginning of the interview. The terminology used throughout the interview was adapted to fit the organisation's terminology. A consolidated copy of the main research instrument, the semi-structured interview guide, is included in Appendix 5.

5.6.3 Interview process – case study process

The case studies were conducted as outlined in Figure 5-8 and were analysed in an ongoing fashion both within each case and across cases. An initial cross-case analysis was done after each set of two cases. Each set of cases included one service-focused organisation and one manufacturing-focused organisation to enhance the balance of the emergent findings early in the research process. A primary purpose of analysing across cases throughout the case study process was to identify themes and to track the additional contribution to the findings from each set of additional cases. The first two cases identified several main themes and areas of commonality and differences between the service and manufacturing environments. These themes were consolidated by the second two cases. After the first four cases a strong level of consistency in the main findings prompted a consideration of whether additional cases would contribute to the analysis. A decision was made to continue and conduct the fifth and sixth cases to see whether any of the main findings were challenged, or whether significant additional findings resulted. These two additional cases supported the main findings, and at this stage the incremental contribution to the research had decreased to the point where the benefit of conducting additional case studies was not high enough to justify conducting further case studies (Gummesson, 1991). Therefore the total number of cases studied was six.

After the completion of the cross-case analysis, the final stage of the process included two-way feedback sessions with the case organisations. These feedback sessions presented the findings to the research participants as a benefit for their participation in the research process. The sessions also provided an opportunity for feedback from the participants on the findings and helped to validate the findings.

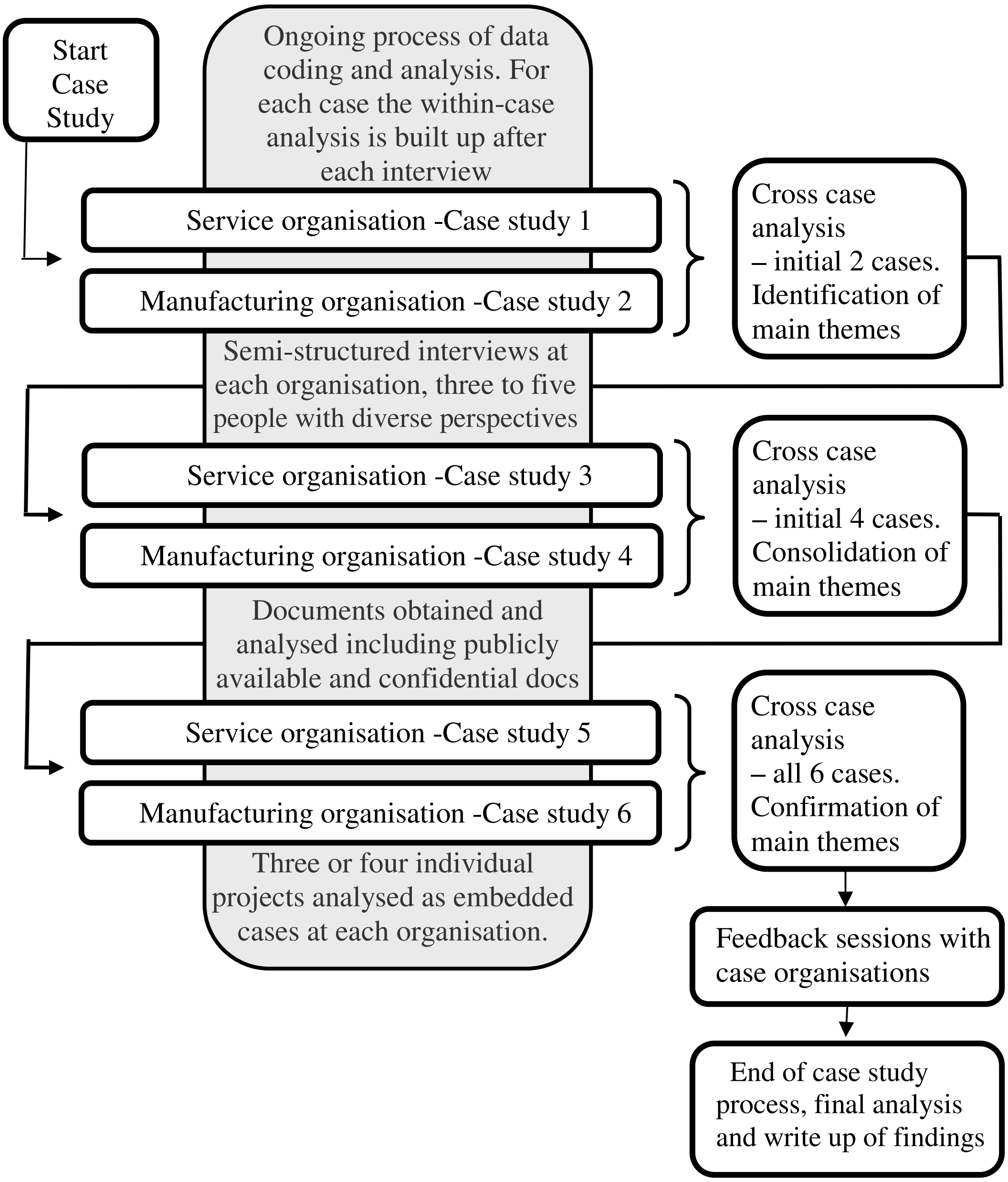

Figure 5-8: Case study process

Figure 5-9 illustrates the profile of the case organisations and the primary and embedded cases that were included in the qualitative phase of the research. The six case study organisations included in Phase 2 produced six main cases (the IPPM capabilities at the case organisations) and 21 embedded cases (individual projects and the resulting products), which were analysed using the methods outlined in the following section.

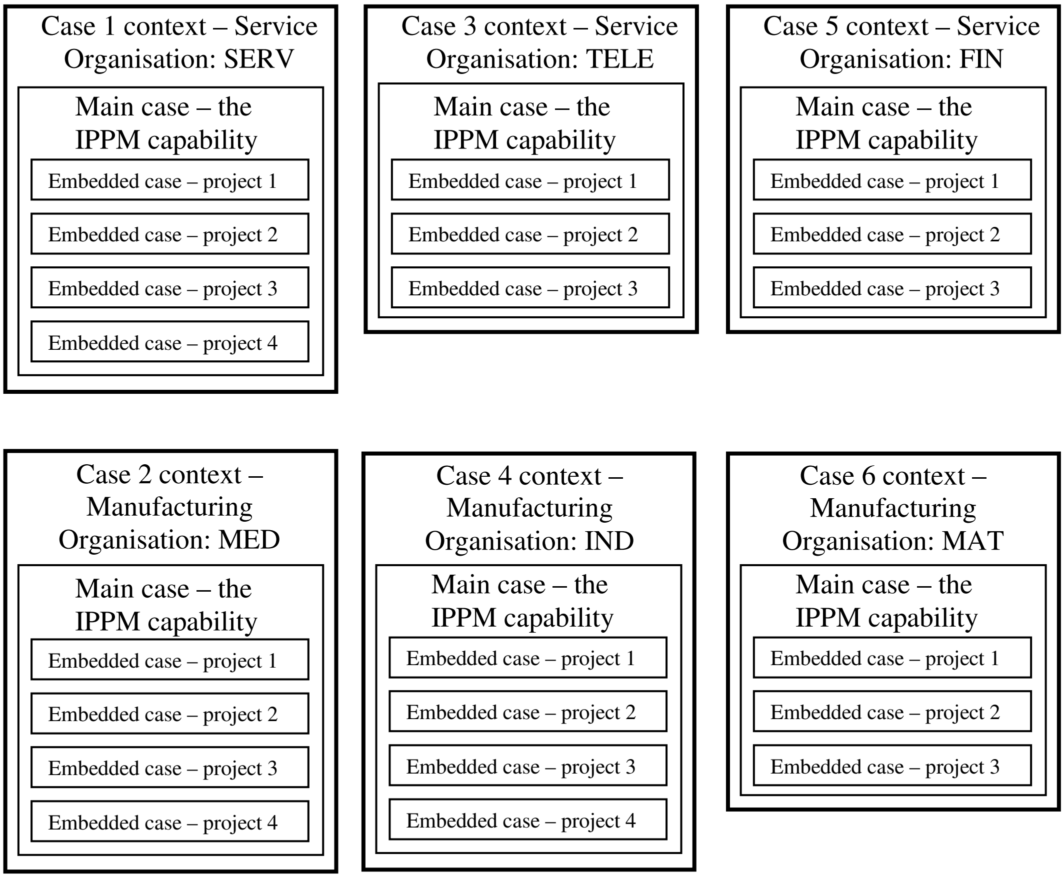

Figure 5-9: Cases and embedded cases

5.6.4 Methods used to analyse the findings

Two methods were used to analyse the case study data: (1) a spreadsheet was used to summarise the data and to conduct initial cross case analysis after each interview, and (2) NVivo qualitative data analysis software was used to code and analyse the data at the end of the case study process. Data were transcribed as soon as possible after interviews by the researcher, as outlined above. Using the two methods of analysis meant that each transcript was thoroughly read and coded at least twice in its entirety. In addition, the transcripts were frequently referred to or searched to clarify or investigate themes during the data analysis phase.

The spreadsheet-based analysis was done using a cross-case matrix that was set up prior to the interviews and then extended and modified during the analysis process. The spreadsheet included rows for each type of information that was supplied by the interview participants, organised in a similar structure to the semi-structured interview guide. Each interview participant's responses were then recorded in a dedicated column, with a summary column for each organisation. The spreadsheet-based matrix was used for both within-case and cross-case analyses, and was updated after each interview. A rolling summary of the case responses was used to consolidate and summarise findings and to prepare for subsequent interviews. Appendix 6 shows a portion of the cross case spreadsheet in Table A6-2.

At the end of the case study interview process, the entire set of interview transcripts was entered into the NVivo qualitative data analysis software system. Coding of the transcripts was used to strengthen and clarify findings on the themes identified in the spreadsheet-based analysis, and also to explore additional themes. The NVivo software application was chosen because it is very efficient at managing large amounts of qualitative data and for identifying and selecting excerpts and quotes from the interviews. NVivo is also particularly useful for tracking emerging themes that appeared anywhere in the interviews. Further detail of the use of the NVivo software is included in Appendix 6.

The findings from the case study process included three levels of analysis. First a within-case analysis was performed for each case study organisation, including the findings from both the main case and the embedded cases for that organisation. Next, the bulk of the findings were reported in a cross-case analysis of the findings on the IPPM capabilities at each of the six organisations. Finally a separate cross-case analysis of the findings from all 21 of the embedded cases (individual projects) across the set of case organisations was conducted. The findings from each of these levels of analysis are reported in Chapter 6.

5.6.5 Research quality, ethics, and limitations of the method

Chapter 3 contains three sections addressing the criteria used to judge the quality of the research, the limitations of the method and the ethical considerations. Only additional information based on the final research design is presented in this section.

Criteria for judging research quality

Chapter 3 addressed the criteria for judging the quality of the research and explained how the research design enhanced the reliability, validity and generalisability of the findings. The multiple-case study for Phase 2 of the research was designed and conducted in accordance with these plans. In particular, the reliability of the findings was enhanced by the methodological triangulation of the quantitative and qualitative phases of research. Reliability was also improved by transcribing interview responses in the qualitative phase and by using direct quotes and responses in the analysis to reduce any bias or influence from the researcher.

The design of the qualitative phase enhanced validity and improved confidence in the findings through the two methods proposed in Chapter 3, triangulation of multiple perspectives and type of data and external validation through feedback sessions. From the pragmatic perspective adopted for this research, these feedback sessions were a primary method of judging the value and quality of the research (Chia and MacKay, 2007). Organisations were selected from a diverse range of industries for the qualitative phase of research to improve the generalisability of the findings. Generalisability was also addressed by comparing findings from the quantitative and qualitative phases of the study. Findings that are consistent across industries and methods are more likely to be generalisable to other organisations or industries than findings that emerge from a particular industry or through a single method of research.

Limitations of the method

The use of two complimentary methods in this two-phase study neutralised the effects of the limitations of either phase of study, as outlined in Chapter 3. The Phase 2 research design presented in this chapter addressed the limitations of the multiple-case study method. As only a small sample size was possible, the cases were selected to maximise the value of the information collected. In addition, although the cases were conducted in a relatively short period of time, the ability to collect temporal data was enhanced by the length of experience of the interviewees (average employment at the case organisation of 16 years) and through questioning about past events and future plans. Interviewer bias was reduced through a tested research instrument designed to draw out the interviewees' experiences through gentle probes without directing or leading the responses. Finally, the potential for interviewer bias was addressed though the interviewer being self-aware and employing interview techniques and conducting the cases according to the research design described in this chapter.

Ethical issues

Section 3.7, Chapter 3 addresses the ethical issues relating to this study. No additional ethical issues have arisen based on the case study research design.

5.7 Chapter summary

This chapter has outlined the research design for Phase 2 of this sequential mixed-method study and has discussed the design of the research instrument, the criteria for selection of the cases, the conduct of the case studies and the methods for analysis for the findings.

The research design addressed the research questions identified in Chapter 2 and built upon the overall research design considerations presented in Chapter 3 and the findings of the Phase 1 quantitative survey presented in Chapter 4. An extended literature review has been presented in this chapter to investigate selected aspects of the literature on strategy and competitive advantage and on the development of organisational capabilities to support the continued investigation into RQ 4 and RQ 5. The findings of the extended literature review were used to help guide the development of the semi-structured interview guide for the case study questioning.

The extended literature review suggests that the dynamic capabilities framework of the RBV is an appropriate framework to apply to research into IPPM capabilities. RQ 4 was therefore adjusted based on this extended literature review to ask "*Can the dynamic capabilities framework be applied to assist in understanding the relationship between IPPM capabilities and competitive advantage?*"

RQ 5 remained unchanged as *"How are IPPM capabilities developed?"* However, the findings of the extended literature review and the decision to use the dynamic capabilities framework for this research provided additional guidance for the Phase 2 investigations.

Chapter 6 Phase 2 findings

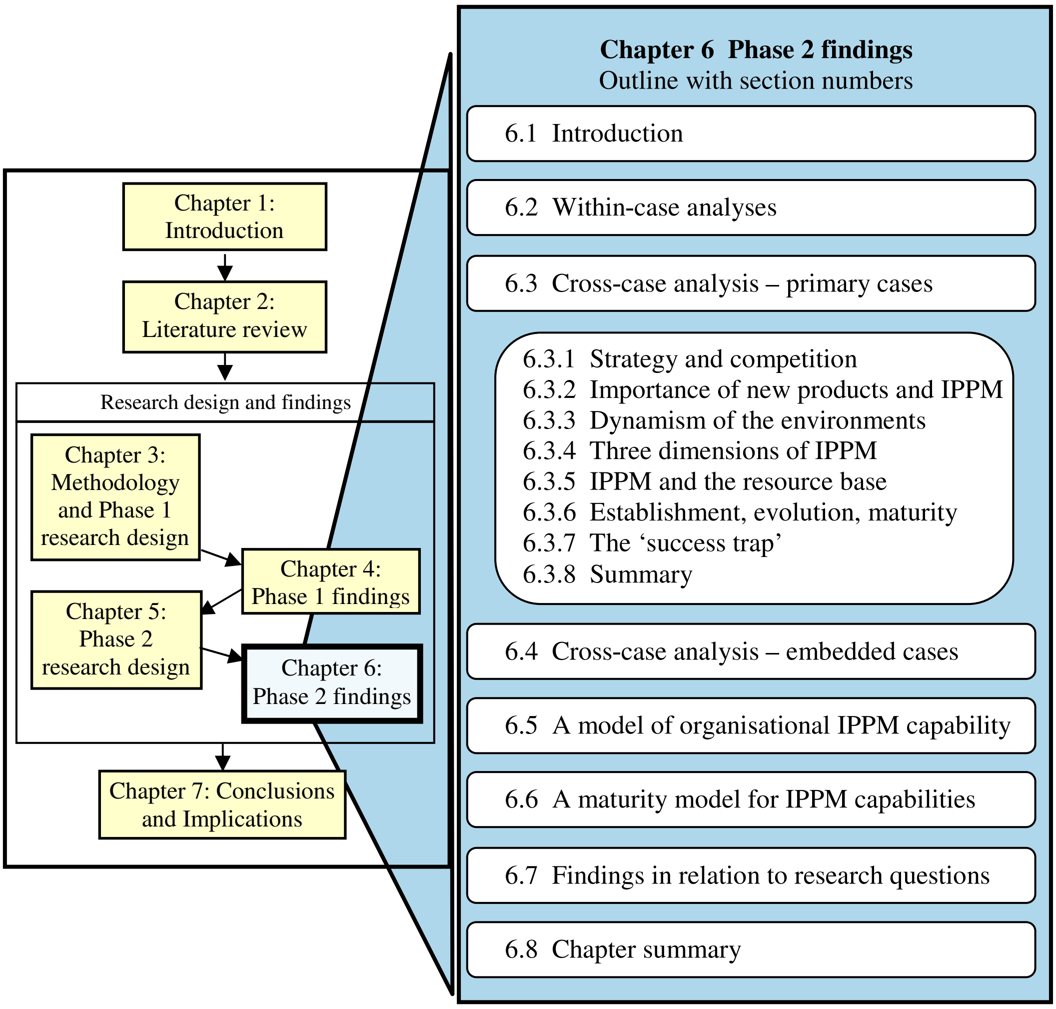

Figure 6-1: Chapter 6 outline within overall thesis structure

6.1 Introduction

This chapter presents the findings and analysis of the second phase of research, the multiple-case study. The chapter is organised as shown in Figure 6-1. The research process follows the methods outlined in Chapter 5 and Appendix 6 for data collection, coding and analysis. In brief, a theoretical sampling method ensured that the six case organisations were successful innovators who represent a diverse range of industries split across manufacturing- and service-based environments. The IPPM capability at each case organisation was analysed by triangulating several sources of data to cross check and strengthen the reliability of the findings.

The case study data were analysed to gain an in-depth understanding both within each case situation and across the cases. The following analyses were used to identify themes and to generate the findings:

- differences or commonalities between responses within a case. If data from multiple perspectives provided a consistent message, this triangulation allowed a greater level of confidence in the findings from that organisation.

- differences or commonalities across all cases. If all cases exhibited commonalities, it was more likely that the findings may be generalisable to other cases and environments.

- differences or commonalities between industry types. The findings from the group of three service-based organisations were compared with the findings from the group of three manufacturing-based organisations and any industry-related trends or differences are summarised with the findings.

- any other trends or relationships between the findings within or across cases.

The research included a 'main case' focused on the IPPM capability and three to four 'embedded cases' focused on individual projects that had passed through the IPPM process at each of the six case study organisations. Figure 5-9 in Chapter 5 illustrated the relationship between the organisations, the six main cases and the 21 embedded cases. A minimum of three and a maximum of five interviews were conducted at each case organisation with managers from a range of disciplinary and departmental perspectives. A total of 23 interviews were completed, with an average length of 109 minutes for each interview. Other data sources such as publications and internal process diagrams and procedure manuals were also analysed. Table A6-1 in Appendix 6 details the sources of data.

The case study findings presented in this chapter were obtained following the documented processes. There is not space within this thesis to provide a detailed description of the source data and the processes used to generate each of the findings on each theme. Therefore after an overview of the data coding and analysis methods,

Appendix 6 presents a detailed illustration of the processes used to generate the findings presented for one of the themes ('The importance of new products and IPPM') as an example of the methods used throughout.

This chapter presents the findings from a within-case analysis of the main cases, followed by cross-case analyses of the primary and embedded cases. These findings are then used to propose a conceptual model of an IPPM capability and a maturity model of IPPM capability development that assist with the analysis of the findings. Drawing upon the case findings and analysis, each of the research questions is then addressed before this chapter's contributions are summarised in the conclusion. Table 6-1 outlines the content of each section of this chapter.

Table 6-1: Overview of Chapter 6

Multiple-case study findings	Summary of the IPPM capabilities at each of the six cases based on within-case analysis (Section 6.2)
	Findings from a cross-case analysis identifying themes and comparing IPPM capabilities across the cases and between industry types (manufacturing or service industries) (Section 6.3)
	Findings from the analysis of the 21 embedded cases (Section 6.4)
Analysis of findings	Findings and a proposed model of the bounds of an IPPM capability based on the case study findings (Section 6.5)
	Outcomes and Learning-based Maturity Model (OLMM) based on the case findings, and findings from an analysis of the six cases using the OLMM (Section 6.6)
Findings related to RQs	Summary of the case findings and analysis that address each of the research questions (Section 6.7)
Conclusion	Conclusions and summary of the main contributions to each of the research questions (Section 6.8)

6.2 Within-case analyses

A within-case summary is presented below for each organisation studied, incorporating information from all data sources, including the findings from the embedded cases for that organisation. Each within-case summary outlines the organisation, its industry and the competitive environment before summarising the IPPM capability and its evolution.

Further details and findings from these case studies are incorporated in the summaries of themes identified in the cross-case analysis presented in Section 6.3.

Note that in this thesis the term ‘IPPM capability’ is used to refer to the organisational capability to manage the portfolio of innovation projects. Although each of the six case study organisations manages a portfolio of innovation projects, they use a variety of terms to refer to their IPPM capability and the use of terms is not always consistent within the organisation. The three manufacturing-based organisations all make some references to terms such as ‘portfolio management’ or ‘portfolio planning’; however, only one of the service organisations uses this type of term. The more financially-focused organisations (SERV and FIN) do not use the term ‘portfolio’ in this context and instead use terms such as ‘innovation process’, ‘ideas process’ or ‘product strategy process’. In the interests of clarity and consistency, each organisation’s specific terms are not referred to in this thesis and instead the terms ‘IPPM capability’ and ‘IPPM process’ are used. Information from the case organisations is identified by providing the relevant coded name(s) in square brackets [SERV, MED, TELE, IND, FIN and/or MAT]. In the case of quotes from the interviews, notations are used to identify which interviewee made the comments. For example, [INDp4] indicates that the quote or information came from the fourth research participant at IND.

6.2.1 SERV – Case summary

SERV is a professional services firm that has introduced an innovation and product development culture over the past three years, driven from the top levels of the organisation. SERV has goals to grow relative to their competitors, and the increased innovation emphasis is part of an overall growth strategy for the organisation. An IPPM capability has been put in place to facilitate growth on the three horizons outlined by Mehrdad Baghai, Stephen Coley and David White in *The Alchemy of Growth*. SERV draws upon the messages from this book, and according to Baghai et al. (1999), organisations that achieve sustained growth invest in innovations for all three time horizons: H1 focuses on expanding revenue from today’s business, H2 focuses on developing the business of tomorrow, and H3, the farthest horizon, looks toward the business of the future. The goals for the IPPM capability are to strengthen innovation on all three horizons and ensure that good ideas get resources and support.

Professional services firms traditionally focus on fee-for-service work for their clients; however, product-based offerings are starting to make an impact in this industry. NPD projects at SERV were previously conducted ad hoc within various departments. The new IPPM capability has not only put more emphasis on NPD, it also addresses problems arising in the previous uncoordinated environment where projects could inadvertently ‘recreate the wheel’ or develop products that were not compatible with other solutions. Product-based service revenue is currently very small, but innovation leaders at SERV expect to see a major shift in the balance of fee-for-service and product-based services in the next three to five years. This shift represents a major cultural change and involves some radical and disruptive technologies. Many of the professional service products are delivered on-line and almost all are supported by information technologies. Some of the new products also include the design and development of manufactured components, bringing SERV into new innovation territory. SERV believes they must be leading the way into the new competitive environment to stay competitive and to grow.

NPD has not traditionally been a major part of the strategy of the organisation. SERV introduced an IPPM process three years ago to increase all types of innovation, especially looking to promote innovation for the longer term. New organisational structures, roles and responsibilities have been developed to support the IPPM capability. SERV has developed a web-based interface for idea capture and to encourage collaboration. For example, one successful project highlighted during the case research is the result of collaboration to expand on and develop an idea that was initially entered into the system in a much more limited form. Projects are managed through a stage-gate style of process, and decisions are made by a team of high-level professionals representing a spread of functional and geographic areas on a very regular basis. Individual projects are evaluated primarily based on financial return and the ability of the new product to differentiate SERV from competitors. In addition, the overall value of innovation projects in enhancing employee retention and morale, and in strengthening the innovation credentials and reputation of the firm provides additional backing for the IPPM capability. The IPPM capability at SERV has evolved considerably over the three years it has been in operation, and continues to evolve. This evolution is recognised by SERV as part of a natural learning curve that all organisations must go through in order to implement IPPM.

SERV finds that incremental innovations tend to dominate the ideas put forward in the IPPM process, and that they need to encourage radical or breakthrough ideas in order to achieve a balance of incremental and radical product projects in their portfolio. As one interviewee explained, "The incremental innovations are really about improving the performance of today about how we operate today in the market; the radical ones are the ones that will shape how our organisation will service its market in the future." Radical projects have longer timeframes and are treated differently than incremental projects. The more exploratory or risky the project, the more likely it will go to a dedicated innovation team with specialised skills and better ability to focus on the project. Incremental projects are more likely to be worked on part-time by people in the functional divisions of the organisation. SERV's process does not enforce a set percentage of different project types. They do, however, take note of the general balance of project types and try to shape the idea bank by influencing the focus of ideas generation sessions and prompting idea input in particular areas.

Resources for innovation are flexible at SERV, and most of their NPD projects involve partnerships with other organisations. Partnering provides faster results and spreads risk as well as reward in a 'win-win' situation. As one manager put it, "My belief is that these days truly competitive advantage is achieved through the cooperation of two entities".

As a result of the introduction of the IPPM capability, SERV now has a growing pipeline of NPD projects and rapidly increasing revenues from completed projects. The IPPM capability is credited with greatly increasing the visibility of innovation in the organisation and in increasing participation in innovation activities. In addition, SERV has developed a consulting product to help clients develop an IPPM capability, building on their experiences in developing an in-house IPPM capability. In the future they plan to extend the ability of the web-based technology to support the process.

6.2.2 MED – Case summary

MED designs, develops, manufactures and sells specialist medical equipment globally. From its inception the organisation has addressed the global market. MED has a very strong market presence, market share and brand name. Their strategy is to deliver high-quality products and good clinical outcomes for customers at a premium price. Their clear product and market focus and strong relationships with customers, combined with superior technologies, are a source of competitive advantage for MED. The company has received numerous design and innovation awards and has been growing at an extremely high rate year-on-year for the past decade. Profits and market capitalisation have been growing rapidly, with the number of employees doubling every three years. This growth has given MED many challenges as well as opportunities. The market in which MED operates is experiencing continued growth, so it is possible to grow with the market; however, for long term success, MED feels that it needs to make a transition to a more strategically-led organisation.

Traditionally, MED has been an engineering-led company with a strong technology focus. This focus enabled the organisation to establish its reputation. However, the technology-led approach resulted in too many projects. There were many good ideas but little oversight and ability to prioritise and rationalise the product lines and projects. Resources were stretched, products were often delivered late to the market, and there were many projects in progress without a clear idea of the customer requirements, launch timing and customer and sales support requirements.

To address these challenges as well as challenges presented by the increasingly competitive market, MED radically redesigned its structure and its IPPM process two or three years ago. The new process is focused on using global marketing input for project prioritisation and resource allocation. An important part of the process involves a marketing requirements specification to articulate the key selling messages, as well as a full financial forecast. Projects are selected to meet growth targets based on strategic fit and financial projections. The IPPM process succeeded in generating a global portfolio view of all projects and in reducing the number of projects being completed; however, resources are still stretched. The shift to a marketing-led process has resulted in short-term vision, and the projects being approved are largely incremental in nature. In addition, it was felt that decisions on individual projects were too easily influenced by political strengths of individual members, and that projects were not evaluated with proper portfolio-level considerations.

The importance of getting the IPPM processes right and the importance of balancing the technical and marketing inputs to the process were highlighted by all research participants. The current process is not well supported, and MED is again in the process of re-developing the methods used to prioritise and select development projects, with a specific goal to ensure that radical or breakthrough ideas are allocated an appropriate share of development resources in the future. In addition, MED has instituted a variety of product development processes to cater for different project types. Project types and timeframes range from very short product refresher projects to much longer-term breakthrough product development projects. Finding the right amount of oversight and control for the processes is a continual challenge at MED. One manager notes that there is a "tension between 'we need to manage things better', but 'we don't want to manage too much'".

MED is transitioning from a focus on selling 'boxes' to a service- and solutions-focused business. The service side of the business is growing steadily and is expected to eventually become the main business. The IPPM processes at MED are still heavily focused on the manufactured components.

MED likes to consider itself the 'BMW' of its industry and has traditionally followed a strategy to produce high-quality products for premium markets. Recently an alternative strategy has been used in a low-cost project that is the first of its kind for MED. To provide a low-cost entry point in response to competitive pressures, MED has completed a project focused on reducing complexity and cost. This project also included outsourced manufacture of several components to keep costs down.

Despite the shortcomings and ongoing adjustments to the IPPM process at MED, the projects are usually successful. However, a mildly successful project takes resources away from other projects that may be more successful; therefore, these successful projects have opportunity costs with regard to the allocation of limited resources.

6.2.3 TELE – Case summary

TELE is a telecommunications provider competing in a highly competitive market. Over the past decade, TELE has been growing at a faster rate than average in a growing industry. TELE has traditionally been seen as innovative and has established a reputation for strong customer service; however, their continued growth has made it difficult to maintain leadership in these areas. In response, TELE has recently undergone a major restructure to reinforce customer focus and to elevate the importance of product development in the organisation. The market is increasingly competitive, margins are low and the business must continually invest heavily in infrastructure and maintenance. This squeezes the capital available for NPD. TELE's NPD and IPPM processes are affected by a review of the overall innovation strategy, and as part of this review the organisation is re-evaluating the appropriate balance between incremental innovation and radical innovation. There is a high-level push for TELE to increase its efforts in radical innovations; however, stretched resources and high levels of risk for radical innovation projects have meant that TELE tends to favour the 'bread and butter' incremental projects.

The IPPM process at TELE has been evolving over the past four to five years within specific business units, and it has become a higher-level portfolio process in the past eighteen months with a restructure of the organisation. All NPD projects are now evaluated in a yearly portfolio planning cycle and prioritised along with other projects. The process receives high-level support and includes executive members from across the organisation. Financial measures are prominent in the IPPM prioritisation process, and NPD projects are expected to deliver a return on investment within three years. Strategic considerations are used as a first cut before projects enter the portfolio and again during negotiations over project prioritisation.

An example of the evolution of the IPPM process at TELE is the recent proposal of a faster-track process for certain types of projects. Some projects do not require high investment and are expected to pay off within one year. Putting these projects through the IPPM process is felt to unnecessarily delay and hinder such low-risk and fast-reward projects and could possibly jeopardise their success, as timing and speed are generally critical in this industry. The management are considering formalising a fast-track process to ensure that such projects are expedited.

The IPPM capability at TELE enables the organisation to gain a better overall perspective on their project portfolio and keeps the numbers of projects within the resource capabilities of the organisation. The resourcing considerations for projects are carefully considered, and developing a suitable team is an important part of the process. Projects often have very short timeframes, and getting a product to market sometimes entails a two-stage process. In these cases, when the introduction of a product has important strategic timing requirements but resources do not allow full development in time, a temporary solution can be followed by a more permanent solution later.

While TELE is primarily a service organisation, there are often tangible elements to the NPD portfolio. Some projects involve working with manufacturers of hardware or hand-held equipment on the design of the tangible products that will be incorporated into a service product offering. In addition, the delivery of services by TELE depends upon investments in tangible infrastructure.

6.2.4 IND – Case summary

IND is a leading supplier of heavy machinery within a global industry. IND is the global leader in their market, with a long-standing reputation for superior products and technology, as well as excellent service and customer relationships. They have a strong patent portfolio and a strategy to ensure that all new products have protectable intellectual property (IP). With a very large share of the global market, IND has excellent knowledge of the customers and the industry. IND has experienced double-digit year-on-year growth over the past decade, with a growing share of the market in a growing industry. The products developed and sold by IND remain in service for decades, generating an ongoing revenue stream for service and spare parts.

Change happens slowly in this industry. In the words of one interviewee, “If we didn’t introduce a new product for five years it wouldn’t have a strong effect on the company’s bottom line; however, in the long term new products are essential to the company”. Even in this slow-moving industry, competitive pressures have increased significantly in recent years. The lucrative spare-part revenue streams are threatened by lower-cost competitors. IND’s patent portfolio protects them from some of the competitive threats; however, the expiry dates for a number of existing patents are approaching. This has prompted an enhanced focus on innovation and the development of new IP. In addition, although IND is a manufacturer, the organisation's service businesses are growing faster than the manufactured products, and service revenues represent an increasing percentage of organisational revenue. Services are primarily spare parts and maintenance contracts, although IND is also looking to a future where data gathering from smart machinery may start to generate new revenue streams for services to capture and manage the data. In light of these changes, IND's strategy has recently been updated to recognise the shift to offering solutions rather than products to their customers.

The IPPM process at IND has been evolving slowly for years, but during the past three to four years the increased importance of IPPM within the organisation has placed more attention and formality on the process. A shift in organisational structures and responsibilities has boosted the importance of NPD and the IPPM processes. In this specialist heavy-industry environment, the marketing people are technically qualified and act as technical consultants, and it is the marketing people that set the agenda for product development. The IPPM decision process taps the global marketing input to determine new product priorities. A major portfolio planning and budgeting exercise is done on a yearly basis and IND is generally able to apply sufficient resources to meet areas of customer need. Ideas are filtered based on strategic criteria, and decisions are then made based on return on investment as estimated in a 'new product plan'.

The IPPM capability enables IND to have a long-term vision across the development of the people and specialist skills and the long timeframes required for the development of new technologies. Due to these long timeframes and resource considerations, the IPPM capability is considered very important for the long-term success of the organisation. Not all specialist skills and capabilities are required to be developed in-house and IND is able to outsource some of the testing to external labs. Product development and manufacture for IND is primarily done in the head office in Australia, although some development and manufacture is starting to be done in other offices around the globe. A recent project has highlighted the difficulties in coordinating a project across different countries and cultures, with the resulting communication breakdowns and delays. Most projects are very successful, however, due to a clear understanding of customer requirements and the development and allocation of the required skills and resources as directed through the IPPM capability.

However, in recent years it had become apparent that the IPPM process was not generating enough really new ideas to ensure that IND retains its technological lead in the longer term. About one year ago, changes were introduced to the IPPM process at IND to address the imbalance between incremental and breakthrough projects. A specific effort has been made to introduce an exploratory component to the project portfolio. Idea generation and creativity sessions have been used to tap expertise and come up with new ideas, and a series of new exploratory projects have now been funded. There is no set percentage, but management now expects a proportion of new developments to be exploratory. Too much structure and control is felt to be inappropriate for exploratory projects, therefore to facilitate the success of these projects, they are handled in a much more flexible manner than the day-to-day projects that are designed to meet an existing customer need.

At the moment IND's IPPM capability only considers the manufactured product projects, although as services increase in number, revenue and profits, IND will need a way to evaluate and prioritise the service ideas and possibly to develop specific service products.

6.2.5 FIN – Case summary

FIN is one of the largest financial services organisations in Australia. FIN has a strong record of growth and expansion spanning its long history, with exceptional growth in recent years. Rapid changes in the industry have been accelerated by the continual evolution of technologies that provide new opportunities and make others obsolete, and the explosion in choices available to an increasingly knowledgeable customer base. Major changes in their strategy, structure and culture over the past two to three years have given FIN a reinvigorated focus on innovation that is accelerating the growth of the organisation. This change had been brought about largely by major changes in the top levels of leadership in the organisation. The shift in the culture has created a much more open style of communication in the organisation, improving both the rates of innovation and the morale of employees. The strategy is now very clear and well communicated and helps the organisation focus its efforts in strategic markets. One manager cited the obstacles to innovation in the past and said that "I felt like I was being punished for bringing a good idea to the organisation" but now "I relish the process… the endorsement, mandate and funding for change" [p3].

This study focuses on the product development project portfolio for one of the divisions of FIN. Although products have been developed and offered to customers over the past decades, the importance of new products led to the creation of FIN's first 'product development' department about two years ago. By creating a product development-focused group, FIN has emphasised the importance of customers and the necessity to deliver a steady stream of competitive offerings in the market. The product development focus has also signified a shifting emphasis in FIN from technologically led development processes to processes that focus on the delivery of solutions to customers. FIN has already achieved positive results from the shift to a product development culture in this group in the form of successful products, increased levels of product innovation and positive return on investments. The product development culture aims to ensure that product innovation is targeted to customer needs, and is generally able to deter the technically led temptation to upgrade products or add features when the customer is not requesting changes. These results have prompted other areas of FIN to consider setting up specialised product development departments.

IPPM within FIN's product development department is considered a strategically important area of organisational capability and they evaluate and improve the process regularly. Support for the IPPM capability is strong; as one manager noted it is a 'life or death' decision-making process for the organisation. The IPPM capability is based around a stage-gate process that is tied into the large organisational processes. FIN evaluates projects individually through a multi-level approval process involving multi-disciplinary teams of experienced executives. They have just had an extra level added to handle the increasing numbers of projects under consideration. The executive teams provide a degree of portfolio-level oversight; however, FIN would like to improve the portfolio perspective of their decision-making processes. The level of approval required for projects depends on the level of risk, cost and complexity. Financial criteria are prominent in the decision-making, with strategic, risk and market impact considerations also playing an important role. Although the decision-making structure is quite formal, it is evolving very quickly with a goal to optimise the level of oversight, process and governance for different project types and to ensure that the process does not stifle innovation. As one of the respondents put it, “Not all projects require the same amount of oversight. We don’t want to drive the pin with a sledgehammer” [p2].

Product development programs at FIN often include a number of projects of different types, some that require resources from outside the product development department. This creates extra challenges for the management of the project portfolio. Although the products in FIN’s portfolio are service products, they may also include a physical component such as a hand held device that is used to access the service. This requires the IPPM capability to manage the integration of different project types. Projects also often need to obtain resources from a central organisational pool of technology-focused IT specialists, which often creates a bottleneck that causes delays. As timeframes are critical to project success in such a dynamic product development environment, this disjoint is a major challenge for the IPPM capability.

One of the challenges for FIN is to balance incremental and breakthrough projects. Because longer projects such as breakthrough projects have significantly higher risks in such a dynamic environment, it is much harder to get approval for these projects. One of FIN’s strategies to manage this risk is to break longer projects into a series of short sharp projects, often developing platforms or modules as separate projects. This allows subsequent stages of a longer-term development an additional level of flexibility for adaptation to changes in the environment. Another strategy used in FIN’s IPPM process is to use outsourcing strategically. Outsourcing can remove risks and opportunity costs associated with tying up internal resources, and can also be used to extend available resources to ensure that all valuable projects can be completed.

6.2.6 MAT – Case summary

MAT is a large and successful manufacturer of materials that range from commodity items to branded products. These materials are primarily used for construction, in domestic and commercial building applications as well as large infrastructure applications. A smaller but growing segment of the materials sold are for use in further manufacturing or specialty applications. MAT has a strong brand name and attracts premium prices for its products due to its reputation for quality, durability and technological excellence. Several of MAT's most successful branded products are protected by patents.

MAT focuses its product development efforts largely on the domestic market and has established a strong advantage in understanding and developing technologies to meet local conditions. Export markets have traditionally been used only to absorb excess production and to balance production levels, although this is under review to consider ways in which exports may be able to contribute more to the profit levels of the organisation. In recent years MAT has experienced accelerating competitive threats from importers, prompting the development of increasingly sophisticated local marketing strategies. Services are being designed to reward loyal customers and provide them with benefits that importers cannot match, such as holding stock and guaranteeing delivery lead times. These services are bundled with the products and must be factored into the development cycle so that timing is planned and costs are fully understood.

MAT has elevated the position of product development in the organisation through restructures in the past couple of years. During this time the IPPM methods have been strengthened and formalised, and they are still evolving. Technology development timeframes are lengthy and the development of specialist skills can take even longer. The availability of these skills is often a constraint. A significant role of the IPPM capability is the provision of a holistic long-term vision of the development and allocation of resources for the projects. The IPPM capability is also credited with aligning the projects with the strategy, instilling an innovative culture throughout the organisation, and ensuring the projects are resourced adequately.

The importance of the IPPM capability at MAT is highlighted by the amount of effort and resources that are invested in it. MAT uses a stage-gate approach for product development and has allocated staff to roles involved in the process, including one full-time person responsible for the process. Their IPPM process includes a high-level multi-functional decision-making team, formal meetings and a strong culture and buy-in for the process. Projects are assessed through multiple criteria including strategic fit, financial return and fit with organisational capabilities. Decisions are based on evaluations of individual projects; however, a portfolio-level perspective is provided by the members of the review committee. The review committee comprises high-level and experienced representatives of multiple disciplines. They receive regular updates on the status of all projects in the portfolio, and have a good perspective on the portfolio balance. Importantly, this review committee also has the authority to make decisions and its members are in positions to ensure that commitment and resources will be given to the approved projects

Recent IPPM process evolution includes introduction of a streamlined stage-gate process for simpler projects and increased use of graphics for portfolio reporting. MAT also plans to shift the decision-making perspective so that projects are evaluated as part of a portfolio rather than individually, and to enhance the ability of the process to better balance the portfolio. MAT also feels that there is still not enough focus on ensuring an adequate proportion of radical or exploration projects in the portfolio.

With a clear focus on strategy and competitive requirements, MAT is becoming more flexible in how it approaches product development and the resourcing for projects. A recent project was the first project to involve licensing IP from an external source rather than developing it in house, which represented a major change to development attitudes and culture. The importance of meeting customer needs and addressing a competitive threat from an importer meant that timing was crucial. Although the first-time experiences with licensing IP caused some unexpected delays in the development process, the project is an example of how this type of partnering can be used to meet market time pressures by reducing the technical risk and shortening overall development time,

Many manufactured product organisations are now developing an increasing level of services to accompany their products; however, most have not made a strategic decision about how the services relate to the manufactured products and have not updated their processes to reflect the growth in service offerings (Auguste et al., 2006). MAT is at the forefront of addressing this situation and has developed a unique approach to the development of their service offerings. They have instituted a stage-gate approach for the development of the service offers and have tied that stage-gate process into the product development process. This process has been developed and implemented during the past year and is still being strengthened and improved. This new process is already improving the communication between the manufacturing and service development efforts and enabling optimised services to be available at the right time.

6.3 Cross-case analysis – primary cases

This section presents a cross-case analysis of the case study findings from the six organisations by theme. These themes were either specifically investigated or emerged during the research, and are presented individually in the following subsections:

6.3.1 Strategy and competition

6.3.2 Importance of new products and IPPM

6.3.3 Dynamism in the environment

6.3.4 Three dimensions of IPPM

6.3.5 IPPM and the resource base

6.3.6 IPPM capability establishment, evolution and maturity

6.3.7 The 'success' trap

In addition to the cross-case analysis across all six cases, each theme was also investigated for differences aligned with industry type. As this study was particularly interested in the comparison of IPPM capabilities across service and manufacturing environments, the six cases were also split into a service and a manufacturing group for the analysis. Any differences between manufacturing and service organisations are noted within each theme. These differences are also highlighted (through italicised text) in the summary table at the end of each theme. A compiled summary and discussion of the differences between IPPM capabilities in service and manufacturing organisations is presented in findings related to RQ 2, "*What is the relationship between IPPM capabilities in service and manufacturing NPD environments?*" in Subsection 6.7.2.

The organisations selected for Phase 2 are successful innovators across a diverse set of industries. Due to the difficulties in measuring outcomes across industries, differentiating the case organisations' level of success was not attempted in this research. Instead, the cases were analysed as examples of successful innovators' IPPM approaches. A comparison of ratings on a set of product portfolio outcome (PPO) measures between Phase 2 interview participants and Phase 1 survey respondents provides support for this approach. As show in Figure A7-1 in Appendix 7, the Phase 2 ratings align with the highly rated Phase 1 respondents – the more successful innovators in both groups have better performance on a range of PPO measures.

6.3.1 Strategy and competition

In order to understand and analyse IPPM capabilities in the six case study organisations in context, the interviews gathered information about the competitive environment facing each organisation, including the sources of competitive advantage and the focus of the strategy. As with each theme, the findings were analysed across the six cases and also compared between the two groups of cases representing the service-based and manufacturing-based industries. Table A7-1 in Appendix 7 summarises the findings on the strategic dimensions of the case organisations.

Sources of competitive advantage – customers and markets predominate

The case organisations were all chosen for their long-term innovation success. When asked about the resources and capabilities that form the basis for their competitive advantage, all of the organisations highlighted customer contacts and market knowledge as major sources of competitive advantage. Other sources of competitive advantage highlighted by both manufacturing and service organisations are the people and their skills, their experience and innovation process capabilities, the level of support for innovation by top management, and their culture. These 'people-related' sources of competitive advantage emerged as strong themes throughout the interviews.

The manufacturing-based organisations all reported a significant shift towards a customer focus from their previous technology and product quality focus. One manager noted that "historically we have been a very strong technically led company, with a very strong sense of entrepreneurship and sense of urgency, …we are moving now to be more market-led and more balanced in terms of customer and competitive analysis …we have decided that we are balancing out from being technically-led to be more market-driven while keeping both integrated" [MEDp1]. While their specialist technological skills and specialist technical capabilities are still a very important source of competitive advantage, the manufacturers now believe that a customer focus is essential and that product quality is still a necessary, but no longer sufficient, criterion for success.

Competitive strategy – differentiation and focus are most important

Competitive strategy at all of the case organisations focuses primarily on differentiating their new product offerings. All the organisations include elements in their IPPM capability to ensure that resources are allocated to projects that will set them apart from competitors, and some managers specifically commented that they did not want to be involved in 'me-too' products. For example, SERV's process asks, "Will it differentiate us?" and "Has it been done before?" in the screening process for new product ideas. IND's process promotes the development of patentable IP, and FIN looks for projects that will differentiate it within its focus market segment area. None of the organisations is focused on a low-cost strategy, and some specifically highlighted that they do not want to get into cost-focused competition. One manager emphasised that "we need new and novel ideas to carry us forward. We must avoid competing on price" [INDp4]. The ability to attract premium prices is attributed to brand name and high quality products, highlighting the importance of keeping up the development of new and better products.

A clearly focused strategy is also an important component of competitive success at the case organisations. All of the manufacturing organisations have a very clear understanding of their market area and focus developments on that area. One of the service organisations [FIN] also specifically focuses on a market segment and believes that this focus has enabled them to compete more successfully than other competitors that "try to do it all". The other service organisations are still working out what the optimal degree of focus is. SERV's IPPM process categorises projects to understand whether they are in core or non-core areas, but initially they set out to undertake any projects that would differentiate the organisation, bring a profit, and be something that has not been done before. Now SERV aims to bring its focus for innovation projects to align with the core business. Customer responsiveness and customer service have always been strengths for TELE, and to focus better in this area TELE has recently realigned its organisation.

Summary of findings on strategy and competition

The case study organisations highlight the importance of their customer relationships and market knowledge as sources of competitive advantage. The successful strategies employed in the case organisations focus on high-quality differentiated products focused at a market they know and understand. The findings on strategy and the competitive environment are summarised in Table 6-2.

Table 6-2: Summary of findings on strategy and competition

Strategy and competition: Summary of findings *No areas of difference are found between the manufacturing-based and service-based organisations*
Sources of competitive advantage – All of the case study organisations, whether manufacturing- or service-based, place strong emphasis on their customer relationships and market knowledge and focus as sources of competitive advantage.
Competitive strategy – All of the case study organisations have a clear and focused strategy. They each seek to differentiate themselves through their new product portfolio, and follow a competitive strategy focused primarily on differentiation.

6.3.2 Importance of new products and IPPM

The managers were asked specifically about the importance of new products and IPPM in their organisations. In addition, comments throughout the interviews provided additional data on the level of importance. A detailed description of the methods used to analyse the data for this theme is presented in Appendix 6. The appendix uses this theme as an example to illustrate the methods used throughout this study.

Importance of new products

Each of the case study organisations highlighted the importance of new products to their competitive position and their strategy. The organisations agree emphatically that new products are essential for their long term success; however, the urgency for frequent new products varies with the dynamism in their industries. Two of the manufacturers (IND and MAT) acknowledge that new products are not essential for short-term success. One manager stated that "in the short term it would not make much difference if no new products were introduced" even though "new products are definitely important for the long term" [INDp1]. In contrast, all of the service organisations operate in environments of rapid change. One manager at a service-focused organisation commented that new products are "life and death – more so lately. I think the internet has opened up the world significantly" [FINp3].

Importance of IPPM

The managers that participated in the case study interviews all felt that their IPPM capabilities were very important or increasingly important to their organisation. IPPM is consistently felt to be important for the alignment of projects to strategy and is credited with helping organisations limit the number of projects so that they can manage the pipeline and resource projects more effectively. The managers in the case study organisations consistently report their belief that IPPM is important for the success of their new product portfolio. They measure this success in terms of profits, growth, return on investment, the ability to improve their competitive position and/or their ability to meet customer needs. Several managers felt that the IPPM capability provides visibility through a transparent decision-making process and that this visibility helps obtain buy-in for IPPM decisions (especially SERV, MAT and FIN). Managers at all of the case organisations stress the importance of the role that senior management play in promoting the IPPM capability or in ensuring that politics and power struggles do not undermine its ability to guide decisions for the best organisational outcomes. These findings on IPPM importance were consistent across both service and manufacturing environments.

While all of the organisation's responses emphasised the importance of the IPPM capability, analysis of the comments reveals that the organisations fall within three bands representing differing levels of importance placed on the IPPM capability. Table A7-2 in Appendix 7 lists a sample of each organisation's responses on the importance of IPPM and indicates each organisation's rating among the three bands of IPPM importance. These findings are summarised here in Table 6-3.

Table 6-3: Importance of IPPM

Importance level for IPPM	IPPM importance characteristics in this band	Cases in each band
1st band	Repeated and consistent strong emphasis on the strategic importance of IPPM from all levels of the organisation including the high levels of the organisation.	SERV (service) MAT (manufacturing)
2nd band	Regular but slightly less consistent emphasis on the importance of IPPM, with particularly strong emphasis from high levels in the organisation.	TELE (service) FIN (service)
3rd band	IPPM importance is generally strong but there is evidence of differing perspectives and lower levels of consistency.	MED (manufacturing) IND (manufacturing)

The responses presented in Table A7-2 in Appendix 7 have been distilled from the interview transcripts to best represent the larger body of comments related to the importance placed on IPPM and on the level of top management support for IPPM at each organisation. The relative rankings were based on the frequency and nature of the comments obtained through the interview process. The importance levels at MAT and SERV stand out and are ranked in the highest band of IPPM importance because IPPM capability importance was repeatedly highlighted from high levels at these organisations. Managers from MAT and SERV also consistently reported that IPPM was felt to be very important across multiple functions and disciplines and at all levels in the organisation. Although each manager at TELE and FIN considered the IPPM capability important, these organisations are placed into the second band of IPPM importance due to lower levels of consistency when compared with the top band. For example, TELE managers highlight the fact that IPPM is important; however, the top management focus is more on innovation processes in general than on IPPM in particular. FIN also emphasises the importance of IPPM, focusing particularly at a strategic level. Managers at the remaining case organisations, MED and IND, also consider IPPM important, but report mixed views on the importance at some levels of the organisations. Therefore these organisations are placed in a third band for IPPM importance.

Service/Manufacturing differences

Managers at both the manufacturing- and service-based organisations consider the IPPM capability important due to its ability to enhance alignment with strategy, improve the success of the product portfolio, manage resource allocation, and improve the visibility and buy-in for the decisions. However, there are also differences in the reasons IPPM is considered important by the two types of organisations, which tend to be related to the different competitive environments in which these organisations operate. One main difference is that manufacturing-based organisations feel more strongly than the service-based organisations that IPPM is important for long-term vision and planning (including the development of resources). Manufacturing-based organisations also put more emphasis on the role IPPM has in creating a balance between exploration and exploitation projects. These differences may be linked to the longer planning timeframes in manufacturing-based organisations – in particular the timeframes required for exploration projects – and the fact that the specialty resources and skills they require usually take a long time to develop.

Compared with the manufacturing-based organisations, service-based organisations feel that IPPM is more important for responding to the dynamic environments in which they operate. They focus more on pipeline management and the effective deployment or acquisition of resources for their project portfolio than on the long-term development of these resources. These differences probably result from the service organisations operating in a more dynamic overall environment than the manufacturing-based organisations, and from resources also being more dynamic and more easily acquired externally for service product development than for manufactured product development.

Each of the service organisations also highlighted that they believe their IPPM capability is important for its ability to help establish and enhance an innovative culture and to help motivate and retain staff, whereas these considerations were not discussed by the manufacturing organisations. This may be related to the fact that innovation in the form of product development is newer to service organisations, and therefore the establishment of an innovative culture is more imperative than in the manufacturing organisations where an innovative culture has often been entrenched for decades.

Top management provide strong support for the IPPM capability in all of the case study organisations. Although the IPPM capabilities in the service organisations are more recently established than in the manufacturing organisations, the processes are now well established after particularly high levels of investment in IPPM. The case studies reveal that the IPPM capabilities in the manufacturing organisations have evolved over long periods as part of their R&D capability, and that the IPPM capability has been primarily driven by the R&D or operational levels of management. In more recent years, a push from the top levels of management has elevated the importance and the visibility of the IPPM process as part of an increased focus on innovation as a main driver of success in these organisations.

Case studies from the service-based organisations show that the IPPM capabilities have evolved more recently because the push for innovation through NPD is generally much more recent in these organisations. In the service organisations, the top management have been the main driver for the development of the IPPM capability – and there has been strong support for a steep climb up the capability evolution curve in the service organisations. In the manufacturing-based organisations the drive to develop the IPPM capability is shared between the top levels of the organisation and the operational levels that have been using and evolving the IPPM capability.

Summary – Importance of new products and IPPM

In summary, the case study organisations consider their IPPM capability to be important and believe that it contributes to their new product success. The level of importance placed on IPPM is divided into three bands representing differing levels of consistency and breadth of importance placed on IPPM at the case organisations. While many of the reasons that organisations consider their IPPM capability to be important are consistent across the case organisations, there are some differences between service- and manufacturing-based organisations. Table 6-4 summarises the findings on the level of importance placed on IPPM and the differences between service- and manufacturing organisations.

Table 6-4: Summary of findings on importance of new products and IPPM

The importance of new products and IPPM: Summary of findings *Italicised entries indicate areas of difference between manufacturing-based and service-based organisations*
Importance of new products – Managers at each of the case study organisations believe that new products are important to their long term success. *New products are also important for short term success in the industries with rapid change and shorter product life cycles such as the service industries.*
Importance of IPPM – Managers at the case study organisations view IPPM as very important and/or increasingly important.
Reasons IPPM is important – Many of the reasons are common (for example, alignment with strategy, success of the portfolio, pipeline and resource planning); however, *manufacturing organisations value IPPM more for its ability to help with long-term planning, whereas service organisations feel IPPM is particularly important for helping them respond to the dynamic environment.*
Top management support – Top management support is strong in both types of organisations. *Top management play a more prominent role in driving the processes in the service-based case study organisations.*

6.3.3 Dynamism of the environments

The case study organisations report challenges associated with the continual change in their industries and markets. There are some differences between the nature of the dynamism and the challenges presented between the manufacturing-based industries and the service-based industries.

The three manufacturers studied are coping with environmental changes but their basic products are not changing rapidly. Technology development and product lifecycles are relatively long, allowing these organisations to operate with relatively long-term planning and vision for NPD. Regular and ongoing technological change and development are part of the usual processes in the manufacturing-based organisations. The main challenges faced by manufacturers as a result of dynamism in their environments can be categorised in three main areas:

- increasing importance of services to their overall offerings and to their bottom line

- increased globalisation altering the competitive landscape
- increased focus on the customer, replacing the previous technology focus.

These changes in the environment mean that the IPPM decisions are more complex and multi-faceted than in previous years. As one manager states, “What has worked well in the past may not be appropriate now. Things have changed” [MEDp1]. Although the manufacturers now have strong customer and competitive considerations, they also have increasingly complex product offerings combining their traditional technology-based development with service aspects. While considering these additional factors, they cannot afford to neglect technology development. The development of high-quality leading technology and patentable IP is still necessary for their competitive success. As one manager reports, “We have strong customer focus as well as competitor focus – and technology is still very important…it is like a triangle” [MATp3].

As presented in the case summaries, the findings show that the three service organisations are operating in an environment of rapid change within their organisations and in their relationships with their customers. The types of products they develop are changing rapidly, often underpinned by changes in the information technologies that they adopt. However, since service organisations tend to adopt rather than develop technologies, the service products they develop are not usually patentable and are often more easily copied than manufactured products. Service products are also more vulnerable than manufactured products to rapid changes in the environment that can destroy a product’s profitability “in the stroke of a pen” through changes in regulations or standards [SERVp3]. Dynamism in the service industries is highlighted in three main areas:

- a new or increasing focus on NPD as part of a service business
- shortening timeframes for product development and a rapidly changing product landscape
- an increasing need to anticipate trends in a fast moving environment. Sometimes this can require that products are developed in anticipation of ‘the right moment’ for implementation.

The timeframes for the NPD processes, planning and future vision differ greatly between the service-focused organisations and the manufacturing-focused organisations. Table 6-5 presents findings that show that projects and long-term planning timeframes are generally more than twice as long in the manufacturing environments as in the service environments. These finding are also supported by findings from the embedded case analysis presented in Section 6.4, where the manufactured product projects studied took more than twice as long as the service product projects (20.7 months compared with 7.3 months).

Table 6-5: Typical timeframes for NPD and IPPM

NPD timeframes	Service products	Manufactured products
Typical NPD lifecycle	3–18 months	6 months – 5 years
Typical planning timeframe	18 months – 3 years	3–8 years
Typical longer-term vision	about 5 years	10–12 years
Average length of establishment for the current IPPM capability	22 months	38 months

NPD and IPPM are newer to service-based case study organisations. There has been a strong and relatively recent push to establish and strengthen the NPD activities at the service-focused organisations, whereas NPD has always been central to the manufacturing-focused organisations. The IPPM capabilities at all of the case study organisations have undergone significant strengthening and continual evolution; however, in the service-based case study organisations, the establishment of the IPPM capability is more recent than at the manufacturing-based organisations. In all organisations it is difficult to determine exactly when an IPPM-type of capability was first established because, as one manager stated, “There has always been some sort of process and a senior management meeting to evaluate the projects” [FINp3]. For the purposes of this study, the time of establishment of the ‘current’ IPPM capability is when the current overall structure and approach was implemented. The IPPM capabilities at the manufacturing-focused organisations have been evolving over longer periods of time, with the current version established on average 38 months ago. The

IPPM capabilities at the service-focused organisations are much newer, and the current versions were established on average 22 months ago. Since establishment of the current IPPM capability, both manufacturing and service organisations have experienced continued evolution of the capability.

Blurring of the boundary between service and manufactured products

The case study organisations illustrate the trend towards the ‘blurring of the boundaries’ between service (intangible) and manufacturing (tangible) products (Andersson, 2000; Slack et al., 2004). Although the case study organisations were selected so that they represented ‘service-product’ development environments and ‘manufactured-product’ development environments, none of the organisations was found to be involved with purely tangible or intangible products.

The service-based products studied are increasingly reliant on technology and often incorporate a tangible aspect to the offering. For example, the embedded case projects analysed at two of the service organisations involved design of the physical components of new product offerings – a new area for these service organisations [SERV, FIN]. The other service organisation regularly invests in large infrastructure projects to support services and sells solutions to customers that include devices made by a third party [TELE]. However, even when new product projects involve the development or incorporation of associated tangible items, the service product organisations studied are clear that they are still primarily delivering a service.

The blurring of the boundaries for the manufactured products is more significant. The three manufacturing organisations studied have moved from being purely ‘box’ or ‘goods’ manufacturers towards being providers of a service. These organisations noted the increased importance of the service aspects of their product offering, and each expected the shift towards service offerings to continue. Examples of the service aspects to the products vary widely. For some products, a data-logging or communication feature has the potential to enable the organisation to sell data management services to complement the manufactured product [MED, IND]. In other environments, the service agreement to accompany the product sale provided valuable services such as storage and supply of spare parts or guaranteed lead times for delivery [MAT]. In these manufacturing-focused environments, it is these types of service features that are increasingly viewed to be the main sources of differentiation and profitability. As one interviewee noted, “Within the next two to five years we are going to be in the service space for sure. Boxes will become enablers as we get into the next period. There is a lot of money being put into the roadmaps looking to that future” [MEDp2]. Another manufacturer reported that they focus “increasingly on the whole process, not just the [equipment]. We are becoming service and operations and process focused – particularly for innovation” [INDp4].

Despite the major changes in the ways that service aspects are becoming increasingly important for manufactured products, the IPPM processes are slow to evolve to incorporate this aspect. For example, in one of the organisations, the product development decisions are still done largely on the basis of producing and selling ‘boxes’ even though they acknowledge a significant shift in focus toward providing services rather than ‘boxes’. They have not yet developed methods to incorporate considerations and planning for eventual service revenue and options into the proposal, justification and review stages for the projects [MED]. However, progress is being made by one of the manufacturers, where they have recently set up a separate service development process that is linked into the product development process. The service development process is a simplified version of the stage-gate process used in the product development process. It is used to develop and approve the service offers that will accompany new products at launch. Although the processes are set up, their use is not yet consistent. The organisation is trying to shift the product development culture; however, the people involved are still very focused on the tangible product development and often do not trigger the appropriate service development process early enough in the process [MAT].

Summary of findings on dynamism of the environments

The case study findings show that they operate in an environment characterised by change in both market and technological areas. The blurring of the boundaries between service and manufactured products present particular challenges to the case organisations, particularly the manufacturers. The findings on dynamism in the environment and the differenced between service- and manufacturing-based organisations are summarised in Table 6-6.

Table 6-6: Summary of findings on dynamism of the environments

Dynamism of the environments: Summary of findings *Italicised entries indicate areas of difference between manufacturing-based and service-based organisations*
Market and customer dynamism – The case study organisations are increasing their customer focus, and experience increased customer expectation, increased competitive pressures and dynamism in the market. These findings are consistent across service- as well as manufacturing-focused organisations.
Technological dynamism and NPD timeframes – *In the case study organisations, services are easily copied and lifecycles are shorter than in manufacturing environments. Technological change is slower and product development takes longer in the manufacturing organisations.* *IPPM processes in service environments are more recently established than in manufacturing environments.*
Service/Manufactured product boundaries – There is blurring of the boundary between manufactured products and service products that is affecting both types of case study organisations. *The effect is stronger in the manufacturing organisations as they are shifting more significantly towards the service end of the spectrum. This shift presents a challenge for IPPM capabilities that have been designed to focus on the manufactured product development projects.*

6.3.4 Three dimensions of IPPM

The themes identified during the cross-case analysis reveal that an organisation's capability for IPPM encompasses much more than the processes and methods used. The emergent themes are categorised as 'structure' dimensions and 'people' dimensions. A new model of an IPPM capability is proposed in Figure 6-2, based on the findings. The findings from the case studies are presented below in three sections outlining the 'structure' dimensions, 'people'-related dimensions and 'process'-related dimensions of the IPPM capabilities. The findings are summarised at the end of this subsection in Table 6.7.

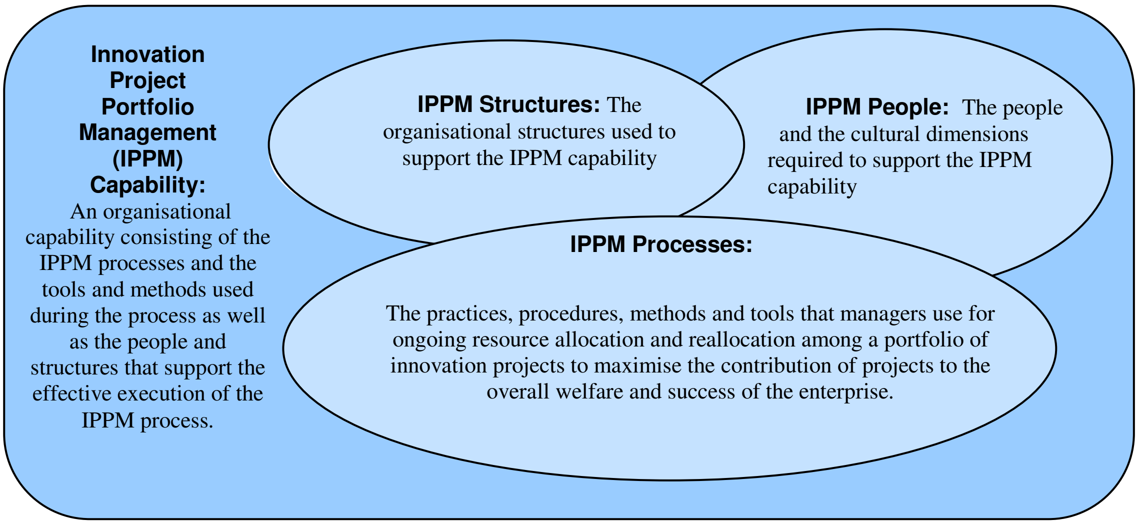

Figure 6-2: Three dimensions of an IPPM capability

Structure

In-depth analysis of the six organisations' IPPM capabilities shows that organisational structures and the assignment of IPPM responsibilities are a major aspect of the capability. Organisational structures vary across all of the organisations studied. In some organisations, the responsibility for IPPM is shared between senior managers in technical and marketing functions, whereas in other organisations one person is responsible for overseeing the process. In some organisations IPPM roles and responsibilities are a part of existing roles; in other organisations new roles and responsibilities are created to specifically focus on the IPPM capability. While there is no standard organisational structure, the level of organisational structure review and change exhibited by the case organisations indicate that structure is an important supporting component of the IPPM capability.

All of the organisations have experienced some changes to their organisational structure in the past three years that have been directly related to the development of their IPPM capability. The changes have varied between slight changes to responsibilities and emphasis on IPPM [IND], elevation of the function responsible for NPD [MAT, TELE, MED] or the creation of new structures for NPD or IPPM [SERV, FIN]. The relationship between changes to an IPPM capability and changes to the organisational structure is strong, although the influence can flow either way or both ways. In some situations a change to the organisational structure has been the catalyst for the development or enhancement of the IPPM capability [TELE, MAT, FIN]. In other situations the changes to the organisational structure have been required as a result of the establishment of an IPPM capability [SERV, MAT]. For example, in FIN the establishment of a new functional area to focus on product development was the catalyst for the development and implementation of tailored IPPM processes and methods. In MAT, a major organisational restructure elevated the position and visibility of NPD, emphasising its importance. This elevation of the strategic importance of NPD led to the increased efforts to establish a formal structured IPPM capability. The establishment of the capability led in turn to further changes in the organisational structure and the creating of roles and responsibilities focused on IPPM.

All of the organisations have a 'Portfolio Review Board' (PRB) that is the main decision-making body for the IPPM capability. The names used for the PRB differ at each organisation, but the groups have similar concept and composition. The members of the PRB are high-level managers in all of the organisations. PRB board members are also generally chosen to represent a diverse set of perspectives – however, the nature of the diversity varies among the organisations studied. For example, one of the manufacturers has a PRB consisting of marketing heads from diverse global regions [MED], while another has a PRB consisting of divisional heads representing different functions [MAT]. One service-based organisation selects its PRB to represent a combination of geographic regions and functional areas [SERV]. The philosophy behind PRB member selection is that a diverse set of perspectives provided by individuals with seniority and accountability as well as broad and deep experience will be able to make balanced portfolio decisions. Further detail on the organisational structures at the six case study organisations is provided in Table A7-3 in Appendix 7.

People

Multiple people-related themes emerged in the case study findings. Issues range from the attitudes toward innovation and IPPM, to the selection of people for NPD and IPPM teams to the development of an organisational culture that promotes innovation and supports the IPPM capability. People-related themes are summarised in this section under the headings Culture, Support for IPPM and Teams.

Culture

The case study findings indicate that organisational culture is considered important to support innovation and the IPPM capability. Managers at each of the organisations discussed their organisational culture with respect to the IPPM capability and expressed their belief that the organisational culture has a large role to play in both creativity and idea generation, and in gaining commitment and buy-in for the IPPM capability. An innovative culture is thought to be important for the generation of a steady stream of new ideas, and the research findings show that four of the organisations have made specific and deliberate efforts to establish or improve the innovation culture [MED, SERV, TELE, FIN]. The managers interviewed characterised the desired culture as one that “removes the fear of failure” and “encourages debate and the challenging of ideas” [SERVp2]. As one manager put it: “Ideas come from people. The challenge is to be able to tap the brains of all of the people in the organisation” [TELEp4]. To meet this challenge, the culture also needs to provide visibility to the IPPM process and generate awareness through “processes where innovation is always on people’s minds” [TELEp4].

However, the managers reported that changing organisational culture is one of the hardest things to do and that it takes time and requires concerted effort and ongoing communication processes. Several managers made specific comments on the importance of rewards and enhanced opportunities for motivating staff to engage in innovation. Recognition for innovation efforts and success takes place through innovation award programs at one of the organisations studied [SERV]. Although the innovation awards include a small monetary value, the managers feel that the motivating value of the awards is the recognition and visibility the awards give to the individuals or teams. At another organisation, the increased level of success resulting from an improved IPPM capability is a source of motivation and provides “better job satisfaction and energy for the job” [FINp3]. Linking opportunities with innovation activities is also found to increase motivation and enhance the innovative culture. For example, innovation participation and success rates are known to enhance promotion opportunities in one organisation [SERV], and to enable innovative staff members to join desirable teams and projects in another [TELE]. These opportunities help create a culture that supports innovation and the IPPM capability and increase the level of employee involvement in innovation programs. An innovative culture is also fostered through the design of facilities that encourage interaction and recreation between employees [MED].

Support for IPPM

The case studies highlight that commitment and support for the process are important at all levels of organisation, not only at the top management levels. In some of the case organisations, the IPPM process being well designed and having the support, respect and commitment of the members of the organisation creates an environment where going through the process is the best way to gain resources for the idea or project. In this way, an effective IPPM capability removes the temptation to circumvent the process to try to fast-track initiatives or gain advantage. In one organisation a manager stressed that "if something really important needs to be done, it is very important that it goes through the process because that is the way you get the engagement and you get the support and it makes things happen – so it will be even faster if you go through the process" [MATp1].

Managers at two of the organisations emphasised the role that positive outcomes and successes play in the establishment of an IPPM capability that is robust and sustainable [SERV, MAT]. They noted that it can be difficult to gain buy-in for the process at first, but once it has been consistently and transparently applied and people can see the results, it becomes easier to gain support. One manager explained that "once it becomes clear to people that the process is really objective, has a necessary level of rigour about it and brings about important things that wouldn't have otherwise necessarily happened, then they will be able to say 'ok, I see why it is important' … [success] gets people to put their other agendas aside and support the process in a practical way" [MATp1]. Another manager put it succinctly: "There is nothing better for entrenching the culture and the processes than success" [SERVp2]. These organisations credited strong senior management support and a dedicated sponsor with getting the IPPM capability established, and the positive outcomes from that effort are in turn credited with the development of wide and sustainable organisational support.

Teams

Findings indicate that teams are central to the IPPM capability. Each has a portfolio review board (PRB) that is ultimately responsible for IPPM decision-making. In addition, product development is done in teams at all of the organisations. As one manager commented, “Teamwork is recommended, we have lots of things we do to encourage team-based innovation” [SERVp2]. In an effective IPPM capability, team members engage with the process and don’t just go through the motions. As one manager pointed out, “You can have all the tools in the world but it is all about how people use them” – it is the “diligence and commitment” of the participants in the process that make the process work [FINp1]. Another manager reported that “what became clear to us early on is that success or failure was not a matter of having [the right book or software], it was about getting the commitment of people to be part of it and getting the right people [on the teams]. That then gives it the authority that is required to make [the IPPM capability] robust and sustainable” [MATp1]. Another manager believes that “people are the important element in the process” and without “passionate individuals … the process just mooches along with ordinary results” [INDp4].

The allocation of staff members to the innovation decision-making teams and to the innovation projects themselves is considered very important to the case study organisations. Special attention is paid to staffing for risky or high-profile projects. In some organisations such projects are allocated to the most experienced staff [SERV, MED]; however, in another organisation they have found that these projects benefit from a combination of experienced staff and relatively new but motivated staff. The newer staff members bring a higher level of innovative thinking to such projects while the experienced staff members provide the experience necessary to steer these projects towards success [TELE].

The IPPM capability is believed to be responsible for nurturing and developing staff members in some organisations [especially SERV, TELE, MAT]. Managers at one organisation specifically highlighted that the portfolio perspective provided by the IPPM capability should be used to protect staff members from ongoing demands that are not sustainable in the long term [TELE]. One manager commented that motivated and capable staff members will “do what it takes” to bring an important or high-profile project to success, but need to be rewarded and recognised [TELEp3]. The manager highlighted the fact that the IPPM capability should help an organisation to balance the demands on their valuable and experienced staff and protect employee morale. If employees are asked to go from one high-stress project that requires extreme time commitments to another they are aware that they could easily damage the goodwill and lose valuable staff. Staffing for projects is therefore a complicated and very important “diplomatic exercise” [TELEp4]. The IPPM capability must include appropriate staff consultation and negotiation, and strong awareness of the importance of human motivation, skills and goodwill. Team-based rewards are a good way to “reinforce and encourage teamwork” [SERVp3].

Summary of findings on the people-related IPPM dimension

In summary, the in-depth case studies clearly highlight the role of people in an organisational IPPM capability. This role is expressed in several themes evident throughout the research. Particularly significant is the role of organisational culture in creating an environment that provides support for the IPPM capability. Organisational efforts to improve culture and involvement in IPPM include incentives and opportunities for the individuals involved. The importance of teams to an IPPM capability and the need to get the right people on IPPM teams are also repeated throughout the research. IPPM is shown to be a people-centred capability. In addition, people are highlighted as an important organisational resource that must be nurtured, developed and allocated effectively through the IPPM capability for best innovation outcomes.

Processes

The research findings include detail of the processes and methods used in the IPPM capability. The types of methods used for IPPM are similar in the case study organisations, although the IPPM capabilities at each organisation are customised to the environment and are continually evolving. All of the organisations, in both manufactured and service product development environments, have first established a stage-gate style of product development process and then integrated this process with a portfolio-level review process at one or more of the gates or decision points. In addition, each organisation has developed more than one version of the process to cater for different project types, as shown in Figure 6-3.

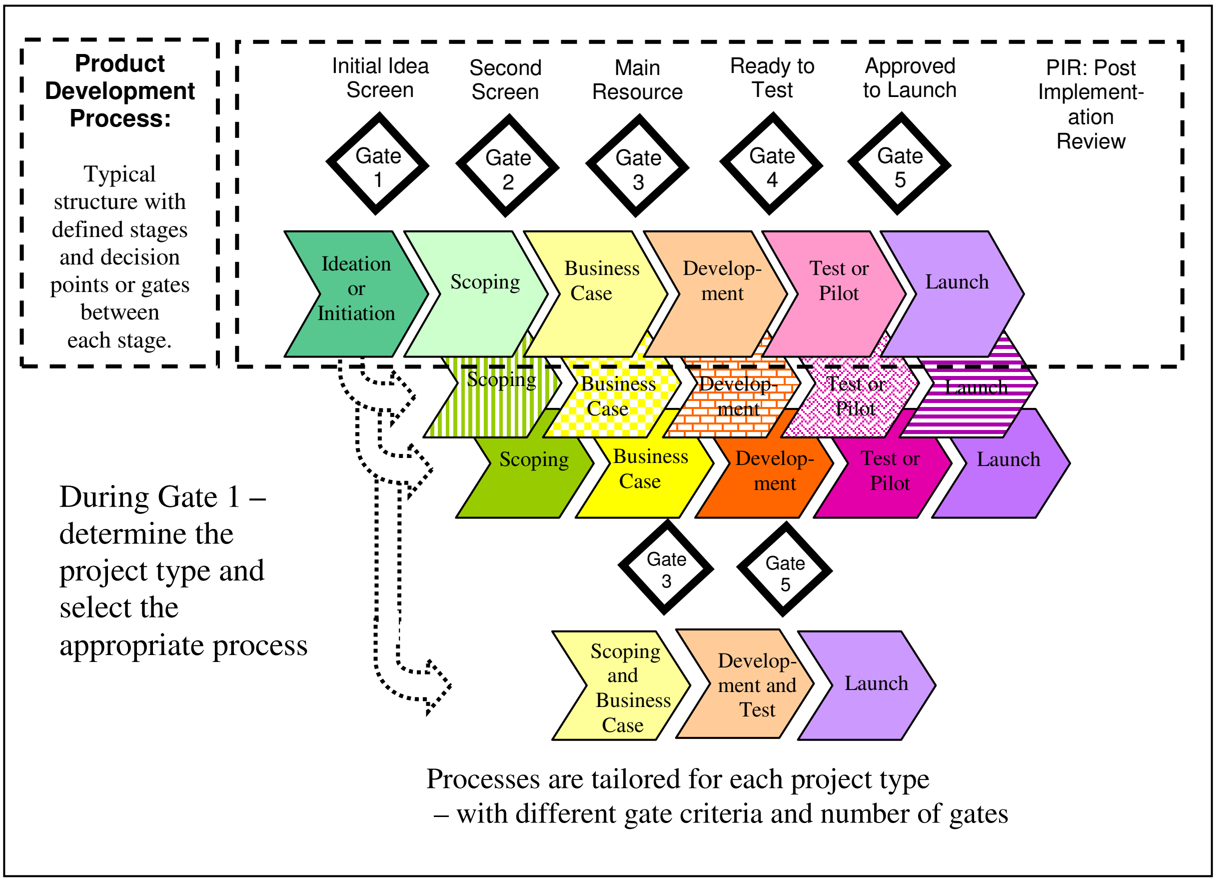

Figure 6-3: Typical product development processes tailored for project type

The main differences between versions of the gated product development processes are in the number of stages and gates and in the types of criteria used to evaluate projects at the gates. Each organisation bases its product development projects on a process with one or more gates in the early stages for the filtering of ideas based on fit with strategy, and initial estimates of project aspects such as technical feasibility, financial attractiveness and the organisation's capabilities and resources available to complete the project. The criteria used to evaluate the projects at each gate are carefully developed and, in some organisations, regularly re-evaluated and updated. The gates are usually reviewed within the business unit or functional area. Business cases are developed for the projects that pass these initial gates, and the most important decision point is usually based on the analysis of the business case. The business cases include a wide range of information, both financial and strategic, following formats and criteria developed for the particular environment. These decisions about the individual projects in the portfolio are done in meetings by a PRB or decision-making team. Some organisations review and rank the entire portfolio of projects, while others consider projects individually, with a portfolio-level perspective provided through portfolio summary documents and/or the vision and experiences of the PRB.

In all of the organisations studied, the business case evaluation gate or equivalent (corresponding with Gate 3 in Figure 6-3) is the last gate that is used as a decision point where projects are likely to be killed if they don't meet requirements. Two of the organisations felt that their IPPM process was effective in killing projects later in the process [TELE, MAT]. One manager put it this way: "It doesn't happen often that projects stop during the process but it can happen and it should happen when the business case no longer makes sense" [TELEp2]. The other four organisations admit that the further gates in their process are used more as milestones or checkpoints, and that decisions are too rarely made to cancel projects at later stages [SERV, MED, IND, FIN]. Managers at these organisations commented on the difficulty in killing projects, and expressed their belief that their IPPM capability needs to be strengthened by ensuring that all gates can be used to kill projects in order to release resources for other projects when this will enhance the success of the overall portfolio. As one manager lamented, "people tend to treat projects like babies" and believe that the "cancellation of a project is a failure on their part. This has got to stop. Culturally, it is a change that has got to occur, but it is probably one of the hardest things to change" [FINp2]. Another manager noted that the "reviews happen, but the gates are really open….we need to tighten the gating process" [INDp1]. The difficulties with killing projects include losing potential opportunities: “There is the difficulty of not wanting to let a potentially good idea go … it is something I lose sleep about” [MEDp3], and breaking attachment to the project “it is an ownership position” [FINp2]. Each of the organisations commented that projects were rarely or never killed. Some managers expressed uncertainty about whether more projects should have been killed. One manager commented that “hopefully we have the will to cut the project if needed” [SERVp1]. When asked whether some projects continue that should have been stopped, another commented, “I would hope not, but I am sure there is” [FINp2].

Financial and strategic fit measures are used in all organisations, with all except FIN also employing some graphical tool like a portfolio map or grid to visualise and balance the portfolio. All of the organisations use spreadsheets or standard databases, and some also used a web-based interface to facilitate interactions with the system [SERV, MAT, FIN]; however, none of the organisations studied use a specialised IPPM software program to perform portfolio-level analysis. Although each IPPM capability is quite different, there are no systematic differences in the methods used between the service-based and manufacturing-based product development environments.

A weak area in most of the organisations studied is in the follow-up to the product development process through a post implementation review (PIR). Only three of the organisations regularly do PIRs once projects are completed [SERV, IND, MAT]. In the other organisations reviews are not consistently done [MED, TELE, FIN]. Although these organisations believe that PIRs are important and believe that they should be doing more, they find it hard to get the resources for such tasks. One manager explained it this way:

> The measurement thing is one of the hardest – we want to have more of a calibration now, we want to go back and say “When we did the business case what were the numbers, the … team commitments? [how was] the launch? How did we go, 6 months after how did we go?” That is the point we would like to get up to so we can weed out the lower performing projects. But it can become quite an argumentative and destructive type of environment, so unless you get a really good fact base it just becomes a big debate about whether it didn’t do well in sales because it was delivered late, or it was delivered on time but the guys stuffed up the

> sales launch so I guess that's where we'd like to get to but [unless done properly] it can cause a negative internal dynamic. [MEDp1]

Many of the case study organisations periodically employ specific idea generation and creativity methods and tools at the front-end of their process. All but one of the six organisations uses a system to capture and record a large number of ideas at the front-end of the process [all but FIN]. In two of the organisations this 'idea management' function is implemented in a web-based interface that allows information input, transparency and comment as well as idea development [SERV, MAT]. Appendix 7, tables A7-4, A7-5 and A7-6 provides further detail of the case study findings comparing the processes and methods used.

Firmness versus flexibility

The findings show that all of the case study organisations, whether manufacturing- or service-based, have struggled to find the right balance between firmness and flexibility and between the level of centralisation and decentralisation in the processes. It is a major challenge to provide an appropriate amount of rigor in the process, but not to bog down projects with too much bureaucracy. Quantifying and structuring decision-making is seen as conducting "business by Excel" at one organisation, and they have a "real aversion" to that type of modelling [MEDp1]. Another organisation tried a formal system to manage their process but found it was "too complex, required too much data and too much time to get the data together. Now there is a more informal process, with spreadsheets showing tasks over time and people to assign" [INDp3]. Recognitions that "we need a type of balance to understand what is really innovation versus projects that are more routine, and the best way to approach these projects" is prompting changes in the IPPM capability at another case organisation [SERVp3]. The challenge to find the correct balance was highlighted repeatedly at each of the case organisations. Additional comments on the balance between firmness and flexibility are summarised in Table A7-7 in Appendix 7.

To address the challenge of balancing firmness and flexibility, the case organisations employ a variety of product development processes as illustrated in Figure 6-3. There are a wide variety of project types and not all projects require the same amount of information or oversight. All of the case study organisations, in both the manufacturing and service sectors, have developed alternative product development processes with fewer requirements for simple projects. As one interviewee stated, “We have taken the standard approach … and created a ‘lite’ version [to cater for situations that require less structure]” [SERVp2]. Another cited the reasons for the introduction of more flexible alternatives: “We had become frustrated in the last year by having it too organised and sequential” [MEDp1]. As one manager explains it, “There is an argument that there should almost be a whole separate process that is − you can describe it as a radical process if you like − some process that enables you to experiment and experiment quickly” [TELEp3]. This type of flexibility has been implemented to some degree at all of the case organisations through the IPPM capability and a choice of development processes suited to the project type.

Tailoring IPPM to the environment

The findings show how each of the case study organisations has developed a unique IPPM capability to suit their environment over time and how the capability continues to evolve. The case findings already presented discuss how organisational structures, the composition of the PRBs, and criteria for the evaluation of projects are customised to suit each organisation’s requirements. In addition, the findings show that each of the organisations has developed multiple versions of a stage-gate style product development process. The IPPM capabilities typically use the initial gate in the product development process to identify the most suitable process for each project, as shown in Figure 6-3. Each of the organisations has introduced a shorter version of the stage-gate process within the past year, or is currently in the process of introducing a shorter version, as outlined in Table A7-4 in Appendix 7. Table A7-3 in that appendix provides a brief summary of changes to the organisational structure to tailor the IPPM capabilities to the environment.

Computerised approaches to IPPM

The increased availability of specialised computer-based applications for the management of project portfolios was acknowledged by managers at each of the organisations interviewed. Most of the managers are watching developments in this area, but are not convinced of the merits of extensive computerisation of the process.

One manager commented, “The thing we keep asking is, if the software asks the same questions … that we put on our spreadsheets, and it puts it all in a nice software package …. should we spend [large sums of money] for a license to use the software? … we are trying to work out if it is justified” [TELEp1].

Managers at MAT and FIN discussed their view of IPPM as a human-centred process and emphasised the value of the PRB in evaluating information and making decisions. They expressed concern that a computer-based method will require complex input on many factors and commented that they did not believe computers can replace the need for managerial oversight and analysis, or the role of intuition and gut feel in decision-making. For example, one manager highlighted the importance of the dialogue generated by the human-centred process: “We have looked at some providers [of software], one thing that makes me reluctant is the great things about the [meetings] is they generate a valuable dialogue around the process” [MATp2]. The dialogue is thought to be a major factor in the success of the IPPM capability, and there are concerns that any change that “reduces the opportunities” for face-to-face dialogue may jeopardise the process [MATp1]. Another manager believes that scoring and weighting systems are “ways to avoid accountability” and notes, “If you had perfect knowledge you might be able to do that, but last time I looked we worked in an imperfect world … so you’ve got to make calls based on your experience and your judgment” [FINp2].

None of the Australian organisations studied uses a comprehensive computer-based IPPM system. While rejecting the notion that computers might become central to the IPPM decision processes, some of the managers did acknowledge the potential benefits that computerising additional aspects of the process could deliver. For example, some plan to improve their ability to generate graphic displays for viewing project data and project scenarios though computerised access to project data in the future [SERV, TELE, MAT]. Portfolio maps or roadmaps are used at all but one [FIN] of the organisations in some form to help IPPM teams overview the portfolio of projects and make decisions. The most common type of change planned for IPPM processes in the future at the case organisations involves improved portfolio view and idea management capabilities using computers.

Table 6-7: Summary of findings on the three dimensions of IPPM

Three dimensions of IPPM capabilities: Summary of findings *No areas of difference are found between the manufacturing-based and service-based organisations*
Structure – All of the case study organisations use a team-based structure for IPPM, with the responsible areas recently elevated or restructured as a part of an NPD focus. The relationship between organisational structure and the IPPM capability flows both ways. The IPPM capabilities studied have prompted changes to organisational structure and have been influenced by changes to organisational structures.
People – People-related themes are strongly represented in the findings. Culture, commitment and support, and team considerations are highlighted repeatedly in all environments.
Processes – The processes and methods used for IPPM are similar across the case study organisations; however, each process has been designed over time and tailored to suit their environment. All have defined different processes to cater for different types of projects. Similar types of stage-gate product development processes integrated with PRB decision processes are used in both types of organisations. While all of the organisations have been increasing the level of structure and process in their IPPM capability, they are also mindful of the tensions between firmness and flexibility and are looking for the correct balance. The organisations stressed the importance of a human-centred and management-friendly approach to IPPM. Whether manufacturing- or service-based, they believe that increased support for the decision-making process can be provided by software, but they do not want a software system that replaces the human interaction and lessens the role of managerial judgment.

6.3.5 IPPM and the resource base

The findings from the case study interviews show how the IPPM capabilities interact with the resource base on three levels. The first level is the role of the IPPM capability in the allocation of existing resources. This is a central aspect of the IPPM capability that has been established in previous IPPM-related studies and is confirmed in this study. The second level is the role of the IPPM capability in the development of organisational resources. The findings in this area extend and deepen the existing understanding of how IPPM capabilities are used to guide the longer term development of the resources base. Finally, the research illustrates a third level, the role of the IPPM capability in extending the resource base available for NPD projects through outsourcing, alliancing or external partnering.

A primary role of the IPPM capability is to allocate resources among the portfolio of projects. Each of the case study organisations report that their IPPM capability is effective in limiting the number of projects to fit with the resource base and in managing resources for the pipeline of development projects. This finding stands out from the first phase findings and existing findings in the literature that repeatedly highlight “too many projects” and “the resource crunch” (Cooper et al., 2001; Cooper and Edgett, 2003; Engwall and Jerbrant, 2003). In all but one of the case organisations, previous problems with stretched resources and too many projects were a main reason for the implementation or improvements to the IPPM capability [MED, MAT, IND, FIN, TELE], and the IPPM capabilities have been effective in addressing the resource problems in all of these organisations.

The findings also show how the IPPM capability provides a framework that is used to configure and allocate organisational resources for product development projects. The findings of the research show that these resources are not fixed, but can be developed or extended to best support innovation goals. The methods used to develop and extend the resource base vary between the manufacturing- and service-focused organisations.

The resource base in the manufacturing organisations studied is not nearly as dynamic or flexible as in the service organisations. Specialty technical skills are a valuable resource in the manufacturing organisations, particularly because these skills enable the development of the patentable IP that can underpin sustainable product leadership and success. These skills take years to develop and cannot easily be obtained from outside the organisation. As one interviewee stated, “In this area it takes a long time to develop resources, the resource development is not very dynamic” [MATp3]. Another manager pointed out that in order “to build resource capability over the past 20 years we have spent [large amounts of resources] on technology for CAD and simulation – this cannot be easily replicated. The cost is high, but takes a long time to incorporate processes to use technology effectively – it is not a good bet to replicate this resource” [INDp5].

Such resources are Valuable, Rare, Inimitable and Non-substitutable ('VRIN') and therefore according to Barney (1991) they provide competitive advantage to the organisations that possess these capabilities. The challenge for IPPM in the manufacturing-based organisations is to ensure that the product development pipeline is managed to maximise the value created by the existing VRIN resources. As these resources cannot be easily expanded, efficient allocation of the resources is especially important. Without good oversight of resource allocation priorities, one organisation notes that their valuable resources can be tied up in "many little projects … that are low value and keep us from innovating" [MEDp3]. In addition, the IPPM capability needs to map out future resource requirements to guide the long-term development of VRIN specialty technical skills. Another highlighted the role of training in the development of resources: "We must see what resources are needed, what gaps there are and then consider how to get what is needed. Lack of resources can hinder projects however training can help move capabilities along" [INDp5].

The findings highlight that resources are more flexible in the service organisations. Service product development organisations generally require product development skills and capabilities that are not as specialised as those used in the manufacturing industries. Product development is often based on information technologies that are accessible to other organisations. Therefore service-focused organisations are able to more easily develop or acquire the required resources for development projects. In addition to service organisations having more options to train existing staff or to employ skilled or experienced people, they also have a much higher possibility of outsourcing or partnering to develop new products. These findings also indicate that the IPPM capabilities at the case study organisations help to develop as well as deploy resources in both manufacturing and service organisations. One interviewee at a service organisation commented on their decision processes: "If the skill needed for a project is not a core skill it may influence the decision to outsource it. For each project that you look at, you do an evaluation of the organisation's capability and whether you import that capability or you develop it. And that is an ongoing part of the development decisions" [TELEp3]. For example, when new capabilities are required due to the introduction of new technologies, "our own people learn and if the program is big enough we can often take advantage of that learning and have them pass it to people under them – so we often grow the capability but we can also import it directly"

[TELEp3]. Another manager explained, "Where you need a certain capability from a technology point of view, generally the trend is who can provide this locally? Who's the best partner? …generally we outsource to organisations out there that specialise in a particular technology. This is generally the trend" [FINp1]. The prevalence of partnering and the benefits gained are highlighted by a manager who points out that "every single one of our breakthrough ideas have some sort of joint venture relationship with an external partner" and believes that "it's more about joint venturing and partner and creating strategic alliances that are really going to create strategic advantage in the market" [SERVp4]. Strategic positioning is also enhanced by partnerships at TELE: "We're taking a bit of a different approach to partner with strong brands like [brand names] – we are partnering with those vehicles" [p1]. These findings show that, due to the dynamic and flexible nature of resources in the service organisations, good opportunities do not often get passed by because of a lack of partners and skilled resources.

In contrast, the manufacturing organisations have traditionally viewed their resources as a static entity due to difficulty in rapidly adjusting the resources. According to one interviewee, this can create a mindset that is "self limiting – you don't tend to do things that are beyond your means and that tends to limit the magnitude of what you can hope to achieve. So it is a chicken-and-egg-type thing, a cycle with a self-limiting scale of outcomes" [MATp1]. It is not only the upwards adjustment of resources that is difficult in the manufacturing industries, it is also difficult to scale down resources temporarily. "It is not a tap you can turn on and off. Once you turn it off it is off for good, and it is hard to get people with the right capabilities. Ramping up won't happen quickly. At the moment we need more people, there are things we cannot do that we would like to do. We have to slow things down due to the lack of resources" [MATp1]. Outsourcing is often not an option for manufacturing organisations due to the difficulty in finding appropriate skills outside the organisations; however, even when it is possible, the manufacturing organisations avoid outsourcing development work because it usually involves IP. IP is an important source of competitive advantage in the manufacturing-based organisations, and they traditionally want to own the IP.

The case study findings show that manufacturing organisations are becoming more open to dynamic resourcing options to meet the requirements of the dynamic market in which they operate. They are beginning to take advantage of the increased resource flexibility offered by outsourcing, partnering or alliancing. For example, one of the manufacturing organisations recently licensed external IP to speed the development process in order to meet market requirements [MAT]. This was the first time they have licensed externally developed IP and partnered with the supplier during the product development process. It is envisaged that licensing and the use of external resources will become more prevalent in the future. One manager highlighted the challenges associated with "handling the IP with a third party…contractual challenges …this will be more and more of a challenge as we go forward, because the realisation is that we will partner more and more with external providers" [MATp2]. The other two manufacturing organisations have also recently experimented with flexible resourcing options for the first time through outsourcing and manufacturing through a partner organisation [MED, IND].

Summary of findings on IPPM and the resource base

A primary role of the IPPM capabilities in the case study organisations is the allocation of resources among product development projects. As well as illustrating the IPPM capability's role in limiting the number of projects to fit with resources at each organisation, the case study findings also provide strong evidence of the role of the IPPM capability in the development of the resource base and in extending the resource base through external relationships.

It is easier for service organisations to develop or acquire skills, and they also have increased opportunities to outsource or develop partnerships for product development compared with manufacturing organisations. However, these findings show that both the manufacturing- and the service-based organisations are seeking increasing flexibility for their resource base and indicate that partnering, outsourcing, and alliancing are likely to increase in both environments.

Table 6-8 summarises the findings, noting the areas where findings differ between service- and manufacturing-based organisations.

Table 6-8: Summary of findings on IPPM and the resource base

IPPM and the resource base: Summary of findings *Italicised entries indicate areas of difference between manufacturing-based and service-based organisations*
IPPM and resources – IPPM capabilities at both types of case study organisations are used to configure, build and extend resources for the innovation project portfolio. The IPPM capabilities at each of the organisations are credited with helping the organisation manage the number of projects to ensure resource adequacy.
Resource flexibility and dynamism – *Resources and skills for service development are more flexible and dynamic than in the manufacturing environments represented in the case studies; however, the manufacturers are now beginning to explore more flexible resourcing models.*

6.3.6 IPPM capability establishment, evolution and maturity

One of the most notable aspects of the IPPM capabilities at the six case organisations is the level of change. The findings reveal a history of change and adjustment to the IPPM capabilities. Some of the organisations have established a new IPPM capability [SERV, FIN] or introduced major re-design of their IPPM capability [MED, MAT, TELE] within the past three or four years, while others have made ongoing incremental changes within an established IPPM capability framework [IND]. The findings at all of the organisations provide evidence of ongoing evaluation and change to the IPPM capability, and each case has made changes within the past year. All of the organisations are also currently planning for further changes and adjustments in the near future as they strive to increase the maturity and effectiveness of their IPPM capability. This section presents the findings on IPPM capability establishment and evolution, and learning mechanisms and investments in organisational learning activities.

The level of maturity of the IPPM capabilities studied is of interest to this research study, but IPPM maturity did not emerge as a specific theme during the data coding process. The findings related to the maturity of the IPPM capability are distributed throughout the findings and require a suitable framework to evaluate the findings and asses the level of maturity. Existing capability maturing models (CMMs) were initially considered before a new CMM was developed to assess the maturity level of the IPPM capabilities at the case organisations. The development and use of the new CMM and the findings on IPPM maturity are presented in Section 6.6.

The findings already presented outline examples of the ongoing evolution of the IPPM capabilities. For example, the findings on IPPM structures and IPPM processes (Section 6.3.4 and tables A7-3 and A7-4 in Appendix 7) include specific information about the nature and timing IPPM capability changes in those areas. The changes are often introduced to help tailor the IPPM capability to cater for the organisations' individual environments and project types, and to enhance the ability of the IPPM capability to address the balance between the short-term 'exploitation' projects and long-term 'exploration' projects.

The in-depth case findings also indicate that both intentional and unintentional learning processes influence the evolution of the IPPM capability. Organisations intentionally invest in learning activities that enhance both tacit and explicit learning mechanisms in order to establish and improve their IPPM capabilities. The research also indicates that IPPM capabilities evolve organically and unintentionally through accumulated decision-making experiences. This unintentional evolution of IPPM capabilities can result in undesirable changes to the IPPM capability such as the 'success trap' discussed below, prompting additional purposeful efforts to counteract these changes.

Learning investments and IPPM capability development

The case findings from each organisation provide evidence of regular investments in the development of their IPPM capability through activities that enhance organisational learning processes. The cases show evidence of purposeful investments in activities to enhance both tacit and explicit learning mechanisms. Three categories of learning investments are identified in the case organisations: learning activities to promote tacit learning, explicit knowledge articulation and explicit knowledge codification. Tacit learning activities are largely experiential and involve trial and error, while explicit learning activities include deliberate processes for the articulation and codification of knowledge. An example of a tacit learning investment for IPPM development is a change to the organisational structure that facilitates IPPM experience accumulation. An example of an investment in explicit learning for IPPM is the creation of a feedback loop where the processes and outcomes are evaluated, discussed and modified (knowledge articulation) and then documented (knowledge codification).

The case study findings also provide evidence of both establishment and evolution modes of IPPM capability development in each of the organisations. The establishment mode is defined as the type of capability development that occurs when an organisation explicitly recognises the need to acquire or re-design an IPPM capability, and engages deliberate actions towards this end. Strong establishment activity often signifies the initial introduction of the capability to the organisation; however, it can also signify a major change in the capability that involves a rebuilding or replacement of the main elements of the capability. The evolution mode is defined as a type of capability development that emphasises continual adjustment and improvement within the existing IPPM capability framework. During the evolution mode the capability is monitored, evaluated, modified and adjusted as required. The strengths of these modes of development vary across the organisations.

Appendix 8 outlines the findings from the case organisations on the strengths of establishment and evolution modes of IPPM capability development and the types of learning investments made at each organisation. These findings show that the strongest levels of investment in learning mechanisms are found in SERV and MAT. The findings also indicate that there is a relationship between the mode of capability development (establishment or evolution) and the learning investments (tacit experience accumulation, explicit knowledge articulation, or explicit knowledge codification). Stronger investments in tacit experience accumulation and explicit knowledge codification learning mechanisms are found in organisations that show stronger evidence of establishment mode activity. The level of investment in knowledge articulation learning mechanisms is fairly consistent across all of the case organisations. There are no overall differences in the levels or types of learning investments across the industry types (manufacturing or service).

Summary of findings on IPPM capability establishment, evolution and maturity

Learning and change are consistent themes across the case studies, with no overall differences aligned with industry type. The case findings show regular and recent changes to their IPPM capabilities, and indicate that organisations regularly invest in activities that enhance organisational learning mechanisms to develop their IPPM capabilities (Table 6-9).

Table 6-9: Summary of findings on IPPM capability establishment, evolution and maturity

IPPM capability establishment, evolution and maturity: Summary of findings *No areas of difference are found between the manufacturing-based and service-based organisations*
Establishment and evolution of IPPM – All of the case organisations show evidence of both establishment and evolution activity in their IPPM capabilities.
Recent changes to the IPPM capability – All of the case organisations' IPPM capabilities have a history of regular evolution and all include changes within the past year.
Investments in organisational learning activities – All of the case organisations invest in developing their IPPM capabilities through a range of learning activities. These learning activities enhance both tacit and explicit learning mechanisms.

6.3.7 The 'success trap'

Evidence of unintentional evolution to the IPPM capabilities is found in all of the case organisations and may be a result of learning through experience. A common dilemma for organisations is to have the vision and foresight to plan for longer-term innovations. This is especially hard when resources are focused on reaping rewards from incremental innovation. Each of the case organisations have reported that their IPPM process has shown symptoms of the 'success trap' (also referred to as the 'exploitation trap') by tending to favour short-term, incremental or low-risk 'exploitation' projects, at the expense of the more radical, breakthrough longer-term 'exploration' projects that they believe are essential for long-term success (Levinthal and March, 1993). The IPPM capability provides a locus for the decision-making processes that enhances ability of experiences to accumulate and the learning to be captured. An unintentional result of this learning is the 'success trap' reported in the case study findings where, with the establishment of the IPPM capability, it became easier and easier to justify safe and short-term projects. As one interviewee explains, "Short versus long-term is most difficult to balance, especially with pressure to turn around in a shorter term. Longer term no one gives you any credit for and it is harder to get justification" [FINp2].

While the IPPM capability is in part to blame for creating an imbalance in the portfolio, it also provides the organisations with the capability to recognise and address the 'success trap' phenomenon. Five of the case study organisations have addressed this problem or are in the process of addressing it through changes to their IPPM capability. The remaining organisation is discussing the imbalance, but has not yet decided how they will approach the problem [TELE]. For each of the organisations, the first step in addressing the problem has been to track the ratio of exploitation to exploration projects and to determine the ratio that is most appropriate for the current situation. Each of the organisations aims to be ambidextrous and to exploit and explore at the same time. While aiming for an improved balance, they also note that too much exploration would also be a problem. As one interviewee states, "We still have to attend to our bread and butter, we can't spend all our resources looking for the next big thing" [TELEp4].

Once the desired ratio between exploration and exploitation projects is determined, one approach identified in the literature is to enforce the ratio as part of the IPPM process (Cooper et al., 2001); however, none of the case study organisations planned to use such a 'prescriptive approach' [MAT]. Instead the organisations' approaches centre on plans to report on and raise awareness of the importance of balancing exploitation and exploration projects in the portfolio, and incorporate measures to help steer the ratio in the desired direction. For example, two of the case study organisations (one service-based and the other manufacturing-based) are using targeted idea generation activities to generate more radical ideas [IND, SERV]. One of the service-based organisations finds it easier to work with external partners on the longer-term projects, and they are able to get more of these projects approved if they "let someone else take the risk and pay them" [FINp2]. Each of the case organisations have developed different processes and evaluation criteria for evaluating longer-term explorative projects, and are continuing to make adjustments. As one manager states, "It is not fair to require people to paint a picture three years out when they just have an idea at an early stage. We don't put a lot of weight on the early stage projections – otherwise it will knock out good ideas" and points out that "it is not a perfect science, you can't find metrics that allow you to make direct comparisons between the two main types of projects and so you have to be prepared to put aside in some crude way some percentage of your resources to work on some of those more strategic longer-term things – otherwise left to natural forces they will wither away" [MATp1]. A full re-design of the IPPM capability at one of the manufacturers has been prompted largely by the existing process being too heavily influenced by marketing, and producing largely incremental innovations. This re-design is expected to create an IPPM environment that results in a better balance between exploration and exploitation projects [MED].

Summary of findings on the 'success trap'

Once an IPPM capability is established and decision-making experiences accumulate, the case organisations each show evidence of unintentional capability evolution. Their decisions increasingly tended to favour short-term exploitation decisions over longer-term exploration decisions, resulting in an imbalance in the portfolio. The IPPM capabilities at these organisations are found to have a strong role in creating this 'success trap', as well as in identifying and addressing it. Each of the case organisations has adjusted, or is planning to adjust, their IPPM capability to address the imbalance (Table 6-10).

Table 6-10: Summary of findings on the 'success trap'

The 'success trap': Summary of findings *No areas of difference are found between the manufacturing-based and service-based organisations*
The 'success trap' – Each of the case organisations has experienced the 'success trap' and is addressing the imbalance between exploitation and exploration projects through changes to their IPPM capability.

6.3.8 Summary of the cross-case analysis of the primary cases

This section has summarised the findings on seven main themes identified in the cross-case analysis. The in-depth findings in this section improve the understanding of IPPM capabilities, how they relate to the resources, and how they are established and evolve.

The findings help to develop a deeper understanding of the relationship between IPPM success factors and outcomes. This section has presented findings related to factors such as the level of importance of the IPPM capabilities and the processes used. The findings for each theme include a summary of the differences between IPPM capabilities and the environments at service- and manufacturing-based organisations. These findings are compiled in Section 0, along with further analysis and discussion to address RQ 4.

6.4 Cross-case analysis – embedded cases

This section presents the findings from a cross-case analysis of the embedded cases. The unit of analysis for the embedded cases is a completed innovation project. Three or four individual projects that have passed through the current IPPM process were selected at each organisation, as illustrated in Figure 5-9 in Chapter 5. This embedded case analysis investigated themes across the 21 embedded cases. The analysis complements the analysis of the embedded cases within the perspective of each organisation, as presented in the cross-case analysis of the primary cases presented in Section 6.3. In that analysis the embedded cases have already been incorporated into the overall findings for each case organisation and have provided a valuable source of additional data for triangulation with findings from the primary unit of analysis, the IPPM capability at each organisation. This section outlines the findings from the embedded cases from the innovation project-level unit of analysis from a study-wide perspective – therefore in this section each project is analysed independently from the analysis of the IPPM capability at that particular organisation, and is compared with the other embedded case projects.

Appendix 9 presents a summary of the data for the embedded case analysis, including a full list of the projects studied, and lists project type, success level, duration of the project, the primary drivers for the project and the primary reasons for the success or failure of the projects. This appendix also includes definitions of project type and success level used for the analysis.

6.4.1 Findings from the embedded cases

The embedded case findings reinforce and extend the findings from the main case studies by providing an additional perspective on the IPPM capability. The analysis looked for information on both previously identified and emerging themes. When new findings emerged during embedded case discussions, they were followed up in subsequent case interviews.

Embedded case findings reinforce findings from the main cases that suggest that manufacturing-based product development projects take about twice as long as service product development projects. The embedded case projects from the manufacturing organisations are more than twice as long in duration (average 20.7 months) with a wider spread (standard deviation 11.7) than projects in the service sector (average 7.3 months, standard deviation 3.4). The embedded case findings also highlight the difficulties in obtaining the required resources for projects, the importance of teamwork and the continual evolution of the IPPM capabilities, reinforcing main case findings.

Understanding of IPPM capabilities is also extended through the embedded case findings on the drivers for NPD projects, the factors believed to be responsible for project success or failure, and in understanding the role of IPPM in sourcing flexible resource options for NPD projects. The embedded case findings highlight the importance of customer relationships and market knowledge to new product outcomes, and reveal that, although all of the projects employ technologies or rely on technical developments, technical factors are not often responsible for new product success or failure. The embedded cases provide enhanced understanding of the role of IPPM capabilities in extending resources through external partnering, in particular by illustrating the use of external resourcing options in manufacturing organisations. A summary of these findings is included with the list of the embedded case projects in Appendix 9.

6.4.2 Summary of embedded case analysis

The embedded case analysis has strengthened and confirmed the understanding of the main case findings on the IPPM capability at each organisation. The main themes reinforced and extended through the embedded case analysis are:

- the importance of resources to project success. The challenges associated with resourcing projects, the importance of good people and good teamwork, and the emergence of outsourcing and partnering to extend resource capability are all highlighted in the embedded cases.

- the importance of customer and market understanding. The embedded case analysis reveals that customer and market knowledge and understanding are the most common drivers for new product projects and the most common factors cited as responsible for the success or failure of the new products.

- the level of change and evolution in the IPPM capabilities. IPPM capability changes at the case organisations were emphasised by the findings.

- different project timeframes between service and manufacturing environments. Product development projects in manufacturing environments took more than twice as long to complete.

6.5 A model of organisational IPPM capability

The multiple-case study analysis has explored the bounds of IPPM capabilities in Subsection 6.3.4 and proposed that IPPM capabilities consist of three main components, as illustrated in Figure 6-2. The case study findings presented in Subsection 6.3.4 also emphasise that each organisation tailors its NPD processes to suit the requirements of the environment and the project type. Figure 6-3 illustrates a typical range of product development processes tailored to project type.

To represent the full IPPM capability, Figure 6-4 proposes a model that includes the three dimensions of an organisational IPPM capability integrated with a range of gated product development process. This model is based on the findings of this research and illustrates the typical bounds of the capability found in the case organisations. The IPPM capability includes processes as well as supporting structures and people, and is integrated with a set of stage-gate processes tailored to the environment and the project type. This model is proposed to help guide further research into IPPM processes by highlighting the main elements that can be studied and how they interact. The model is also used to guide the development of a maturity model, as discussed in Section 6.6.

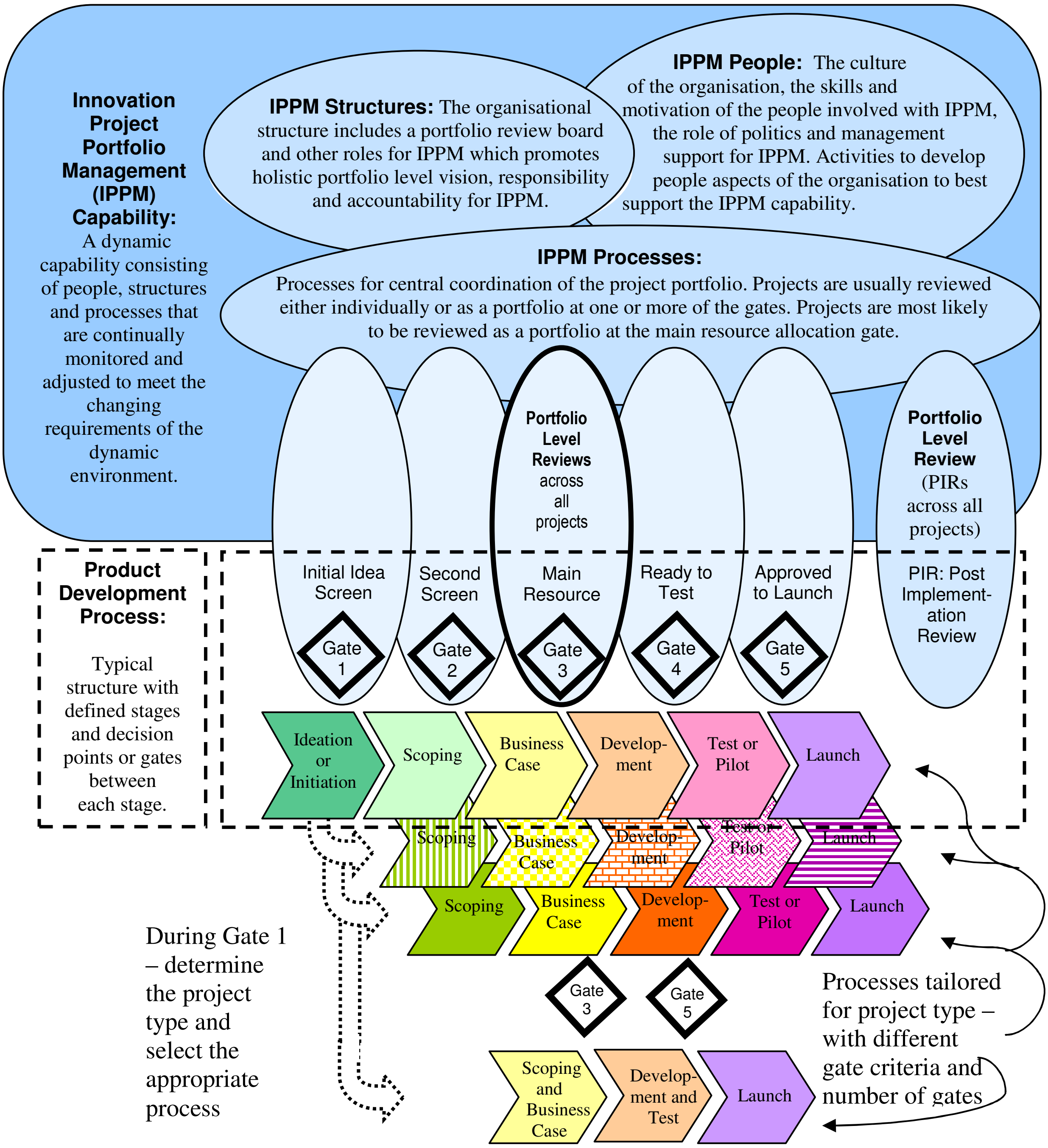

Figure 6-4: Model of an organisational IPPM capability

6.6 A maturity model for IPPM capabilities

This section introduces a maturity model that has been developed as part of this research project and is used to assess the level of maturity of the IPPM capabilities at the case organisations. Existing capability maturity models (CMMs) were reviewed and evaluated and were found to be limited in scope and not adequate for representing the maturity of the IPPM capability at the case organisations (PMI, 2003a; Jeffery and Leliveld, 2004; O'Connor, 2004; Kahn et al., 2006; Crawford, 2007). The IPPM Outcomes and Learning-based Maturity Model (OLMM) presented in this section was developed to include all the elements of an IPPM capability as shown in Figure 6-4 and to address the weaknesses of the existing CMMs. The initial testing and use of the OLMM as part of this research is outlined in Subsection 6.6.4. The OLMM is at an early stage and will require further testing and development as discussed in Subsection 6.6.5.

6.6.1 Overview of the Outcomes and Learning-based Maturity Model (OLMM)

A brief overview of the OLMM is presented here, with further detail on the OLMM, including the stages of development and testing, presented in Appendix 10. The OLMM is implemented in a spreadsheet, with three 'pages' or worksheets. The 'main page' evaluates organisations on their overall progress from the initial foundations for an IPPM capability through to their performance on the main goals for an IPPM capability. The other two pages support this main page: the NPD page outlines the NPD-related capabilities that support an IPPM capability, and the PPM page details the components of the IPPM capability in more detail.

A simplified version of the main page is presented in Figure 6-5. The coloured bars show the ratings for the 6SI Benchmark – the average rating from the 'six successful innovators' (6SI) that are the six case study organisations. The use of both colour and numerical ratings is designed to provide 'feedback-at-a-glance'. For example, the areas where the 6SI Benchmark shows strong performance (pink and orange) and less strong performance (yellow) can be quickly observed. Similarly, when individual organisations' numerical rating data are entered into the allocated cell (below the 6SI benchmark cell), the corresponding colour is also displayed, enabling quick comparison with the 6SI benchmark and reveal the areas of strength and weakness. (See Appendix 10 for an example of organisational rating on the OLMM.)

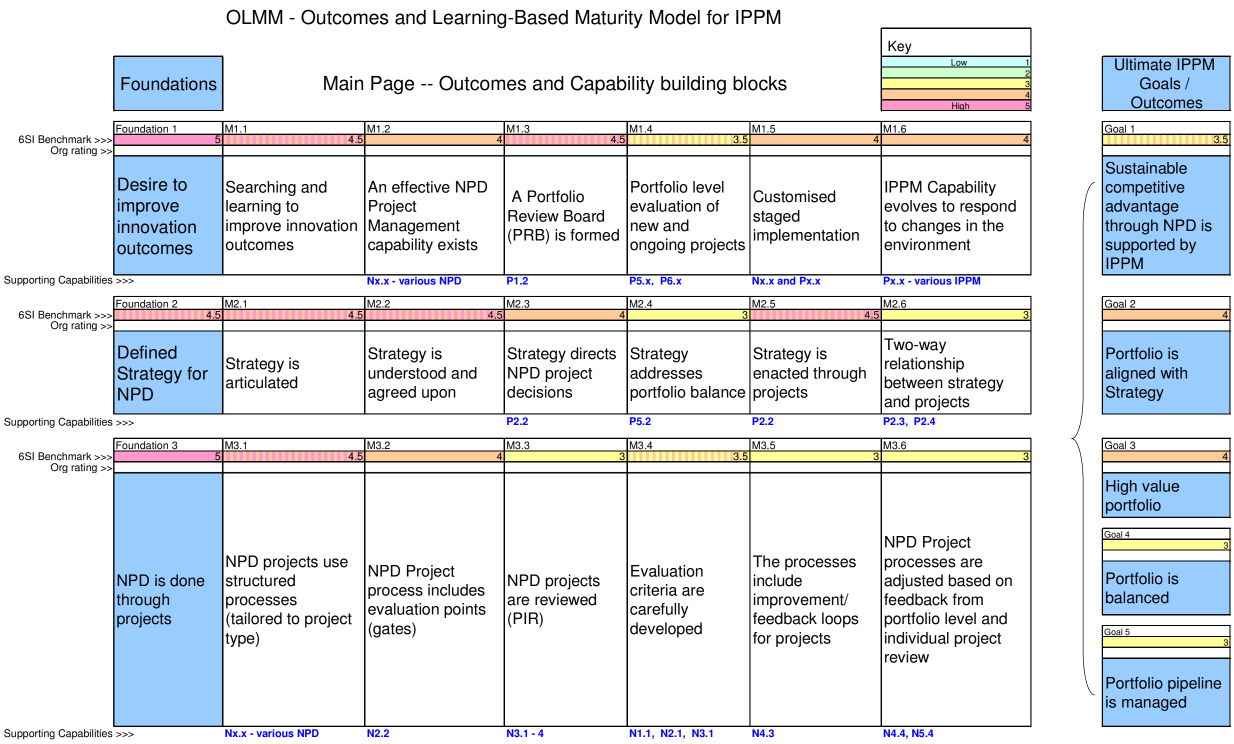

Figure 6-5: Overview of the Outcomes and Learning-based Maturity Model for IPPM

6.6.2 Benefits of the OLMM over existing CMMs

The OLMM has been designed to focus on NPD environments and to address weaknesses in existing CMMs. The OLMM builds upon existing models but takes a different approach. The OLMM has been developed to assess existing maturity levels for the case organisations and to help identify areas of priority for improvement of IPPM capabilities.

The five main benefits of the OLMM model, compared with other IPPM Maturity Models are: (1) the inclusion of the full breadth of components of the IPPM capability, (2) the focus on outcomes rather than activities, (3) the inclusion of organisational learning capabilities, (4) the recognition of antecedents for maturity stages that build upon other capabilities, and (5) explicit attention to the IPPM capabilities that will assist in balancing exploration and exploitation projects. These five benefits are outlined in more detail in Appendix 10.

6.6.3 Feedback on the OLMM

The OLMM was tested and refined through feedback from IPPM professionals and research leaders before being used to assess the case study organisations. After the analysis, the case study organisations had the opportunity to receive feedback on their IPPM capability through the OLMM. Four of the six case study organisations elected to participate in an interactive feedback session. The feedback sessions included an average of six participants (range four to eight participants) representing a range of disciplines (executive management, marketing, customer service, product development, operations, and research/science) for an average time of 1 hour and 40 minute (range one hour to two hours). During the feedback sessions, the OLMM was explained and the organisation's IPPM capability ratings were discussed. The participants were asked to help evaluate and comment on the findings on their organisation's IPPM capability. They were advised that the data entered in the OLMM were based on perceptions gained through case study interviews and other documents and may not have been accurate or complete. The ensuing discussions confirmed that the findings are generally representative of the IPPM capabilities, and that the OLMM helped to identify areas for further capability development. Some participants commented on the complexity of the model, and thought that a simpler model would be more useful. Others discussed the limitations of simple models and felt that something like the OLMM could help provide better feedback through detailed analysis and by identifying specific areas for IPPM capability development. It was also acknowledged that further testing and use of the model and a larger sample for the 'benchmark' indicator would improve the utility of the OLMM.

6.6.4 Case study evaluation using the OLMM

This section outlines the findings from the use of the OLMM to evaluate the maturity of IPPM capabilities at the case organisations. An in-depth understanding of the IPPM capability at each of the case organisations was developed through the case study process and the triangulation of multiple sources of data. The OLMM provides a structured framework to analyse and compare the IPPM capabilities across the case study organisations. The case study findings were used to rate each organisation's IPPM capability for each of the capability items on the OLMM.

Each organisation's ratings on the OLMM were validated through analysis of the OLMM items and linked capabilities, looking for a logical relationship between capabilities and seeking explanation for any anomalies and through feedback sessions as outlined in Subsection 6.6.3 above. Appendix 10 provides an illustration of the use of the OLMM at a typical case organisation.

Table 6-11: IPPM capability maturity ratings based on OLMM analysis

Organisation >>	SERV	MED	TELE	IND	FIN	MAT
TOTAL Ratings on Maturity areas or Themes						
Strategic Alignment	52	38	41	47	45	53
Learning and evolution	78	62	71	83	60	98
IPPM Process capability	177	125	155	175	144	211
IPPM People capability	93	57	79	82	73	95
IPPM Structure capability	24	22	22	22	21	24
Evaluation and Review Criteria	57	45	51	53	53	66
Portfolio level perspective	42	23	43	41	29	51
Project review capability	32	22	31	47	36	61
Resource management	47	21	42	37	31	49
TOTAL Ratings on OLMM Pages						
Main Page	76	54	65	73	70	84
NPD Capability Page	44	30	40	57	50	72
IPPM Capability Page	180	91	146	137	116	165
Total of Ratings on OLMM	300	175	251	267	236	321
Rank Based on Total Ratings (confirmed by Theme ratings)	**2nd**	**6th**	**4th**	**3rd**	**5th**	**1st**

Maturity Key = Maturity ranking compared with other case organisations	High or Highest	Medium-High	Medium or mid-ranking	Medium-Low	Low or Lowest

Table 6-11 compares the IPPM capability maturity levels across the case organisations. The findings indicate that MAT has the highest overall IPPM capability maturity followed by SERV. MED's IPPM capability maturity is lowest; however, it is important to keep in mind that all of the case organisations are successful innovators and are likely to have higher IPPM capability maturity than average organisations. The top section of the table compares ratings based on maturity areas or themes. Each capability area in the OLMM is associated with one or more of these themes. The total ratings for all capability areas within each theme are presented for each organisation in Table 6-11.

The lower section of the table presents the total capability rating scores for each of the three OLMM 'pages' for each organisation. This section also presents the sum total of the ratings across all three pages for each organisation. Both types of comparisons result in the same general conclusions about overall IPPM maturity and the relative ranking of the maturity levels of the case organisations. However, the comparison of maturity areas in the top section of Table 6-11 provides a deeper level of understanding and a richer comparison of the individual IPPM capabilities across the case organisations. The total ratings for capabilities that contribute to each of the nine primary maturity areas are displayed using a colour coding system based on relative rather than absolute scores. Pink and orange indicate the higher ratings, yellow indicates mid-range ratings and blue and green indicate lower ratings for each of the nine maturity areas.

Due to the complexity of the environment, the single numeric indicator (the total ratings on OLMM in Table 6-11) does not reflect the full depth of capability strengths and weaknesses. This example shows how the total rating can be used along with analysis of individual maturity areas to provide an overall picture of an organisation's capability maturity. Figure A10-2 in Appendix 10 and the related discussion shows how further analysis of the individual capability items can be used to identify weaknesses and to prioritise improvement to IPPM capability maturity.

The individual OLMMs developed for each organisation are not presented in this thesis, although the detail of 'Organisation X' in Appendix 10 provides a typical example. Analysis of each organisation's OLMM shows that organisations are generally strong in capabilities relating to strategy and strategic alignment and weak in capabilities for performing reviews of project and portfolio outcomes and in using such reviews as part of a process to evaluate and improve the IPPM capability. Organisational learning capability performance is patchy. The OLMM has been developed to highlight learning and feedback mechanisms within the IPPM capability. The IPPM capabilities at all of the case organisations show evidence of regular change and evolution; however, only one of the case organisations shows high performance in the implementation of specific mechanisms to ensure that feedback from regular reviews are embedded to improve the IPPM capability [MAT].

6.6.5 Conclusions

The OLMM has been developed and tested as part of this case study research project, and feedback indicates that the OLMM can be a useful tool for organisations to better understand and improve their IPPM capabilities.

The OLMM is designed to improve upon existing CMMs for IPPM. Organisational learning capabilities are incorporated in the OLMM to keep the IPPM capability responsive to changes in the environment. The OLMM also incudes capabilities to help organisations become 'ambidextrous' by ensuring that their IPPM capability manages the balance between exploration and exploitation projects effectively. As exploration projects are essential for sustainable competitive advantage through NPD, it is particularly important that the IPPM capability is designed to cater for the special requirements of these projects. Although the OLMM has evolved and improved through several stages of iteration and feedback, continued use and analysis of the OLMM is required and is expected to result in further improvements to the model.

The results of the comparison of IPPM maturity show that overall MAT and SERV have the highest levels of IPPM capability maturity. This maturity persists across multiple capability areas. The findings on IPPM capability maturity at the case organisations are used to address RQ 1 in Subsection 6.7.1.

6.7 Findings in relation to the research questions

This section summarises the case study findings with respect to the research questions. Some of the findings presented in sections 6.2–6.6 provide insight to more than one of the research questions. These findings are only briefly outlined in the discussions for each research question, with the relevant section indicated as the source of more detail.

6.7.1 RQ 1

RQ 1 asked "*What is the relationship between an organisation's IPPM capability and its new product outcomes?*" As this qualitative phase of research focused on organisations with sustained successful new product outcomes, and did not attempt to differentiate between levels of success between companies, the case study findings do not directly address the relationship between the IPPM capability and the outcomes. The findings address the relationship between different measures of product portfolio outcomes and build upon the findings from Phase 1 that support the use of multiple types of measures of portfolio outcomes. As illustrated in Figure A7-1 in Appendix 7, Phase 2 findings align with Phase 1 findings that show that organisations with better new product success rates also have better performance on IPPM goals, such as alignment with strategy and limiting the number of projects. The main findings from Phase 2, however, that address the relationship between an organisation's IPPM capability and new product outcomes are:

- Improved understanding of the IPPM success factors. The success factors of IPPM importance, maturity and methods are identified in the conceptual model in Chapter 2 in relationship to IPPM outcomes. The case study findings extend the understanding of these factors and how they interact as outlined below.

- Improved understanding of the scope of an IPPM capability. As outlined below, this improved understanding helps define an IPPM capability and provides a framework for future studies to further investigate the relationship between IPPM capabilities and new product outcomes.

IPPM importance and maturity

IPPM importance and maturity were identified as success factors for IPPM performance in the conceptual model proposed in Chapter 2 and this is supported through correlation testing based on Phase 1 findings. The Phase 2 findings presented in this section build upon the Phase 1 findings by providing in-depth understanding and analysis of the level of maturity and the level of importance placed on the IPPM capability, and a thorough overview of the processes used at the case organisations.

In this section the case study findings are used to illustrate the relationship between the previously identified factors of importance and maturity and introduce a new factor, the level of investment in developing the IPPM capability.

IPPM capability maturity

Subsection 6.6.4 presented the findings from the maturity model (the OLMM) that was developed and applied to the case organisations. These findings have resulted in a detailed analysis of the specific areas of maturity and areas of weaknesses in the IPPM capabilities at the case organisations. The OLMM also provides an indication of overall IPPM maturity levels across the case organisations that can be used to analyse relative levels of maturity.

Importance placed on the IPPM capability

As discussed in Subsection 6.3.2, the importance of IPPM is strongly emphasised in the in-depth research. Although all organisations feel that IPPM is important, the responses indicate three bands of importance as outlined in Table 6-3 in Subsection 6.3.2. The two organisations in the highest band consistently emphasise the importance of IPPM throughout the organisational levels, whereas organisations in the lowest bands of IPPM importance show evidence of differing perspectives and lower levels of consistency.

Level of investment in the IPPM capability

The case study findings indicate that a high level of investment is being made by the case organisations to evaluate and improve their IPPM capabilities, as discussed in Subsection 6.3.6. The relative levels of investment in the development of the IPPM capability are presented in Appendix 8.

Comparison of maturity, importance and investment in IPPM development

To understand how these three factors compare across the six case study organisations, the data on IPPM maturity, the importance placed on the IPPM capability and the level of investment in the development of the IPPM capability are presented in Table 6-12.

Table 6-12: Comparison of maturity, importance and investment in IPPM development

Key: orange represents the highest two organisational ratings, yellow the middle two and green the lowest two ratings (Note: three organisations' ratings for the level of investment are highlighted in yellow due to equal scores).

Finding	SERV	MED	TELE	IND	FIN	MAT
Maturity ranking based on OLMM analysis (1st is highest IPPM capability maturity). See Subsection 0.	2nd	6th	4th	3rd	5th	1st
Importance band from case interviews (three bands - first is highest level of importance placed on IPPM). See Subsection 0.	1st	3rd	2nd	3rd	2nd	1st
Level of investment in activities to promote learning and development of the IPPM capability (higher number indicated higher level of investment). See Subsection 6.3.6.	18	10	14	11	11	16

The table is colour coded to assist the analysis. The highest two organisational ratings for each item are highlighted in orange. The next two organisational ratings are highlighted in yellow, with the lowest two ratings highlighted in green. This table shows strong alignment between ratings across the three measures. The two organisations with highest ratings, SERV and MAT, are clearly ahead on each indicator and overall the table indicates a level of alignment between IPPM maturity, importance and investment in the six case study organisations.

Table 6-12 should be read with the understanding that all of the case organisations consider their IPPM capability important, and all are investing in improving their capabilities. The organisations SERV and MAT place the most consistent and highest level of importance on their IPPM capability, and have also developed IPPM capabilities with the highest level of maturity compared with the other case organisations. In addition, higher levels of investments in organisational learning activities are observed in these organisations. The findings suggest a possible mechanism through which the importance placed on IPPM capabilities may be responsible for improved levels of IPPM maturity. Organisations that feel IPPM is very important may place priority on investments for the development of their IPPM capability. This could result in a high level of organisational learning activity which may in turn be responsible for the higher level of IPPM capability observed in these organisations. This proposed relationship is discussed further in Chapter 7 in combination with the findings from Phase 1.

Processes for IPPM and the scope of the IPPM capability

The in-depth and explorative nature of the multiple-case study research has allowed the bounds of an IPPM capability to be investigated while providing in-depth understanding of the methods and processes used for IPPM. Case findings, presented in the model in Figure 6-4 in Section 6.5, provide a comprehensive view of the bounds of an IPPM capability. Along with the processes and methods used for IPPM, the case study findings explicitly acknowledge the role of organisational structure and people-related considerations in an IPPM capability as reflected in the model. In addition, the model acknowledges the role of the IPPM capability in interacting with and selecting between a number of different product development processes that are tailored to suit different project types.

Conclusions of RQ 1 findings

The contribution of the second (qualitative) phase of research to the understanding of the relationship between an organisation's IPPM capability and new product outcomes is focused on developing an in-depth understanding of the IPPM capability. Through this phase of research the IPPM capability is shown to include more than the IPPM processes: two other important dimensions of the IPPM capability are the organisational structure, and the human-related elements. The relationships between the level of importance placed on the IPPM capability and the maturity of the capability have been explored. These findings illustrate how IPPM capabilities are used in organisations with successful new product outcomes, and indicate how the level of importance placed on the IPPM capability may lead to the development of improved IPPM capability maturity through the increased levels of investment in activities to enhance organisational learning.

6.7.2 RQ 2

RQ 2 asked "*What is the relationship between IPPM capabilities in service and manufacturing NPD environments?*" The case study findings provide in-depth understanding of IPPM capabilities and how they compare between service-based and manufacturing-based environments. The findings presented in Section 6.3 cover the themes that emerged in the in-depth study into IPPM capabilities. Within each of these themes, the data were analysed by comparing the findings from the three service-based organisations with the three manufacturing-based organisations to identify possible differences aligned with the industry type. The findings are summarised at the end of each subsection in Section 6.3, with the differences between service and manufacturing organisations emphasised through the use of italicised characters. These findings are brought together in this section to address RQ 2.

Overall, the findings of the case studies indicate that IPPM capabilities are largely similar across manufacturing and service environments. Although each IPPM capability is unique and there are differences among the individual cases, these differences are not aligned with the industry type for most of the findings. Some themes show no differences between the service and manufacturing organisations. Organisations in both types of industries exhibit strong strategic focus on markets and customers (Subsection 6.3.1) and experience high levels of customer dynamism (Subsection 6.3.3); their IPPM capabilities are composed of the three dimensions of structures, people and processes (Subsection 6.3.4) and they develop their IPPM capabilities along similar paths, using learning investments for the establishment and evolution of the capability (Subsection 6.3.6).

Other themes show areas of similarity but also include aspects that show industry-related differences. For example, the strong level of importance placed on new products and IPPM is common to both service and manufacturing organisations, and many of the reasons that organisations feel IPPM is important are common; however, some differences exist (Subsection 6.3.2). For example, manufacturing organisations value IPPM more for its ability to help with long-term planning, whereas service organisations feel IPPM is particularly important for helping them respond to the dynamic market environment. In addition, top management support for IPPM is strong in all of the case study organisations; however, IPPM is generally a newer capability in the service-based organisations and the top management seem to play a particularly strong role in driving the establishment and evolution of the capability. IPPM is also shown to have a strong role in shaping and deploying other organisational resources across industries, although resources are more flexible in service industries than in manufacturing industries (Subsection 6.3.5).

One of the main differences between the service-based organisations and the manufacturing-based organisations is the differing levels and types of dynamism and change in the environments. While all of the organisations studied compete in a dynamic environment and are experiencing significant changes in their relationships with customers, the rate of change in the types of products and the underlying technologies are more dynamic in the service-focused organisations (Subsection 6.3.1). Because they don't usually own the technologies they adopt, services are easily copied and lifecycles are short. Managing longer-term technological change, the development of IP and the ownership of patents are more important in the manufacturing organisations. Another area of difference between industry types is the significant difference in the length of time required to develop products and to develop skills and resources necessary for product development. Service products are developed much more quickly than manufactured products, and service-based organisations find it much easier to develop or acquire the necessary skills for their product development projects. The specialist product development skills required in the manufactured product development environments studied take much longer to develop and are not usually available outside the organisation (Subsection 6.3.3). Therefore manufacturing organisations have a longer term planning horizon, and must plan earlier for the development of the specialty skills that are anticipated in the future. Manufacturing organisations are often resource-constrained and are unable to complete some projects due to lack of skills, whereas the service-based organisations can more easily outsource or form partnerships in order to develop products.

There are also differences in the ways that the boundaries are blurring across the tangible-intangible spectrum for the products developed at the case study organisations (Section 6.3.3). While the service-based products include some tangible components, these are generally viewed as enablers or accessories and the service organisations expect to continue to gain most of their revenue from selling services. In contrast, a major shift is becoming evident in the manufacturing-based organisations. These organisations are adding new service features and enhancing existing service aspects of their product offerings, and they expect a continuing trend towards services. Managers at each of the manufacturing organisations expressed their belief that they will be in the service business in the future and that the manufactured products will become the enablers: a necessary component of their offering, but not sufficient for success.

This is an area of great potential for further evolution of IPPM capabilities. As the boundaries between tangible and intangible product offerings become increasingly blurred, managers must consider both aspects in order to select the best portfolio of projects for product development. In particular, the service aspects of manufactured products need to be incorporated into product planning decisions in areas such as estimating costs and benefits, timing, risks and resource usage in order to maximise the revenue streams generated by these products. Customised procedures and processes will need to be developed and, more importantly, a shift in the mindset is required as product manufacturers become more service-oriented.

Conclusion of RQ 2 findings

The in-depth exploration of the IPPM capabilities in both service and manufacturing organisations reveals that the capabilities are largely similar, with some areas of difference between the two environments. Table 6-13 briefly lists the IPPM capability themes where differences are not evident, and Table 6-14 expands on the areas where IPPM capability differences were found between service and manufacturing environments.

Underlying the differences in IPPM capabilities are two main areas of environmental difference: the differing levels and type of technological dynamism in the environments, and the blurring of the boundaries between service and manufactured products. These environmental differences are reflected in IPPM capability differences such as the reasons new products and IPPM are felt to be important, the levels and types of top management support for IPPM and in the IPPM capability's influence on the level of resource flexibility. The identification of areas of difference sharpens the understanding of IPPM capabilities. The fact that the IPPM capability differences are anchored in differences in the levels and types of dynamism in the environment highlights the IPPM capability's role in responding to environmental dynamism. In particular, the findings highlight differences in the ways that IPPM capabilities are used to develop and manage resources. The relationship between the IPPM capabilities and the resource base is explored further in RQ 4 from a dynamic capabilities perspective.

Table 6-13: Summary of IPPM capability themes that are common across industry types

IPPM capability themes that are consistent across the manufacturing and service organisations that participated in the case studies
All of the case study organisations have a clear and focused strategy. They each seek to differentiate themselves through their new product portfolio – and follow a competitive strategy focused primarily on differentiation.
Managers at the case study organisations view IPPM as very important and/or increasingly important.
The case study organisations are expanding their customer focus, and experience greater customer expectation, increased competitive pressures and dynamism in the market.
The IPPM capabilities at each of the case study organisations are composed of structures, people and processes.
IPPM and resources – IPPM capabilities at both types of organisations are used to configure, build and allocate resources for the innovation project portfolio. The IPPM capabilities at each of the case study organisations are credited with helping the organisation manage the number of projects to ensure resource adequacy.
All of the case organisations show evidence of both establishment and evolution activity in their IPPM capabilities, with regular evolution including changes within the past year.
Each of the case study organisations invests in developing their IPPM capabilities through a range of learning activities. These learning activities enhance both tacit and explicit learning mechanisms.
Each of the case study organisations has experienced the 'success trap' and is addressing the imbalance between exploitation and exploration projects through changes to their IPPM capability.

Table 6-14: Summary of areas of IPPM capability difference between industry types

Findings on IPPM capability themes that show differences between the manufacturing and service organisations that participated in the case studies
Technological dynamism and NPD timeframes – *In the case study organisations, services are easily copied and lifecycles are shorter than in manufacturing environments. Technological change is slower and product development takes longer in the manufacturing organisations.* *IPPM processes in service environments are more recently established than in manufacturing environments.*
Service / Manufactured product boundaries – There is blurring of the boundary between manufactured products and service products that is affecting both types of case study organisations. *The effect is stronger in the manufacturing organisations as they are shifting more significantly towards the service end of the spectrum. This shift presents a challenge for IPPM capabilities that have been designed to focus on the manufactured product development projects.* As services become increasingly important in manufacturing environments, the IPPM capabilities may need to be adjusted to ensure adequate consideration of service aspects for product development decisions.
Importance of New Products – Managers at all of the case study organisations believe that new products are important to their long term success. *New products were viewed as more important for short term success in the service industries than in the manufacturing industries. This view is based on the rapid change and shorter product life cycles in the service industries.*
Reasons IPPM is important – Managers at all of the case study organisations place strong importance on their IPPM capability and many of the reasons are common (for example, alignment with strategy, success of the portfolio, pipeline and resource planning) however *manufacturing organisations value IPPM more for its ability to help with long term planning, whereas service organisations feel IPPM is particularly important for helping them respond to the dynamic environment.*
Top Management Support – Top management support is strong in both types of case study organisations. *Top management play a more prominent role in driving the processes in the service-based organisations that participated in the study.*
Resource flexibility and dynamism – IPPM capabilities at both types of case study organisations are used to configure, build and allocate resources for the NPD portfolio; however, *resources and skills for service development are more flexible and dynamic than in manufacturing environments, although manufacturers are now beginning to explore more flexible resourcing models.*

While this study targeted organisations with service product development portfolios to compare their IPPM capabilities with organisations with manufactured product portfolios, the findings show that products at the case organisations contain both service and tangible or manufactured aspects. This blurring of the boundaries between service and manufacturing products is consistently reported and is expected to increase. The changing product landscape has a particularly strong effect on the manufactured product-based organisations. The findings indicate that these organisations will be in the service business in the future, where quality manufactured products are necessary but not sufficient for success. Therefore these organisations will need to develop new ways of working, including making adjustments to their IPPM capability so that the service aspects of manufactured products are considered. This is of critical importance since these manufacturers believe that their ability to differentiate their products and to generate profits will be increasingly based on the service aspects of the product. The evidence indicates that adjustments to the IPPM capability are lagging behind the changes to the environment, with only one of the three manufacturing organisations addressing the changes through changes to their IPPM capability.

6.7.3 RQ 3

RQ 3 asked “*How do IPPM capabilities in Australia and North America compare?*”

RQ 3 was not addressed in Phase 2.

6.7.4 RQ 4

RQ 4 asked “*Can the dynamic capabilities framework be applied to assist in understanding the relationship between IPPM capabilities and competitive advantage?”*

The Phase 2 findings strongly support the use of the dynamic capabilities framework to better understand the relationship between IPPM capabilities and competitive advantage. The dynamic capability framework follows the RBV of strategy and competitive advantage by viewing an IPPM capability as an organisational resource. An organisational routine or capability is a dynamic capability if it contributes to competitive advantage through its ability to integrate, build and reconfigure their resources to compete in dynamic environments (Teece et al., 1997), and through its role in modifying other organisational resources and routines (Zollo and Winter, 2002; Winter, 2003). Phase 2 findings indicate that IPPM capabilities contribute to competitive advantage through the mechanisms identified for a dynamic capability. To address RQ 4, this section summarises the main characteristics and mechanisms of a dynamic capability as presented in the literature and then outlines the case findings on organisational IPPM capabilities following the same structure.

Characteristics of dynamic capabilities identified in the literature are: they allow organisations to respond to changes in dynamic environments (Teece et al., 1997); they can be easy to copy and acquire and often have identified ‘best practices’ (Eisenhardt and Martin, 2000); they must be tailored to the environment (Winter, 2003; Easterby-Smith and Prieto, 2007); they add to competitive advantage as an enabling resource in combination with other organisational resources (Smith et al., 1996; Zollo and Winter, 2002), and they require a sequential order for implementation (Eisenhardt and Martin, 2000).

Teece, Pisano and Shuen (1997) identify a ‘Processes, Positions, Paths’ framework to illustrate the mechanisms used in a dynamic capability to create competitive advantage. In the framework, the dynamic capability’s processes or routines create value by allocating resources and building upon the resource position, and they are shaped by the historical choices and future paths available, as shown in Figure 5.4 in Chapter 5.

Each of these characteristics and mechanisms are evident in the case study findings. Table 6-15 summarises the case study findings with respect to the main characteristics that are used to identify an organisational capability as a dynamic capability. The table classifies each characteristic according to the ‘Processes, Position, Paths’ model, or as a general environmental characteristic. Table 6-15 also lists a primary source(s) of literature that identifies each characteristic; however, all these characteristics are repeatedly identified in multiple sources of literature on dynamic capabilities. Finally, the findings from the case study research are briefly identified, with reference to the relevant section for further detail. These findings are also expanded upon in the following discussion.

Table 6-15: Characteristics of dynamic capabilities and IPPM case study findings

Characteristic of dynamic capability	Sample reference(s)	IPPM capability case study findings illustrating the characteristic
Environmental Characteristic		
Operates in dynamic environments	(Teece et al., 1997)	Customer and technological dynamism (Subsection 6.3.3), blurring between service and manufacturing product boundaries (Subsection 6.3.3).
Process characteristics		
Contains identified 'best practices' and are relatively easy to copy and acquire	(Eisenhardt and Martin, 2000)	IPPM capabilities have similar practices that are aligned with the 'best practice' literature (Subsection 6.3.4).
Must be tailored to suit the environment	(Eisenhardt and Martin, 2000)	IPPM capabilities are developed individually to suit the environment (Subsection 6.3.6) and play a strong role in tailoring product development processes to the environment (Subsection 6.3.4).
Position characteristics		
Does not act alone, requires other resources to deliver competitive advantage	(Smith et al., 1996; Zollo and Winter, 2002)	IPPM capabilities are strongly integrated with and depend upon product development capabilities and the underlying resource base (skills, knowledge, equipment, funding) to deliver competitive advantage (Section 6.5 and Subsection 6.3.4).
Modifies operational routines	(Zollo and Winter, 2002; Winter, 2003)	IPPM capabilities are responsible for initiating, monitoring and controlling product development processes or routines (Subsection 6.3.4), and direct the modification of these routines (Subsection 6.3.4).
Integrates, builds and reconfigures organisational resources	(Teece et al., 1997)	IPPM capabilities effectively allocate resources and help ensure resource sufficiency for projects in the case organisations. They also have a strong role in resource development and in extending the resource base through external partnering (Subsection 6.3.5).
Paths characteristics		
Requires a sequential order of implementation	(Eisenhardt and Martin, 2000)	Findings show that the case organisations follow maturity paths (subsections 6.3.4 and 6.3.6). The OLMM has been developed to illustrate the order of implementation (Section 6.6).
Historical choices and future paths direct capability evolution	(Teece et al., 1997)	Once established, the IPPM capabilities in the cases studied exhibited a trend toward incrementalism resulting in a 'success trap'. This situation has prompted adjustment and evolution of the capability (Subsection 6.3.7).
Must be dynamic and evolve to cater for changes in the environment	(Winter, 2003)	IPPM capabilities undergo regular changes, organisations invest in activities that help their IPPM capabilities evolve to cater for environmental changes (Subsection 6.3.6).

Environment

The dynamism of the organisational environment revealed by the case study investigations supports the applicability of the dynamic capabilities framework. The case findings show that the organisations are experiencing continual changes in their environments from technological change and evolution to increasing levels of change in the markets (Subsection 6.3.3). In addition, by nature a product development environment is an environment of change, as each project is unique and unproven and the resource situation fluctuates with the demands from competing projects and the dynamic environment (Tatikonda and Rosenthal, 2000b; Danneels, 2002). There is a heightened degree of change in the case organisations due to the blurring of the boundaries between the service aspects and the manufactured aspects of the products (Subsection 6.3.3). The case findings clearly illustrate the nature of the dynamism in the case study environments and the challenges this presents for the case organisations and their IPPM capability.

Processes

The case findings also clearly show that IPPM capabilities have identified 'best practices' and can be easy to copy and acquire. This is particularly evident through the experiences of the case organisations that have used similar methods to learn about, implement and evolve their IPPM capabilities (see Subsection 6.3.6). In addition the resulting IPPM capabilities have common elements (see Subsection 6.3.4 and Appendix 7). These findings also reinforce findings from the literature that identify the best practices used in IPPM capabilities (see, for example, Cooper et al., 2004a; Kahn et al., 2006). Although 'best practices' and common elements are found at the case organisations, the findings reinforce findings from the literature (Griffin, 1997; Loch, 2000) and show that each IPPM capability also regularly makes adjustments to tailor the capability to the environment (Subsection 6.3.4).

Position

The case findings show that the underlying resource position of the case study organisations provides the basis for the IPPM capabilities to contribute to competitive advantage. The processes used (Subsection 6.3.4) highlight the role that IPPM plays in allocating resources and illustrate that without an underlying resource base, the IPPM capability would not be able to add value. The product development capability can be seen as an organisational resource that is modified by the IPPM capability. The IPPM capability has a strong influence on the modification of the product development capability (Subsection 6.3.4) as well as control over its deployment through resource allocation and ongoing monitoring (Subsection 6.3.4). The IPPM capability also plays a strong role in building and extending the resource base through alliancing, partnering, or outsourcing (Subsection 6.3.5). A two-way relationship between the IPPM capability and the resource base is identified in the case study findings where the resource base influences and is influenced by the IPPM capability (Subsection 6.3.5).

Paths

The findings of the case study research illustrate several ways that the IPPM capability is influenced by past and future choices. The proposition that an IPPM capability develops along paths over time and that past actions affect future and current developments is strongly supported, and is embodied in the OLMM that has been developed based on the case study findings. The OLMM outlines development paths and order of implementation for component capabilities of an organisational IPPM capability. For example, the antecedent requirement for a PM capability to be established before an organisation can implement an IPPM capability is a finding from the case study research (Subsection 6.3.4) that is reflected in the OLMM (Section 6.6). Another example of a path-dependent evolution of IPPM capabilities is the fact that all of the case organisations have experienced the ‘success trap’ and that their capabilities are evolving further to address the situation (Subsection 6.3.7). Finally, dynamic capabilities must be dynamic themselves in order to remain dynamic capabilities. The case study findings reveal that the case organisation’s IPPM capabilities are undergoing continual evolution in response to changes in the environment (Subsection 6.3.6). This evolution is enhanced by the ongoing investment in learning activities investments at the case organisations, as discussed in more detail in response to RQ 5.

IPPM as a dynamic capability

Following the dynamic capabilities perspective, the case findings have identified multiple characteristics of IPPM capabilities that align with the recognised characteristics of a dynamic capability. In addition, as reported in Subsection 6.3.2, the case study organisations are successful innovators that believe that their IPPM capability is important for their ongoing NPD success. These findings indicate that IPPM capabilities are dynamic capabilities that rely on the underlying resource position and the organisation's past and future paths to create sustainable competitive advantage.

The application of the processes, positions and paths dynamic capabilities framework structure highlights the mechanisms used in an IPPM capability to work with the resource base and build upon past experiences, as well as to look toward future choices to contribute to organisational competitive advantage. Figure 6-6 builds upon Figure 5-4 in Chapter 5 to illustrate relationships between the IPPM processes, the resource position, past and future paths and the development of competitive advantage in a dynamic environment. The model also presents IPPM as a dynamic capability that encompasses the three elements of processes, structures and people as identified in Subsection 6.3.4.

Conclusion of RQ 4

The case study findings strongly support the use of the dynamic capabilities perspective to explain and understand how IPPM capabilities contribute to competitive advantage. This is a major finding that contributes to the literature on IPPM, as well as the literature on dynamic capabilities. The IPPM literature has been shown to be rapidly growing and starting to produce research findings, although it lacks a unifying perspective (see Chapter 2, Subsection 2.3.1). The dynamic capabilities perspective provides a framework that supports the findings of the current case study as well as previous IPPM research as shown in Chapter 5, Section 5.3. This framework identifies the mechanisms through which an IPPM capability contributes to competitive advantage. The literature on dynamic capabilities has also been growing and research is now generating findings on specific organisational capabilities that act as dynamic capabilities to illustrate the theories and propositions on dynamic capabilities. The findings presented here strengthen the understanding of dynamic capabilities by illustrating the ways that an IPPM capability can act as a dynamic capability.

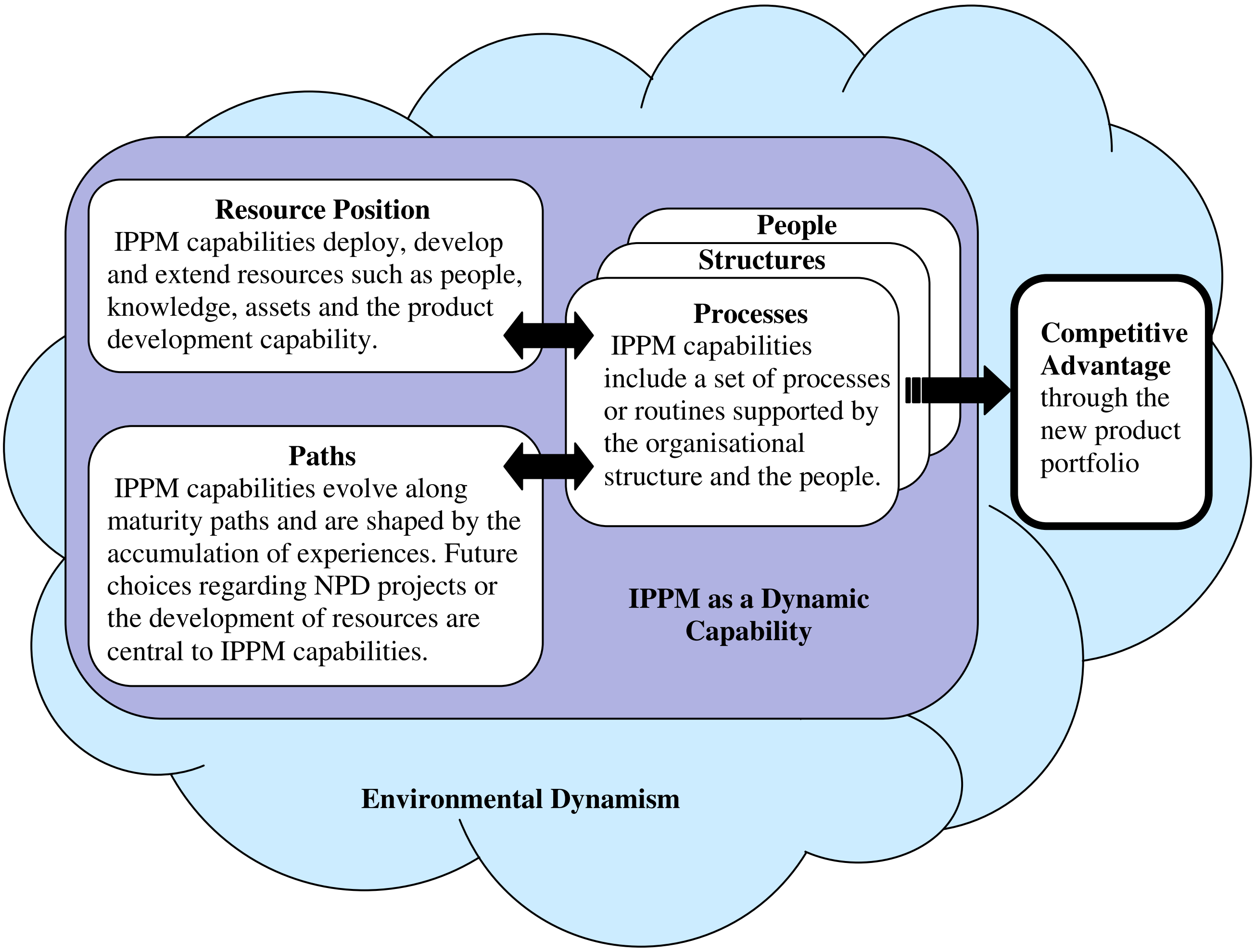

Figure 6-6: An IPPM capability as a dynamic capability illustrating the processes, positions and paths framework

6.7.5 RQ 5

RQ 5 asked "*How are IPPM capabilities developed?*" The final major area of exploration for the in-depth case study was to understand how IPPM capabilities are developed. The findings presented in this chapter provide information on how IPPM capabilities develop, how they are established and evolve over time, and the types of investments organisations make to develop their IPPM capabilities. In addition, the identification of IPPM as a dynamic capability enables this study to draw on the growing literature on the development of dynamic capabilities to improve the understanding of IPPM capability development. This literature and the case study findings highlight the role of organisational learning processes in the establishment and evolution of dynamic capabilities like IPPM. Table 6-16 summarises the main findings from the in-depth case studies on the development of IPPM capabilities and links these findings to theories and findings from previous research.

The findings on the development of IPPM capabilities overlap with the findings that identify IPPM as a dynamic capability, particularly in the identification of areas of path dependency.

Through the case study findings, organisational learning is shown to have a large role to play in the establishment and continual evolution of IPPM capabilities in response to the dynamic competitive environment. As outlined in the previous section addressing RQ 4, IPPM capabilities have been identified as a dynamic capability. As summarised in Table 6-16, the case study findings support the proposition that dynamic capabilities co-evolve through a combination of tacit and explicit learning mechanisms, and that investments in organisational learning activities are regularly used to enhance these learning mechanisms (Zollo and Winter, 2002). The findings also indicate relationships between establishment and evolution of IPPM and type of learning investments (Subsection 6.3.6).

Table 6-16: Case study findings on IPPM capability development

Theory or finding from literature	Source(s)	Findings from IPPM case studies (section where findings are detailed)
Organisational learning is a 'second-order' dynamic capability due to its role in shaping 'first-order' dynamic capabilities.	(Winter, 2003; Cepeda and Vera, 2007)	Organisational learning processes are shown to evolve the IPPM capabilities through both purposeful investments in learning activities (Subsection 6.3.6) and through the unintended consequence of accumulated experiences (Subsection 6.3.7).
Dynamic capabilities co-evolve through tacit experience accumulation, explicit knowledge articulation and explicit knowledge codification. Learning investments can amplify these learning mechanisms.	(Nonaka, 1994; Zollo and Winter, 2002)	Organisations regularly invest in activities that enhance all three learning mechanisms to develop their IPPM capabilities. Their IPPM capabilities are shown to co-evolve through the combination of the three learning mechanisms (Subsection 6.3.6). The findings indicate that investments in tacit experience accumulation and explicit knowledge codification are particularly important for the establishment or for making major changes to an IPPM capability (Subsection 6.3.6).
IPPM capabilities evolve along maturity paths with required antecedent capabilities	(Kleinschmidt, 2006; Crawford, 2007)	Case study findings summarised in the case summaries (Section 6.2) and in the overview of capability development and evolution (Subsection 6.3.6) show the evolution paths and the prior implementation of antecedent capabilities. These findings are embodied in the OLMM used to analyse IPPM maturity in the case organisations (Section 6.6).
Organisational learning processes can lead to a 'success trap' where accumulated decision making experiences favour exploitation over exploration.	(March, 1991)	The 'success trap' is evident in the case study findings. It seems to be a symptom of unintended IPPM capability evolution and has prompted purposeful IPPM capability evolution (Subsection 6.3.7).

The case study findings also demonstrate how organisational learning can be seen as a higher order dynamic capability due to its role in the establishment and evolution of

IPPM. This relationship is illustrated in Figure 6-7 where IPPM is identified as a first-order dynamic capability through its role in shaping the operational product development capability. Organisational learning is therefore identified as a second-order dynamic capability for its role in the ongoing development of the IPPM capability. Some sources identify product development as a dynamic capability due to its role in allocating and configuring organisational resources through product development projects (Eisenhardt and Martin, 2000; Salvato, 2003). However, product development has been identified as an operational capability in the model to support the case study findings that indicate that the sources of dynamic responsiveness and development of the product development capability reside primarily in the IPPM capability rather than in the product development capability.

All of the organisations show relatively strong performance in the regular evolution of their IPPM capabilities, but only one organisation uses explicit feedback mechanisms to incorporate organisational learning into the process as outlined in the OLMM. This finding indicates that the evolution of the IPPM capabilities at the remaining organisations is a result of processes, which may be quite informal, that are not captured on the OLMM. This raises questions about what processes are at work, how formal they are, whether they provide a reliable mechanism for ongoing capability development, and what actions organisations can take to enhance these processes. Further research to better understand informal processes for IPPM capability evolution should aim to address these questions. Based on such research, it may be possible to make improvements the OLMM to better identify and recognise learning capabilities.

Conclusion of RQ 5

The case study findings indicate that organisational learning capabilities are behind the ongoing change and evolution of the IPPM capabilities evident at all the case study organisations. An organisational learning capability is therefore viewed as a higher order dynamic capability that influences the development of the IPPM capability. Purposeful organisational learning investments direct the establishment and evolution of capabilities by enhancing three learning mechanisms: tacit experience accumulation; explicit knowledge articulation and explicit knowledge codification. In addition, experience accumulation can unintentionally lead to a 'success trap' where exploitation decisions are favoured over exploration decisions, resulting in an imbalance in the project portfolio. This path-dependent situation is shown to prompt further evolution of the IPPM capability to address the imbalance. The case study findings also provide detail about the establishment and evolution of IPPM capabilities over time, revealing maturity paths and required antecedents that have been captured in the OLMM. However, the findings indicate that the OLMM does not capture the full set of feedback mechanisms that contribute to the development of IPPM capabilities. Further research is indicated to better understand the full range of formal and informal feedback mechanisms at play in the evolution of IPPM capabilities.

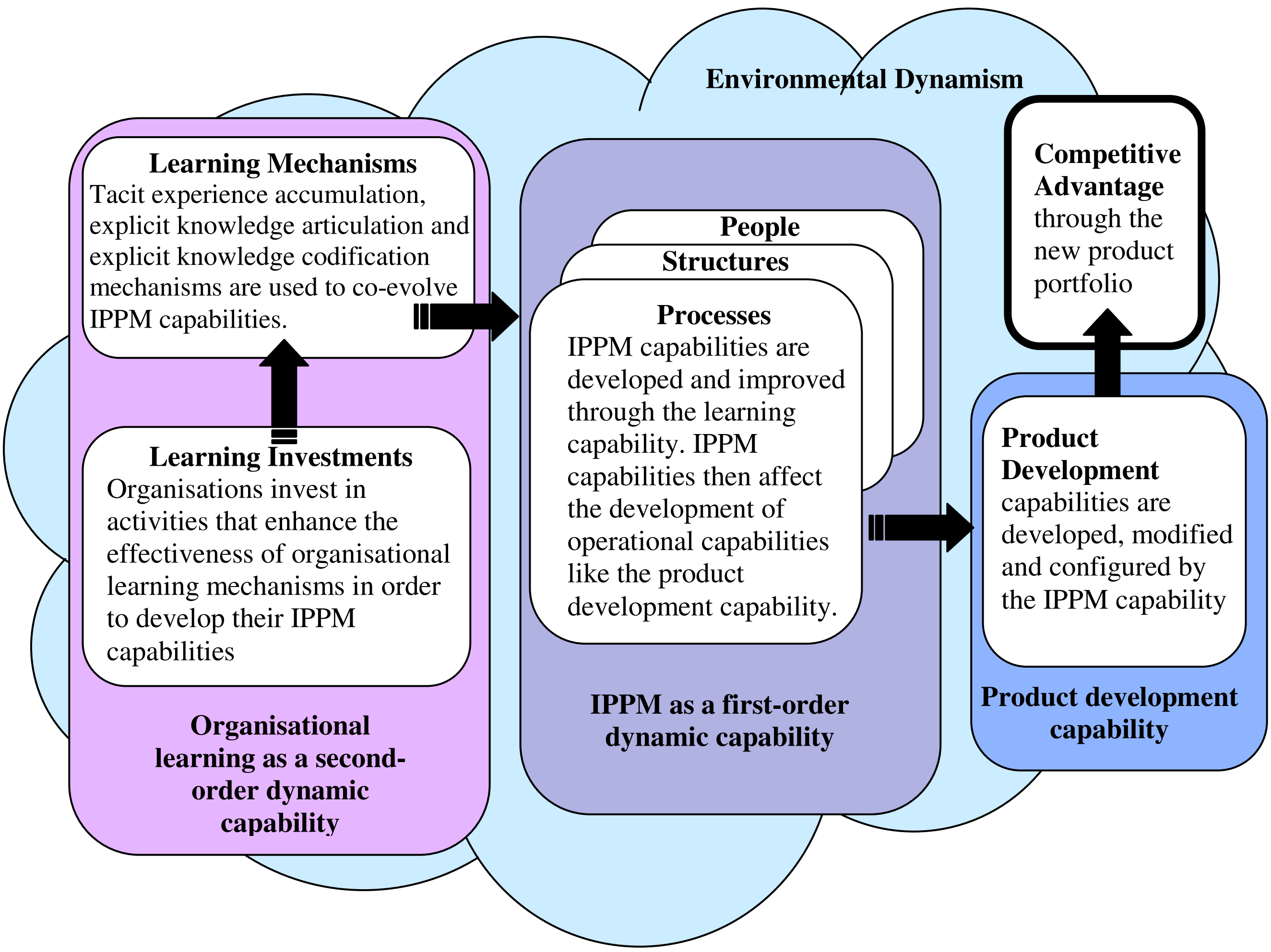

Figure 6-7: Organisational learning as a second order dynamic capability

6.8 Chapter summary

The multiple-case study phase of research has produced in-depth findings that identify IPPM capabilities as dynamic capability and improve the understanding of the relationship between IPPM capabilities and competitive advantage. The main findings from this section are summarised in Table 6-17 in relation to the research questions.

The identification of IPPM as a dynamic capability provides a framework to understand and further analyse the IPPM capabilities. These findings highlight the role of organisational learning and purposeful investment in learning activities in the development and evolution of IPPM capabilities. Organisations that place importance on IPPM are shown to invest strongly in the learning activities and have higher IPPM maturity.

The primary research question guiding this research is:

> "What is the relationship between an organisation's IPPM capability and its ability to establish sustainable competitive advantage through improved new product outcomes?"

Table 6-17 outlines the main findings from the qualitative phase of research. The multiple-case study research method, incorporating primary and embedded cases, provides a deep level of understanding of the organisational environment and the entire set of organisational capabilities that comprise an IPPM capability. As outlined in Table 6-17, the findings address the research questions and enhance the understanding of IPPM capabilities and their relationship to an organisation's ability to establish sustainable competitive advantage.

Further discussion of these findings is reserved for the final chapter, where a comparative examination of the literature and the results from both phases of the research is compiled and presented.

6.8.1 Contributions of this chapter

The most significant contribution from the case study findings presented in this chapter is the identification of IPPM as a dynamic capability in response to RQ 4. This finding links this enquiry with a growing body of literature investigating dynamic capabilities, their establishment and evolution through organisational learning and their relationship to sustainable competitive advantage. The findings on IPPM capability evolution in response to RQ 5 are strengthened by the use of the dynamic capabilities framework and form another valuable contribution from this phase of the research.

Another major goal of this research is to compare IPPM capabilities across service and manufacturing environments. The case study method has enabled in-depth exploration into the environments and reveals several areas of difference between IPPM capabilities across these industry types, however there is a surprising level of similarity in the processes used and the overall maturity level of the capabilities. The findings provide insight into the areas of difference in IPPM capabilities and indicate that most of the differences are related to the differing types and levels of dynamism between service and manufacturing environments. This finding highlights the role in IPPM capabilities in responding to dynamic environments and shows how the IPPM capabilities are tailored for the environment.

This chapter also proposes several conceptual models based on the case study findings. These models assist with understanding IPPM capabilities and will help guide further research in this area. The most significant are highlighted here. Findings in response to RQ 1 highlight the relationship between the level of importance placed on IPPM and the level of maturity of the IPPM capability through the use of increased investments in developing the capability. A model representing the bounds of an IPPM capability is presented in Figure 6-4 in Section 6.5. This model includes a wider range of capabilities and considerations than is traditionally incorporated in IPPM research and may be useful in guiding future IPPM capability research. Another related model using a dynamic capabilities perspective to illustrate the relationship between organisational learning capabilities, IPPM capabilities and product development capabilities is presented in Figure 6-7. These models each contribute to the understanding of IPPM capabilities and their relationship with competitive advantage through new products.

Each of these models will require further research to test and validate or improve the models.

Table 6-17: Main findings from Phase 2

Research Question	Main findings from qualitative phase of research
1- What is the relationship between IPPM capabilities and New Product Outcomes?	Improved understanding of IPPM capabilities and factors that are proposed to be related to new product outcomes. Proposed relationship between factors of IPPM importance and IPPM maturity with the introduction of a new factor, the level of investment in developing the IPPM capability.
2- What is the relationship between IPPM in service and manufacturing NPD environments?	Service- and manufacturing-based organisations have largely similar IPPM capabilities. Differences in the types of organisational dynamism, the level of flexibility in resources, and the way that the boundaries between service and manufactured products are blurring underpin areas of difference in the IPPM capabilities.
3- How do IPPM practices in Australia and North America compare?	Not addressed in this phase
4- Can the dynamic capabilities framework be applied to assist in understanding the relationship between IPPM capabilities and competitive advantage?	The use of the dynamic capabilities framework is highly supported and findings clearly indicate that IPPM acts as a dynamic capability in the case organisations. IPPM capabilities deploy, develop and extend the resource base and are influenced by past experiences as well as future choices as they evolve to contribute to organisational competitive advantage.
5- How are IPPM capabilities developed?	Organisational learning processes are highlighted as a second-order dynamic capability. Organisations regularly invest in purposeful learning activities to develop their IPPM capabilities. The Outcomes and Learning-based Maturity Model (OLMM) highlights the importance of incorporating learning elements in the IPPM capability to ensure it evolves to remain relevant in the dynamic environment.

Finally, this research included the initial development of a maturity model (the OLMM) based on the case study findings. This model incorporates organisational learning capabilities and explicitly addresses the capabilities required for an IPPM capability to effectively address the balance between exploitation and exploration projects. Initial testing of this model indicates that it may be useful for organisations to evaluate their IPPM capabilities and to identify areas for development of the capability. Further use and refinement of the model is suggested.

Chapter 7 Conclusions and implications

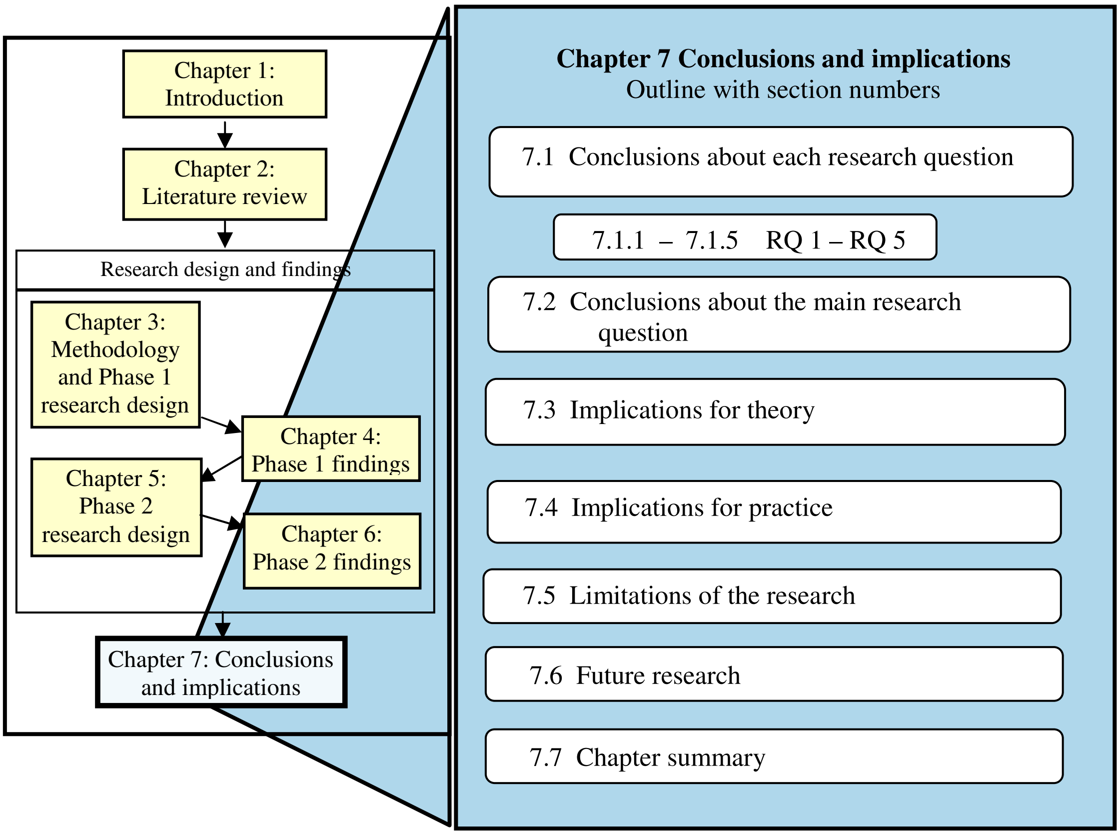

Figure 7-1: Chapter 7 outline within overall thesis structure

Following the structure illustrated in Figure 7-1, this final chapter compiles the findings from the two phases of research, presenting conclusions about each of the five specific research questions and drawing together the findings to address the main research question.

The aim of the research – investigating the relationship between IPPM capability, competitive advantage and new product outcomes – was introduced in Chapter 1. The literature review in Chapter 2 identified five research questions to drive the research. A sequential mixed-method research study with a quantitative phase followed by a qualitative phase was justified and outlined in Chapter 3, which also presented the design of Phase 1, a quantitative survey. Chapter 4 presented the findings from the questionnaire survey in Phase 1 and addressed each of the research questions.

Considerations for Phase 2 were identified based on the findings of Phase 1. Following an extended literature review to support Phase 2 of the research, the design of the multiple-case study method was described in Chapter 5. These findings were presented in Chapter 6, culminating with a discussion on the contribution of the Phase 2 findings to each of the research questions.

7.1 Conclusions about each research question

Each of the research questions focuses on an aspect of the main research question to build understanding of the relationship between an organisation's IPPM capability and its ability to establish sustainable competitive advantage through improved new product outcomes. The literature review that underpins this study also contributes to the understanding – it is the first review to bring together the literature related to IPPM comprehensively.

The findings for each research question from the two phases of the research have been presented in chapters 4 and 6. The sequential mixed-methodology has enabled each phase to contribute to the understanding, and provides a more reliable result than could be achieved with only one of the phases. This section draws overall conclusions about the findings for each research question based on both phases of research, and places the findings in the context of the literature.

7.1.1 RQ 1

RQ 1 asked "*What is the relationship between an organisation's IPPM capability and its new product outcomes?*" This question is central to much of the IPPM research conducted to date. The majority of prior research from both quantitative and qualitative studies indicates a positive relationship between formal structured IPPM capabilities and better outcomes (see, for example, Cooper et al., 1999; Ernst, 2002; McDonough and Spital, 2003; Cooper et al., 2004a; Cauchick Miguel, 2008), with best outcomes achieved when IPPM capabilities are tailored to the unique requirements of each situation (Loch, 2000).

The findings from both the quantitative and qualitative phases of this study, outlined in Section 4.2 3 in Chapter 4 (Phase 1) and Section 6.7.1 in Chapter 6 (Phase 2), support previous research findings and extend the understanding of the relationship between an organisation's IPPM capability and new product outcomes. In combination, the findings from the two phases build upon each other in addressing RQ 1 and extend the existing understanding as presented in the literature by:

- identifying a new factor in the relationship between IPPM capabilities and new product outcomes
- illustrating relationships between the use of specific IPPM methods and product portfolio outcomes (PPO)
- illustrating the multiple dimensions of an IPPM capability
- supporting the use of multiple types of outcome measures to understand PPO.

These four aspects are discussed individually below.

Identifying a new factor in the relationship between IPPM capabilities and new product outcomes

The research identified explanatory relationships between the level of importance placed on the IPPM capability, the level of maturity of the capability and PPO in Phase 1. An extension to these relationships is suggested in Phase 2, where the level of investment in learning and capability development provides the mechanism for the level of importance placed on the IPPM capability to lead to increased maturity of the IPPM capability. The findings from phases 1 and 2 suggest a new conceptual model, as shown in Figure 7-2. This model builds upon the model in Figure 4-4 (Chapter 4) and the findings presented in Subsection 6.7.1 (Chapter 6).

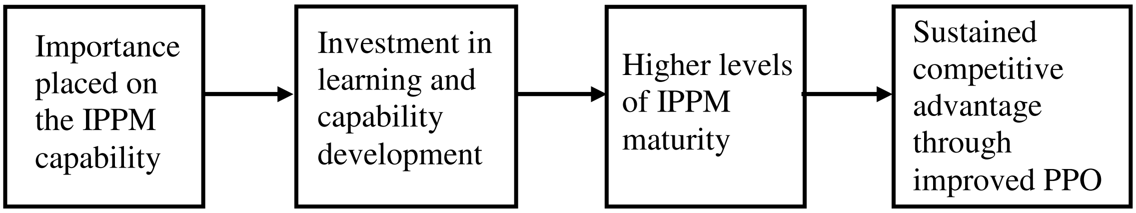

Figure 7-2: Conceptual model on IPPM capability importance, learning, maturity and PPO

This model proposes that the level of importance placed on the IPPM capability influences the level of investment in activities that enhance learning mechanisms and contribute to IPPM capability building. This in turn may lead to higher levels of IPPM maturity that may lead to sustainable competitive advantage through improved PPO. The new factor, the level of investment in learning and capability development, could therefore be an important success factor for IPPM. This factor has not been identified in previous IPPM-related literature (such as Griffin, 1997; Cooper et al., 2001; Jeffery and Leliveld, 2004) and further research is required to determine whether it is a success factor and to test the model in Figure 7-2.

Illustrating relationships between the use of specific IPPM methods and product portfolio outcomes (PPO)

Phase 1 highlighted the importance of strategic IPPM methods and criteria and showed how strategic methods make the strongest contribution to improved PPO. Phase 2 supported and extended these findings by illustrating the use of strategic filtering methods in all of the case organisations and the dominance of these methods along with financial measures in all organisations. In addition, Phase 1 shows that the use of financial measures as the dominant factor for IPPM decisions is correlated with the weakest outcomes – a finding supported by Phase 2, which found that none of these successful innovators considers financial measures in isolation.

Phase 1 findings highlight the weakest area of IPPM performance as the ability to ensure that the portfolio contains the ‘right number of projects’ to fit with resource demands. None of the methods in Phase 1 showed any significant correlation with performance on achieving the ‘right number of projects’ (refer to Section 4 of Appendix 4), indicating that further research could aim to identify or develop methods for organisations to improve performance on this measure. In contrast, Phase 2 findings show a relatively high level of performance on the goal of the ‘right number of projects’ (see Figure A7-1 in Appendix 7). The Phase 2 organisations credited the IPPM capability with their ability to effectively limit the number of projects, although no specific method was indicated as leading to this result. These findings confirm the need to better understand how organisations can use their IPPM capability to limit the number of projects in the portfolio (Cooper, 2002a; Engwall and Jerbrant, 2003).

Illustrating the multiple dimensions of an IPPM capability

A deeper understanding of the bounds of an IPPM capability developed through Phase 2 is presented in the model in Figure 6-4 in Chapter 6. In this model an IPPM capability – the overall organisational ability to manage the innovation project portfolio and maximise its contribution to the success of the organisation – is shown to consist of:

- a set of processes and methods that are tailored to suit the environment
- the organisational structures that support the process
- human dimensions such as the culture and the level of support for the IPPM capability.

This model includes a wider range of capabilities and considerations than is traditionally incorporated in IPPM research. This model may be useful in guiding further research, and further testing and validation of this model is suggested.

Supporting the use of multiple types of outcome measures to understand product portfolio outcomes (PPO)

Phase 1 extended the types of PPO measures used to evaluate IPPM capability outcomes by measuring 13 variables across three types of PPO measures, as outlined in Section 4.2.3 in Chapter 4. The findings provide support for the use of a variety of indicators to measure IPPM outcomes. Phase 2 findings on the PPO measures for the six successful innovators align well with the higher performing band of Phase 1 ratings, as outlined in Figure A7-1 Appendix 7. This alignment provides further support for the appropriateness of these indicators in measuring PPO. This research suggests further investigation of the use of extended measures of new product outcomes in order to best evaluate the contribution of the IPPM capability to organisational outcomes through the new product portfolio.

In summary, this research shows that an organisation's IPPM capability consists of supporting organisational structures and human dimensions in addition to the processes and methods used. The research builds on and supports prior research by indicating positive relationships between aspects of IPPM capabilities and new product outcomes. The level of investment in learning and capability development is identified through this research as a new factor in the relationship between IPPM capabilities and outcomes. The findings propose a relationship where organisations that consider IPPM important and that make investments to develop and improve the IPPM capabilities have higher levels of IPPM maturity and improved new product outcomes, as illustrated in the model above in Figure 7-2.

7.1.2 RQ 2

RQ 2 asked "*How do IPPM capabilities in service and manufacturing NPD environments compare?*" The findings of both phases of the research combine to produce the first overview of IPPM capabilities in service product development environments, and to highlight the similarities and differences between IPPM capabilities across manufacturing and service environments.

The increasing importance and prevalence of NPD project investments in service environments (OECD, 2000; Edwards and Croker, 2001) indicates that IPPM for service product development is an increasingly important organisational capability. However, IPPM research to date has focused on manufactured product development environments. Although the literature indicates that IPPM capabilities share common elements and may be transferable across industries (Cooper et al., 2004a; Center for Business Practices, 2005; Maizlish and Handler, 2005), it also emphasises that IPPM capabilities must be developed over time and tailored to the environment to be most effective (Reinertsen, 1997; Loch, 2000). Service environments represent an unexplored set of challenges to which IPPM capabilities need to be tailored. Therefore, the enhanced understanding of IPPM capabilities in service industries provided by this research fills a significant gap in the literature and will help service organisations tailor their IPPM capabilities to their environments.

The findings on the comparison of IPPM capabilities between service and manufacturing environments are presented in Section 4.2.4 of Chapter 4 (Phase 1) and Section 6.7.2 of Chapter 6 (Phase 2). The findings indicate that the processes and methods used for IPPM are largely similar between manufacturing and service environments, while highlighting areas where differences are observed.

The combination of the findings from the two phases provides an increased level of depth and understanding that is not achieved from either phase alone. The main areas of difference between the two environments are:

- differences in how recently IPPM capabilities have been established in manufacturing and service environments
- differences in the level of teamwork used in manufacturing and service environments
- differences related to the differing types and levels of dynamism in the two environments
- differences related to the differing levels of resource flexibility in the environments

- differences in the ways that the boundaries between manufactured and service products are blurring.

These five areas of difference are discussed individually below.

Differences in how recently IPPM capabilities have been established in manufacturing and service environments

IPPM capabilities are more recently established in service environments, but maturity levels are similar across both environments. This finding is confirmed by both phases of the research. Because IPPM maturity is thought to develop over time (O'Connor, 2004; Kahn et al., 2006), the finding that IPPM capabilities are newer in service organisations would be expected to align with findings of lower levels of IPPM maturity. However, both phases of the research showed similar levels of IPPM maturity across the two environments. This finding raises the question of how and why IPPM capabilities that are more recently established in service organisations may be at a similar level of maturity to longer-established capabilities in manufacturing environments. While Phase 1, with its quantitative approach and larger sample size, provides statistically-based support for the findings on length of IPPM establishment compared with maturity levels, the question of 'how' and 'why' was addressed through the in-depth qualitative research in Phase 2. The in-depth understanding of the environment shows that, although IPPM is newer in service organisations, it is driven more strongly from the top levels of the organisation than IPPM capabilities at manufacturing organisations. The IPPM capability in service organisations is valued particularly for its ability to enable response to the dynamic environment. The service organisations have been able to come up a steeper learning curve and develop their IPPM capabilities relatively quickly – this may be due to the drive from top management.

Differences in the level of teamwork used in manufacturing and service environments

Both service and manufacturing NPD environments use teams for making IPPM decisions. However, Phase 1 findings indicate that cross-disciplinary teamwork and input is more central to manufactured product NPD processes, and the use of teams and associated team-based IPPM tools is more prominent in manufacturing organisations. Phase 2 findings show consistent and strong use of cross-disciplinary teams by the successful innovators in both environments – providing support for the association between innovation success and cross-disciplinary teamwork found in other research (see, for example, Griffin, 1997; Thieme et al., 2003; Söderlund, 2005).

Differences related to the differing types and levels of dynamism in the two environments

Phase 2 findings show that, although both service and manufacturing organisations report increasing levels of dynamism in their environments, service organisations operate in particularly dynamic environments with shorter product lifecycles, rapid environmental changes and products that are easier for others to copy. The IPPM capabilities at service organisations reduce risk by promoting shorter projects that can respond quickly to environmental changes. This finding highlights the role of IPPM capabilities in responding to dynamic environments and illustrates one of the ways that IPPM capabilities are tailored for the environment.

Differences related to the differing levels of resource flexibility in the environments

Phase 2 findings show that organisations in both service and manufacturing industries report increasing use of flexible resourcing options such as partnering, outsourcing, alliancing or contracting. They expect that the use of such strategies will continue to grow. Such flexible resourcing opportunities are still very limited in manufacturing organisations and are only just beginning to be used in a small percentage of projects. In contrast, service organisations use flexible resourcing options as a central part of their NPD strategy. The ready availability and transferability of resources for service product development projects intensifies the level of competition as organisations are less likely to own rare, valuable or proprietary resources that will protect the products they develop from rapid copying.

Differences in the ways that the boundaries between manufactured and service products are blurring

Both phases of the research highlight that many organisations do not consider themselves as purely service-product or manufactured-product providers. Indeed, their portfolios contain both types of products or products that represent a mix of manufactured and service (or tangible and intangible) components. Phase 2 findings indicate that the blurring of the boundaries is affecting the manufacturing organisations particularly strongly. Each of the manufacturing-based organisations say that they are now in the service business or will be soon, whereas the service-based organisations remain clearly focused on the delivery of services even though an increasing percentage of their product offerings have a tangible or manufactured component.

In summary, the IPPM capabilities in service and manufacturing environments are largely similar, with the main processes and dimensions of the capability common across environments. The areas of difference highlighted by both phases of research increase the understanding of the environments and how IPPM capabilities are tailored to meet organisational and industry differences. IPPM capabilities in service environments have special challenges due to the dynamism in the market and technologies, short product lifecycles and the ability for product to be imitated or copied easily. IPPM in manufacturing environments face a different set of challenges in managing relatively inflexible resources in a dynamic competitive environment and managing the trend toward an increasing service focus in their product offerings.

Due to the challenges posed by the blurring of the boundaries between service and manufactured products, researchers propose that manufacturing organisations need to adjust their strategy and develop better integration between project and business processes in order to most effectively manage the transition (Gann and Salter, 2000; Auguste et al., 2006). Phase 2 findings confirm these challenges and illustrate one example where processes are being altered to address these challenges by integrating a service offer development process into the product development process.

This is an important and under-researched aspect of IPPM capabilities and further research on service-related IPPM is warranted, especially as many managers in manufacturing environments feel that they are moving to becoming service providers. This issue is discussed further in section 7.2.

7.1.3 RQ 3

RQ 3 asked "*How do IPPM capabilities in Australia and North America compare?*" RQ 3 was addressed in Phase 1 where North American data that correspond to the Australian data were available for comparison. The findings are outlined in Section 4.2.5 in Chapter 4. In summary, a high level of similarity was found between responses to IPPM survey questions in Australia and North America, indicating that the IPPM capabilities and outcomes in these two regions are largely comparable. The findings from Phase 1 are therefore strengthened by these findings supporting prior North American research findings.

Because differences in regional environments can influence innovation processes, they must be taken into consideration before findings from one country are applied to other regions (Harzing and Hofstede, 1996; Lee et al., 2000; Garrett et al., 2006). The findings from this research reinforce the cultural clustering of Australia and North America with respect to IPPM practices, and indicate that findings from the Australian IPPM research may be relevant in North America and possibly also in other countries in the same Anglo-Celtic cluster (Harzing and Hofstede, 1996; Hofstede, 1997).

7.1.4 RQ 4

RQ 4 asked *"Can the dynamic capabilities framework be applied to assist in understanding the relationship between IPPM capabilities and competitive advantage?"* The findings clearly identify the dynamic capabilities framework as an appropriate perspective for developing a deeper understanding of the relationship between IPPM capabilities and competitive advantage. Using the dynamic capabilities framework, an IPPM capability is viewed as a source of competitive advantage through its ability to build, reconfigure and allocate resources and to modify operational capabilities to respond to the dynamic environment. The Phase 2 findings support the identification of IPPM as a dynamic capability though the 'processes, positions, and paths' framework (Teece et al., 1997), as outlined in Subsection 6.7.4 of Chapter 6. An IPPM capability is shown to have a two-way relationship with resources, by both deploying and developing capabilities, and to exhibit path dependencies in the ways that they develop over time and are modified through experiences and through choices about future options and opportunities.

The identification of IPPM as a dynamic capability is significant for several reasons. Most importantly:

- The dynamic capabilities framework provides an understanding of the mechanisms that enable the IPPM capability to lead to competitive advantage.
- The dynamic capabilities framework provides a framework that helps to unify the existing literature as well as future research on IPPM capabilities.
- The findings link the study of IPPM capabilities with a growing set of literature investigating dynamic capabilities, their establishment and evolution through organisational learning, and their relationship to sustainable competitive advantage. This literature is also strengthened by the addition of IPPM capability as an example of a specific organisational capability that acts as a dynamic capability (Eisenhardt and Martin, 2000).

RQ 4 addressed an exploratory area for IPPM research and was adjusted during the process of this research. Based on the observation that the existing literature on IPPM is fragmented and lacks a unifying theoretical basis, RQ 4 was initially stated as *"Can theories or frameworks be developed or used to better understand the relationship between IPPM capabilities and competitive advantage?"* Phase 1 highlighted the importance of strategy and strategic alignment in IPPM capabilities, indicating that strategic frameworks may be appropriate. An extended literature review conducted after Phase 1 identified the RBV and, in particular, the dynamic capabilities framework as promising theoretical approaches that may address the understanding of the relationship between IPPM capabilities and competitive advantage. RQ 4 was therefore restated to focus on dynamic capabilities during Phase 2.

In summary, the findings provide a resounding ‘yes’ to this research question: the dynamic capabilities framework is shown to be very useful in understanding the relationship between IPPM capabilities and competitive advantage.

7.1.5 RQ 5

RQ 5 asked “*How are IPPM capabilities developed?*” The findings on IPPM capability evolution in response to RQ 5 are another valuable contribution from this research. These findings are strengthened by the identification of IPPM as a dynamic capability and the findings, in turn, strengthen the body of literature on the development of organisational capabilities, in particular dynamic capabilities.

The role of organisational learning is clearly shown. Phase 1 highlights the importance of IPPM maturity and raises questions about how IPPM capabilities in service environments have reached a similar level of maturity to manufacturing environments in a shorter period of time. Findings from Phase 2 build on these findings and highlight the role of organisational learning in IPPM capability development. Organisational learning is evident in purposeful efforts to establish or evolve the IPPM capability through investments in activities that enhance both tacit and explicit organisational learning mechanisms. Organisational learning is also evident in the unintentional capability evolution that can result from the accumulation of experiences. This unintentional learning can lead to a ‘success trap’ where exploitation decisions are favoured over exploration decisions, resulting in an imbalance in the project portfolio (Levinthal and March, 1993; March, 1994). This path-dependent situation is observed in each of the case study organisations and is shown to prompt further purposeful evolution of the IPPM capability to address the imbalance

At first glance, the high level of ongoing change and adjustment observed in the IPPM capabilities at the case study organisations is surprising; however, the application of the dynamic capabilities framework justifies and explains the ongoing evolution as part of the functioning of a dynamic capability. A dynamic capability must change and evolve in response to environmental dynamism in order to remain effective (Teece et al., 1997; Eisenhardt and Martin, 2000). Dynamic capabilities depend upon the organisational learning capabilities that enable the organisation to identify, evaluate and implement these changes (Zollo and Winter, 2002; Wang and Ahmed, 2007). Therefore dynamic capabilities such as IPPM capabilities exist in conjunction with organisational learning capabilities that act as 'higher order' dynamic capabilities through their ability to modify the lower order capability (Winter, 2003).

The increased understanding of the role of organisational learning in IPPM capability establishment and ongoing evolution as a result of this research contributes to the overall understanding of the processes and stages of IPPM capability development. This understanding has been used to develop the 'Outcomes and Learning-based Maturity Model' (OLMM) for IPPM capability development based on maturity paths and required antecedents. The OLMM explicitly recognises the importance of change and evolution and incorporates organisational learning capabilities. It also explicitly addresses the capabilities required for an IPPM capability to effectively achieve a balance between exploitation and exploration projects. Initial testing of this model indicates that it may be useful for organisations to evaluate their IPPM capabilities and to identify areas for development of the capability, and further testing of the model is suggested.

In summary, organisational learning capabilities enable IPPM capabilities to develop and evolve in response to the environment. In this way IPPM capabilities can remain dynamic and sustainably contribute to competitive advantage. The findings of the research show how learning investments can enhance the development of IPPM capability. Based on these findings an initial version of a maturity model (the OLMM) has been developed to help organisations analyse their IPPM capability and to identify areas for improvement.

7.2 Conclusions about the main research question

The findings related to the five research questions discussed in the previous section each address an aspect of the main research question. This section draws the major findings together to directly address the main research question:

> "What is the relationship between an organisation's IPPM capability and its ability to establish sustainable competitive advantage through improved new product outcomes?"

The findings of this research provide evidence of the relationship between an organisation's IPPM capability and its ability to establish sustainable competitive advantage through improved new product outcomes. One aspect of the findings is the development of in-depth understanding of IPPM capabilities and the use of several measures of PPO to understand the relationship between the IPPM capabilities and outcomes, as summarised in the findings for RQ 1 above. The findings for RQ 2 and RQ 3 provide detail of how this relationship compares between service and manufacturing environments and between North American and Australian environments, and show that IPPM capabilities are largely similar across these environments. The findings that address RQ 2 provide insights into the environments and the IPPM capabilities in service product development environments. The findings from RQ 4 support the identification of IPPM capabilities as dynamic capabilities and use Teece, Pisano and Shuen's (1997) 'processes, positions and paths' framework to illustrate mechanisms through which the IPPM capability contributes to competitive advantage. Finally, the findings from RQ 5 show how organisational learning capabilities contribute to the establishment, evolution and development of IPPM capabilities, and highlight the importance of capability development in a dynamic capability like an IPPM capability.

This section focuses on the findings, spread across several of the research questions, related to aspects of the IPPM capability that enable it to provide 'sustainable' or long-term competitive advantage. For sustainable competitive advantage to be established, the findings from RQ 4 and RQ 5 combine to show how IPPM capabilities can be dynamic capabilities that are able to adjust to meet changing requirements in a dynamic environment. Phase 1 findings emphasise the strategic emphasis of IPPM capabilities. The dynamic capabilities framework and the findings from Phase 2 provide enhanced understanding of the ways that the IPPM capability deploys − as well as builds − the resource base, responds to dynamic environments, and is built over time following past paths and considering choices about future paths. As a dynamic capability, the role of organisational learning in the development and evolution of the IPPM capability is highlighted by the findings. Organisational learning mechanisms, aided by investments in learning activities, are shown to help the IPPM capability evolve in response to the dynamic environment and thus to remain relevant and able to help establish sustainable competitive advantage through new products.

In addition, sustainable success through new products requires a balance between 'exploration and exploitation' projects. The literature indicates that exploitative innovation, following established paths and exploiting existing capabilities, can deliver competitive advantage to an organisation for only a limited period of time. For sustainable competitive advantage through new products, organisations must also employ exploratory innovation processes that extend their capabilities and explore new areas (Danneels, 2002; Benner and Tushman, 2003). Therefore an important role of the IPPM capability is to ensure that the innovation project portfolio contains a mix of new product projects that exploit current capabilities and those that develop new capabilities (Cooper et al., 2001). In addressing RQ 1, findings from both phases of the research show that performance on the IPPM goal of balance in the portfolio is generally weak and that the imbalance is caused by too many incremental 'exploitative' projects and too few longer-term 'explorative' projects. The findings from RQ 2 confirm that this imbalance persists across both manufacturing and service product development environments, and the findings from RQ 3 confirm that this imbalance is also an area of weak IPPM performance in North American studies.

Investigations of the dynamic capabilities concept and the application of the 'processes, positions and paths' framework to the understanding of IPPM capabilities in response to RQ 4 provide further detail of the mechanisms of the capabilities. Due to the path-dependent nature of IPPM decision-making, each of the organisations in Phase 2 has experienced a 'success trap', where the accumulation of experiences is thought to be responsible for a trend where 'exploitation' projects are favoured over 'exploitation projects' (Levinthal and March, 1993). This trend is attributed to exploitation decisions being more frequent, providing feedback on the level of success more quickly and having a higher success rate than the longer-term and riskier exploration projects (March, 1991).

The Phase 2 findings also show how the IPPM capabilities have evolved or are evolving to address the imbalance between 'exploitative' and 'explorative' innovation projects and further reinforces the dynamic nature of IPPM capabilites. Investigations of the evolution of IPPM capabilities, in response to RQ 5, reveal that organisations regularly invest in activities that enhance learning and contribute to the development of the capabilities to meet changing requirements. While the IPPM capabilities in the case organisations are thought to contribute to the 'success trap', each of the organisations invests in learning activities to enable its IPPM capability to address the resulting imbalance between 'exploitation' and 'exploration' in the project portfolio.

Contributing to sustainable competitive advantage is a goal of the 'Outcomes and Learning-based Maturity Model' (OLMM) initiated as part of this research. The OLMM's initial use was to evaluate the level of maturity of the IPPM capabilities in Phase 2 in response to RQ 1. It was also developed to capture the evolution paths and antecedent capabilities for IPPM capability evolution based on findings from investigations into RQ 5. An important feature of the OLMM is the inclusion of organisational learning capabilities and explicit attention to the IPPM capabilities that will assist in balancing exploration and exploitation projects. Further testing and development of the model is suggested, with a goal of enabling the OLMM to help organisations build an IPPM capability that delivers sustainable competitive advantage.

Finally, the ability of the IPPM capability to deliver sustainable competitive advantage is highlighted by the research that encompasses both service and manufacturing product development environments. Prior IPPM research has focused on manufactured product environments; however, the growing importance of service products and the blurring of boundaries between service and manufactured products mean that IPPM capabilities are increasingly being required to operate effectively for service product development projects, even in manufacturing industries. This research indicates that IPPM capabilities are just beginning to evolve to reflect the shift toward 'embedded services' or 'service-enhancements' in manufactured product environments, and that further change and evolution will be required for the IPPM capabilities to contribute to sustainable competitive advantage in this dynamic environment.

In summary, this research indicates a positive relationship between a mature and valued IPPM capability and an organisation's ability to establish sustainable competitive advantage through new products. It strongly supports the use of the dynamic capabilities framework to understand the relationship between IPPM capabilities and competitive advantage. This finding contributes to the literature on IPPM, as well as to the emerging body of literature on dynamic capabilities. As a dynamic capability, an IPPM capability can create value by modifying operational capabilities, by allocating resources, and by developing and configuring the resource base in response to dynamic environments. IPPM capabilities have a particularly important role to play in managing the balance of 'exploitation' and 'exploration' projects required for sustainable competitive advantage through new products. The research also finds that an organisational learning capability is an important component of sustainable competitive advantage. Organisational learning enables the IPPM capability to evolve in response to changes in the environment and thus continue to act as a dynamic capability.

7.3 Implications for theory

As emphasised in the findings for RQ 4, a significant finding from this research is the identification of IPPM as a dynamic capability. This finding has strong implications for the use of theoretical frameworks to improve the understanding of IPPM capabilities in the future. Identifying IPPM as a dynamic capability adds to the dynamic capabilities literature by providing, first, an example of a specific organisational capability acting as a dynamic capability and, second, a link to the existing research on IPPM that can form evidence to further the understanding of dynamic capabilities (Eisenhardt and Martin, 2000). Identifying IPPM as a dynamic capability also opens up a new perspective and a growing body of literature on dynamic capabilities that can be used to evaluate and understand IPPM capabilities. For example, the literature on organisational learning and dynamic capability development has been used to analyse and understand the use of learning investments in the evolution of IPPM capabilities in this research (Zollo and Winter, 2002; Cepeda and Vera, 2007). Two modes of capability development have been identified through the research, and an analysis of the use of the three types of tacit and explicit learning mechanisms identified by Zollo and Winter (2002) has been used to understand the different learning emphases during these two modes. The identification of these two different modes of capability development, establishment and evolution, contributes to the existing dynamic capabilities theory.

This is the first study that identifies IPPM capabilities as dynamic capability, which consequently allows existing research to be viewed through the dynamic capability lens, but, more importantly, provides a theoretical underpinning that may influence future research. Earlier authors have identified related capabilities such as product development and resource allocation routines (Eisenhardt and Martin, 2000), knowledge management (Prieto and Easterby-Smith, 2006; Cepeda and Vera, 2007), and adaptive strategic routines (Salvato, 2003) as dynamic capabilities[1]. Therefore the identification of IPPM as a dynamic capability builds upon the existing logic in the dynamic capabilities literature. The body of research into IPPM capabilities is increasing as it has become an established, identifiable and strategically important organisational capability across multiple industries (Dye and Pennypacker, 1999; Cooper et al., 2001; Jeffery and Leliveld, 2004; De Reyck et al., 2005; Dye, 2006; Lowe, 2006). The increasing importance and visibility of IPPM means that the identification of IPPM as a dynamic capability has the potential to make a large impact by improving understanding of IPPM capabilities and by guiding future research.

In summary, the identification of IPPM as a dynamic capability has two main implications for theory. First, the theories and understanding behind the dynamic capabilities approach can be used to influence and enhance understanding from existing as well as future research on IPPM capabilities. Second, it provides a valuable example of a dynamic capability and access to a growing body of literature and research on IPPM that furthers the understanding and development of the dynamic capabilities framework.

7.4 Implications for practice

There is strong awareness and interest in improving IPPM capabilities among project and portfolio management practitioners, as evidenced by increases in the literature as well as by strong practitioner interest in the outcomes of this research. Research shows strong commonalities among portfolio management capabilities across different project

[1] In addition, a forthcoming publication has been obtained that identifies ‘portfolio planning’ as a dynamic capability, providing further support for the identification of IPPM capabilities as a dynamic capability. See Newey, L R and Zahra S A (in press) The Evolving Firm: How Dynamic and Operating Capabilities Interact to Enable Entrepreneurship. *British Journal of Management* Special Issue: Dynamic Capabilities.

environments, and that learnings can be shared across environments. Findings from this research provide benefits to managers and practitioners interested in IPPM, and also to those who want to understand dynamic capabilities and their development. The interest in this research has extended beyond the NPD-focused IPPM environments, and many of the benefits apply to other PPM environments. Through regular speaking invitations, the ongoing progress and findings from the research have been disseminated in practitioner-focused forums such as industry conferences (Marcus Evans Product Portfolio and Branding Conference 2005, IIR IT PPM conference 2007), and industry-based seminars (Innovative Technology Network Seminar 2005, New South Wales State and Regional Development Breakfast 2006, Project Management Institute (PMI) Breakfast 2007). In addition, a chapter on the human factor in IPPM has recently been published in a practitioner-focused book on the human dimensions of innovation (Killen et al., 2008).

The implications of the research for management and practice derive from four main avenues:

- the development of a model representing the overall IPPM capability. Managers gain improved understanding of the scope of IPPM capabilities through the model (Figure 6-4 in Chapter 6) illustrating the processes, structures and people dimensions and the linkages with product development processes. This provides benefits by enabling managers to better identify, understand and improve their IPPM capabilities. This model has already been cited as a valuable outcome of the study and “very useful for illustrating our processes [to the board]” by managers at one of the case study organisations [MAT].

- the provision of a benchmark and guidance on specific IPPM processes and methods. As this benchmark is the first to document IPPM capabilities in Australia, and the first to include service product-focused portfolios, it provides a unique snapshot of the IPPM landscape in these two previously unexplored environments. Due to the growing importance and investments in service product development, this benchmark provides a particularly valuable resource to practitioners in this area.

- the provision of guidance on the types of organisational learning investments that enhance the establishment and evolution of IPPM capabilities, with potential for broad impact on management and practice. The findings provide guidance to managers seeking to establish or improve IPPM or PPM capabilities. The types of investments used to enhance the organisational learning that underpins IPPM capability development are outlined in this research with specific examples that make the findings accessible to practitioners. The findings may also assist management understand how learning activities improve other organisational capabilities.

- the initial development of the OLMM. The learning and evolution of IPPM capabilities is captured in the OLMM and it provides an overview of the stages, interdependencies and development paths for IPPM capabilities that may help managers analyse and plan improvements for their IPPM capabilities. The OLMM also includes specific capabilities to help organisations design an IPPM capability that helps the organisation achieve a balance between 'exploitation' and 'exploration' capabilities in their project portfolio and to avoid the 'success trap', thus enhancing their ability to achieve sustainable competitive advantage through new products.

7.5 Limitations of the research

Phase 1 is based on a sample of 60 respondents across diverse industries and Phase 2 is based on a sample of six organisations. Although the research was designed to allow cross-industry comparisons, the findings may not be generalisable to other organisations. In addition, the research was conducted over a relatively short period of time at each organisation, and therefore the findings related to the longer-term development and evolution of IPPM capabilities may not be as accurate as could be achieved through a longitudinal study. Section 3.6 in Chapter 3 and Subsection 5.6.5 in Chapter 5 provide a more detailed discussion of the limitations of the research and how these limitations have been addressed.

7.6 Future research

The findings of this research highlight several potential directions for future research. These research opportunities relate to the study of IPPM capabilities as well as other areas of innovation capability, and to the further development of the theories of dynamic capabilities and capability development through organisation learning. The pragmatic approach of this research suggests the potential of both quantitative and qualitative studies. Future research opportunities fall into three main areas related to the main findings of this research.

Dynamic capabilities and capability evolution – for IPPM capabilities and other organisational capabilities

This research is the first to identify IPPM capabilities as a dynamic capability and, as research and interest in IPPM capabilities continue to grow, the possibilities for future investigations of IPPM as a dynamic capability are broad. Such studies could take a quantitative or a qualitative approach and could target particular industries or certain dimensions or components of the IPPM capability. The model of an organisational IPPM capability presented in Figure 6-4 in Chapter 6 could be used to guide the identification and selection of IPPM capability dimensions or components for a targeted study.

The findings on IPPM capability development suggest future longitudinal research to better understand the development of IPPM capabilities and the role of investments in learning activities, their influence on the effectiveness of learning mechanisms and the resulting changes to the IPPM capabilities and outcomes. The model of organisational learning as a second-order dynamic capability in Figure 6-7 of Chapter 6 may be useful to guide an in-depth study into IPPM capability development. The types of relationships illustrated in this model may also be applicable to the development of other dynamic capabilities, opening up another potential area for further research.

Understanding IPPM capabilities in service environments or in 'service-enhanced' manufacturing environments

The findings of this research develop an established theme in IPPM research: improving understanding of how IPPM capabilities can be tailored to suit different environments. In particular, this research has provided an initial understanding of IPPM capabilities in service product development environments and how they compare with manufacturing environments.

This research has also highlighted the blurring of the boundaries between manufactured and service offerings, and the fact that manufacturing focused organisations are increasingly becoming service providers with the manufactured products as enablers of services rather than the primary product. This is an area of great importance that is under ongoing development and evolution. Future research in this area would be of great value to illustrate and track the evolution of 'service enhancements' to manufactured product offerings, for which longitudinal research is suggested. In addition, studies could investigate any adjustments to IPPM capabilities or product development processes in order to cater to the shifting environment; this could be part of a longitudinal study, or it could be done in a cross-sectional study employing either case study investigations or survey-based research.

Testing and validation of proposed models

Several conceptual models and a maturity model have been proposed based on the findings from this research. Large-scale quantitative studies are suggested for testing and validation of some of these models. Models that may lead to large-scale quantitative studies include the model in Figure 7-2 that proposes a new IPPM capability success factor, the level of investment in learning and capability development. The model in Figure 6-7 in Chapter 6 illustrates a similar mechanism that could benefit from further testing – it uses the dynamic capabilities framework to show how learning investments can contribute to IPPM development and lead to competitive advantage through the new product portfolio. Finally, the initial version of an 'Outcomes and Learning-based Maturity Model' (OLMM) developed and used as part of this research project will require further testing to assess its effectiveness evaluating and improving organisational IPPM capabilities and enhancing organisational ambidexterity. In-depth research into the aspects of the IPPM capability that enable organisations to balance their project portfolios and limit the number of projects could be used to improve the OLMM and enable it to guide organisations in achieving these goals.

In summary, the findings from this research indicate several areas for future research, ranging from large scale quantitative studies to test proposed models, to longitudinal case studies to track the development of IPPM capabilities, to practice-based testing of the OLMM. Future research could be guided by the dynamic capabilities framework and organisational learning perspectives. In the particularly important and unexplored area of service product development IPPM capabilities, future research should aim to extend the initial findings of this study and to understand the evolving nature of 'embedded services' or 'service-enhanced' manufacturing project environments and the implications for IPPM capabilities. Finally, further studies that test the OLMM in practice are suggested to refine its usefulness in helping organisations evaluate and improve their IPPM capabilities, especially their ability to avoid the 'success trap' when they implement IPPM capabilities.

7.7 Chapter summary

A sequential mixed methodology enabled this research to produce statistically significant findings and to develop in-depth understanding of IPPM capabilities. This chapter has summarised the findings from both phases of research and highlighted areas for future research. The research has investigated the relationship between IPPM capabilities, new product outcomes and sustained competitive advantage, building on prior research and extending the research to include an area of growing importance: IPPM in service product development environments. The findings include evidence of the blurring of the boundaries between service and manufactured products – and indicate continuing challenges in developing IPPM capabilities that evolve to cater for the shifting product environments.

This research uses the dynamic capabilities framework to explain and understand the relationship between IPPM capabilities, the resource base and competitive advantage, and in doing so makes a broad contribution to the ongoing development of the dynamic capabilities framework. Following the dynamic capabilities framework, this research recognises the importance of learning mechanisms in developing capability maturity and contributing to competitive advantage. This research shows how unintentional organisational learning mechanisms can contribute to the 'success trap', where exploitation projects are favoured over exploration projects, and how purposeful organisational learning investments can enable the IPPM capability to respond and evolve to redress the imbalance. Conceptual models are proposed that illustrate the relationship between learning processes and an IPPM capability's ability to contribute to competitive advantage. Finally, this research contributes to practice through the initial development of the OLMM as a tool for evaluating and improving IPPM capabilities. Feedback mechanisms for learning and capability improvement in the OLMM aim to facilitate the creation of dynamic and responsive IPPM capabilities that will remain relevant in changing environments. The OLMM also aims to guide organisations in maintaining a balance of exploitation and exploration projects for sustainable competitive advantage through new products.

Based on empirical findings and the application of the dynamic capabilities framework and organisational learning concepts, this two-phase study improves the understanding of the relationship between an organisation's IPPM capability and its ability to establish sustainable competitive advantage through improved new product outcomes. The study also contributes to the ongoing development of this area by providing frameworks to unify and guide future research.

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Appendix 1

Annotated literature review of the empirical research related to IPPM

This appendix provides a summary of empirical research on IPPM methods and outcomes, presented in international refereed journals and conference proceedings. Some articles focus on IPPM capability research, while other studies present findings related to IPPM from a broader perspective.

The empirical evidence presented in this section includes benchmark studies, surveys and multiple-case study research. While the PPM and IPPM literature provides many single case examples, most adopt a limited perspective to show an application of a proposed method. Most of these single case studies are not viewed as 'empirical evidence' for the purposes of this review; however, some comprehensive single case studies have been included if their research methods are robust and the findings make a contribution to the understanding of IPPM capabilities.

This appendix does not include literature reviews or bibliometric analyses, it does not include theoretical papers, and it does not include papers that develop and document processes and methods, except where case studies are included.

Note: In the references cited, several terms are used to refer to PPM and IPPM practices. Terms like 'multi-project management' and 'portfolio planning' are found in the literature and used in some cases in this review. In general, however, this literature review uses the standard terminology adopted for the thesis, referring to 'PPM' for research not specific to product development projects and 'IPPM' for research that is dedicated to product development projects, or at least includes a large proportion of product development projects in the study.

Andersen, E S and Jessen, S A (2003) ***Project maturity in organisations. International Journal of Project Management,*** **21 (6), 457-461.**

> **Survey of 59 managers.** Development and partial validation of a model of project maturity in organisations. The model includes a ladder from project management, to program management to portfolio management. Three dimensions of Attitudes, Knowledge and Action are evaluated for each level. The survey supports some of the relationships proposed in the model, but significance and number of data points are low. In addition it is not clear how the different aspects of attitude, knowledge and action are evaluated at each level.

Blichfeldt, B S and Eskerod, P (2008) Project portfolio management - there's more to it than what management enacts. ***International Journal of Project Management,*** **26 (4), 357-365.**

> **128 in-depth interviews in 30 companies conducted over 2 years.** Exploratory study into the consequences of PPM for project work. Findings suggest that a shortcoming of many PPM processes is that the portfolio often covers a subset of ongoing projects, and resources allocated to projects outside the portfolio can affect the resources available for the portfolio. These findings highlight the tradeoffs between including all projects in the portfolio and keeping the portfolio focused or contained.

Blomquist, T and Muller, R (2006) Practices, roles, and responsibilities of middle managers in program and portfolio management. ***Project Management Journal,*** **37 (1), 52-66.**

Muller, R and Blomquist, T (2006) Governance of program and portfolio management: Middle managers' practices in successful organisations. ***PMI Research Conference*****, Montreal, July 16-19.**

> **Semi-structured interviews with 11 managers from 5 organisations and a web-based survey with 242 survey responses**. Investigation of how project type and organisational complexity determine middle managers' roles and responsibilities, and their use of PPM practices. Findings show that higher complexity leads to the use of specific PPM practices and that the use of software is low. PPM managers are found to split their time between PPM and other management roles, suggesting that PPM research may benefit from including the wider project management context.

Brown, S L and Eisenhardt, K M (1997) The art of continuous change: Linking complexity theory and time-paced evolution in relentlessly shifting organizations. ***Administrative Science Quarterly,*** **42 (1), 1-34.**

Eisenhardt, K M and Brown, S L (1998) Time pacing: competing in markets that won't stand still. ***Harvard Business Review*****, 76 (2), 59-69.**

> **Multi-project Innovation in six organisations** in the computer industry (extension of the research to 12 organisations for the 1998 paper). Successful IPPM practices in these organisations show that management of the relationships and timing between multiple product development projects is important for success and that project management capabilities are required to support IPPM. Managing the transition between projects and the flow of projects over time must be done with a vision of all projects and their relationships across the portfolio. In addition, portfolio decisions are aided by low cost probes into the future.

Cauchick Miguel, P A (2008) Portfolio management and new product development implementation: A case study in a manufacturing firm. ***International Journal of Quality & Reliability Management,*** **25 (1), 10-23.**

> **Single case study** of IPPM in a manufacturing organisation in Brazil. Data were gathered through participation in portfolio meetings, interviews and document analysis. The study found that portfolio management was implemented using a framework which employed a scoring system and qualitative information, and it provides an example of portfolio management practices as identified in the literature.

Center for Business Practices (2005) *Project portfolio management: A benchmark of current practices*. Haverstown, PA, Center for Business Practices.

Benchmark survey of 64 project management practitioners. Results indicate that organisations with mature PPM practices perform consistently better in all phases of PPM (inventory, analysis, planning, tracking, review) and are more likely to have a central repository to capture project information and make portfolio decisions. Almost all organisations think PPM is important (97%) but only 64% have a PPM process in place. Executive support is seen as important for implementing effective PPM; however, there is no standard practice as to which organisational unit is responsible for PPM.

Christiansen, J K and Varnes, C (2008) From models to practice: Decision making at portfolio meetings. *International Journal of Quality and Reliability Management,* 25 (1), 87-101.

Single case study to examine the decision-making behaviour in IPPM meetings on innovation projects, using a theoretical framework derived from sociology. The findings indicate that decision-making is shaped by multiple competing factors and decision processes involved making appropriate decisions rather than making rational decisions.

Combe, M W (1999) Project prioritization in a large functional organization, in Dye, L D and Pennypacker, J S (Eds.) *Project portfolio management: Selecting and prioritising projects for competitive advantage.* Havertown PA, Center for Business Practices, pp. 363-369.

Single case study of PPM in a large life insurance organisation. Highlights the importance of the existence and communication of a clear, tangible strategy for IPPM success and shows that project management processes are required before IPPM implementation. Suggests that everyone in the organisation needs to be responsible for the achievement of strategy and that project outcomes should be measured in terms of business benefits and not project-related criteria.

Coombs, R, McMeekin, A and Pybus, R (1998) Toward the development of benchmarking tools for R&D project management. *R&D Management,* 28 (3), 175-186.

Fieldwork in six business units in ICI and five companies from other industries. Developed a benchmarking and audit model for the process of R&D project management that presents three different models for different types of projects. The three variants reflect the fact that R&D projects take place in different circumstances and have different objectives. Identifies IPPM methods – such as alignment with strategy and regular reviews to ensure alignment – are important for all project types, and suggests that formal IPPM decision-making and review is most appropriate for known technologies and product areas. A more streamlined process is suggested for 'major impact' new product processes or project to create new platforms.

Cooper, R G, Edgett, S J and Kleinschmidt, E J (1997a) Portfolio management in new product development: Lessons from the leaders – I. *Research Technology Management,* 40 (5), 16-28.

Cooper, R G, Edgett, S J and Kleinschmidt, E J (1997b) Portfolio management in new product development: Lessons from the leaders – II. *Research Technology Management,* 40 (6), 43-52.

In-depth exploratory investigation of 35 organisations. Purposeful selection of leading manufacturing-based organisations to study IPPM practices and performance – not designed to produce statistically valid relationships. Findings reveal three common goals for IPPM: to maximise the value of the portfolio, to achieve the right balance and mix of projects, and to link the portfolio to the business strategy. Identified common methods such as a stage-gate NPD processes and financial, strategic, ranking and scoring methods. Common problems include low success rates for innovation projects, stretched resources affecting project performance, and difficulties in terminating poor projects. Results published in a set of two papers.

Cooper, R G, Edgett, S J and Kleinschmidt, E J (1998) Best practices for managing R&D portfolios. *Research Technology Management,* 41 (4), 20.

Cooper, R G, Edgett, S J and Kleinschmidt, E J (1999) New product portfolio management: Practices and performance. *Journal of Product Innovation Management,* 16 (4), 333-351.

Survey of 205 organisations on their IPPM practices and performance. The performance of the IPPM process is evaluated through user-perceived measures and correlated with the detail on the methods used. Findings reveal a statistically significant relationship between more formal IPPM processes and the performance measures. Among the specific findings is the revelation that, although financial measures are the most common method used, they are not the best method to use as primary selection criteria. Bubble diagrams or portfolio maps and strategic methods have stronger links to successful IPPM outcomes. Confirms that best outcomes are achieved through hybrids or composites of multiple methods, rather than any single method alone. Highlights the tendency for too many short-term low-risk projects and for resources to be stretched causing project cycle time problems – and the need for better IPPM approaches. The 1998 publication presents a cluster analysis dividing organisations into four quadrants – Cowboys, Crossroads, Duds and Benchmark businesses.

Cooper, R G, Edgett, S J and Kleinschmidt, E J (2000) New problems, new solutions: Making portfolio management more effective. *Research Technology Management,* 43 (2), 18.

Multiple-case study of 40 organisations chosen to represent typical companies known to be actively addressing IPPM issues. Continuation of earlier investigations into IPPM practices and performance in industry. Includes anecdotal discussions of pipeline gridlock, too many projects and a lack of methods to trim projects and the lack of solid information for portfolio decisions. Organisations regularly report too many small, short-term low- risk projects and not enough long-term projects with high potential. Outlines methods to integrate gates into the IPPM process.

Cooper, R G, Edgett, S J and Kleinschmidt, E J (2004a) Benchmarking best NPD practices - II. *Research Technology Management,* 47 (3), 50.

Cooper, R G, Edgett, S J and Kleinschmidt, E J (2004b) Benchmarking best NPD practices - I. *Research Technology Management,* 47 (1), 31-43.

Cooper, R G, Edgett, S J and Kleinschmidt, E J (2004c) - Benchmarking best NPD practices - III." *Research Technology Management,* 47 (6), 43.

Five site visits plus a survey with 105 responses. Investigation into NPD best practices that also incorporates questions on seven IPPM practices. Performance is highest on alignment with strategy and lowest in achieving a balance of project types. The study also highlights IPPM-related NPD issues such as the importance of planning and early stage processes and the need for decision points to be effective in terminating projects when necessary. Results published in a series of three papers, with the second paper focusing on the IPPM aspects of the study.

Cormican, K and O'Sullivan, D (2004) Auditing best practice for effective product innovation management. *Technovation,* 24 (10), 819-829.

Survey of eight senior research and development managers and case outlines of two organisations. Survey is used to identify the critical success factors for effective product innovation management (PIM) and development of a best practice model and scorecard. Poor IPPM capability is identified as one of the four main reasons for PIM failure. Balancing the portfolio, alignment to strategy and product idea screening are highlighted as important factors. Includes an outline of implementation of the model in two organisations.

Crawford, L, Hobbs, B and Turner, J R (2006) Aligning capability with strategy: Categorising projects to do the right project and to do them right. ***Project Management Journal,*** **37 (2), 38-50.**

Nine focus groups and 119 responses to an online questionnaire to develop a framework for understanding and categorising categorisation of project types. Categorising projects is shown to help determine priority for PPM and to help guide the resource planning for the projects.

Dawidson, O (2004) Expectations to be fulfilled by R&D project portfolio management. ***11th International Product Development Management Conference,*** **Dublin, Ireland, June 20-22, pp. 331-346.**

Dawidson, O (2005) Project portfolio management at SCA, tissue AFH - process and tools. ***12th International Product Development Management Conference,*** **Copenhagen, Denmark, June 12-14.**

In-depth case study of a business unit of one organisation involving 16 respondents. The many different expectations for IPPM found within the organisation are distributed among several business units. The authors propose that organisations implementing IPPM should try to understand and map the expectations across the relevant business units. In addition, they suggest that more importance should be placed on expectations that are shared among several organisational units, even if those expectations are not of a particularly high importance in any single unit. The 2005 paper is a continuation of the study and outlines the use of multiple tools and methods. Findings confirm that no one method or tool is best, but that a combination of tools is able to fulfil the multiple goals and expectations for IPPM.

De Reyck, B, Grushka-Cockayne, Y, Lockett, M, Calderini, S R, Moura, M and Sloper, A (2005) The impact of project portfolio management on information technology projects. ***International Journal of Project Management,*** **23 (7), 524-537.**

Survey of 31 IT organisations to understand the relationship between PPM adoption and IT project outcomes. Three levels of PPM adoption are identified and the correlation with improved outcomes is established although significance and sample size is low. A phased PPM implementation process is proposed; however, the authors acknowledge that it is not necessary to implement all aspects of PPM to obtain benefits and that each organisation should identify and implement appropriate PPM methods.

Dietrich, P (2006) Mechanisms for inter-project integration - empirical analysis in program context. ***Project Management Journal,*** **37 (3), 49-61.**

Multiple Case study of four companies involving 33 interviews. Within-case and cross-case analyses revealed 15 integrating mechanisms used for multiple project management. The mechanisms focus on how people meet and communicate and are divided into formal and informal group mechanisms, formal and informal personal mechanisms and informal impersonal mechanisms. Findings suggest that all of these mechanisms are important for integration, and that the best use of the mechanisms will depend upon the particular PPM environment and context.

Dietrich, P and Lehtonen, P (2005) Successful management of strategic intentions through multiple projects - reflections from empirical study. ***International Journal of Project Management,*** **23 (5), 386-391.**

Empirical survey of 288 organisations analysing practices that organisations use in managing development projects (both product development and internal projects). Several success factors are found related to both single- and multiple-project management. In contrast with other research, the formality of the decision-making processes is not linked to success or failure on average. In some organisations this research indicates that formality may be quite positive or negative, and the appropriate or effective level of formality may depend upon the situation. The linkage between strategy process and project management, as well as the availability of high-quality information, are identified as success factors.

Dwyer, L and Mellor, R (1991) Organizational environment, new product process activities, and project outcomes. ***Journal of Product Innovation Management,*** **8 (1), 39-48.**

Survey of 74 Australian organisations on NPD processes and outcomes for 95 different new products (all manufactured products). A conceptual model is verified relating organisational characteristics to proficiency of NPD activities and to outcomes. IPPM-related activities such as initial screening and preliminary analyses of technologies and business cases are linked with success, although causality is not determined.

Dye, R (2006) Improving strategic planning: A McKinsey survey. ***McKinsey Quarterly,*** **(3).**

Survey with 796 responses from worldwide executives. The highest priority among survey respondents is to improve company alignment with the strategic plan. Findings show that activities may not be aligned even when a formal strategy is in place, and respondents highlight the need for an activity such as PPM that explicitly links operations to strategy.

Elonen, S and Artto, K A (2003) Problems in managing internal development projects in multi-project environments. ***International Journal of Project Management,*** **21 (6), 395-402.**

In-depth study of PPM in two case organisations through interviews, workshops and a survey. The study focuses on portfolios of internal performance improvement projects and the challenges in a multi-project environment. Findings show a wide range of factors that contribute to problems beyond the commonly cited process- and method-related factors. These other factors include unclear roles and responsibilities, a lack of resources, low levels of support or commitment and poor information flow.

Engwall, M and Jerbrant, A (2003) The resource allocation syndrome: The prime challenge of multi-project management? ***International Journal of Project Management,*** **21 (6), 403-409.**

Qualitative research including two in-depth case studies. The case organisations were selected to investigate contrasting multi-project environments. Findings show common approaches for multi-project management across the diverse environments and that both organisations were absorbed in ongoing resource allocation issues and experienced a shortage of resources. Causes of the 'resource allocation syndrome' are attributed to a range of organisational factors revealing that resource measurement and understanding are weak, and that political games exacerbate the problem.

Eskerod, P, Blichfeldt, B S and Toft, A S (2004) Questioning the rational assumption underlying decision-making within project portfolio management literature. ***PMI Research Conference*****, London, 11-14 July.**

Qualitative research of 32 organisations, including 126 interviews, workshops and other data to explore how companies manage their project portfolios. NPD as well as IT and other projects are included in the study. The findings highlight that although rational decision-making processes are presumed in most PPM literature they are not the only type of decision-making processes used. The research identifies the use of a combination of decision-making perspectives and suggests that the entire spectrum of decision-making perspectives be acknowledged and understood.

Farrukh, C, Phaal, R, Probert, D, Gregory, M and Wright, J (2000) Developing a process for the relative valuation of R&D programmes. ***R&D Management,*** **30 (1), 43-54.**

Single case, action research. This paper outlines the development of a practical approach for R&D project selection and application within a manufacturing company (aerospace industry). The approach shows no evidence of mathematical optimisation or programming methods. The findings support the development of company-specific IPPM processes to meet each company's unique needs.

Frick, S E and Shenhar, A J (2000) Managing multiple projects in a manufacturing support environment. ***IEEE Transactions on Engineering Management,*** **47 (2), 258-268.**

> **Five case studies, qualitative research,** in manufacturing industries. Findings suggest that multiple-project management requires different skills than single project management. Single project success factors of ownership, staff experience and communication are stronger success factors in multi-project environments. Other success factors for IPPM include prioritisation, division and assignment of resources, and flexible customisation of management style.

Hart, S, Jan Hultink, E, Tzokas, N and Commandeur, H R (2003) Industrial companies' evaluation criteria in new product development gates. ***Journal of Product Innovation Management,*** **20 (1), 22-36.**

> **Survey of 166 managers in manufactured product development environments** to understand what criteria are used at decision gates in a stage-gate NPD process, which is an important part of the IPPM process. Findings show that different criteria are used at different gates, and suggest that gate criteria should be aligned with goals of each stage. Marketing and customer considerations are prevalent at all gates, emphasising the importance of keeping in touch with the changing voice of the customer. Portfolio managers can benefit from the increased understanding of gate criteria used.

Kahn, K B, Barczak, G and Moss, R (2006) Perspective: Establishing an NPD best practices framework. ***Journal of Product Innovation Management,*** **23 (2), 106-116.**

> Development of an NPD Best Practices Model **based on previous benchmarking studies** by Griffin (1997) and Cooper et al. (2004a, 2004b). IPPM is one of six areas for NPD best practices identified in the model. This paper does not present empirical research, but uses empirical research as referenced to develop the NPD maturity model.

Kapur, V, Ferris, J, Juliano, J and Berman, S J (2006) The winning formula for growth: Course, capability and conviction. ***Strategy & Leadership,*** **34 (1), 11.**

> **Global study of 1238 companies from S&P Global 1200 over a decade**. Concludes that top growth companies excel in three areas: course, capability and conviction. PPM processes are an important component of setting the right growth direction (course).

Khurana, A and Rosenthal, S R (1998) Towards holistic "Front ends" In new product development. ***Journal of Product Innovation Management,*** **15 (1), 57-74.**

> **Twelve exploratory case studies in Japan and the US.** A holistic approach to front-end NPD reveals two levels – a strategic level including IPPM and a project-specific level. Different management skills and levels of engagement and influence are needed at the two levels. Formal processes are preferred and most common in US organisations, whereas a cultural approach is preferred in Japanese organisations.

Lawson, C P, Longhurst, P J and Ivey, P C (2006) The application of a new research and development project selection model in SMEs. ***Technovation,*** **26 (2), 242-250.**

> **Single case of a hybrid project selection model applied in a small engineering company**. Costs outweigh benefits, and the small organisation feels that they can maintain high quality decisions without the assistance of a mathematical software-based model. Findings indicate that, although project selection and portfolio management systems have been shown to be beneficial for large firms, this may not be the case with small to medium enterprises (SMEs).

Loch, C (2000) Tailoring product development to strategy: Case of a European technology manufacturer. ***European Management Journal,*** **18 (3), 246-258.**

Sample of 90 projects in a large diversified European technology manufacturer used to examine the effect of 'best practice' principles in NPD projects. Prior literature suggests a formalised project selection process is a success factor; however, this study shows only one-third of projects follow the formal approach and others are 'under-the-table' or 'pet' projects. No 'best' approach for IPPM is evident and findings indicate that projects are not integrated well with strategy. A process is proposed to achieve strategic alignment through the development of a customised portfolio of NPD projects with methods to ensure linkages between NPD projects.

Martinsuo, M and Ikavalko, H (2006) Strategizing through projects: practices and strategy realization in single projects and project portfolios. ***EGOS Colloquium*** **Bergen, Norway.**

Martinsuo, M and Lehtonen, P (2007a) Role of single-project management in achieving portfolio management efficiency. ***International Journal of Project Management,*** **25 (1), 56-65.**

Survey of 279 firms in Finland. Thirty-four per cent of respondents named product development as the major product type and the rest were organisational development or IT projects. Two papers draw on these data to present PPM-related findings. The 2006 paper explores the link between project practices and strategy realisation. PPM activities are shown to have a stronger positive association with strategising than single project activities. The findings of the 2007 paper verify the often hypothesised contribution of project management attributes to the efficiency of PPM processes. The most influential aspects are information availability, goal setting and systematic decision making. The survey results suggest that increasing project managers' awareness and involvement in portfolio management issues will assist in PPM efficiency by ensuring that project management processes support the portfolio management effort.

Matheson, D, Matheson, J E and Menke, M M (1994) Making excellent R&D decisions. ***Research Technology Management,*** **37 (6), 21-24.**

Benchmark study of 200 executives on R&D decision quality. IPPM decision-making practices are one of the four 'quality decision' categories identified and tested. IPPM decision practices identified as highest priorities for improvement are: 'Balance across strategic objectives', 'Balance innovations and incremental improvements' and 'Manage the pipeline'. Several other project practices that support IPPM are also highlighted including: 'Evaluate projects quantitatively', 'Agree on clear measureable goals', Fully resource projects, and 'Evaluate and plan all projects'.

Maylor, H, Brady, T, Cooke-Davies, T and Hodgson, D (2006) From projectification to programmification. ***International Journal of Project Management,*** **24 (8), 663-674.**

Multiple-case study of six cases in the UK including NPD and other projects. Findings identify a clear move toward 'programmification' or some form of program or PPM among the cases. 'Portfolio', 'chain' or 'network' structures for projects are identified and found to relate to the interdependencies and relationships between the projects.

McDonough III, E F and Spital, F C (2003) Managing project portfolios. ***Research Technology Management,*** **46 (3), 40-46.**

Survey of 85 managers responsible for the NPD project portfolios. Findings show that uncertain projects are managed differently, use more resources, require more slack, and achieve higher outcomes than less risky projects. Findings indicate that stretching resources or switching team leaders or core team members is associated with negative portfolio performance. Success in the market is associated with more frequent portfolio reviews, more attention to schedules and increasing resources to meet schedules when needed.

Menke, M M (1997) R&D decision quality practices of outstanding R&D organisations, *Portland International Conference on Management and Technology (PICMET),* Portland, Oregon, 27-31 July.

Questionnaire responses from 79 leading R&D organisations regarding use of 45 best practices for R&D decision-making. Six of the specific 'best practices' are aspects of IPPM processes. These practices are all seen as important for success; however, some of the IPPM practices were poorly actualised. Attention to these important but poorly actualised IPPM practices such as 'Evaluate the R&D portfolio', 'Hedge against technical uncertainty', 'Balance across strategic objectives', and 'Manage the pipeline' is recommended to improve R&D success.

Miller, R and Floricel, S (2004) Value creation and games of innovation. *Research Technology Management,* 47 (6), 25.

Study involving 72 CTOs and R&D VPs in Europe, US and Canada. Best practices for managing innovation include portfolio management as one of the 5 main areas for best practice. Firms create value differently, and best practice will depend upon the type of 'Game of Innovation' employed. Portfolio management practices are important in all eight 'Games' identified, and it is most significant to organisations in R,D&E products and Service development.

Milosevic, D Z and Srivannaboon, S (2006) A theoretical framework for aligning project management with business strategy. *Project Management Journal,* 37 (3), 98-110.

Multiple case study involving eight organisations. Exploratory study to understand the nature of the alignment between project management and business strategy. In all cases a PPM type of process is used, although in half of the cases the term 'project portfolio management' was not recognised. Classifies business strategies in terms of the competitive strategies outlined by Porter (1980) and explores links with PM capabilities including PPM processes. PPM and strategic planning are found to mediate the relationship between strategy and projects, and the stage gate method is central in the reciprocal relationship between projects and strategy. Changing business and project conditions are often revealed during gate reviews, providing valuable feedback for the development of corresponding adjustments to strategy.

Morris, P W G and Jamieson, A (2005) Moving from corporate strategy to project strategy. *Project Management Journal,* 36 (4), 5-18.

Four exploratory case studies and **75 responses** from PMI Europe survey on moving from corporate strategy to project strategy. The cases show that PPM is considered important but is used primarily to select and prioritise projects, not for ongoing management of projects. Fifty per cent of respondents have a PPM process, however most perceive PPM to be for managing projects around a theme rather than balancing and selecting the best projects. The results are not representative of the general PM population (the survey obtained a 2% response rate from PMI members), and it is suggested that the respondents are likely to be the more professionally conscientious members of PMI. If this is true, there may be even lower levels of understanding of PPM goals in the broader population.

Murphy, S A and Kumar, V (1997) The front end of new product development: A Canadian survey. *R&D Management,* 27 (1), 5-15.

Survey of 53 individuals from 15 high technology firms in Canada to identify activities and outcomes from the pre-development stage of product development. Clarification of project requirements is seen as the most important objective of pre-development, followed by idea prioritisation. Respondents highlight the importance of activities that gain organisational support, such as those that align the strategic vision and the capabilities of the organisation. Go/No-go decisions are found to be often made due to non-analytical factors like 'gut-feel'. Comment: the authors use the term 'portfolio management' to refer to the ongoing management of the project portfolio, separate from the pre-development stage. It is now standard to include the pre-development stage as an integral part of the portfolio management process.

Nobeoka, K and Cusumano, M A (1997) Multiproject strategy and sales growth: The benefits of rapid design transfer in new product development. ***Strategic Management Journal,*** **18 (3), 169-186.**

One hundred and sixty interviews at 17 organisations worldwide focusing on 210 projects in the automotive industry. Findings show that organisations benefit from capabilities to manage information flows across projects, particularly capabilities for quickly leveraging learning across multiple projects. The findings highlight the organisational and strategic challenges in a multi-project environment and suggest that effective IPPM capabilities cannot be acquired instantaneously and are more difficult to implement than single project capabilities.

Payne, J H and Turner, J R (1999) Company-wide project management: The planning and control of programmes of projects of different type. ***International Journal of Project Management,*** **17 (1), 55-59.**

Survey of 150 project managers in the UK, illustrative case study. Investigation into project type and project management approach. Findings indicate that in most cases it is best to tailor the project management style to the project type for best results. The results also suggest that a standard approach is appropriate at strategic (PPM) levels, while the operational (PM) level needs to be tailored to the needs of individual projects.

Pellegrinelli, S, Stenning, V, Partington, D, Hemmingway, C, Mohdzain, Z and Shah, M (2006) Helping or hindering? The effects of organisational factors on the performance of program management work. ***PMI Research Conference, Montreal, July 16-19*****.**

Eighteen informants at eight organisations interviewed to determine what organisational factors are perceived by program managers to help or hinder their work. The study also explores whether managers at differing levels have different perspectives. Identifies helpful organisational factors such as a positive culture, supportive organisational structures and top management support. Hindering factors include a low tolerance of change and resistance to change. Lower-level managers prefer structured and mechanistic predictable environments; however, this preference may be more appropriate for project management than PPM level management where strategic change may be required. The assumption that project managers can naturally and without additional development and training become effective PPM level managers is challenged.

Pennypacker, J S (Ed.) (2005) ***Project portfolio management maturity model.*** **Haverstown PA, Centre for Business Practices.**

Survey of 54 senior-level PPM practitioners. Findings show that PPM is new to most organisations (70% of those surveyed had PPM in place for 2 years or less) and that PPM is considered important in over 90%. The maturity of PPM is generally low, and the ability to kill poor projects and to allocate resources optimally are the measures that rate the lowest. The best PPM performance is on the alignment of projects to strategy and improving the focus of the portfolio.

Phaal, R, Farrukh, C J P and Probert, D R (2001) ***Technology roadmapping: Linking technology resources to business objectives*****. Cambridge, Centre for Technology Management, Institute for Manufacturing.**

Investigation of 20 roadmaps from 11 organisations to understand the use and benefits of roadmaps. Roadmapping is shown to support a range of business aims, primarily in the area of strategic planning and IPPM. Findings indicate that roadmaps should be customised to the environment, and require clear understanding of the business need, the commitment of senior management and the involvement of the right people. Roadmaps are not decision-making tools, however, and must be integrated with other decision-making methods.

Phaal, R, Farrukh, C J P and Probert, D R (2006) Technology management tools: Concept, development and application. ***Technovation,*** **26 (3), 336-344.**

Two case examples showing the application of technology management tools. Technology management tools are categorised and four classes of matrix type tools are detailed. PPM applications of the tools are evident throughout the discussion. A portfolio matrix application example highlights the importance of customising the matrix for the situation in order for it to be an effective IPPM decision-making tool. An example of roadmapping shows the input this type of method provides to the IPPM process when integrated with analysis and decision-making elements.

Poskela, J, Dietrich, P, Berg, P, Artto, K A and Lehtonen, T (2005) Integration of strategic level and operative level front-end innovation activities. ***Portland International Conference on Management of Engineering and Technology (PICMET),*** **Portland Oregon, July 31- August 4.**

Multiple-case study of 20 Finnish organisations. Investigation into how the strategic level and operative level front-end activities can be effectively integrated. Integration of strategic and operative activities is found to be a two-way process and is moderated by three factors: (1) the level of concreteness of business strategies, (2) business emphasis in decision-making, and (3) the balance between control and creativity.

Reginato, J and Ibbs, C W (2006) Employing business models for making project go/no-go decisions. ***PMI Research Conference, Montreal, July 16-19.***

Twelve new product projects evaluated at six biopharmaceutical companies to determine the relationship between business models and project outcomes. Products that reached market satisfied all business model elements, where the terminated projects all had information missing from their business models. This research reinforces the importance of including business models in IPPM decisions so that the portfolio accurately reflects business strategy.

Stander, M J and Buys, A J (2008) Linking projects to business strategy through project portfolio management. ***Proceedings of the International Association of the Management of Technology (IAMOT) Conference*****, Dubai, UAE, April 6-10.**

Survey responses from 32 technology organisations in South Africa. Results indicate that strategy implementation improves with the adoption of IPPM. Project and strategy failures are linked to not having 'breakthrough' projects sufficiently separated from day-to-day activities and from having too many projects in the portfolio. The study also notes that some projects that are viewed as a failure from an operational perspective (due to exceeding time or budget, for example) may actually be very successful in terms of their contribution to organisational revenue

Vähäniitty, J (2006) Do small software companies need portfolio management? ***13th International Product Development Management Conference,*** **Milan, Italy, June 11-13.**

Multiple-case study of four small software companies. Identified characteristics and symptoms of inadequate PPM determined from a literature review and found that the four software SMEs showed evidence of inadequate PPM. The study highlights particular challenges in smaller organisations, such as the need to manage multiple types of projects in one portfolio and the need for the portfolio manager to perform other roles as well. The findings suggest that existing software solutions for PPM are not tailored to meet the needs of smaller organisations.

Appendix 2

Items and survey questions for success factors and PPO measures

Tables A2-1 and A2-2 list the names of the items used to measure the six factors in the conceptual model, a summary of the questions used to collect data on these items, and the type of data collected.

Table A2-1: Success factors

Item name	Item question	Data type
IMP	Level of importance of IPPM	
IMP_exec	To what extent is portfolio management considered to be a vital or critically important task in your business… ... by Corporate Executives?	Likert scale 1–5 Ordinal data
IMP_sman	… by Senior Management?	
IMP_techman	... by Technology Management People?	
IMP_mkt	… by Marketing/Sales Management People?	
IMP_opman	… by Operations or Production Management People?	
MAT	Level of maturity of IPPM	
MAT_est	We have an established, explicit method for portfolio management and project selection.	Likert scale 1–5 Ordinal data
MAT_rules	Our portfolio management method's rules and procedures are very clear; there is a well-defined procedure here.	
MAT_cons	Our portfolio management method is consistently applied – to all the projects it should be.	
MAT_supp	Management buys into the portfolio management method; through its actions, management strongly supports its use.	
MAT_port	Our method treats all projects as a portfolio – considers all projects together and compares them against each other.	
Methods	Processes and Methods for IPPM	
METH_fin	Do you use a financial method for project selection?	Nominal Yes/No coded into 0 and 1
METH_check	Do you use a checklist method?	
METH_score	Do you use a scoring model method?	
METH_strat	Do you use the business strategy as a basis for allocation of money for different types of new product projects?	
METH_map	Do you plot projects on a bubble diagram or portfolio map and look for projects in certain zones or quadrants of the bubble diagram?	
DOM_meth	Which method is dominant for decision making?	Nominal code
*details	For each method used, extra information is collected on the specifics of the use of the method	Various types
*other	Other methods were also indicated and detailed in open response areas of the survey	Various - Primarily qualitative

Table A2-2: Product portfolio outcome (PPO) measures

Item name	Item question	Type of data
PPM	Performance on IPPM goals	
PPM_number	We have the right number of new product projects for our resources – people, time and money – available.	Likert scale 1–5 Ordinal data
PPM_time	Our projects are done on time – in a timely and time efficient fashion.	
PPM_value	Our portfolio of new product projects contains only high value ones to our business – profitable, high return projects with solid commercial prospects.	
PPM_balance	Our portfolio of new product projects has an excellent balance in terms of long versus short term, high versus low risk, across markets and technologies, and so on.	
PPM_alignstrat	The projects in our portfolio are aligned with our business objectives and our business's strategy.	
PPM_spendstrat	The breakdown of spending (resources) in our portfolio of projects truly reflects our business's strategy.	
OPP	Performance on product portfolio opportunity goals	
OPP_newmkt	Our new product program enables our business to enter new markets.	Likert scale 1–5 Ordinal data
OPP_develtech	Our new product program develops our existing technologies and technological competencies.	
OPP_newtech	Our new product program brings new technologies to our business.	
OPP_newarena	Our new product program leads our company into new product arenas (product categories or types not offered 3 years ago).	
NPP	New Product Performance	
NPP_sales	What percentage of your sales is generated by new products?	Percentage
NPP_profit	What percentage of profit is generated by new products?	
NPP_success	What percentage of new product/service projects that are launched are successful?	

Appendix 3
Phase 1 Survey Instrument

Australian Project Portfolio Management
Best Practices Study Survey

Before you start the survey, please read these notes and definitions:

The intent of this study is to consider substantive new product projects rather than minor changes, product fixes, minor process improvements, product maintenance or technical service. We use the term 'New Product Projects' to refer to projects to develop both goods and services. The term 'Portfolio Management' is used to describe the processes for both the selection of individual projects and the overall assessment of the total mix of projects.

NOTE: This survey is designed to determine what methods are currently applied to the task of portfolio management in Australia. Most organisations will only use a fraction of the listed methods and techniques. Some organisations will have little or no discernable portfolio management practices while others will have a documented and formal method. We encourage you to fill out the survey to your best ability and please do not be concerned if many of the items are not used or familiar to your organisation.

→ *Each survey will be important to the overall picture of Portfolio Management in Australia* ←

⇓ ⇓ ⇓ ⇓ **The Survey** ⇓ ⇓ ⇓ ⇓

Section A Context of your responses

Your answers should refer to **your own business unit or division** – which will be referred to as **"your business"** in this survey. Please check either or both choices below to indicate the context(s) you will be using to answer this survey.

[1] Corporate Projects
[2] Group / Business Unit / Divisional Projects

This survey will be looking at new product projects for **both goods (physical products) and service products**. Your portfolio of new product projects may relate to either goods or services or a mix of the two. Please indicate the approximate project mix that applies to your responses:

Our portfolio contains only physical product projects (goods)				Our portfolio contains a mix of goods and service product projects				Our portfolio contains service product projects only	
[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]

Section B   Some General Questions about your Portfolio Management Process

To what extent is **portfolio management** considered to be a vital or critically important task in your business…	Not Too Important	Somewhat Important	Quite Important	Very Important	Critically Important
... by Corporate Executives?	[1]	[2]	[3]	[4]	[5]
… by Senior Management?	[1]	[2]	[3]	[4]	[5]
... by Technology Management People?	[1]	[2]	[3]	[4]	[5]
… by Marketing/Sales Management People?	[1]	[2]	[3]	[4]	[5]
… by Operations or Production Management People?	[1]	[2]	[3]	[4]	[5]

Please indicate how much you agree or disagree with each statement: (answer from the perspective of what is relevant in your business currently)

Portfolio management is vital in our business ….	Strongly Disagree				Strongly Agree
… because project selection is closely **linked to business strategy** in our business.	[1]	[2]	[3]	[4]	[5]
… because strategy begins when you start spending money – resource allocation to projects is **how strategy gets implemented**.	[1]	[2]	[3]	[4]	[5]
… because project selection is important to maintaining our competitive position.	[1]	[2]	[3]	[4]	[5]
… because we want to be **focused** – not do too many projects for the resources we have available.	[1]	[2]	[3]	[4]	[5]
… because our new product resources, - people, time, and money – are **very scarce** and we don't want to waste them on the wrong projects.	[1]	[2]	[3]	[4]	[5]
… because it's important to have the **right balance** of projects – a balance between long and short term, or high and low risk, and so on.	[1]	[2]	[3]	[4]	[5]
… because we are relatively **risk adverse/conservative**; so we must be **very careful** in project selection so as to have no failures.	[1]	[2]	[3]	[4]	[5]

Section C How Portfolio Management is Done and How Projects are Selected in Your Business

Please think about the way your business determines its R&D or new product portfolio – that is, selects, rates and ranks new product projects, and allocates resources to projects. Please answer the following questions to characterise your general approach to portfolio management.

We have an **established, explicit method** for portfolio management and project selection. 1 = not at all; our method is not established. 5 = very much so; an established, explicit method.	[1] [2] [3] [4] [5]
Our portfolio management method's **rules and procedures** are very clear; there is a well-defined procedure here. 1 = not at all; 5 = very much so.	[1] [2] [3] [4] [5]
Our portfolio management method is **consistently applied** – to all the projects it should be. 1 = not consistently applied, many projects "go around" the method. 5 = consistently applied to all the projects it should be.	[1] [2] [3] [4] [5]
Management **buys into** the portfolio management method; through its actions, management strongly supports its use. 1 = management does not buy in. 5 = management strongly endorses and uses the method.	[1] [2] [3] [4] [5]
Our method treats **all projects as a portfolio** – considers all projects together and compares them against each other. 1 = focuses on individual projects – one at a time. 5 = looks at all projects together, as a portfolio.	[1] [2] [3] [4] [5]

How is this portfolio of projects configured?
[1] Business Unit ONLY [2] Entire Corporation ONLY [3] At BOTH levels

For how long have you had this established method?
[1] Less than Six Months
[2] Six Months to Two Years
[3] Two Years to Five Years
[4] More than Five Years
[5] Not Applicable

Section D   Nature of Portfolio Management Method(s) Used

1. Which word best describes your new product portfolio management method or procedure?

[1] FORMAL
[2] INFORMAL

2. Which best describes your decision making process?

[1] Go/Kill and investment decisions on projects are handled in a management meeting. They discuss projects, use their best judgement and make decisions.
[2] A senior manager or executive makes the decision.
[3] Both decision making processes are used.
[4] Other (please specify) [25]______________________________.

Please indicate which methods or practices best describe your new product portfolio management method or procedure. Check as many methods or practices as apply.

3. Do you use a financial method for project selection? This means that you determine the profitability, payback, return or economic value of the project (e.g., return on investment, net present value, or some other financial measure) and judge projects on this criterion.

[1] YES →
[2] NO → go to Question 4

In using your financial method, which method(s) do you use?

[1] Determine the project's expected financial results or economic value (e.g. return or profitability) and **compare this to your hurdle rate or acceptable criterion** to make the Go/Kill decision.

[1] Determine the project's expected financial results or economic value and use this to **rank projects** against each other. The highest ranked ones (with highest economic value) are picked to be included in the portfolio of projects.

4. Do you use a checklist method? Projects are evaluated via a list of Yes-No questions. Each project must achieve either all Yes answers (or a certain number of Yes answers) to proceed.

[1] YES →
[2] NO → go to Question 5

In using your check list method, which method(s) do you use?

[1] Make Go/Kill decisions on individual projects based on the number of "Yes" scores.

[1] Use the "Yes" scores to rank all projects against each other. The projects with the most "Yes" scores are picked to be in the portfolio of projects

.

5. Do you use a scoring model method? Projects are rated or scored on a number of questions, for example Low-Med-High, or on 1-5 or 0-10 scales. The ratings on each scale are then added to yield a Total or Project Score, which is the criterion used to make the project selection decision.

[1] YES
[2] NO

go to Question 6

Are these rating scores added together in a weighted or unweighted fashion to yield an overall score?

[1] WEIGHTED
[2] UNWEIGHTED

In using your scoring model approach, which method(s) do you use?

[1] Compare the Total or Project Score to some hurdle. Projects which clear this hurdle are Go.

[1] Use the Project Scores to rank all projects against each other. The projects with the highest scores are picked to be in the portfolio of projects

6. Do you use the business strategy as a basis for allocation of money for different types of new product projects? For instance, having decided the business strategy, you then allocate money for different types of projects into 'buckets' or 'envelopes'. Projects are ranked or rated within these envelopes or buckets.

[1] YES
[2] NO

go to Question 7

Please list some dimensions and sample categories, envelopes or buckets which you use to split up funding or resources. (for example: we split by markets, Markets A, B, C; or we split by project type – new products, enhancements, fixes, discovery research; etc)

________________ ________________ ________________

________________ ________________ ________________

Once you have set aside money or resources into 'buckets' or 'envelopes' for different types of projects, how do you rate and rank projects within the buckets or envelopes? Please check all that apply:

[1] No Formal method: management meeting(s)
[1] No Formal method: a senior manager decides
[1] Financial method
[1] Check List method
[1] Scoring model
[1] Bubble diagram

7 Do you plot projects on a bubble diagram or portfolio map, and look for projects in certain zones or quadrants of the bubble diagram, much like the sample below?

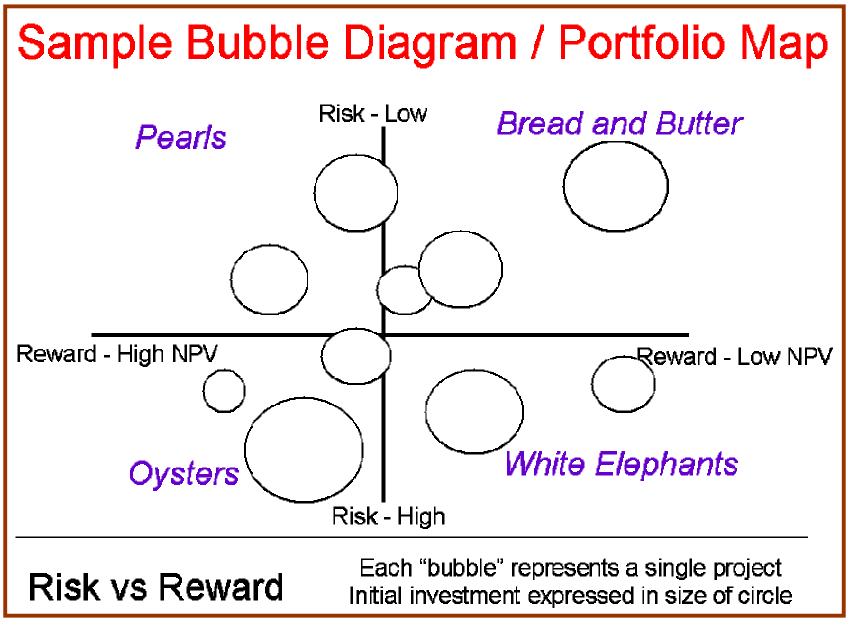
[1] YES →
[2] NO
↓
go to Question 8

How many different types of maps or X-Y bubble diagrams do you plot to display your portfolio of projects? ____________

What are the most useful plots, and what are the north-south, east-west or X-Y axes that you plot for each (for example, Reward vs Risk as in the sample below?

Vertical Axis	vs.	Horizontal Axis
________________	vs.	____________________
________________		____________________
________________		____________________
________________		____________________
________________		____________________
________________		____________________

What else is captured on your diagram(s)?



8. Do you use a project selection method that is not described above in questions 3 through 7?
If so please describe or attach forms or charts.

____

____

____

9. You may have indicated more than one project selection method. Which ONE method dominates your decision making process? Please select **one method only**

[1] Scoring model method
[2] Bubble diagram
[3] Financial method
[4] Strategic planning method
[5] Check List method
[6] Other (Please specify) ______________________

11. What factors are included in your company's process of portfolio assessment by which one project is compared against another for determining the final mix of projects to be selected? Please **tick all that apply.**

[1] Pay-off
[2] Commercialisation
[3] Synergy between projects
[4] Strategic Fit/Core Competence
[5] Timing
[6] Technology
[7] Protectability
[8] Risk/Probability of Success
[9] Other (Please specify) ______________________

12. What factors are considered most important in any first round trade-offs necessary to optimise the mix of projects selected? What factors are considered in a second round, if necessary?

	Important in First Round	Important in Second Round
Pay-off	[ ]	[ ]
Commercialisation	[ ]	[ ]
Synergy between projects	[ ]	[ ]
Strategic Fit/Core Competence	[ ]	[ ]
Timing	[ ]	[ ]
Technology	[ ]	[ ]
Protectability	[ ]	[ ]
Risk/Probability of Success	[ ]	[ ]
Other (Please specify)	[ ]	[ ]

13. What are the most significant challenges you face in portfolio management?

14. What are the most immediate opportunities for improving the benefits your company gets from portfolio management?

Section E Are your Portfolio Assessment and Project Selection Methods Satisfactory?

Consider the main/dominant method(s) you use for portfolio assessment and project selection decisions.

Answer for both types of methods	Overall Portfolio Assessment Methods	Individual Project Selection Methods
Our method is **truly used** to make go/kill decisions on projects. 1 = rarely used; 5 = always used	[1] [2] [3] [4] [5]	[1] [2] [3] [4] [5]
Our method **fits our management's style** of decision-making. 1 = does not fit; 5 = fits well	[1] [2] [3] [4] [5]	[1] [2] [3] [4] [5]
Our method is **understood** by management. 1 = don't understand; 5 = understood well	[1] [2] [3] [4] [5]	[1] [2] [3] [4] [5]
Our method is very **"user friendly"** and easy to use. 1 = no, very complex and difficult 5 = very user friendly and easy	[1] [2] [3] [4] [5]	[1] [2] [3] [4] [5]
Our method is **realistic** capturing the key facets of the problem. 1 = no, it is simplistic; 5 = very realistic	[1] [2] [3] [4] [5]	[1] [2] [3] [4] [5]
Our method is perceived by management to be **efficient**. 1 = laborious and wastes time; 5 = very efficient	[1] [2] [3] [4] [5]	[1] [2] [3] [4] [5]
Overall **we would rate** our method as excellent. 1 = poor; 5 = excellent	[1] [2] [3] [4] [5]	[1] [2] [3] [4] [5]
We would **recommend** our method for use by other businesses like ours. 1 = not at all; 5 = very much so	[1] [2] [3] [4] [5]	[1] [2] [3] [4] [5]

Section F Performance Results of Your Portfolio Management Methods

Are your portfolio assessment and project selection method(s) really working?

Relative to competitors in our field, our new product program is successful. 1 = not at all successful; 5 = very successful.	[1] [2] [3] [4] [5]
We have the right number of new product projects for our resources – people, time and money – available. 1 = no, we're spread far too thin; 5 = right number of projects for our resources.	[1] [2] [3] [4] [5]
Our projects are done on time – in a timely and time efficient fashion. 1 = no, they're slow and late; 5 = on time and timely.	[1] [2] [3] [4] [5]
Our portfolio of new product projects contains only high value ones to our business – profitable, high return projects with solid commercial prospects. 1 = no, many poor, mediocre, low value projects; 5 = definitely yes, high value projects to the business.	[1] [2] [3] [4] [5]
Our portfolio of new product projects has an excellent balance in terms of long versus short term, high versus low risk, across markets and technologies, and so on. 1 = no, unbalanced and skewed; 5 = excellent balance.	[1] [2] [3] [4] [5]
If portfolio unbalanced, how? Too many or too few of what?	
The projects in our portfolio are aligned with our business objectives and our business's strategy. 1 = no, many are off strategy or have no strategy; 5 = aligned and on strategy.	[1] [2] [3] [4] [5]
The breakdown of spending (resources) in our portfolio of projects truly reflects our business's strategy. 1 = no, spending breakdown is inconsistent with our business strategy or have no strategy; 5 = spending consistent with strategy.	[1] [2] [3] [4] [5]
Our new product program enables our business to enter new markets. 1 = no; 5 = yes, our new products regularly help us enter new markets.	[1] [2] [3] [4] [5]
Our new product program develops our existing technologies and technological competencies. 1 = no; 5 = yes, our new products often leverage our existing technologies and skills.	[1] [2] [3] [4] [5]
Our new product program brings new technologies to our business. 1 = no; 5 = yes, our new products often use new technologies.	[1] [2] [3] [4] [5]
Our new product program leads our company into new product arenas (product categories or types not offered 3 years ago). 1 = no; 5 = yes, our new products are often in new arenas.	[1] [2] [3] [4] [5]

New Product Performance Measures:

Please answer the following questions based on **recent performance** at your organisation:

Note: "New Products" refers to all products introduced within the past 3 years

What percentage of your sales is generated by new products? ___________%

What percentage of profit is generated by new products? __________%

How many new products are launched by your organisation each year? _________

How many new product projects are in progress in your organisation at any time? ________

Approximately how many months does the typical new product project take? (time taken from project start [usually receipt of funding] until product launch)? ____________(months)

Of all new product/service projects that receive specific funding, what percentage are abandoned or 'killed' before launch? ______________%

What percentage of new product/service projects that are launched are successful? ______%

Performance Measures / Success Factors for the new product or service development program.

For each of the following types of data that your organisation measures, please indicate how **important** this measure is to **the overall success rating** of the project.
If your organisation does not collect that type of data, please check 'not measured' in the final column.

Importance of data type to overall success rating	1 = very important				5 = not very important	0 = not measured
NPV/IRR	[1]	[2]	[3]	[4]	[5]	[0]
Return on Investment (ROI)	[1]	[2]	[3]	[4]	[5]	[0]
Payback period	[1]	[2]	[3]	[4]	[5]	[0]
Profit	[1]	[2]	[3]	[4]	[5]	[0]
Customer satisfaction	[1]	[2]	[3]	[4]	[5]	[0]
Sales volume / Market Share	[1]	[2]	[3]	[4]	[5]	[0]
Growing existing markets	[1]	[2]	[3]	[4]	[5]	[0]
Entering new markets	[1]	[2]	[3]	[4]	[5]	[0]
Degree to which Budget is met	[1]	[2]	[3]	[4]	[5]	[0]
Degree to which Schedule is kept	[1]	[2]	[3]	[4]	[5]	[0]
Time to market	[1]	[2]	[3]	[4]	[5]	[0]
Others? Please specify	[1]	[2]	[3]	[4]	[5]	[0]

For each of the following measures of new product/service success, how does your organisation **compare with competitors and/or similar organisations**?

How we compare with competitors / similar organisations	1 = better than most		3 = about average		5 = worse than most	0 = don't know / not compared
ROI on new product investment	[1]	[2]	[3]	[4]	[5]	[0]
Other financial measures	[1]	[2]	[3]	[4]	[5]	[0]
Number of new product launches	[1]	[2]	[3]	[4]	[5]	[0]
Customer satisfaction with new products	[1]	[2]	[3]	[4]	[5]	[0]
Sales volume / Market Share of new products	[1]	[2]	[3]	[4]	[5]	[0]
Growing existing markets	[1]	[2]	[3]	[4]	[5]	[0]
Entering new markets	[1]	[2]	[3]	[4]	[5]	[0]
Degree to which new product/service budget is met	[1]	[2]	[3]	[4]	[5]	[0]
Degree to which schedule is kept	[1]	[2]	[3]	[4]	[5]	[0]
Time to market	[1]	[2]	[3]	[4]	[5]	[0]
Other? Please specify	[1]	[2]	[3]	[4]	[5]	[0]

Section G Demographic Questions

1. What is the approximate size of your total organisation, as measured in annual sales?

____________________________________ (A$ annual sales)

2. What is the size of the business unit used as a reference in the survey, as measured in annual sales?

____________________________________ (A$ annual sales)

or tick box

[   ] Same as above, business unit used in the survey represents the total organisation

3. What is your total spending on new product development projects as a percentage of annual sales revenue?

_______________________ %

4 Which one of the following best describes the business unit primary industrial classification?

[1] Basic Products (Pulp and paper, agriculture, metals, concrete, etc)
[2] Food, Beverage and Tobacco
[3] Textile, Clothing, Footwear and Leather
[4] Printing, Publishing and Recorded Media
[5] Petroleum, Coal, Chemical and Associated Industries
[6] Machinery and Equipment
[7] Aviation/Aerospace and related industries
[8] Automotive and related industries
[9] Electrical and Electronics
[10] Biotechnology and related Industries
[11] Utilities: Electricity, Gas and Water Supply
[12] Transport and Storage
[13] Construction
[14] Hotel and Hospitality
[15] Communication and Telecommunication Industries
[16] Computers, Computer Related Industries
[17] Finance and Insurance
[18] Property and Business Services
[19] Government Administration and Defense
[20] Education
[21] Health and Community Services
[22] Cultural and Recreational Services
[23] Personal and Other Services
[24] Consulting
[25] Other (Please specify)____________________

5. Please identify your department and the title of your position in the organisation:

Department:____________________ Years at your organisation: ________

Title: ____________________ Years in current or similar position: ______

The information below will be kept confidential and is requested purely so that we can verify data if necessary.

*Please **attach a business card** or fill out the requested fields*

Name: ______________________________

Company Name: ______________________________

Address: ______________________________

Preferred contact method: Please tick and provide details

[ ] Phone ________________

[ ] email ________________

Thank you, your contribution to this project is greatly appreciated. Please return this survey by mail, fax or email as soon as possible. Upon receipt of your survey we will send you a copy of a recent publication on Portfolio Management Best Practice. Please remember to include the research office copy of the consent form. (Addresses and fax details supplied)

Appendix 4

Details of quantitative data collection and analysis

Section 1: Respondent details

The 60 respondents to the Phase 1 survey represented a wide range of organisations. The breakdown of the primary industrial classification is presented in Table A4-1.

Table A4-1: Industrial classification for Phase 1 respondents

Classification	**Number** and	**Percentage** of total
Finance and Insurance	9	15.0
Basic Products, agriculture	6	10.0
Computer and related	6	10.0
Comm and Telecomm	5	8.3
Health and Community Services	4	6.7
Electrical and Electronics	3	5.0
Food, Beverage, Tobacco	3	5.0
Petroleum, Coal, Chemical	3	5.0
Construction	3	5.0
Biotechnology	2	3.3
Education	2	3.3
Consulting	2	3.3
Pharmaceutical	2	3.3
Large diversified businesses	2	3.3
Security services	2	3.3
Machinery and Equipment	1	1.7
Automotive and related	1	1.7
Transport and Storage	1	1.7
Property and Business services	1	1.7
Personal and other services	1	1.7
Animal Health	1	1.7

Respondents also represented a wide range of departmental perspectives and positions within their organisations.

Respondents were spread across several departments with no dominant area.

Department	Number of respondents
Engineering / Product Development/R & D	9
Executive/Corporate	9
Logistics/Operations/Production	8
Marketing/Business Planning	10
Finance/Accounting	4
Other	12
Not answered	8

Position	Number of respondents
Managing Director/CEO	11
VP Technical/Engineering Manager/R&D manager	14
Marketing manager, business development manager	5
Project manager	12
Other professional manager	13
Financial controller/director	3
Other	2

Respondents' level of experience	years
Years at organisation	7.9
	(standard deviation 7.4)
Years in current position	5.3
	(standard deviation 5.0)

Section 2: Detailed findings on the IPPM methods used in Australia

This section provides additional detail on the Australian IPPM benchmark findings to complement the results presented in Chapter 4.

Use of IPPM methods in responding organisations

On average, the respondents used two of the five methods listed in detail on the survey. Following is a breakdown of the use of each type of method.

Financial methods: Financial methods were used for project selection by 77% of respondents. Of these organisations, 67% used a hurdle rate or other criterion to make a Go/Kill decision, and 41% ranked projects against each other to make a decision.

Business strategy: Strategy methods were used in the portfolio management processes of 56% of the organisations. Tables A4-2 and A4-3 show the most common categories used to allocate money within a strategic model and the methods used to rank projects within each category (refer to Table A4-4 on page 362 for information about confidence intervals for the sample of 60).

Table A4-2: Common funding categories within strategic resource allocation models

Funding category:	Percentage of organisations
Customers/market categories	53 %
Project type	44 %
Financial return or investment	25 %
Technology	19 %
Product line/type of business	16 %
Strategy type	13 %
Geographic area	6 %
Resources	6 %

Table A4-3: Common ranking methods within strategic resource allocation models

Ranking Methods used:	Percentage of organisations
Financial	41 %
Management meeting	38 %
Senior manager decides	31 %
Scoring model	22 %
Checklist	19 %
Bubble diagram / portfolio map	19 %

Bubble diagrams/portfolio maps: Bubble diagrams or portfolio maps were used by 25% of the organisations surveyed. The difference between organisations that focus on service products and those that focus on physical products is significant, with the physical product organisations more likely to use bubble diagrams or portfolio maps (significance 0.047). Eighty per cent of the businesses that used bubble diagrams are primarily introducing physical products.

Most bubble diagram or portfolio map users regularly charted two or three different scenarios. The most common type of bubble diagram used was the 'risk versus reward' chart. Some version of a map evaluating risk (sometimes commercial or technical risk or difficulty) versus reward (sometimes specified as NPV, ROI) was listed by 78% of bubble diagram users. Other popular portfolio maps that included financial return measures compared market segments or market shares with profit, or compared profit margins with total revenue or volume.

Many of the bubble diagrams and portfolio maps did not include financial measures. Nearly half of bubble diagram users developed charts displaying risk or difficulty measures versus impact or advantage measures. The same proportion of organisations detailed the use of some type of portfolio map focused on customer and competitive measures. These individualised maps also included aspects such as resources, technical ability and maturity.

Other than the popular (and well publicised) 'risk versus reward' portfolio maps, most charts were designed to meet the specific decision-making needs of the organisations that use them. Many organisations included other project, organisation or market information on their individualised maps. This additional information is usually indicated by labels or through the size or colour of the 'bubbles'.

Scoring model methods: Twenty-seven per cent of respondents used a scoring model. Of these:

- 69 % used a weighted model
- 25 % compared the total or score to a hurdle to say 'GO'
- 69 % used scores to rank all projects against each other.

Checklist methods: Only 14 % of respondents used a checklist method. Of these:

- 62 % made a decision based on the number of 'yes' scores
- 38 % used the checklist to rank projects.

<u>Other methods used</u>: Thirty-eight per cent of respondents reported using a method not described in the survey. These were:

- 10% used customer demand and/or the interest and commitment of customers
- 8% analysed their resources and capabilities (staff skills, staff and company experience, resource availability, etc)
- Others mentioned a variety of informal (intuition/whim) and formal methods (risk analysis, modified checklists and spreadsheet models including financial and strategic information).

Dominant IPPM methods

When multiple portfolio methods are used, the dominant method will have the most effect on portfolio decisions. The most dominant methods are displayed in Figure A4-1. Financial Methods or Strategic Planning Methods were dominant in 75% of firms, with a fairly even split between the two. Of the remaining methods, the Scoring Model dominated in 9% of organisations.

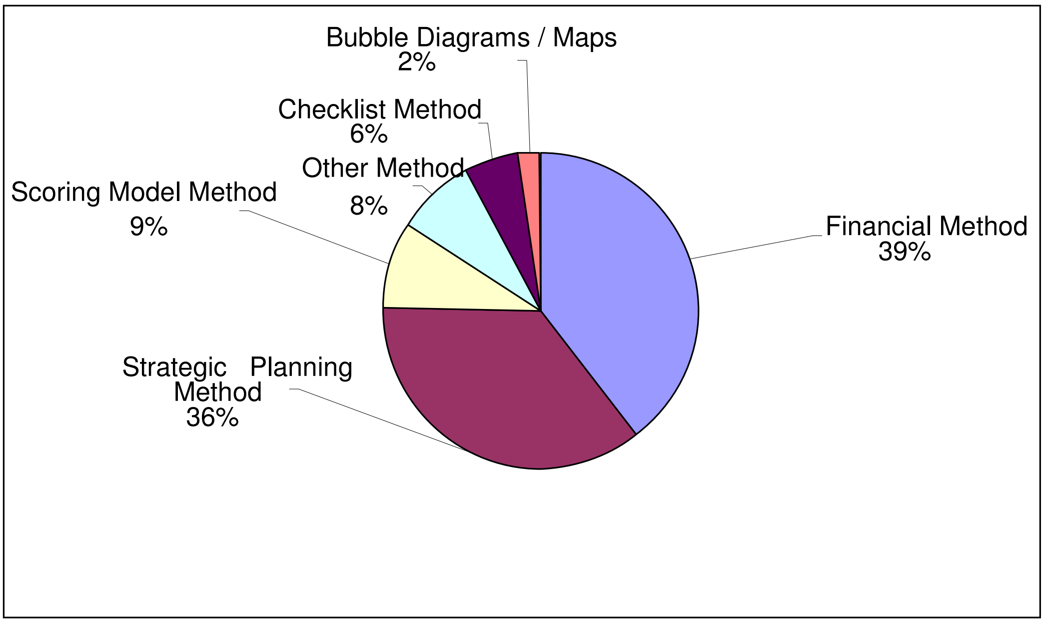


Figure A4-1: Dominant portfolio methods

Criteria used for portfolio assessment

A range of criteria are used regularly in the portfolio assessment process. These criteria are used to compare projects against each other to determine the final mix of projects to be selected. The surveyed organisations used an average of four criteria. Figure A4-2 shows which criteria were most often used as assessment criteria and the percentages of businesses that used each type of criteria. Strategic and financial criteria were the most frequently used methods. Technology capability, risk factors and timing considerations were also very common assessment criteria.

Some portfolio decision methods use a multiple-stage system for decision-making. A common approach is to use select criteria in a 'first round' assessment to weed out certain types of projects, and then to refine the project selection using 'second round' criteria. The first round is generally more important, and may present 'hurdles' or 'must meet' criteria. As shown in Figure A4-3, for this survey, the first round was dominated by strategic and financial criteria, as would be expected based on earlier data. The second round criteria were used to further refine the decision once projects had passed the first round. Second round criteria tended to vary between organisations depending upon their specific strategies and challenges. The strongest second round criteria were technology and risk considerations and the synergy between projects.

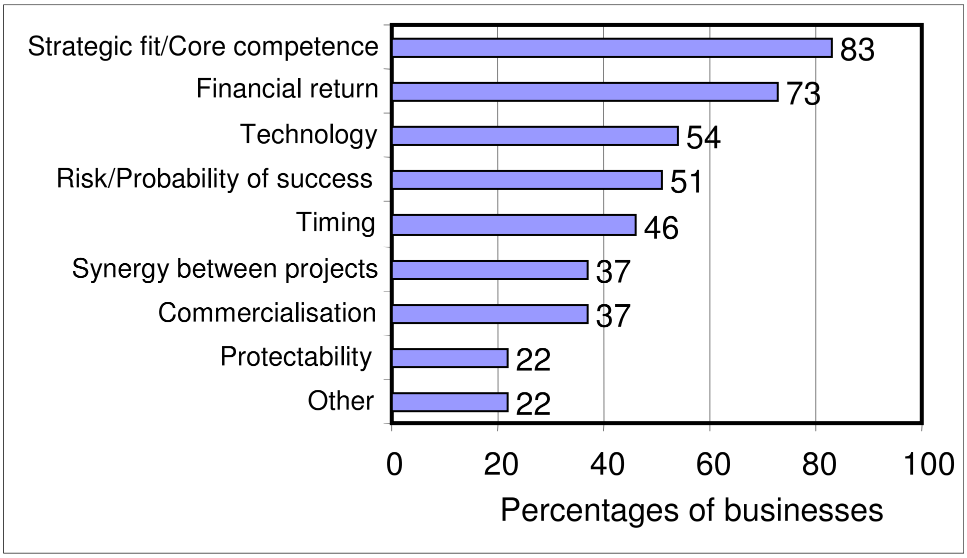


Figure A4-2: Criteria used to compare projects

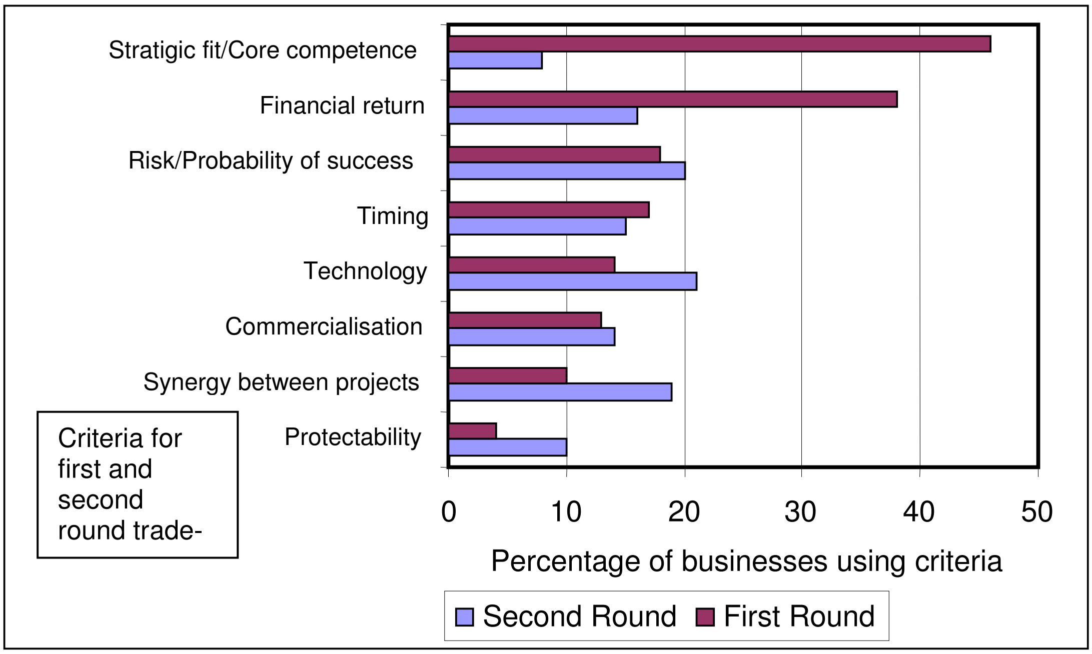


Figure A4-3: Criteria considered important in trade-offs to optimise the mix of projects

Comment on sample size and confidence intervals

The margin of error associated with statistical findings from a questionnaire surveys depends upon the sample size (Ticehurst and Veal 1999). The quantitative survey for Phase 1 of this study included a relatively small sample size of 60 respondents. The small sample size means that the findings have the following 'confidence interval' or margin of error (Table A4-4). The 95% confidence interval indicates that a survey finding that 30% of respondents use a particular method indicates a 95% likelihood that among the true population there is a 30%, plus or minus 11.9%, adoption of that method (18.1%–41.9%). The findings from the survey have been analysed with this confidence interval in mind.

Table A4-4: Confidence intervals for a sample of 60

Survey finding (the percentage of respondents found to have a characteristic or to use a particular method)	95% confidence interval
5 / 95	5.7
10 / 90	7.8
20 / 80	10.4
30 / 70	11.9
40 / 60	12.8
50 / 50	13.0

Section 3: Factor and reliability analysis for constructs

Factor and reliability analysis was conducted to ensure the most robust constructs were used in the analysis. This section outlines the factor analysis and the composition and description of the constructs used in the analysis. Item names and descriptions are listed in Appendix 2, Section 1.

Tests for normality of distribution

Before embarking on statistical analysis, the data were checked for normal distribution by testing the Skewness and Kurtosis of the distribution. The criteria used for determining relative normality of the distribution had been set at a ratio of skewness and kurtosis statistics divided by their standard error of between +/-2 for skewness and +/-3 for kurtosis. The choice of +/-3 as the cut-off for kurtosis to determine the relative normality of the distribution represents the relaxed end of the acceptable spectrum. This relaxed limit is acceptable for this first stage of research and the relatively exploratory nature of many of the investigations. A limit of +/-2 is more commonly used, and for some analyses the limit may be tightened to +/-1 (Garson, 2006).

Items based on Likert scale responses: IMP, MAT, NPP and OPP items

All of the items that are based on Likert scale responses and their associated constructs have been tested and all have ratios of skewness and kurtosis statistics divided by their standard error within the limits outlined above. These findings confirm that the responses fit a relatively normal distribution and that statistical methods assuming a relatively normal distribution may be applied to these items and constructs.

Items measuring the use or non-use of methods – METH items

The METH items are awarded a value of 1 or 0 for use and non-use of these methods. A range of other items collect data on details of the methods used. These items are not expected to fit into a normal distribution and cannot be usefully combined into a single construct for IPPM methods. To test the relationships on the conceptual model, the individual IPPM method measures were used as shown in tables A4-8 and A4-9 on page 367.

Items measuring new product performance – NPP items

The values for the NPP items are all percentages. The NPP_success item results fit a relatively normal distribution; however, the NPP_sales and NPP_profit items do not fit into the limits set to determine relative normality of the distribution. Therefore these items have not been combined into a single construct for testing the relationships on the conceptual model. Instead the NPP items were retained in the analysis as individual items. Further analysis was conducted using these individual items, keeping in mind the fact that the results were not strengthened by the use of a construct.

Construct development: IMP4, MAT4, PPM4, OPP4

Each of the constructs included four items that represented the best loading and the highest value for cronbach alpha. The PPM4 construct is the only construct where more than one item was removed from the set of factor or outcome items to strengthen the construct. However the four-item PPM4 construct represented the four main goals of an IPPM process, and therefore was a valid representative set of items to represent IPPM goal performance. The PPM4 construct included the following items:

PPM_number - We have the right number of new product projects for our resources

PPM_value - Our portfolio of new product projects contains only high value ones to our business

PPM_balance - Our portfolio of new product projects has an excellent balance

PPM_alignstrat - The projects in our portfolio are aligned with our business objectives and strategy.

Table A4-5 shows the four constructs, the included items, and the value for cronbach alpha. Factor analysis was conducted using principal component analysis extraction methods with varimax rotation. Each rotated component matrix converged in three iterations. The rotated component matrices are presented in Table A4-6 for the success factor constructs (independent variables on the conceptual model in Figure 4-3) and Table A4-7 and for the PPO constructs (dependent variables on the conceptual model in Figure 4-3).

Table A4-5: Details of the constructs

Construct	IMP4	MAT4	PPM4	OPP4
Items	IMP_exec	MAT_est	PPM_number	OPP_newmkt
	IMP_sman	MAT_rules	PPM_value	OPP_develtech
	IMP_mkt	MAT_cons	PPM_balance	OPP_newtech
	IMP_opman	MAT_supp	PPM_alignstrat	OPP_newarena
Cronbach alpha	0.738	0.918	0.794	0.782

Table A4-6: Rotated component matrix for the success factor constructs

Item name	Component	
	IMP4	MAT4
IMP_exec	**0.723**	
IMP_sman	**0.863**	
IMP_mkt	**0.702**	
IMP_opman	**0.616**	
MAT_est		**0.915**
MAT_rules		**0.916**
MAT_cons	0.426	**0.794**
MAT_supp	0.449	**0.761**

Table A4-7: Rotated component matrix for the PPO constructs

Item name	Component	
	PPM4	OPP4
PPM_number	**0.693**	
PPM_value	**0.849**	
PPM_balance	**0.728**	0.432
PPM_alignstrat	**0.776**	0.273
OPP_newmkt	0.438	**0.510**
OPP_develtech		**0.826**
OPP_newtech		**0.811**
OPP_newarena		**0.871**

Section 4: Analysis of relationships between constructs and items on the conceptual model

This section provides additional detail to support the analysis presented in the findings for RQ 1 in Subsection 4.2.3 of Chapter 4. The correlations between the four constructs (IMP4, MAT4, PPM4, and OPP4) are presented in Table 4-5 in that section. The relationships between the use of different types of IPPM methods and outcome items and constructs identified by relationships R 1, R 2 and R 3, as labelled on the conceptual model in Figure A4-4, are presented in Table A4-8.

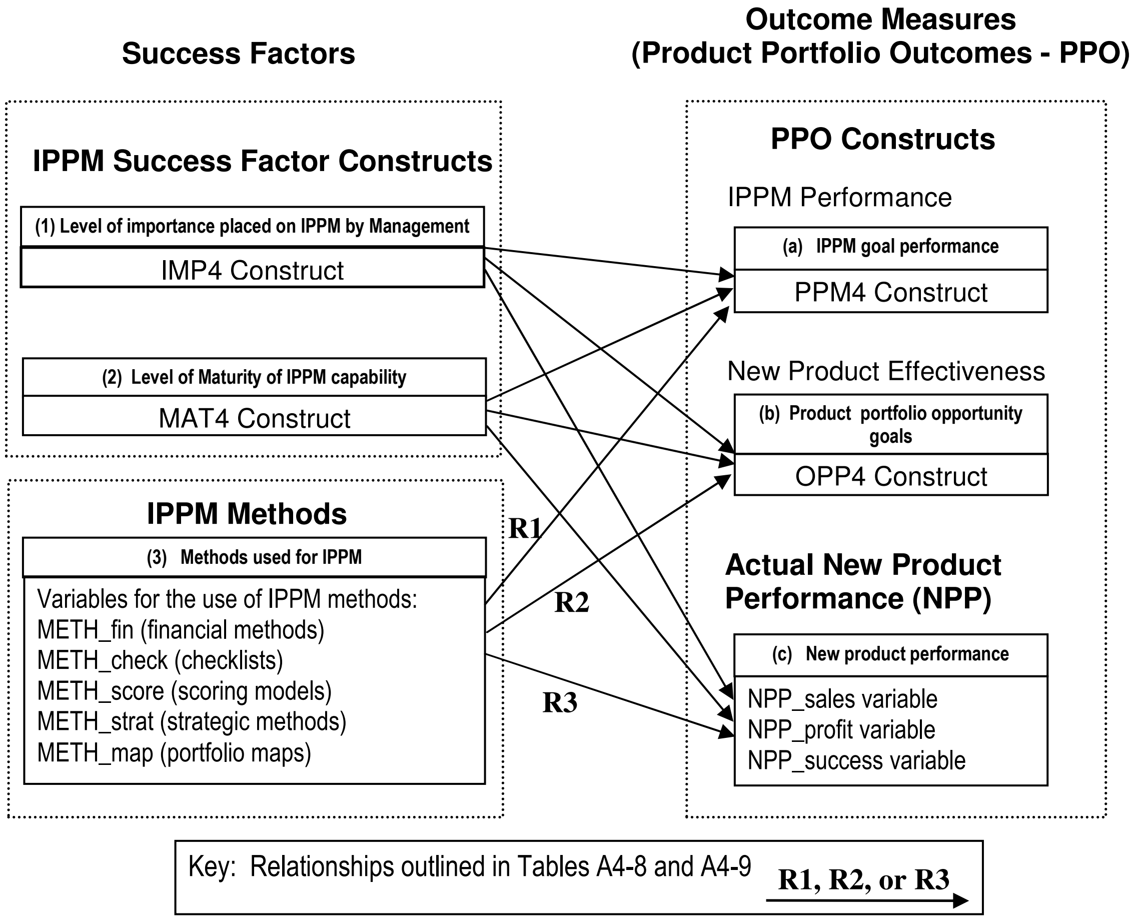


Figure A4-4: Conceptual model with constructs identified and relationships labelled

Table A4-8 shows the mean differences in findings for PPO constructs and items between organisations depending upon whether they used a particular IPPM method. Most of the reported relationships indicate positive outcomes from the use of IPPM methods. In the only negative correlation found, the use of financial methods was negatively correlated to one of the outcome items, OPP_newarena. The use of financial measures was also positively correlated with one item, while the use of strategy methods was correlated with improved outcomes on all three outcome constructs and on eight of the thirteen individual outcome items, and the use of portfolio maps was correlated with improved outcomes on two of the outcome constructs and four of the individual outcome items. These findings indicate that the use of strategy methods and portfolio maps are linked with better PPO measures than the use of financial methods. When used as a dominant method, financial methods showed even poorer performance, with only negative correlations found with PPO, as shown in Table A4-9. The use of a strategy-based method as a dominant method for IPPM correlated with positive PPO on two measures.

Table A4-8: Comparison of outcomes between use and non-use of IPPM methods

Use or non-use of method:	Outcome construct or item compared:	Relation-ship tested (see Figure A4-4)	Mean Group1 (method used)	Mean Group 2 (method not used)	Mean diff	t stat	Sig. (0.05 or better reported)
Strategy	PPM4	R1	3.40	2.80	0.60	2.837	0.006
	OPP4	R2	3.80	3.15	0.64	2.979	0.004
	PPM_alignstrat	R1	4.16	3.22	0.93	3.374	0.001
	PPM_spendstrat	R1	3.59	2.73	0.86	3.303	0.002
	PPM_balance	R1	3.25	2.46	0.79	3.279	0.002
	PPM_value	R1	3.63	2.85	0.77	2.773	0.008
	OPP_newmkt	R2	3.66	2.88	0.77	2.655	0.010
	OPP_newtech	R2	3.81	3.23	0.58	2.298	0.025
	NPP_sales	R3	36.8%	17.3%	19.5%	2.273	0.009
	NPP_profit	R3	33.0%	13.4%	19.6%	2.567	0.014
Financial	PPM_spendstrat	R1	3.36	2.69	0.66	2.107	0.049
	OPP_newarena	R2	3.16	3.92	- 0.77	-2.004	0.050
Portfolio Maps	PPM4	R1	3.60	2.97	0.63	3.562	0.001
	OPP4	R2	3.90	3.37	0.53	2.076	0.043
	PPM_balance	R1	3.47	2.70	0.77	2.747	0.008
	PPM_alignstrat	R1	4.40	3.50	0.90	3.742	0.001
	PPM_value	R1	3.87	3.07	0.80	2.472	0.016
	OPP_develtech	R2	4.53	3.60	0.93	3.097	0.003

Table A4-9: Comparison of outcomes for dominant IPPM methods

Use of method as dominant method:	Outcome construct or item compared:	Relation-ship tested (see Figure A4-4)	Mean Group 1 (method dominant)	Mean Group 2 (method not dominant)	Mean diff	t stat	Sig. (0.05 or better reported)
Financial	OPP4	R2	3.15	3.69	-0.53	-2.192	0.033
	OPP_newarena	R2	2.81	3.53	-0.72	-2.116	0.039
	NPP_sales	R3	14.5	32.4	-17.8	-3.047	0.004
	NPP_profit	R3	12.2	29.6	-17.4	-2.627	0.013
Strategy	PPM4	R1	3.41	2.96	0.45	2.113	0.040
	PPM_alignstrat	R1	4.32	3.37	0.944	3.589	0.001

Section 5: Regression analysis

Linear regression analysis was conducted on a limited number of constructs to strengthen and clarify the strongest correlations between constructs. In keeping within the limits of the sample size, only three constructs (IMP4, MAT4 and OPP4) were included in the regression analysis. Before conducting the analysis, the three constructs were tested for fitness for linear regression. Linearity was confirmed through generation and analysis of scatter plots and line-fit options. Multicollinearity was found not to occur between the three constructs. Collinearity tolerances of over .60 and variance inflation factors of less than 1.5 confirmed the non-multicollinearity of the data.

Factor analysis of the items in the constructs IMP4, MAT4 and PPM4 showed that the items load onto the three constructs, as shown in Table A4-10.

Table A4-10: Rotated Component Matrix for Factor analysis

Item name	Component – Construct name		
	1 - MAT4	2 - IMP4	3 - PPM4
IMP_exec		**0.767**	
IMP_sman		**0.876**	
IMP_mkt		**0.662**	
IMP_opman		**0.638**	
MAT_est	**0.909**		
MAT_rules	**0.879**		
MAT_cons	**0.670**	0.426	0.345
MAT_supp	**0.683**	0.449	0.326
PPM_number			**0.807**
PPM_value	0.438		**0.743**
PPM_balance	0.387		**0.684**
PPM_alignstrat	0.446		**0.675**

Although some contamination of the independence of some of the constructs is shown, removing items did not improve the independence. The level of independence of the constructs was viewed as sufficient to continue the analysis without adjustment to the constructs (Ticehurst and Veal 1999).

To conduct the regression analysis each set of relationships was tested between the three constructs that showed the strongest correlations: IMP4, MAT4 and PPM4.

Regression analysis IMP4-PPM4

Independent variable – Importance, IMP4
Dependent variable – PPM performance, PPM4

The regression analysis showed that the relationship between IMP4 and PPM4 was not significant, as shown in Figure A4-5. This relationship showed only marginal correlation as reported in Table 4-5 in Subsection 4.2.3 of Chapter 4. Details of the regression analysis are presented in Table A4-11.

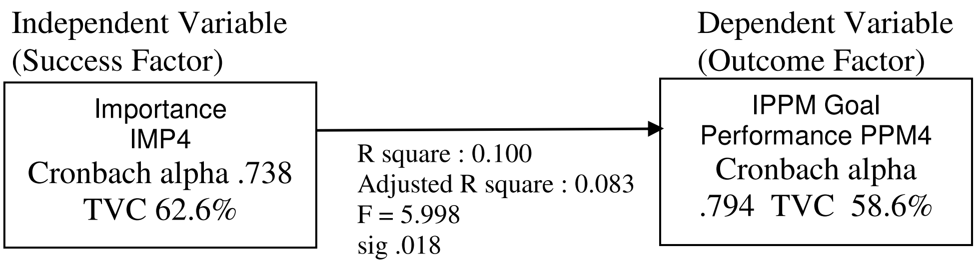


Figure A4-5: Regression results IMP4 – PPM4
(TVC is Total Variance of components)

Table A4-11: Regression analysis IMP4-PPM4

Construct	Beta	t-value	Significance
Constant			**.000**
IMP4	**.316**	**2.449**	**.018**
R square	**= .100,**		
R square adj.	**= .083**		
F-value	**= 5.998 (0.018)**		
Dependent variable	**= PPM4**		

Regression analysis IMP4-MAT4 and MAT4-PPM4

IMP4-MAT4

> **Independent variable – Importance, IMP4**
> **Dependent variable – Maturity, MAT4**

MAT4-PPM4

> **Independent variable – Maturity, MAT4**
> **Dependent variable – PPM performance, PPM4**

Regression analysis showed the strongest explanatory relationships between the importance of IPPM (IPM4) and the maturity of the IPPM capability (MAT4), and an explanatory relationship between the maturity of the IPPM capability (MAT4) and the performance on IPPM goals (PPM4), as illustrated in Figure A4-6. Details of the regression analysis are presented in tables A4-12 and A4-13.

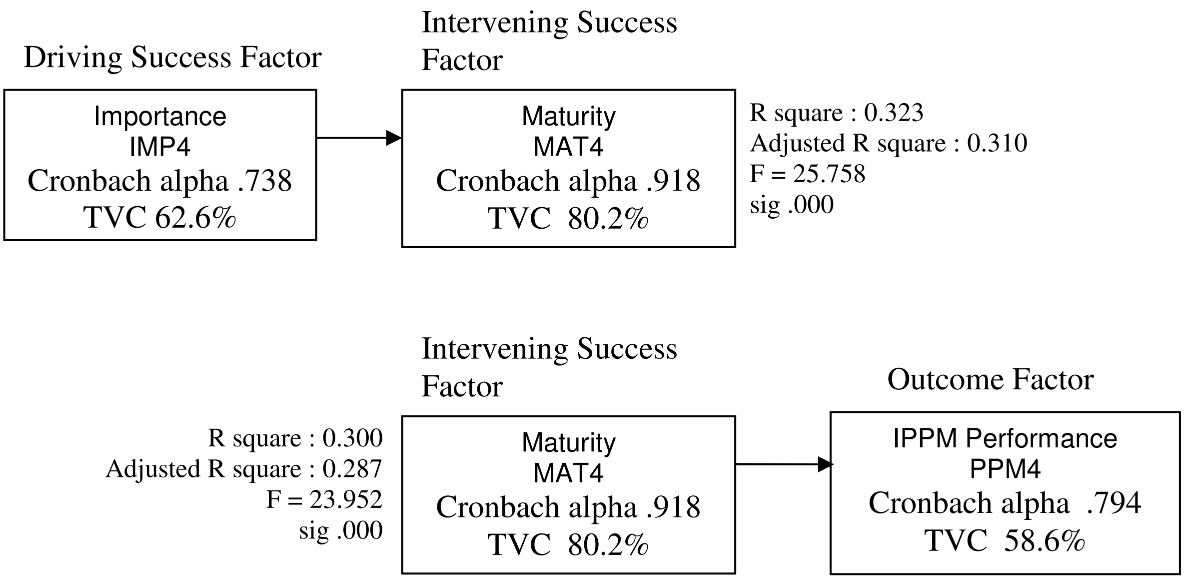


Figure A4-6: Regression results: IMP4 – MAT4 and MAT4 – PPM4

(TVC is Total Variance of components)

Table A4-12: Regression analysis IMP4-MAT4

Construct	Beta	t-value	Significance
Constant			.000
IMP4	.568	5.075	.000
R square = .323 R square adj. = .310 F-value = 25.758 (0.000) Dependent variable = MAT4			

Table A4-13: Regression analysis MAT4-PPM4

Construct	Beta	t-value	Significance
Constant			.000
MAT4	.547	4.894	.000
R square = .300, R square adj. = .287 F-value = 23.952 (0.000) Dependent variable = PPM4			

Multiple/combined regression analysis

The multiple regression analysis showed s strong relationship between MAT4 and PPM4, but that the relationship between IMP4 and PPM4 was not at all significant as shown in Figure A4-7. Details of the multiple regression analysis are shown in Table A4-14.

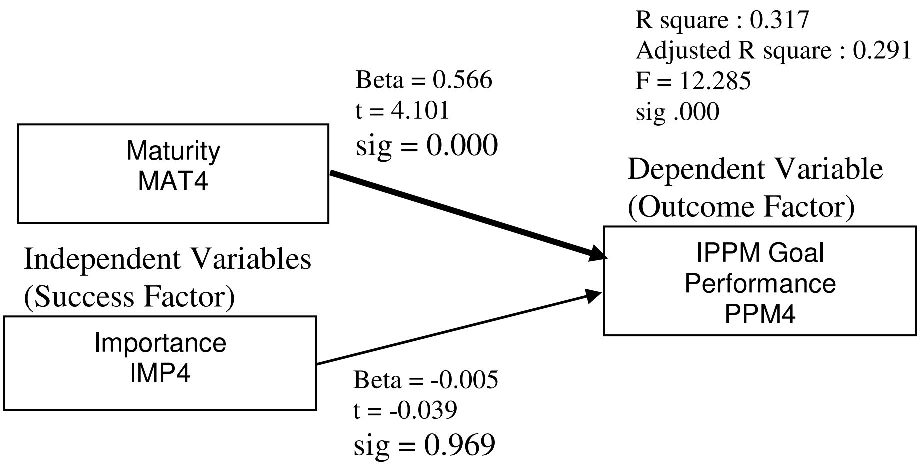


Figure A4-7: Multiple regression results for MAT4 and IMP4 – PPM4

Table A4-14: Multiple regression analysis for MAT4 and IMP4 – PPM4

Construct	Beta	t-value	Significance
Constant			**.000**
MAT4	**.566**	**4.101**	**.000**
IMP4	**-0.005**	**-0.039**	**.969**
	R square	**= .317,**	
	R square adj.	**= .291**	
	F-value	**= 12.285 (0.000)**	
	Dependent variable	**= PPM4**	

Section 6: Relationships between outcome constructs and measures

The final analysis aimed to understand the relationships between the three different outcome measure constructs. The PPM4 and OPP4 constructs measured performance on goals for the IPPM capability that were proposed to lead to improved new product success in the market as measured by the NPP items. Correlations between these measures are tabulated in Table A4-15 and illustrated in Figure A4-8.

Table A4-15: Correlations between outcome measures

Outcome measure goal construct	Correlated with Outcome construct or item	Pearson Chi Square correlation	Significance
PPM4	OPP4	**0.426**	**0.001**
PPM4	NPP_sales	0.227	0.121
PPM4	NPP_profit	0.208	0.187
PPM4	NPP_success	**0.609**	**0.000**
OPP4	NPP_sales	**0.428**	**0.002**
OPP4	NPP_profit	**0.444**	**0.003**
OPP4	NPP_success	**0.355**	**0.033**

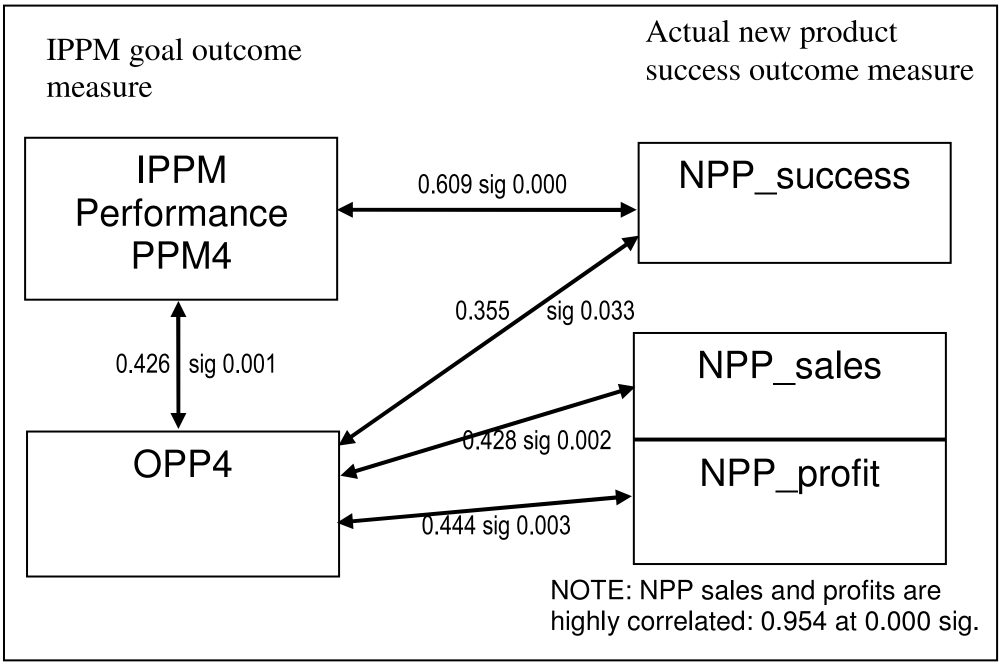


Figure A4-8: Illustration of relationships between PPO measures

Appendix 5

Phase 2 semi-structured interview guide

Introduction

This appendix contains a consolidated version of the research instrument for Phase 2 – the full guide contained more space for recording information. This document was used to guide the researcher during the interview process. The first portion of this appendix provides an overview of the preliminary information covered at the interview. Sections 1 through 5 include the questions, prompts and follow-up questions used during the interviews.

NOTE: IPPM vs. PPM: *Although the term IPPM for Innovation Project Portfolio Management is used throughout the thesis, the more simple and standard term PPM was used with the research participants. All research participants were selected based on their innovation project portfolios, and interviews focused on these innovation project portfolios – so the term PPM in this context is the same as IPPM.*

Organisation code ____________ Participant number ____________

Date ____________ Time ____________

General information

Title and department: ____________________

reports to ____________________

responsible for ____________________

years in current role, previous roles, experience etc.

Consent form(s) completed ______ Audio Consent? _______

Researcher background

(researcher to introduce qualifications and background, introduce the current PhD project)

Research overview

(researcher to follow this script – or paraphrase the information)

Previous survey research (including the first phase of this study) has found that some PPM practices are associated with improved innovation outcomes. The purpose of this research is to explore PPM capabilities in more depth.

Definition of PPM – To clarify what I mean when I discuss the project portfolio management practices or capability: I am talking about the process used within the organisation or business unit to evaluate and monitor the portfolio of projects in order to allocate resources to the best overall combination of projects. The process often considers and monitors ongoing projects as well as new project proposals. Processes vary considerably, and many are not called 'portfolio management processes' – however whatever process is used to allocate the budget and other resources across new product projects is the subject of this research. The project portfolios investigated in this research can be service products or manufactured products or a combination of both. In some organisations the new product development portfolio is managed as an entity, in other organisations it is encompasses in a larger portfolio that includes other project such as infrastructure or change management projects. As we discuss the environment at your organisation during this interview, we will need to clarify the details of the project portfolio and the portfolio management process this case study will focus on.

This project asks the following questions:

What PPM practices are used by successful innovators?

Are PPM practices different between manufacturing and service industries?

What is the relationship between an organisation's PPM capability and its ability to achieve competitive advantage through new products?

Overview of the interview

This research interview is designed to be fairly open-ended and I want to encourage the information to flow in a relatively informal way. However, to keep within the time available I will try to steer the discussion within a structure, and will also ask you to provide a rough 'rating' for some items.

The overall structure of the interview includes 5 sections as follows:

1. Overview of the industry, strategy, competitive advantage and importance of new products.

2. Product development and project management environment.

3. Project Portfolio Management (PPM) process – detail on the actual processes used, history of previous processes and evolution of the process, future plans for the PPM process

4. Perceptions of satisfaction, importance and outcomes from the PPM Process.

5. Description of two to four different projects that have passed through the PPM process.

For the items that request a 'rating' – these will either be simple 'average' 'high' or 'low' impressions – or will be on a scale from 1 to 5 where 5 is the 'higher' rating. In these cases I will provide an example of the meaning of the rating, such as "5" means 'very successful' and "1" means 'not at all successful'. It is not necessary to be very analytical about your responses – it is better to answer with your initial impression.

<u>Key to sections 1-5 of the interview guide</u>: **Bold text** represents **key terms** that will be covered in the interview. *Italicised text is used for indicating types of follow up questions or prompts or notes for the interviewer's reference.*

<u>Section 1) Strategy, Competitive Advantage and New Products</u>

<u>1a) Organisation and organisational setting.</u>

<u>Participant 1 only</u>:

Organisational Measures Sheet completed? ________

Term 'portfolio management' used? ______________________

What **level of portfolio** will this case focus on? ______________________

Who is responsible for this process? Is there a **particular department or person responsible** for this process? ______________________

<u>1b) Strategy and Leadership</u>

How would you describe the **strategic orientation** of your company?
Customer focus, Competitor focus, Technological focus, (Interfunctional)

How would you describe your organisation's **new product development strategy**?
Is there a strategy? How is the strategy formed? (workshops, individual decision, cross-functional teams, etc) How formal is it? How does the NPD strategy relate to organisational strategies?

Does top management display **strategic leadership**?
Does the top management communicate a vision throughout the company?

Are organisational **actions aligned with the strategy**?
Are the actions of the top management in line with the vision/strategy?
What methods are used to relate organisational activities and the NPD strategy to the organisation's business strategies?

1c) Competitive position and resource base

What are the main **sources of competitive advantage** at your organisation?

What **resources** does your organisation have that help it compete successfully?

Resource examples:
Assets, People/skills, attitude/culture, processes and organisational capabilities

Examples of success measures:
Growth, leadership, profitability

How is **the resource base developed**? *(resource base = the underlying assets or capabilities that support the competitive advantage of the organisation)*

How dynamic or flexible is your ability to develop or acquire resources?

Do you use outsourcing, partnering, or alliances to extend capability?

What is the relationship between resources and project selection?

What methods are used to plan the future directions for resources/capabilities?

To what degree do the **PPM decisions affect the development of the resource base**?

To what degree does the **current resource base affect the PPM decisions**?

1d) Markets and success

How do you view the **general success rate** of new products that are introduced by your organisation? *Are some projects much more successful than others? How does the organisation compare with competitors and similar organisations?*

How important are **new products** to your organisation's success?

How important are **international markets** to your organisation's products?

Section 2) Product Development and Project Management Environment

2a) Project Profiles – types, newness and complexity

What **types of projects** are included in the Project Portfolio?
New Product and/or Service Projects only? Other types of projects? Estimated percentages of incremental vs. radical for example? List of project types?

1 (tangible) – 10 (service) nature of the products________

Product Newness: relative to your industry:
(Scale – 1 very new, 2 average, 3 not at all new)

Are your products "New" to the Market ? ________

Are your products or technologies "New" to your firm? ________

Are your products or technologies "New" to the industry? ________

Technical complexity: of your projects**:** *(High, Medium, Low)*
____

Level of uncertainty/risk in your portfolio: relative to your industry**:**
(High, Medium, Low)

Technical Uncertainty? ________

Market Uncertainty? ________

Project interdependencies?

Project Resource Interdependencies: *(people, other)*

Technical Interdependencies: *(platform technologies, etc)*

<u>2b) NPD Project Management</u>

INTRO: *Before moving on to discuss the decision making processes related to the selection and composition of the NPD project 'portfolio' and the ongoing evaluation of these projects, I would first like to get a brief picture of the NPD process itself – the processes used and the nature of the environment where the individual new product projects are executed.*

What is the **product development environment** like at your organisation?
What is the structure of the organisation (matrix, functional, project based?)
What is the culture?

Are products developed in **teams**? How are staff members allocated to teams?

Are team leaders and members **dedicated** to teams?
About **what percentage of their time** is allocated to a typical team? ________

Are **uncertain or risky projects** staffed differently than more standard/predictable projects?

Briefly **describe the processes** used to develop new products at your organisation **(NPD process).**

Is a **stage-gate** style process used? ________ yes / no

How **formal or informal** is the NPD process? ________ formality high/med/low

What types of **documentation and/or software systems** are used during the process?

________ any s/w used?

Are projects **fully (adequately) resourced**? Do you leave some slack resources?

What is done if projects are slipping behind schedule or not meeting objectives?

<u>Section 3) Project Portfolio Management (PPM) process</u>

Are there **more product ideas** and proposals **than resources** to complete these projects?
(if this has not already been covered)

<u>3a) Detail of PPM Processes and Methods</u>

How does your organisation determine which projects get the go-ahead?

Is there a **formal PPM process** at your organisation?
Will you explain the formal process/procedures? Are the processes and procedures documented? Can I have/look at a copy of the formal procedures?
(open free discussion encouraged to solicit all aspects of the process, in the course of the discussion ensure that the items below are discuss / assessed)

____

____

Are all new product projects considered as part of a **portfolio or individually assessed**?

____

How is **data collected** for use in PPM decision-making?
How is **data analysed and/or displayed** for decision making?

____

How integral are **computer databases or applications** to the PPM decision making process? *Do you use any computer-based project and/or portfolio management system?*

__________yes / no
re computer PM

What types of **methods or tools** are included in the PPM process?

Financial? (Types)
Checklist? Scoring Model?
Strategic basis for allocation of funds?
Other Strategy methods?
Bubble Diagrams? (Portfolio Maps?) Examples ?

Which method(s) is/are **dominant in decision making**? __________ dominant method(s)

Are PPM decisions made in meetings or by individuals?

Are **teams** (or cross functional teams) involved in the PPM process?
What people or departments are involved in the process? **How Many?** How often do teams meet?

3b) Establishment and Evolution of the PPM Process

How long has this process been in place? __________ *(time)*

How was your PPM process established? Over time what changes have been made or are planned?
(open free discussion encouraged to solicit all aspects of the establishment and evolution of the process, in the course of the discussion ensure that the items below are discuss / assessed)

> *Was there a previous process? If so what was the earlier process like?*
> *Why was the process changed? Do you see any benefits from the new process?*
> *Are there any plans for PPM evolution in the future?*
> *Where have you obtained information about PPM processes, how has this information been shared? Have meetings or review sessions been part of the process of establishing and evolving the PPM process?*

3c) Project proposals and project success

What types of **benefits** are generally expected from new products and new product projects? *(financial, leadership, develop capabilities, other)?*

How is success of the new product projects determined?
(open free discussion encouraged on project success estimation and measurement during the PPM process, in the course of the discussion ensure that the items below are discuss / assessed)

> *How is benefits realisation **estimated** during the project proposal or approval process and how do you **measure** the resultant benefits? **Who** is responsible? **When are benefits measured?** How long does it take before you can evaluate success or otherwise of a project? after launch? If so, how long after launch?*
>
> *Are **benefits linked back to the justification** for the initiation of the project and the basis for funding?*
>
> *Examples of product success measures:*
> *ROI, Number of new product launches, Customer satisfaction with new products, Sales volume or market share of new products (3 years or less), Growth of existing markets, degree to which NPD projects meet budget or schedule, Development time (time to market), Technology leadership, platform development, developing organisation capability and skills, any others?*

3d) PPM processes and long term planning

How far in the future does your organisation plan for new product development or the development of technologies that will support NPD? (or how far does your organisation project future trends etc?)

__________time

Does your organisation perform **basic research** or technology development projects to support future NPD projects?

__________Y/N

What percentage of the budget is for basic research? __________ %

How does this compare with competitors/industry? __________ High/Low

What methods are used for long-range planning at your organisation?
Are long term considerations part of the PPM process, or a separate process? If separate, are the two processes (PPM and the long-term planning process) integrated in any way? How?

(Interviewer to have a list of methods to check, plus will look for explorative information/methods/input)

Technology Council / Steering committee or separate body to plan long-term?

Are Platforms or Modular product architectures used?

Roadmapping?

Forecasts? Experts?

Financial measures for long term? Real Options?

Other?

Section 4) Perceptions of the PPM Process.

4a) PPM Processes – performance

Perception of the new product development program – and the portfolio of projects

Relative to competitors in our field, our new product program is successful. 1 = not at all successful; 5 = very successful.	[1] [2] [3] [4] [5]
We have the right number of new product projects for our resources – people, time and money – available. 1 = no, we're spread far too thin; 5 = right number of projects for our resources.	[1] [2] [3] [4] [5]
Our projects are done on time – in a timely and time efficient fashion. 1 = no, they're slow and late; 5 = on time and timely.	[1] [2] [3] [4] [5]
Our portfolio of new product projects contains only high value ones to our business – profitable, high return projects with solid commercial prospects. 1 = no, many poor, mediocre, low value projects; 5 = definitely yes, high value projects to the business.	[1] [2] [3] [4] [5]
Our portfolio of new product projects has an excellent balance in terms of long versus short term, high versus low risk, across markets and technologies, and so on. 1 = no, unbalanced and skewed; 5 = excellent balance.	[1] [2] [3] [4] [5]
If portfolio unbalanced, how? Too many or too few of what?	
The projects in our portfolio are aligned with our business objectives and our business's strategy. 1 = no, many are off strategy or have no strategy; 5 = aligned and on strategy.	[1] [2] [3] [4] [5]
The breakdown of spending (resources) in our portfolio of projects truly reflects our business's strategy. 1 = no, spending breakdown is inconsistent with our business strategy or have no strategy; 5 = spending consistent with strategy.	[1] [2] [3] [4] [5]
Our new product program enables our business to enter new markets. 1 = no; 5 = yes, our new products regularly help us enter new markets.	[1] [2] [3] [4] [5]
Our new product program develops our existing technologies and technological competencies. 1 = no; 5 = yes, our new products often leverage our existing technologies and skills.	[1] [2] [3] [4] [5]
Our new product program brings new technologies to our business. 1 = no; 5 = yes, our new products often use new technologies.	[1] [2] [3] [4] [5]
Our new product program leads our company into new product arenas (product categories or types not offered 3 years ago). 1 = no; 5 = yes, our new products are often in new arenas.	[1] [2] [3] [4] [5]

<u>4b) Importance of PPM</u>

(Importance will probably be indicated by earlier discussion, this will be used to cross validate answers to specific questions about Importance)

How **important is PPM** at your organisation? Is top management supportive? What about other levels or areas of management?

How much **attention or emphasis** is placed on making decisions to do the right projects?

If PPM is important, **what are the reasons** PPM is important to your organisation?

Project Selection is linked to strategy?
To maintain competitive position?
To use resources efficiently?
To avoid failures?
Allocating money implements strategy?
To focus on the best projects (and not do too many)?
To obtain the right balance?

4c)<u> Consistency and use of the PPM Method</u>

(Consistency and use of PPM methods will probably be indicated by earlier discussions, this will be used to cross validate answers to specific questions about this area)

How **well understood** is the PPM method? Are the rules clear?

Is the process consistently applied?
Do some projects skip the process? examples?
Are different measures or methods used for different types of projects?
Is the method truly used to make Go/Kill decisions?
How often are projects killed, or slowed down/sped up, or put on hold?

<u>4d) Final Questions</u>

(Encourage participants to discuss any aspects of the processes, especially in areas not yet discussed. Allow time for new themes or considerations/concerns to emerge)

What are your **main PPM challenges**?
(open free discussion encouraged particular challenges or plans, encourage any additional comments on any aspect of the environment)

Section 5) Selection of example projects to study

Participant 1 only. *In order to get some examples of your PPM process in action, I would like to focus on two or three projects that have been through the process. Can you identify a two or three completed projects that I can review? The projects should be completed to a stage where you can identify whether the project was successful or unsuccessful. Ideally I would like to study two successful projects and one unsuccessful or less successful project. Of the successful projects, one should be a fairly incremental or day-to-day type of project and one a more radical or 'new' type of project. (Interviewer to work with one participant (usually participant 1) to identify completed projects that represent different types of projects using the definitions in the tables below)*

Definitions of Project Types:

Project type label	Definition
Radical	New product using newly developed technology or for emerging market areas / product arenas – so either high technology or market newness or both qualifies the project as radical for this analysis.
New	New product with relatively new approach or features, but not radical or first time use of technologies or entry into market areas. Often applies to combining existing elements for a new solution.
Incremental	Incremental add-on or change to existing product.

Categorisation of project success levels:

Project success label	Definition
Exceeding expectations	A level of success well above the expected projections, success to a surprising level.
Meeting expectations	The project success is solid and falls in the range of projection scenarios for the project – includes the moderately above and below levels of expected or projected success.
Below expectations or failed	The project does not meet expectations and falls well below expectations. The money would have been better spent elsewhere in most of these cases – although sometimes over time these projects may turn out to be relatively successful if they are not totally killed.

Project 1: Successful Project – Incremental

Project: ____

Brief explanation of the incremental nature of the project and the project outcome / level of success:

____

____

Project 2: Successful Project – Radical or Very New

Project: ____

Brief explanation of the radical/new nature of the project and the project outcome / level of success:

____

____

Project 3: Identify an unsuccessful or less successful project if possible.

Project: ____

Brief explanation of the type of project and the project outcome / level of success:

____

____

Project 4: Optional additional project?

Project: ____

Brief explanation of the type of project and the project outcome / level of success:

____

____

For each of the example projects, the following Project 'X' Embedded case interview guide is used to prompt for the information on that project's journey through the PPM process.

PROJECT 'X': Embedded case interview guide

For each project: *In an informal fashion the participant is encouraged to discuss the progress of the project through the decision making stages.*

Can you take me through **the PPM decision making processes related to this project**?

(Encourage participants to explain the process, prompt as necessary to cover the following questions)

Briefly describe the project – is it radical/incremental relative to other projects?

How did the idea for this project initiate?

Did this project follow the 'normal' or 'standard' PPM process? Explain…

How detailed was the project plan when funding was allocated?

What were the projected benefits? How novel were the objectives of the project? (was this project to deliver a new type of benefit?)

When funding was allocated was it done in one hit or more than one?

How was this project staffed? (Number of staff, percentage of time allocated to the project by leader/staff approx) Were there any major changes in staffing or resource allocation during the course of this project?

Did this project require skills or resources or capabilities that were not available at your organisation? Were resources developed, acquired or obtained for this project?

How often was the project reviewed from a portfolio management standpoint?

How did the project rate at each review stage?
How long did this project take to complete?

________ time

What **challenges** did you encounter during this project?

____

____

Was the project **successful/unsuccessful?** On what measures was it successful/unsuccessful?

____

____

What do you think are some of the **reasons for the success (or lack of success)** for this project?

____

Appendix 6

Phase 2 data sources and analysis methods

This appendix outlines the sources of data and the methods used to analyse the data in Phase 2 of the research.

Introduction

A variety of data sources were used to understand and analyse the PPM capabilities at the case organisations. The main source of data was the interviews conducted with multiple participants representing different organisational perspectives. These interviews were transcribed from audio tape in five of the organisations, and summarised as completely as possible directly after the interviews in the sixth organisation. In addition to the interview transcripts, additional data sources such as annual reports, company websites, Product brochures and information, internal process documents, graphic portfolio display documents were used in the case study analysis.

Table A6-1 summarises the sources of information used for the case study analysis, including the numbers of interviews, duration of interviews and additional documents used.

The data were analysed in two ways. During the interview process the data were entered onto a cross-case analysis spread sheet after each interview. A rolling summary of the findings for each organisation was updated after each interview, including information that needed to be clarified with a follow-up or information to focus on in subsequent interviews. This ongoing summarising process helped direct the case questioning and to ensure that emerging themes were identified early and cross checked with other participants.

The cross-case spreadsheet contained columns for each participant and over 100 rows for data. Several paragraphs of data were included in some of the cells. A condensed version of the spreadsheet is shown in Table A6-2. This excerpt of the spreadsheet shows the type of format and row headings used. The data entered into the spreadsheet included information from the interview transcripts and information from other sources, where relevant.

Once the case studies were completed, the interview transcripts were coded into the NVivo qualitative data analysis software. Initially it was thought that the cross-case spreadsheet would be adequate for the purposes of this research. However, managing the data became difficult due to the size of the spreadsheet and the requirement to manually link entries on the spreadsheet back to the original source. To address these difficulties, the specialist qualitative data analysis software, NVivo, was chosen to code all data.

In addition to using NVivo to aid the data analysis and maintain documents for the case study findings, it was also beneficial to revisit all of the data through the process of coding the data into the program. This process allowed a consistent approach for all of the data, and allowed the early data to be analysed with respect to emergent themes as well as the anticipated themes.

Introduction to the NVivo analysis

This section describes how NVivo was set up for analysis of the interview transcripts.

The interview transcripts were imported into NVivo as the main sources of data. Each interview was entered using a code such as 'SERV_P1', where SERV is the organisation code name and P1 indicates the first interview.

Nodes were set up for coding the data. Initial nodes were set up based on the interview themes, and themes identified in the spreadsheet-based cross-case analysis. During the coding of data on NVivo, additional nodes were added to address emerging themes such as comments on 'resources for doing PPM' and on 'tiered decisions, governance'. The interview transcripts were then analysed and coding was checked a final time to allow for coding on the new nodes from all transcripts. NVivo allows the identification of multiple themes or nodes for selections of the interview text. For example, comments on a facilitated workshop that was used to develop new IPPM criteria would be coded under the node for specific examples of explicit knowledge articulation activity ('A2-Facilitated meeting') as well as under the node for 'evolution of IPPM'.

Tables A6-3, A6-4 and A6-5 list the nodes used for the data coding. These nodes included expected as well as emergent themes. Table A6-3 lists Tree Nodes, which are hierarchical and some have sub-nodes. Table A6-4 lists the 'Free Nodes', stand alone nodes, with no hierarchy. Table A6-5 shows the main nodes that were analysed for each of the themes identified in the cross-case analysis in Section 6.3 of Chapter 6.

The combination of the cross-case spreadsheet and the NVivo coded transcripts were used to analyse the data and to generate the findings of the multiple case study research. This appendix provides an overview of the types of data collected and the methods used to analyse the data. It also includes some specific examples showing how NVivo hierarchy of nodes was used (illustrated with the 'learning mechanisms and investments' example in Figure A6-1), how NVivo was used to collate data into themes (illustrated with an excerpt from the 'evolution of IPPM' theme in Figure A6-2), and how the source data were used to generate findings (illustrated with a detailed step-by-step discussion of the process for the theme 'Importance of new products and IPPM' on pages 400–402).

Table A6-1: Sources of case information

Case Organisation	Number of Participants	Total Interview time (hours)	Number of follow-up contacts *	Number of functional areas represented
SERV	4	7.25	2	3
MED	3	5.75	2	3
TELE	4	8.00	2	4
IND	5	8.25	4	4
FIN	3	4.50	1	3
MAT	4	8.00	1	3
TOTALS	**23**	**41.75**	**12**	**N/A**
Averages	3.8	7.0	2.0	3.3

* Note: Follow-up contact by email or telephone

Case Organisation	Consent to record interviews	Other documents
SERV	yes	W, P, PR, G, O
MED	yes	A, W, P, G
TELE	yes	A, W, P, PR, G, O
IND	no	A, W, P, PR, G, O
FIN	yes	A, W, P, PR, O
MAT	yes	A, W, P, PR, G, O

key for other documents:
A=Annual Report
W=Website
P=Product information,
PR=Internal process documents
G=graphic portfolio displays
O=Other

Table A6-2: Excerpt of the cross case analysis spreadsheet

Cross Case Analysis	ORG X				
	P1	P2	P3	P4	Summary and comments
Title					
Reports to:					
Length of employment/ Time in position					
1) Strategy, Competitive Advantage and New Products					
1a Org and Org setting					
Is the term portfolio management used? Is the group of projects a 'portfolio' of projects?					
Dept or person responsible for IPPM?					
Comments on Changes to Structure for IPPM					
1b Strategy and Leadership					
Focus of Strategy (customer focus, competitor focus, technology focus, hybrid)					
< items for NPD strategy, leadership, alignment, consistency of understanding of strategy, etc >					
1c Competitive Advantage, Competitive Position, Resources					
Competitive Advantage (CA)					
What Resources for CA					
How is the resource base developed?					
Dynamic / flexible resource capablities - outsourcing, etc					
To what degree do the IPPM decisions affect the development of the resource base?					
To what degree does the current resource base affect the IPPM decisions?					
Other resource base information					
Summary of resource base / IPPM relationship					
1d New Product (NP) Importance, Markets and Success					
Success Rates of NP?					
Importance of NP?					
How important are International Markets/considerations?					
2) Product Development and Project Management Environment					
2a Project Profiles / project types					
Level of Service (10) to tangible (1) product mix					
Information about Service/Tangible nature of the products					
Other info re breakdown of Portfolio - exploitation/exploration or other aspects					
< items for project profiles, interdependencies, etc >					
2b - NPD Project Management					
NPD environment , culture, structure					
Team composition and staffing					
Stage- Gate type of process?					
Level of formality					
Changes to Stage-Gate or Alternate processes for different types of projects? More or less formal, different stages, etc?					
Recent changes to Stage Gate and/or IPPM process -- what stimulated the change, what was the change, when?					
NPD software used?					
3) IPPM Process					
Are there more product ideas and proposals than resources to complete these projects?					
3a - Detail of IPPM Process and Methods					
Formal IPM process? How established or explicit?					
Comments on Flexibilty vs Formality					
Project evaluated individually (1)? As part of portfolio (10)? In between?					
Brief summary of process - methods, levels, etc					
3b - Establishment and Evolution of IPPM					
Length of time IPPM process established					
Previous IPPM process and reasons for change					
Plans for IPPM in future					
What activities have influenced the establishment and evolution of the IPPM capability?					
3c Project proposals and success					
3d IPPM - Long Term Planning					
4) Perceptions of IPPM					
4a Performance of IPPM					
4b - Importance of IPPM					
4c - Consistency of use of IPPM methods					
4d - Final Questions - IPPM Challenges, Other, Misc					
ORGANISATIONAL MEASURES					
Approx size of org in annual sales (in million AUD)					
Total spend on NPD (% of annual sales)					
< other organisation measures >					

Table A6-3 - NVivo Tree Nodes – Full list showing hierarchy of nodes

Establishment, Evolution and Change Establishment of PPM Evolution of PPM Org dynamism and change	**Resource Issues** Resource devel - building capability Resource for competitive advantage Resources for doing PPM
Learning Mechanisms and Investments Explicit Knowledge Articulation A1 - Meetings scheduled A2 - Facilitated meetings A3 - Reviews scheduled A4 - Use of idea sharing system A5 - Training PM and PPM Explicit Knowledge Codification C1 - Documentation C2 – Devel of idea database system C3 - Devel computer or web systems C4 - Spreadsheet database, formats C5 - Graphical Displays C6 – Status, outcome report formats Tacit Experience Accumulation T1 - change structure T2 - Team composition T3 - Employment continuity T4 - Previous experience	**Process Detail** Stage-Gate processes Skipping PPM Prioritisation Long term planning Killing projects Data display Creativity tools Computers and software **Performance Rating Comments** 1 Success of portfolio 2 right number of projects 3 done on time 4 high value 5 balance 5a Comments on balance 6 links with strategy 7 enter new markets 8 develops existing technologies 9 bring or develop new technologies 9a enter new product arenas
Environment – the human side Commitment and Support Communication Cross functional team Innovative Culture Motivation and Recognition Politics and Power **Benefits Criteria Business Issues** Accountability Benefits from projects in portfolio Business Case Issues	**Embedded Case_Data** * Benefits from Case Project Challenges - For Case Project Incremental or Radical Case Project Process used for Case Project Resources for Case Project Success Reason * In addition the embedded cases were given NVivo attributes for the project type and the success level.

Key:
Bold Text – Top Level Node
Normal text – second level node
Indented text – third level node

Table A6-4: NVivo Free Nodes – Full list

Challenges for PPM
Competitive position
Exploit, explore or radical, incremental
Firmness vs. flexibility
Global issues
Importance - new products
Importance of PPM
Individual vs. portfolio level of analysis
Markets, customers and success
Network, partnering and alliances
Project types and interdependencies
Quotes (tagged collection of quotes to use)
Service vs. manufactured products
Strategy and leadership
Tiered decisions, governance

Table A6.5: NVivo Nodes and Themes

6.3.1 Strategy and competition	**6.3.5 IPPM and the resource base**
Strategy and Leadership Competitive Position Global issues Markets, Customers and Success	Resource Issues (plus sub-nodes) Resource devel - building capability Resource for CA Resources for doing PPM Network_Partnering_Alliance
6.3.2 Importance of NP and IPPM	**6.3.6 Establishment, evolution, maturity**
Importance of new products (NP) Importance of IPPM, IPPM Commitment and Support	Establishment of PPM Evolution of PPM Learning Mechanisms and Investments (plus two levels of sub-nodes)
6.3.3 Dynamism in the environment	**6.3.7 The success trap**
Org Dynamism and Change Global issues Markets, Customers and Success Service vs. manufactured products	Exploit Explore-Radical, Incremental Firmness vs. Flexibility Evolution of PPM
6.3.4 Three dimensions of IPPM	**Key: Bold headings with section numbers are the themes outlined in Chapter 6 Section 6.3** Normal text below each heading lists the main NVivo nodes that contributed to that theme. Both 'Free nodes' and 'Tree nodes' are included in the list.
Process Detail (plus sub-nodes) Individual vs. Portfolio level of analysis Firmness vs. Flexibility Tiered Decisions, Governance Benefits and criteria (plus sub-nodes) The human side (plus sub-nodes) Org Dynamism and Change	

Tree node hierarchy – learning mechanisms and investments example

The screen shot from NVivo (Figure A6-1) shows how the hierarchy of nodes was used to code the comments on Learning Mechanisms and Investments. Items could be coded at any level (or multiple levels) of the hierarchy, depending upon whether they were specifically related to one of the individual activities (for example A1 – meetings scheduled), or to explicit knowledge articulation in general, or to Learning Mechanisms and Investments overall. The summary data indicate how many sources (interviews) were coded into this node, and how many total references were coded (from all sources). These numbers are useful indicators of the frequency of comments, but higher numbers are not necessarily indicative of 'higher' use of these mechanisms. Each comment was evaluated individually. The NVivo software aided the process by tagging and collating the information.

Tree Nodes

Name	Sources	References
Learning Mechanisms and Investments	2	2
Explicit Knowledge Articulation	7	18
A1 - Meetings scheduled	13	24
A2 - Facilitated meetings	7	9
A3 - Reviews Scheduled	6	6
A4 - Use of Idea sharing system	5	7
A5 - Training PM and PPM	14	16
Explicit Knowledge Codification	1	5
C1 - Documentation	16	30
C2 - Development of Idea database_system	3	3
C3 - Devel Computer_Web systems	3	6
C4 - Spreadsheet database and formats	4	6
C5 - Graphical Displays	9	15
C6 - Status and Outcome Reporting formats	5	6
Tacit Experience Accumulation	2	5
T1 - change structure	8	12
T2 - Team Composition	3	6
T3 - Employment continutiy	4	5
T4 - Previous Experience	9	12

Figure A6-1: NVivo 'Tree Node' example for 'learning mechanisms and investments' node

Example excerpt from NVivo node on 'Evolution of IPPM'

This example (Figure A6-2) shows how NVivo can display coded items from a range of sources at each node. The node displayed shows a portion of the coding for 'Evolution of IPPM'. All comments discussing changes to the IPPM capability, whether past, current or planned, were coded into this node. NVivo displays the coded information, and provides information on the source of the information and the quantity of that source's data that is relevant to this node. NVivo also allows the coded information to be viewed in context in the original interview source.

The data have been modified slightly to protect confidentiality.

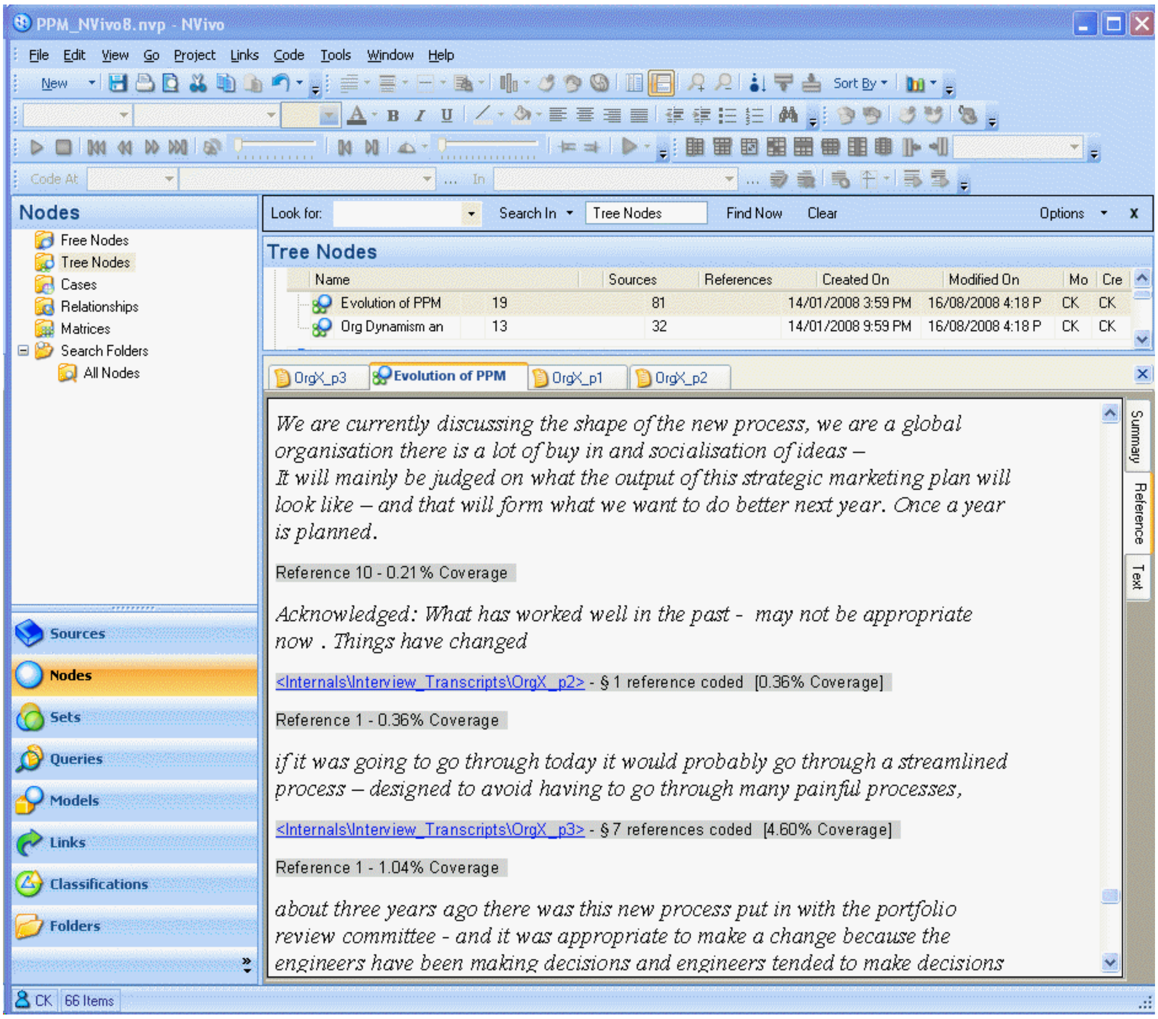


Figure A6-2: NVivo example of data coded into nodes

Example of processes used to analyse data and generate findings – ‘Importance of new products and IPPM’

This example explains the data analysis processes in detail using the ‘Importance of new products and IPPM’ theme as an example of the type of process used for all of the data and the findings.

Data relevant to the ‘Importance of new products and IPPM’ were found throughout the transcripts of the interviews. Responses to specific questions about the importance of new products and the IPPM capability to the organisation were one source of data for this theme. In addition, many of the case study participants also discussed the importance of new products or IPPM while answering other questions and while providing examples during the interviews. Therefore interview transcripts were coded where there was any reference to the importance of new products or IPPM, not just the section of the transcript where targeted questions were addressed. Other sources of data were also included in the data analysis. For example, the data on the percentage of current sales generated by products less than three years old added context to the statements about the importance of new products.

Initially the responses to the questions and relevant comments on each theme were entered into a ‘cross-case analysis spreadsheet’ (see Table A6-2 for an example of the format). As this coding was done after each interview, the spreadsheet provided a short overview and summary to aid preparation for the following interviews. A summary of responses and any comments were also recorded in the spreadsheet.

After the completion of the case study interview process, all of the transcripts were coded into NVivo (initially coding was done in Version 7, but was then upgraded into Version 8).

NVivo was set up with nodes for expected and emergent themes. Three of the nodes captured the data relevant to ‘Importance of new products and IPPM’. For a list of the nodes relevant to the other themes see Table A6-5; for a full list of all NVivo codes, see tables A6-3 and A6-4.

NVivo nodes relevant to 'Importance of new products and IPPM'

- Importance of new products
- Importance of IPPM
- IPPM Commitment and Support

The first two nodes (Importance of new products and Importance of IPPM) are examples of nodes established in the initial setup of the NVivo environment to address expected themes. The 'IPPM commitment and support' node was created to capture a theme that emerged during analysis. It was established due to the prevalence of comments focusing on specifically on the importance of commitment and support for successful IPPM capability establishment and development. The node for commitment and support is relevant to the theme of 'Importance of new products and IPPM', since commitment and support for the IPPM capability is one way managers show they believe the IPPM capability is important. There was some overlap between items coded into the commitment and support node and those coded into the IPPM importance node; however, there were also differences that improved the depth of understanding in this area. Coding in this way using the NVivo software allowed efficient and reliable capture of comments spread throughout the interviews. NVivo also enabled easy tracking of the comments so they could be viewed in the context of the interview for further depth of understanding. This process allowed deeper and more reliable data analysis than would have been possible with the spreadsheet cross-case analysis alone.

For each theme, the data were analysed to gain an in-depth understanding, both within each case situation and across the cases. The data were evaluated for differences or commonalities between responses within a case, differences or commonalities across all cases, differences or commonalities between industry types, and any other trends or relationships between the findings within or across cases, as outlined in Section 6.1 of Chapter 6.

All of the coded items from each organisation were read and analysed to gain a deep understanding of the level of importance placed on IPPM at that organisation, what areas of the organisation consider IPPM important, and why they consider IPPM important (or unimportant). Table A7-2 in Appendix 7 shows a representative sample of the quotes on the importance of IPPM from each of the case organisations. The sample have been selected to represent a balanced range of the types of comments made at that organisation from multiple sources.

The findings presented in Subsection 6.3.2 of Chapter 6 include a discussion of the importance of IPPM at the case organisations, including some selected quotes from the interviewees to illustrate the comments and provide a direct linkage to the data free from the influence of the researchers' interpretation. The discussion includes a discussion and comparison of the reasons IPPM is important contrasted between the service and manufacturing based organisations. Each of the themes was analysed to determine whether any differences were observed between the service and manufacturing-based organisations. Three bands of importance level are discussed and identified in Table 6-3 in Subsection 6.3.2 in Chapter 6. The different bands are not aligned with industry type, so these data show no overall industry-based differences in the level of importance place on IPPM. However, there are industry-based differences in the reasons that IPPM is important at the case organisations. These differences are summarised in the findings presented in Table 6.4 in Subsection 6.3.2 of Chapter 6.

Appendix 7
Phase 2 findings on IPPM environments, methods and outcomes

Table A7-1: Findings on strategy and competitive advantage

	SERV	MED	TELE	IND	FIN	MAT
Industry type	Service	Manufacturing	Service	Manufacturing	Service	Manufacturing
Strategy focus area	Strong customer focus, with increasing level of technology enabled solutions. Success measured against competitors	Technology focus moving to customer focus	Strong customer focus	Technology focus moving to customer focus	Technology-led moving to market- and customer-led	Technology focus moving to customer focus. Competitors are also considered in developing strategies
Competitive strategy	Differentiation	Quality and Differentiation. Low cost is not a primary strategy but is used for certain products	Differentiation	Quality and differentiation strategies. Not low-cost-focused.	Differentiation – with a focus on serving target areas	Differentiation. Aim to receive premium prices for products
Sources of Competitive Advantage	Innovation culture and process with strong support from above. Customer knowledge and contacts. Supporting technologies	Customer contacts, strong product area focus, superior technology	Customer relationship and focus, innovative solution capability, size advantages (larger than many competitors) but still able to be nimble	Brand name, customer contacts, strong product area focus, superior technology, people and their specialised skills	Good people, clear strategy and focus on main market, good process and strategic decision-making ability	People and skills, Brand name, premium prices, specialist knowledge and technology, customer knowledge

Table A7-2: Findings on the importance of IPPM

Case Name	Excerpts from interviews on importance of IPPM (direct quotes)
SERV 1st band strongest emphasis	• The CEO sends the message that this is important and that senior leadership is responsible. It is everyone's responsibility to [be part of the process] – it is well communicated. (p1) • The process is very important for growth and to achieve targets. (p1) • With the [IPPM process] the focus of the organisation has changed to say innovation is more important. (p4)
MED 3rd band	• [IPPM is] very important at [senior management] levels, however there is a bit of scepticism from the very top, and questions about the ability to be entrepreneurial and to adhere to processes. There is an attitude of 'just get on with it and do it'. (p1) • Very important – [lack of IPPM] has caused a huge frustration to the company. (p1) • [IPPM is] important for 'leading us into the future'. (p3)
TELE 2nd band next strongest emphasis	• It is very important, yes it is. … we think is it being done well, but we can improve, we are interested in continual improvement. (p2) • Is extremely important, because it's what happens in the organisation where we compete for the limited [resources]. It is where decisions are made as to what actually gets delivered and what gets priority. (p4) • In our industry everyone's talking about innovation … [our innovation initiatives] are being driven by the CEO, [but decisions need to be made…] do we make small incremental changes in key areas, or do we go and risk failure? … Where do you strike that balance? (p3)
IND 3rd band	• Importance is increasing, we are managing the processes better. (p1) • A lot of effort has gone into improving the process. (p4) • Important at high levels in the organisation; however, others may find it a hassle or a hurdle. (p1) • [IPPM] is important to maintain our competitive position by linking projects to strategy and balancing project types. (p4)
FIN 2nd band next strongest emphasis	• It is important for strategic positioning and alignment of the projects with the strategy. We may have resourcing issues, but more important is strategic conflict. [Without IPPM] we could be taking businesses in directions that conflict with other areas. (p2) • Important to have that experienced set of people [the PRB] making input across the portfolio … (p3) • The nuts and bolts approach to [IPPM] … is perhaps less important than understanding the strategic position of the business you are in and where you want to take it. (p2)
MAT 1st band strongest emphasis	• The process is very important … it is important to gain superior results and to align projects to targeted areas for innovation … It is becoming increasingly important, not just in product development department, … the whole idea of the IPPM process is about organisational engagement. (p1) • It allows us to investigate new ideas and new market opportunities that would otherwise not be picked up and allows us to kill the ones that for whatever reason don't make sense. So yes, the process is quite important for us. (p3) • I am aware of challenges to the business, the globalisation challenges etc., these challenges underline the need for the [IPPM] process and it has been very effective. (p3)

Table A7-3: Responsibility and organisational structure evolution

Case name	SERV	MED	TELE	IND	FIN	MAT
Industry type	**Service**	**Manufacturing**	**Service**	**Manufacturing**	**Service**	**Manufacturing**
Who is responsible for IPPM ?	For the strategic level it is led by the chief executive officer (CEO) and executive steering team. Day-to-day management by a dedicated team	Team of three – Technology Vice President (VP), Marketing VP, and Global President	Group Director, marketing and product focus. Strong input and day-to-day management by the NPD General Manager	Shared between the Global Technology VP and the Global Marketing VP	Executive committees responsible at multiple levels	Executive committee. The Tech VP has primary responsibility. Day-to-day management by a dedicated team
Change to Org Structure for IPPM?	SERV created a whole new section to manage its IPPM program, with clear roles and responsibilities. In addition the members of the review boards are defined and methods for determining review board membership are defined	MED has restructured. Previously the decisions were led by engineering, then the IPPM capability was set up shifting the primary decision responsibility to marketing managers. This is about to change again. NPD structures have also changed, and continue to change	TELE has been restructured overall to emphasise customer focus. In addition the product area was not elevated to have a more strategic focus and is now higher in the hierarchy, to Group Director level - now reporting directly to the CEO	IND has had minor structural changes, and has elevated the positions strategically that relate to the IPPM decisions. The global marketing VP is now performing a more strategic role in the IPPM process – it is shared between global technology marketing VPs	FIN has had a new CEO and major realignment towards more innovative practices. New area for Product Development in a service environment created specifically to be able to better provide a stream of competitive products as a major part of strategy	MAT had a major re-organisation 3 years ago specifically to elevate the importance of product innovation. Created a new role overseeing the technology development area and new roles to monitor the process, such as gatekeepers and process leaders

Table A7-4: Methods and processes for NPD and IPPM

Case name	SERV	MED	TELE	IND	FIN	MAT
Industry type	**Service**	**Manufacturing**	**Service**	**Manufacturing**	**Service**	**Manufacturing**
Stage Gate process used	**yes**	**yes**	**yes**	**yes**	**yes**	**yes**
Lite as well as full stage gate versions	**yes**	**yes**	**yes**	**yes**	**yes**	**yes**
Changes to stage gate	Regular refinement to have created processes for different types of projects. Changes during the past year	Special accelerated development teams and processes have been instituted in the past year	Currently designing and gaining approval for a simplified process for low risk, short payback projects	Have instituted new processes for 'blue sky' projects with fewer hurdles and different evaluation criteria in past 1-2 years	Currently in the process of implementation of a new 'lite' process for smaller, simpler projects	Stage-gate lite process has been implemented in the past 1-2 years. Service development gated process introduced 10 months ago
Portfolio vs. Project level evaluation -------------- Overall emphasis rated on a scale of 1= individual 10=portfolio	Portfolio view achieved through decision-making team's memory but projects evaluated individually -------------- **3**	Individual projects considered at a monthly meeting -------------- **2**	Portfolio plan set once a year, portfolio adjustments considered based on individual projects -------------- **7**	Portfolio plan set once a year, portfolio adjustments considered based on individual projects -------------- **9**	Portfolio view achieved through decision-making team's memory but projects evaluated individually -------------- **4**	Portfolio view achieved through decision-making team's memory but projects evaluated individually -------------- **4**

Table A7-5: Project evaluation methods in the case organisations (√ indicates dominant methods)

Case name	**SERV**	**MED**	**TELE**	**IND**	**FIN**	**MAT**
Industry type	**Service**	**Manufacturing**	**Service**	**Manufacturing**	**Service**	**Manufacturing**
Dedicated Software for PPM?	Yes – for idea management through a collaboration tool. Process is mainly based on spreadsheets	No only spreadsheets	No only spreadsheets – plus data is made available from project-focused computer systems	No only spreadsheets. and intranet	No only spreadsheets and intranet	Yes – for idea management. IPPM process is mainly supported by spreadsheets and intranet
Financial	√ **yes**	√ **yes**	√ **yes**	√ **yes**	√ **yes**	√ **yes**
Strategic filter	√ **yes**	√ **yes**	√ **yes**	√ **yes**	√ **yes**	√ **yes**
Growth targets	**yes**	√ **yes**				
Ability to execute						√ **yes**
Strategic buckets		**yes**		**yes**		
Graphic aids	**yes**	**yes**	**yes**	**yes**	only minor use	**yes**
Scoring model and/or Checklists	**yes**				**yes –** time to completion and market impact	**yes**

Table A7-6: Detail of the IPPM project evaluation methods

Methods used for project evaluation	Explanation and/or examples of use
Financial	All organisations use net present value (NPV) analysis for project proposals, some also use return on investment (ROI) or payback period measures.
Strategic filter	Organisations use a strategic filter before or in conjunction with the financial methods. These filters can be sophisticated scoring and ranking systems or involve informal methods to consider the alignment with strategy to select projects that fit with organisational goals. For example, at SERV the strategic filter is dominant – it requires that projects offer differentiation from competitors to ensure they invest in things that have not been done before.
Growth targets	MED explicitly sets growth targets through gap analysis. Although others have growth as a goal, the methods are not highlighted as dominant.
Ability to execute	Although all organisations must need to consider whether they have the capability to execute the project, only one [MAT] highlighted it as a specific decision making criterion
Strategic buckets	The division of the budget at a high level to allocate a lump or percentage of the total to sub areas based on strategic planning and priorities across the areas. This type of top-down division of funds is used by MED and IND.
Graphic aids	All of the organisations mentioned some form of graphic aid as part of the decision process [only weak use in FIN]. These aids range from portfolio maps (bubble charts) to pie charts to line/bar graphs. None of the organisations used a graphic aid as a central or dominant part of the process, although two [SERV and MAT] are planning increased use of portfolio maps.
Scoring model and/or Checklists	Checklists are lists of criteria that are a standard part of the evaluation, in a scoring model these criteria are rated and often weighted to obtain a total score that represented multiple criteria. In FIN, important criteria include ‘time to completion’ (primarily to minimise risk – and also to get return more quickly) and ‘market impact’ (market share considerations that are strategic rather than financial measures)

Table A7-7: Comments on firmness and flexibility from the case organisations

Case Name	Excerpts from interviews on 'firmness and flexibility' (direct quotes)
SERV	• We need a type of balance to understand what is really innovation versus projects that are more routine, and the best way to approach these projects. (p3) • We have taken the standard approach … and created a 'lite' version [to cater for situations that require less structure]. (p2) • We use] fluid flexible teams pulled together on an as needed basis… the [IPPM capability provides structure] making sure it is all happening. (p3)
MED	• The more formal and structured you get, the more negativity around teamwork. (p1) • I don't think we got here by managing and bureaucracy, in a competitive environment you better be prepared to change quick – flexibility is really important – you have to be prepared to take a punt. If you become too prescriptive things will change on you no matter where you are. We are seeing the effects of that now. (p2) • We're going to this thing right now trying to figure out how much should be central versus how much should be decentralised. We really are in a flux here over many things including how much influence should the regions have over decisions. (p3)
TELE	• We've grown over 10 years -- and as a result we now have …. all of bureaucracy and a lot of problems [of a bigger organisation]. What the CEO, wants to do is to bring back … the way we used to think, the way we used to be aggressive … (p3) • [We are more business driven now and] a lot more emphasis is paid on justifying things -- it can stifle innovation and creativity though with too much concern about the bottom line. (p4)
IND	• Tried to implement a formal stage gate, still have one but it is not really formal.(p3) • The formal systems were too complex, required too much data and too much time to get the data together. Tried things like MS Project – too much detail for our needs. (p3) • Now there is a more informal process, with spreadsheets showing tasks over time and people to assign, reviewed each week with drawing office manager. (p3)
FIN	• – so the better we can get the process to work and minimise paperwork, the more success we will have. (p3) • We had rigorous templates forcing the process down particular paths – now we use a [more streamlined] model with two-page summaries allowing faster process. (p3) • Each line of business has to be able to manage projects that don't impact other businesses within resource constraints that they have in their business … but they also need to have a single point around resource conflicts to resolve those. (p2)
MAT	• As you get more efficient at this you try to get more and more information early. But the danger is that you may not have enough information at early stages and you may kill an innovative project too early. (p2) • The constraints of having a traditional stage gate – it can be a little bit limiting in terms of timing because you are tied to the stage gate meetings and [PRB] meetings, some people preach a more organic process with a collaborative type style. (p2) • Yes, I am very conscious about that, often you get feedback about getting snowed under, bureaucratic procedural types of stuff… (p4)

PPO findings from both phases of research

Figure A7-1 compares the perceptions of the IPPM capabilities at the six case study organisations in Phase 2 with the findings from the 60 organisations that responded to the survey in Phase 1. Each phase asked participants to rate their performance on several PPM measures on a 5-point Likert scale. Figure A7-1 displays the data from Phase 1 and Phase 2 respondents on 12 questions common to both phases.

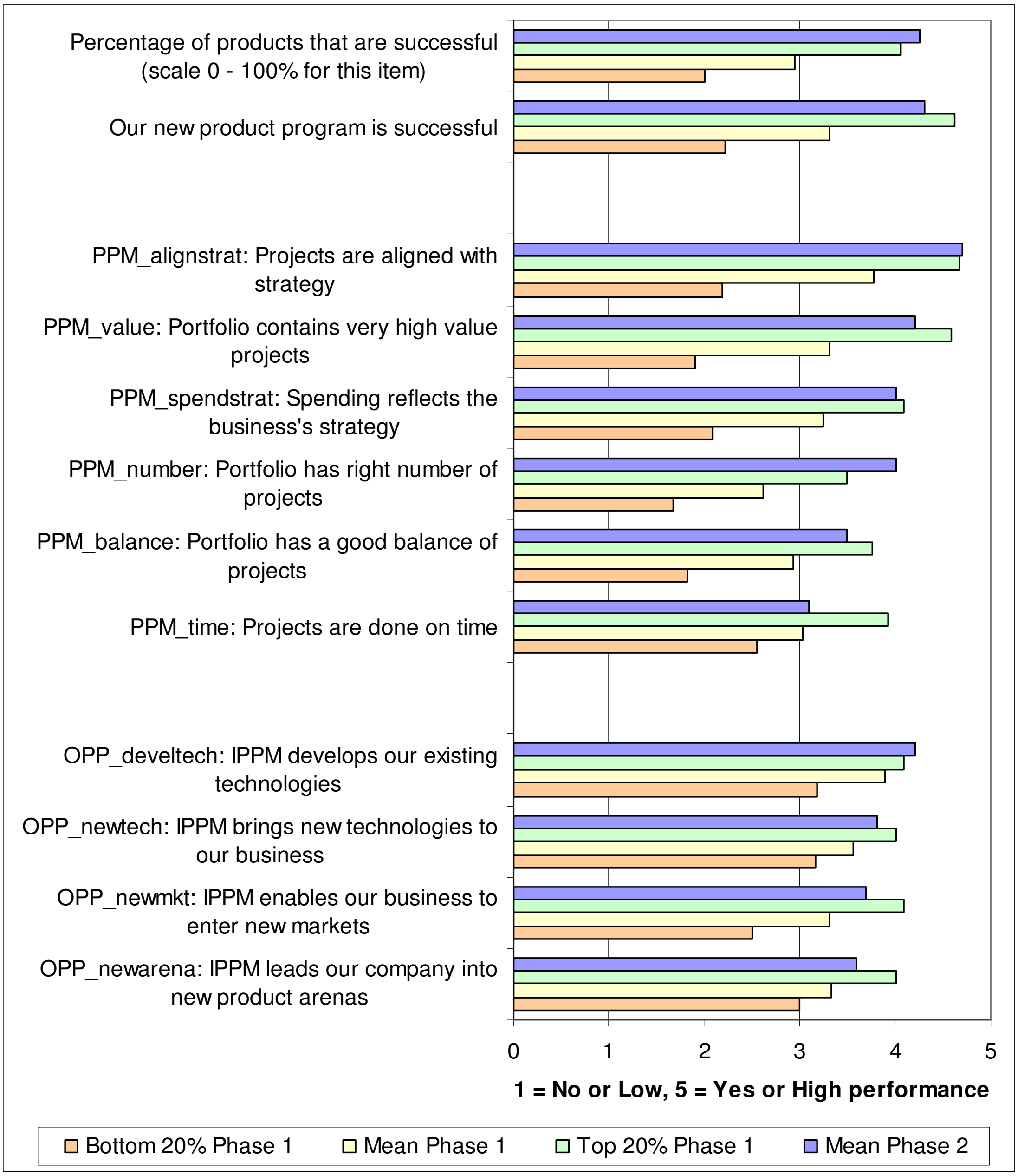


Figure A7-1: Product Portfolio Outcome (PPO) measures across Phase 1 and Phase 2
(see below for further explanation of the four groups of data)

This paragraph explains the four data bars to assist with interpretation of the data in Figure A7-1. The figure displays the mean ratings for all 60 respondents in Phase 1 (second lowest bar, lightest colour, light yellow) and the mean rating for the six organisations from Phase 2 (top bar, darkest colour, blue). In addition, two extra groups of Phase 1 respondents have been identified, analysed and displayed separately – the 'top 20% Phase 1' and the 'bottom 20% Phase 1' groupings are based an analysis of the average of all ratings for the six PPM variables across the 60 organisations in the Phase 1 sample. The 'top 20% Phase 1' group represents organisations with highly rated IPPM capabilities (the top 20% of the sample, second bar from top, second lightest colour, light green) and the 'bottom 20% Phase 1' group represents those with low ratings (bottom 20% of the sample, bottom bar, second darkest colour, orange). By illustrating these 'top' and 'bottom' performers separately, Figure A7-1 displays the spread of performance across the Phase 1 sample and allows the Phase 2 ratings to be compared with the 'top', 'mean', and 'bottom' rated IPPM capabilities from Phase 1. Due to the small sample size from Phase 2, this analysis does not aim to be statistically significant, but rather to provide an indication of how the Phase 2 organisations rated their IPPM capabilities compared with the findings from Phase 1.

Analysis of PPO findings from both phases of research

The Phase 2 organisations were selected based on their innovation leadership and sustained record of new product success. Drawing from the findings of Phase 1 and prior research that indicates correlation between new product success and higher performance on IPPM goals (Cooper et al., 2001), the IPPM capabilities at the Phase 2 organisations would therefore be expected to have relatively high ratings on the product portfolio outcomes (PPO) measures. Analysis of Figure A7-1 confirms these expectations and shows that the mean ratings from the Phase 2 sample are most closely aligned with the ratings from the 'top' rated Phase 1 organisations.

During the case study interviews the managers at the Phase 2 organisations reported that their IPPM capability was generally effective in helping them limit the number of projects, and in most cases that was the main reason the IPPM capability was established or enhanced. This finding was unexpected, given that achievement of the 'right number of projects' is one of the lowest areas of performance during Phase 1 and in prior research (Cooper et al., 2001; Engwall and Jerbrant, 2003; McDonough and Spital, 2003; Stander and Buys, 2008). Figure A7-1 shows that the Phase 2 organisations rate their portfolio more highly than the 'top 20%' from Phase 1, confirming that the Phase 2 organisations feel that their IPPM capability is fairly effective in limiting the number of projects.

Surprisingly, the other area where Phase 2 ratings differ considerably from Phase 1 'top 20%' organisations is in performance on 'projects are done on time'. Given that the IPPM capability is believed to be more effective at limiting the number of projects to fit with available resources than the 'top 20%' of Phase 1 respondents, it is surprising that they rate their ability to get 'projects done on time' as lower than the 'top' Phase 1 respondents. Generally the assumption is that limiting the projects to fit with resources will enable these projects to proceed effectively and to have a better chance of being completed on time. One reason for these seemingly contradictory findings may be the time lag involved. In several of the organisations, the ability to limit the number of projects is relatively recent – therefore, especially in areas where projects take a long time to complete, any benefits of more reliable project completion may have yet to flow through.

Appendix 8

Organisational learning investments and the development of IPPM capabilities

The information in this appendix is extracted from Killen et al. (2008).

Analysis of the development of PPM capabilities in these organisations provides an overview of the learning investments that have been used in the establishment and evolution of an effective PPM capability for each organisation. Both tacit and explicit learning mechanisms have been observed to develop the PPM capabilities in the case organisations. Table A8-1 summarises the main types of learning investments that have been applied in the case organisations to enhance the three types of learning mechanisms identified by Zollo and Winter (2002): tacit experience accumulation, explicit knowledge articulation, and explicit knowledge codification.

Table A8-2 presents a summary of the case study findings. The strength of emphasis on the 'establishment' and 'evolution' of the PPM processes at the six organisations has been evaluated based on the level of change and the types of recent and current activities. For example, SERV has put a large amount of effort into the introduction of an entirely new PPM capability to their organisation over the past two years – therefore the strength of emphasis on PPM establishment has been rated as 'strong'. SERV has also been actively reviewing and evolving their process as it is being established, and is making a continual stream of iterative changes – therefore the evolution strength has also been rated as 'strong'. In another example, IND's PPM capability has been slowly evolving for several years. The process is not newly established and there have been no major initiatives or large-scale changes to the process recently, so the strength of emphasis on PPM establishment is rated at 'low'. The emphasis on the ongoing evolution of IND's PPM capability is rated as 'mid' based on a moderate level of emphasis on evaluating and adjusting the process.

Table A8-1: Summary of main learning investments applied to enhance the three types of learning mechanisms in the case study organisations

	Tacit Experience Accumulation
T1	Change of organisational structure that creates or elevates the locus for PPM activities.
T2	Determining the composition of the portfolio review board or team.
T3	Creation of environment that encourages the retainment of employees as longer serving employees can better accumulate and learn from experiences
T4	Hiring employees or engaging consultants with desired experiences and attributes
	Explicit Knowledge Articulation
A1	Schedule meetings and workshops for review and discussion and improvement of the PPM processes
A2	Engage consultants and facilitators to develop and manage information development and sharing sessions.
A3	Schedule regular reviews of project outcomes, evaluate and incorporate feedback to improve the process
A4	Use idea capture systems for input as well as comment, discussion and development or improvement of ideas.
A5	Conduct training programs for employees on the processes for project management and PPM
	Explicit Knowledge Codification
C1	Documentation of processes, creation of flow charts, templates, checklists.
C2	Development of idea capture system or database
C3	Development of web-based systems or computer applications
C4	Creation of spreadsheet based data formats to compare project information.
C5	Creation of standard graphical displays such as portfolio maps
C6	Develop formats for reporting on PPM status and outcomes

Relative ratings are presented in Table A8-2 to indicate the level of each type of learning investment at each organisation. The ratings represent the sum of scores of between zero to three for each of the activities in each learning mechanism that are identified in Table A8-1. A maximum of three points is awarded for evidence of strong effort and emphasis on an activity. Two points are awarded for moderate levels of effort or emphasis, one point for some mention of the activity and zero points are awarded if the activity was not evident at the organisation. The ratings are a rough measure only and are meant to highlight differences between organisations. They should not be used for fine-grained analysis.

The following two examples illustrate how the scores are derived from the case study findings. The first example focuses on the tacit experience accumulation learning activities or investments for T2, ‘determining the composition of the portfolio review board or team’. T2 is rated at Level 3 (high) for SERV and Level 1 (low) for IND. All of the organisations studied have a review board of some type with some method or criteria for membership in the review board. SERV has put a lot of effort into developing processes for the selection of the portfolio review board and into the actual selection of the review board. The board is carefully selected to represent all of the main functional as well as geographical areas. The processes for nomination, selection and confirmation of the review board members also include the length of tenure and processes for replacement and renewal of the review board. Careful attention is paid to phasing replacements to ensure adequate continuity for effective functioning of the review board. SERV’s strong efforts in this area are rated at 3, the highest level. In contrast, IND’s portfolio review board consists primarily of the regional marketing managers. There is not a lot of thought or effort put into the selection of the members of the review board which is heavily dominated by the marketing discipline. Therefore, IND’s relatively lower efforts and results in this area are rated at 1.

To further illustrate the derivation of scores based on the case study findings, the second example focuses on findings for the explicit knowledge codification learning investment, C5, ‘the creation of standard graphical displays or portfolio maps’. MAT is investing considerable effort to develop a comprehensive reporting format involving a series of graphical displays. These include portfolio matrix displays, colour coded resource pipeline planning projections and traffic signal colour-coded visual summary formats. FIN does not specify any type of portfolio map or graphical display in their formal PPM process. Sometimes such displays are used in particular submissions, but they have not invested in developing standardised graphical displays as part of the codified process. Therefore, C5 is rated at Level 3 (high) for MAT and Level 1 (low) for FIN. In this manner scores are allocated to each organisation for each type of learning investment identified.

The relative levels of learning investments presented in Table A8-2 represent a sum of the scores for learning activities or investments within each of the three main learning mechanisms. For example, the rating for ‘learning investments for explicit knowledge codification’ for FIN represents the sum of scores for each of the explicit knowledge codification items identified in Table A8-1. For FIN, the activity for C1 (Documentation of processes, creation of flow charts, templates, checklists) is rated at 3 (high), C2 (Development of idea capture system or database) is rated at 0 (none), C3 (Development of web-based systems or computer applications) is rated at 2 (medium), C4 (Creation of spreadsheet based data formats to compare project information) is rated at 3 (high) and C5 (Creation of standard graphical displays such as portfolio maps) is rated at 1 (low, as explained above), and C6 (Develop formats for reporting on PPM status and outcomes) is rated at 2 (medium). Therefore the total of the ratings for C1-C6 (3+0+2+3+1+2) has been entered as the relative level of '11' in Table A8-2 for 'learning investments for explicit knowledge codification' for FIN. In this way, each of the ratings entered in Table A8-2 indicates the overall relative level of investment in learning activities for each of the learning mechanisms.

Table A8-2: Relative levels of learning investments during PPM capability development

Organisation code	SERV	TELE	FIN	IND	MED	MAT
Strength of emphasis on PPM Establishment	STRONG	MID	LOW	LOW	MID	STRONG
Strength of emphasis on PPM Evolution	STRONG	STRONG	MID	MID	STRONG	STRONG
Learning investments for tacit experience accumulation	11	7	6	7	7	11
Learning investments for explicit knowledge articulation	13	11	11	12	11	12
Learning investments for explicit knowledge codification	18	14	11	11	10	16

Table A8-2 shows that all of the case organisations invest regularly in each of the learning mechanisms indicating that PPM capabilities are shaped by the co-evolution of both tacit and explicit learning mechanisms as proposed by Zollo and Winter (2002). Each of the organisations studied has a successful project portfolio and believes that their PPM capability contributes to this success, therefore the PPM capabilities are considered effective.

The level of investment in knowledge articulation activities does not vary much across the case organisations and is independent of the strength of emphasis on establishment or evolution. This finding indicates that knowledge articulation investments may assist with the development of effective PPM capabilities in a relatively consistent manner throughout the establishment and evolution of PPM capabilities.

The two organisations that have the strongest level of emphasis on PPM capability establishment (SERV and MAT) also make much higher levels of investment in tacit experience accumulation and knowledge codification activities than the organisations that have lower levels of emphasis on establishment. These findings indicate that the level of investment in tacit experience accumulation and explicit knowledge codification learning mechanisms required for effective development of a PPM capability varies relative to the level of emphasis on establishment of the capability.

Appendix 9

Embedded case findings

This appendix summarises the data from the analysis at the embedded case unit of analysis for Phase 2 of the research. Twenty-one embedded cases with the unit of analysis as a single project that had gone through the IPPM process were studied as part of the multiple-case study phase of the research.

Table A9-1 lists the projects, project type, success level, duration of the project, the primary drivers for the project and the primary reasons for the success or failure of the projects. The definitions used to categorise the project types and success levels are presented in Table A9-2.

Classification of the embedded cases

The embedded cases were selected to represent a variety of project types and success levels at each organisation. Table A9-2 lists the labels and definitions used to categorise the embedded cases according to project type and success level. Project types are classified based on the degree of newness or change. The 21 embedded case projects studied are split evenly in the three categories of Radical, New and Incremental, with seven projects in each category. Project success levels among the embedded cases studied were overwhelmingly positive. The successful organisations studied did not have many project failures and, in the three service organisations, there were no failed projects that had gone through the current IPPM process. Among the successful projects there was a difference in success level between projects that exceeded expectations and those that just met expectations, however, and even successful projects may have represented an opportunity cost if the resources could have been allocated to more highly successful projects.

Table A9-1: Embedded case project data

Primary Case Organisation	Embedded Case	Newness	Success	Duration (months)	Primary Driver(s)	Reasons for Success or failure
SERV	Project 1	Radical	High Success	6	Customer need/Market opportunity Technology opportunity	Understanding Customer/Market Harnessing Technology
	Project 2	New	Success	3	Customer need/Market opportunity Efficiency/consolidation	Understanding Customer/Market Harnessing Technology
	Project 3	Radical	Success	12	Customer need/Market opportunity	Understanding Customer/Market High priority - team and resources
	Project 4	Radical	Success	4	Customer need/Market opportunity	Understanding Customer/Market IPPM process/communication High priority - team and resources
MED	Project 1	Radical	High success	24	Customer need/Market opportunity	Understanding Customer/Market Harnessing Technology High priority - team and resources
	Project 2	Incremental	Success	6	Customer need/Market opportunity	Understanding Customer/Market
	Project 3	Incremental	Below expectations	9	Customer need/Market opportunity Competitive strategy	Not understanding Customer/Market IPPM/communication problems
	Project 4	Radical	Success	24	Customer need/Market opportunity Competitive Strategy	Understanding Customer/Market Harnessing Technology Flexibilty in resources High priority - team and resources
TELE	Project 1	New	Success	6	Regulatory Requirement	High priority - team and resources IPPM process/communication
	Project 2	Rad	High Success	12	Customer need/Market opportunity	Understanding Customer/Market Harnessing technology High priority - team and resources
	Project 3	Incremental	Success	3	Customer need/Market opportunity Technology opportunity	Understanding Customer/Market Speed to market
IND	Project 1	New	High Success	48	Customer need/Market opportunity	Understanding Customer/Market Harnessing Technology
	Project 2	Radical	Below expectations	24	Customer need/Market opportunity Competitive Strategy	Teamwork and communication difficulties
	Project 3	Incremental	Success	24	Customer need/Market opportunity	Understanding Customer/Market Harnessing Technology
	Project 4	Incremental	Success	6	Customer need/Market opportunity	Understanding Customer/Market
FIN	Project 1	New	Success	9	Customer need/Market opportunity	Understanding Customer/Market
	Project 2	New	High Success	9	Customer need/Market opportunity	Understanding Customer/Market Speed to market
	Project 3	New	Success	9	Customer need/Market opportunity	Understanding Customer/Market
MAT	Project 1	Radical	High Success	18	Customer need/Market opportunity	Understanding Customer/Market Harnessing Technology Flexibilty in resources High priority - team and resources
	Project 2	Incremental	Below expectations	24	Customer need/Market opportunity Efficiency/consolidation	Unanticipated Technology Challenges
	Project 3	Incremental	High Success	21	Customer need/Market opportunity	Understanding Customer/Market High priority - team and resources

Table A9-2: Definitions for project type and success levels for embedded cases

Embedded Case - Project type	
Project type label	Definition
Radical	New product using newly developed technology or for emerging market areas / product arenas – so either high technology or market newness or both qualifies the project as radical for this analysis.
New	New product with relatively new approach or features, but not radical or first time use of technologies or entry into market areas. Often applies to combining existing elements for a new solution.
Incremental	Incremental add-on or change to existing product.

Embedded Case - Project success level	
Project success label	Definition
Exceeding expectations	A level of success well above the expected projections, success to a surprising level.
Meeting expectations	The project success is solid and falls in the range of projection scenarios for the project – includes the moderately above and below levels of expected or projected success.
Below expectations or failed	The project does not meet expectations and falls well below expectations. The money would have been better spent elsewhere in most of these cases – although sometimes over time these projects may turn out to be relatively successful if they are not totally killed.

The spread of project types and success levels of the projects studied is summarised in Table A9-3. This table is presented to provide an overview of the projects rather than to propose a statistical relationship. The numbers of projects studied are not large enough to draw any conclusions on the relationships between project type and success level.

Table A9-3: Embedded case projects – project type and success level

	Project type		
	Radical	New	Incremental
Success of Case Project			
Exceeding expectations	4	2	1
Meeting expectations	2	5	4
Below expectations or failed	1		2

Findings from the embedded case analysis

The embedded cases reinforced many of the main case findings as outlined in Section 6.4 in Chapter 6. Findings from the embedded cases that extend understanding of IPPM capabilities are summarised in that section and are detailed here.

Extending resources through partnering

The findings of the primary case analysis presented in Section **Error! Reference source not found.** show the role that flexible resourcing options play in service product development environments. The embedded case analysis provides evidence that these flexible resourcing options such as outsourcing, alliancing or partnering are becoming an increasingly important part of the strategy in all environments. The embedded case analysis confirms the primary case findings that show that service industries have fewer resource constraints than manufacturing organisations, because service development skills can be developed more quickly and obtained more easily from external sources through outsourcing or partnering. The embedded cases in the service organisations used partnering regularly to speed development, spread risk and provide opportunities through combinations of capabilities. One of the interviewees at a service organisation commented that the path to "truly competitive advantage is through cooperation of two entities" through strategic partnering relationships [SERV]. This type of cooperation is illustrated in the embedded cases in the service environments.

The primary case analysis at the manufacturing organisations highlighted constraints due to resource limitations and stressed that the required highly specialised skills take a long time to develop. Although this fact is supported by many of the embedded cases in the manufacturing organisations, the embedded cases also revealed that each of the manufacturers have also begun to use partnering or outsourcing strategies in their NPD. For each of the manufacturers the use of such strategies is very new, but appears likely to increase. One manager commented on the challenges in setting up a partnering framework and indicated that getting the processes right is important "because the realisation is that we will partner more and more with external providers"[MAT].

Drivers for projects

Knowledge and understanding of the customers and markets are the main driving forces behind the initiation of the projects. An understanding of the customer requirements or the market situation is the clear driver for 13 of the 21 projects analysed. In seven other projects the customer and marketing issues are strong drivers, along with other considerations such as technology opportunities and specific strategic moves. Only one project is not driven by customer or market considerations – this project is driven by a requirement to achieve compliance with regulations for a component of a new product offering.

Success factors

A good **understanding of customer requirements and knowledge of the market** are also the main the reasons given for success or failure of projects. Another common theme is the importance of **adequate resources and good teamwork**, particularly when timeframes are crucial. In eight of the embedded case projects the interviewees specifically emphasised that the project was identified as high priority through the IPPM system and was therefore able to gain excellent resources both in quantity and quality. **The most important resource cited was people** – getting people with the best experience and good commitment on the team enabled teamwork to bring the project to success. All eight of the high priority projects were successful, as shown in the summary of embedded case project data in Table A9-1.

Although all of the projects have a technological basis, and all are either developing technology or using technology in new ways, **technical problems and hurdles are not a major factor in the success or failure of most projects**. Only 3 of the 21 projects focused on technical aspects of the project as reasons for success or failure of the project. One 'below expectation' result was based on an anticipated technical side effect and two of the successful projects cited the successful development of technology, along with other factors.

Appendix 10

The Outcomes and Learning-based Maturity Model (OLMM) for IPPM

The OLMM has been developed and used for this research, and is also proposed as a useful tool for organisations to assess and improve their IPPM capabilities. This appendix outlines the rationale and processes for the initial development of the model and suggests future activities for its ongoing development.

OLMM overview

Section 6.6 of Chapter 6 introduces the OLMM and refers to this appendix for further detail. The model is implemented in a spreadsheet over three capability 'pages': (1) the main page, (2) a NPD-focused page outlining the NPD related capabilities that support an IPPM capability, and (3) a PPM-focused page that details the components of the IPPM capability. Figure 6-5 in Chapter 6 presents an overview of the 'Main Page' of the model, and is reproduced here for convenience (Figure A10-1). This page includes 26 capability items that can be rated to indicate an organisation's level of performance on elements such as foundational capabilities, links between strategy and projects, project management processes, and the main outcomes for IPPM.

Each item on the main page of the OLMM has a customised key for capability rating. A sample of the rating keys is presented in Table A10-1. Specific descriptions are used in the capability keys to improve the reliability of the responses. The main page (Figure A10-1) contains links to supporting capabilities from the other two pages of the OLMM. These links are indicated by the 'req' (required antecedent capability) or 'pref' (highly preferred antecedent capability) notes below the relevant capability block, as shown in Figure 6-5 in Chapter 6. Codes starting with 'N' refer to capabilities on the NPD-focused page, and codes starting with 'P' refer to capabilities on the IPPM-focused page of the OLMM.

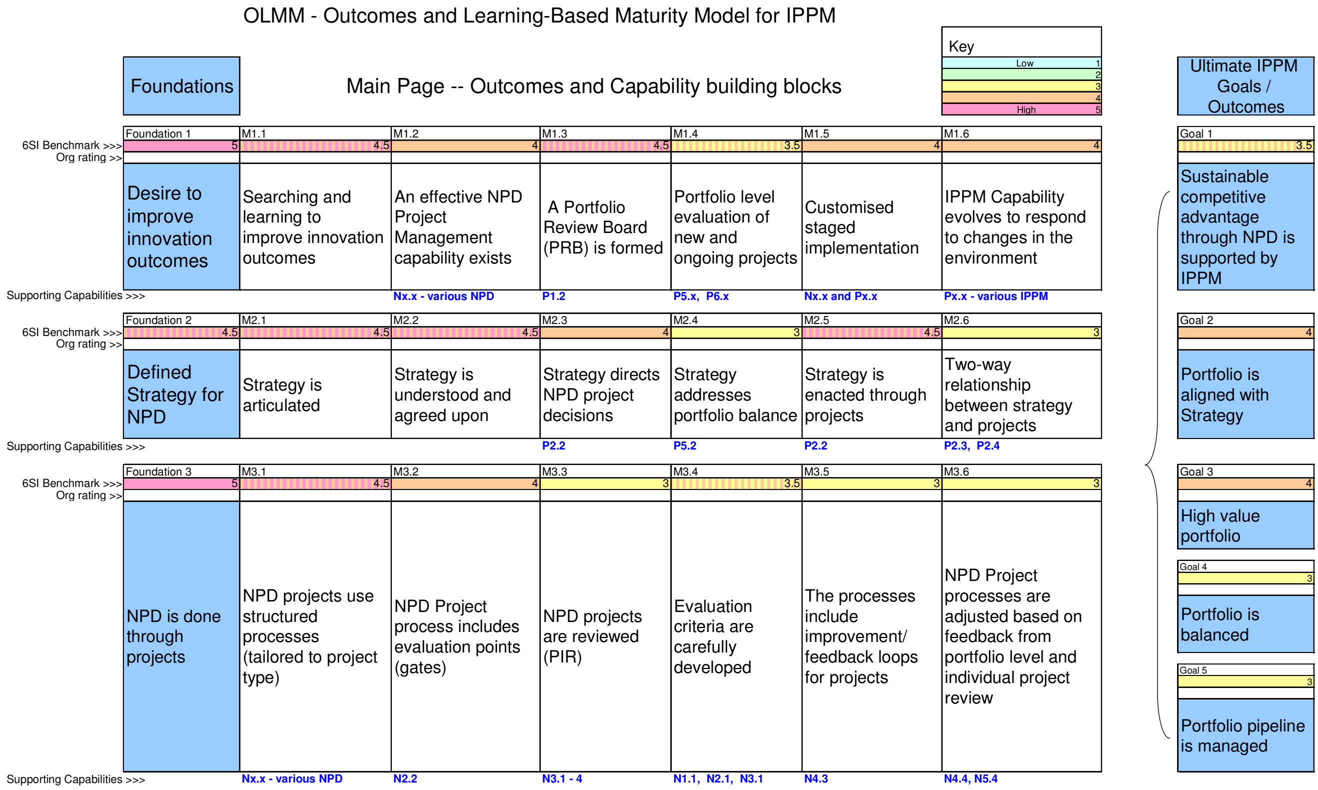


Figure A10-1:Overview of the Outcomes and Learning-based Maturity Model for IPPM

(reproduced from Figure 6-5 in Chapter 6)

Table A10-1: Sample of Capability rating keys from the OLMM

Capability code	Foundation 1	M1.1	M1.2	M1.3
Brief Description	Desire to improve innovation outcomes	Searching and learning to improve innovation outcomes	An effective NPD Project Management capability exists	A Portfolio Review Board (PRB) is formed
Key for Rating	0 = No desire evident to improve innovation outcomes 1 = Minimal desire evident 2 = Some desire 3 = Medium levels of desire and commitment 4 = Strong desire and commitment from some levels of the organisation 5 = Strong desire and commitment from top levels of the organisation to improve innovation outcomes	O = No evidence of interest in improving innovation outcomes 1 = Would like to improve, but no actions are evident working towards that goal 2 = Some searching and learning activities are evident 3 = Commitment to improve NPD/innovation outcomes. 4 = Commitment to improve NPD/innovation outcomes and focus on PPM. Periodic searching and learning activities for NPD improvement activities. 5 = as in (4) but with strong and continuous searching and learning activities.	0 = No NPD process exists 1 = The NPD process is only loosely structured 2 = The NPD process is structured 3 = The NPD Process is structured with phases (stages) and evaluation points (gates) 4 = More than one type of structured phase/gate NPD process is available for use 5 = The different structured phase/gate NPD processes are clearly linked with their applicability and benefits for particular project types. There are different processes tailored for exploration and exploitation projects.	O = Individual decisions only 1 = No identified review board or team, but multiple people make decisions. 2 = Some type of team or group is used - quite informal 3 = A PRB or decision-making team is identified and given some PPM decision-making responsibility 4 = the PRB is formal and is given full PPM decision-making responsibility 5 = As in (4) with the PRB membership selected carefully through an established and transparent process. The PRB contains experienced cross disciplinary professionals.

The NPD-focused page of the OLMM identifies NPD capabilities that support IPPM in four sections: (1) The front-end stage of NPD, (2) the implementation stage of NPD, (3) the review stage of NPD, and (4) Improvement/Feedback loops for NPD project processes. Throughout the NPD-focused page, the OLMM includes specific capabilities for the establishment, evaluation and improvement to the criteria used for evaluation and measurement during the NPD and IPPM processes.

The IPPM-focused page identifies IPPM capabilities and organisational capabilities that support IPPM in eight sections: (1) organisational structure and responsibility, (2) support for PPM, (3) communication capabilities, (4) front end capabilities such as idea generation, idea management and project proposal capabilities, (5) capabilities to manage PPM Criteria, (6) PPM process and portfolio level analysis capabilities, (7) pipeline management capabilities to manage the timing and resourcing of projects, and (8) culture, people and team issues. The NPD- and IPPM-focused pages of the OLMM are not illustrated in this appendix.

As discussed in Subsection 6.6.1 of Chapter 6, each capability in the OLMM shows the ratings for the 6SI Benchmark and provides a cell to display the ratings for the organisation under evaluation. The 6SI benchmark is discussed further below. The colour coding on the OLMM provides feedback at a glance. For example, on the main page summarised in Figure A10-1, the areas of 6SI IPPM capability strength (red and orange) and mid-range performance (yellow) can be quickly observed. Similarly, the example OLMM for organisation "X" in Figure A10-2 on page 433 provides quick feedback through the use of colour.

The 6SI Benchmark indicator

As discussed in Chapter 6, the OLMM has been developed to assist with the evaluation of the existing maturity levels for the case organisations, and to help identify areas of weaknesses and priority areas for improvement of IPPM capabilities. In order to enable the case organisations compare their performance with others in the study, the mean capability rating across the six cases for each OLMM element is presented as a 'benchmark' rating. This benchmark rating is called the 6SI indicator – for six successful innovators – to indicate that this rating is based on a limited number of successful organisations and is not representative of average organisational IPPM capability. With further use and testing of the OLMM it is envisaged that a new benchmark rating would be developed based on a larger sample of data.

Development of the OLMM

The development of the OLMM followed five roughly sequential steps based on five main inputs: (1) evaluation and analysis of existing CMMs for PPM, (2) a review of the literature on IPPM, (3) the emerging findings from the in-depth case studies, (4) feedback and advice from IPPM experts and, finally, (5) feedback from the case organisations. These stages are summarised below:

(1) First, the strengths and weaknesses of existing CMMs were evaluated and the main maturity paths and themes were identified. Many of the existing CMMs have been developed for generic PPM environments (PMI 2003; Crawford 2007a) or for IT PPM environments (Jeffery and Leliveld 2004). Two CMMs that focus on IPPM (i.e. PPM for the NPD environment) were also reviewed. One is a section of an NPD CMM (Kahn et al., 2006), and the other focuses on implementation steps for IPPM in a NPD environment (O'Connor, 2004b). An initial set of themes that are appropriate for IPPM maturity was condensed from these existing models. The weaknesses of the existing models were analysed and addressed during the stages of the OLMM development. These weaknesses and the specific aspects of the OLMM that address these weaknesses are summarised below.

(2) Second, the general literature on IPPM capabilities was reviewed to determine whether further themes are indicated for the maturity model. One of these themes is the ability of the IPPM capability to be tailored to the environment and to cater for multiple project types through different NPD processes. The literature review also supports the recognition of antecedent capabilities within the OLMM, such as: project management capability is required for IPPM capability; and gate criteria must be developed before evaluations can take place. The result of the first two stages of development was a set of themes and

examples of likely maturity stages and antecedent linkages based on previous models and findings in the literature.

(3) The emerging findings from the case studies were used to help rationalise the themes indicated by the first two stages of OLMM development and to determine whether additional themes should be included. The emerging findings from the OLMM highlighted the importance of organisational structure and considerations related to the development and management of human resources. The emerging findings also indicated that organisations sometimes performed higher level capabilities very well, even when they had weak capabilities on earlier stage capabilities in the same theme. These findings led to a change in philosophy and the OLMM was designed to assess the capability at each level within a theme, rather than to expect organisations to 'complete' one stage before moving to the next capability stage. Using this design philosophy, the feedback from the OLMM is more detailed and realistic. The first draft of the OLMM was produced using these three phases of input. The OLMM was designed to be used to rate an organisation's IPPM capability for each of the capability stages across the themes. A colour-coded rating system was implemented to make the OLMM easy to interpret, so that a glance at the spread of colours indicates capability strengths in each area.

(4) The OLMM was then shared and evaluated by experts in the field, and additional considerations and improvements were suggested through an iterative process of review and adjustment. Part of this iterative process of OLMM development also included preliminary testing of the model to determine how well the case findings could be analysed using the model. The design of the OLMM was then determined and used to make a final analysis of all six case organisations' IPPM capabilities. The mean ratings for the six case study organisations were then added to the OLMM as a benchmark rating for comparison purposes. This benchmark rating is called the 6SI indicator and is presented on the OLMM in a colour-coded format for easy interpretation of weak and strong capability areas. See below for further discussion of the 6SI benchmark indicator.

(5) The final stage of development of the OLMM for this research study was to present the findings on the OLMM to the case study organisations and to receive their feedback on the model and the analysis of their organisation's IPPM capability using the model. Feedback indicates that the model is useful in analysing an IPPM capability and in identifying areas for improvements (see below for a brief summary of the feedback). This final stage did not result in any major changes to the OLMM, although some items were clarified by rephrasing the description.

Benefits of the OLMM over existing CMMs

As outlined in Section 6.6 of Chapter 6, the OLMM has been designed to focus on NPD environment and to address weaknesses in existing CMMs. The five main benefits of the OLMM model compared with other IPPM Maturity Models are: (1) the inclusion of the full breadth of components of the IPPM capability, (2) the focus on outcomes rather than activities, (3) the inclusion of organisational learning capabilities, (4) the recognition of antecedents for maturity stages that build upon other capabilities, and (5) explicit attention to the IPPM capabilities that will assist in balancing exploration and exploitation projects. These five benefits are outlined in more detail below:

(1) The existing maturity models do not explicitly recognise the breadth of the IPPM capability as represented in the model in Figure 6-4 in Chapter 6. The OLMM includes maturity elements for all of the components of an IPPM capability.

(2) Most capability models focus largely on activities that an organisation should undertake in a staged process, however organisational contingencies are especially significant in a development environment and the same activities may not be appropriate across different organisations to achieve the same 'maturity level' outcomes. The OLMM model focuses more on the outcomes the IPPM capability delivers at each stage than the actual activities that take place. For example the degree of computerisation required to enable appropriate access to project and portfolio data will vary depending upon the number, size, and complexity of the projects as well as the stability, knowledge and dynamism of

the environment. Rather that using activity-based stages in the maturity model, the OLMM model specifies the stages of outcome maturity for data handling and sharing. For example the activity-based model presented by O'Connor (2004) specifically lists "Using Online forms/XML to SQL database" for the 4th level of maturity in Data Gathering and Handling but it is not clear what these forms are meant to achieve, and why the "XML to SQL database" should be used. In contrast, the OLMM includes several items that show what types of data based outcomes are required. For example, one of these items is "data from ongoing projects is available for comparison with criteria specified in the project proposal on a portfolio wide basis". By using an outcomes-based approach to the maturity model, the OLMM enables the organisation to clearly identify what outcome they should aim to achieve and allows them to consider a range of methods to achieve that outcome. Since the appropriate level and type of method will vary across different organisational environments as well as over time and with technological development, the OLMM offers a more robust and enduring model for IPPM capability development.

(3) For an IPPM capability to stay relevant in a dynamic environment it must be able to evolve. The OLMM includes organisational learning capabilities in the maturity model through the inclusion of specific capabilities based on findings from the research. For example the OLMM evaluates performance on items such as "Project Review data is used at the portfolio level to identify areas for learning and to make improvements or adjustments to the NPD project process" or "Organisational structure, responsibility profiles, and the processes to select and develop the 'Portfolio Review Board' are regularly reviewed and altered when necessary to ensure they continue to best support the IPPM process in a changing environment". The inclusion of learning capability items on the OLMM ensures that organisations incorporate review and learning processes for double loop learning to enable their IPPM capability to be responsive to the environment.

(4) Existing maturity models tend to acknowledge a logical order of maturity development within a theme, but fail to acknowledge antecedents across themes (Kleinschmidt, 2006). Previous maturity models sometimes also fail to recognise when maturity may progress to 'higher' stages without strong (or sometimes

any) capability at 'lower' stages within the same theme. For example some models list individual project evaluation at a maturity stage before portfolio level project evaluation – however although it is common for organisations to progress in this way, it is not essential or necessarily desirable for an organisation to first review projects individually before progressing along the maturity path to portfolio level project evaluation. The OLMM explicitly lists the antecedents that are necessary to support further IPPM capability maturity development. For example the OLMM uses cross-theme notations to show that project proposal criteria must be established before data based on such criteria can be used to evaluate projects. In addition, the OLMM acknowledges varying levels of performance for each capability instead of assuming that organisations fully satisfy one level before moving forward.

(5) Finally, the important ability of the IPPM capability to ensure that the NPD project portfolio contains a healthy balance between exploitation and exploration projects is addressed in the OLMM. Repeated research shows that the introduction of an IPPM capability, while improving organisational outcomes on some of the IPPM goals, may actually reduce the balance between exploitation and exploration projects. This may be a result of the more frequent and positive feedback from exploitation projects and the organisational learning processes that reinforce such exploitation decisions. In each of the organisations studied in depth, this tendency was noticed during the evolution of the IPPM process, and steps were then taken to implement mechanisms that would allow exploration projects to be evaluated using different metrics, to be completed using different processes and/or to influence the balance between exploitation and exploration projects. These findings have been used to include items in the OLMM such as "Different types of NPD processes are available to meet the different needs of exploitation and exploration projects or other types of projects" or "The NPD strategy addresses the desired balance between exploitation and exploration projects" to help organisations avoid the 'success trap' (or the 'exploitation trap') (Levinthal and March, 1993). Existing IPPM maturity models do not address this balancing issue and do not enable organisations to identify or assess whether their IPPM capability is addressing this issue.

Illustration of the use of the OLMM in "Organisation X"

Figure A10-2 provides an example of OLMM results for an example organisation, referred to as "Organisation X". To protect confidentiality, some of the notes and all identifying information, including information on the industry type, are removed from this example. The example illustrates how the OLMM provides a summary of IPPM capability maturity across multiple capability areas, and how the OLMM is then used to indicate areas for improvement to focus investments in capability development.

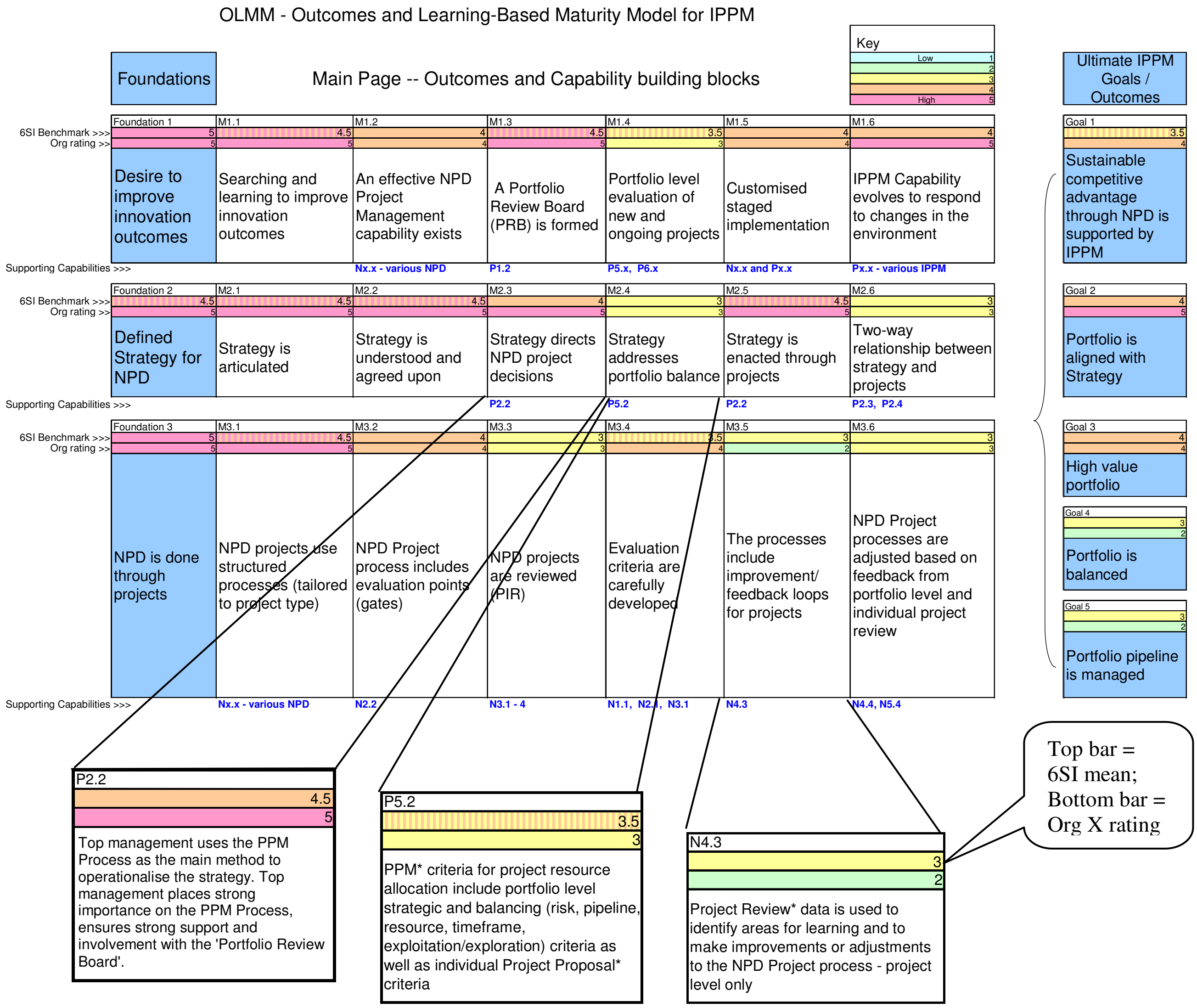


Figure A10-2: Organisation "X" Ratings on the OLMM Main Page
with insets from the IPPM capability page (P2.2 and P5.2) and the NPD capability page (N4.3)

Figure A10-2 is an extract from the OLMM for "Organisation X" showing how the colour coding helps provide quick visual feedback on capability areas, performance levels and performance relative to the 6SI benchmark. Strong performance is indicated by the pink rating bars, highlighting several areas of strength, including that "Organisation X" has a clear strategy with strong alignment of the project portfolio to the strategy. Weaker areas of performance are indicated by yellow, green or blue rating bars. This colour coding highlights several areas of weakness, including portfolio balance and in the use of improvement feedback mechanisms for projects.

Figure A10-2 also shows a sample of supporting capabilities from the other pages of the OLMM. For example, the IPPM capability P2.2 supports the strong performance on the use of strategy to direct project decisions (capability M2.3 on the main page). The inset P2.2 shows how that capability's high rating supports the high performance. The link between the main page capability of the strategy addressing the portfolio balance (M2.4) and the supporting IPPM capability P5.2 is also illustrated in an inset on Figure A10-2. The final inset in Figure A10-2 shows that the relatively weak performance on the supporting capability N4.3 helps to explain the weak performance on the main capability related to improvement feedback mechanisms (M3.5). Capability N4.3, the improvement of project processes based on feedback data, is also supported by other capabilities such as the existence of a feedback mechanism and the use of feedback data to evaluate projects. For simplicity, these additional supporting capabilities are not shown in Figure A10-2.

The model shows that for "Organisation X" to develop IPPM processes with feedback loops for improving project processes, it must first improve its performance on project review feedback capabilities. To do this, the organisation must first define project review criteria, implement a mechanism to collect the data and to feed those data into a review process, and then use the results to improve the project processes. In this way, the OLMM helps organisations identify areas to improve in order to improve performance.

Further development of the OLMM

Initial feedback from the case organisations, while representing only a small sample, provides indications of the acceptance and utility of a tool like the OLMM for organisational PPM capability development.

The OLMM aims to improve on existing maturity models in several ways, as outlined earlier. Future research should test the OLMM to determine how well it meets the aims and whether improvements should be made to the model. In particular, further research is suggested to evaluate whether the OLMM adequately incorporates learning and feedback mechanisms for IPPM capability development. Findings suggest that the evolution of the IPPM capabilities at the case organisations results partly from mechanisms not identified in the OLMM. Therefore future research should aim to identify the aspects of IPPM capabilities that influence capability development, with the aim of improving their representation on the OLMM.

Ongoing development and testing of the OLMM will enable the OLMM to evolve and improve. The current OLMM has been tested with only six organisations. Further testing, review and feedback are required to determine whether the OLMM is a useful tool and to strengthen the data bank behind the benchmark indicator. Future studies could involve testing this model on a number of organisations to provide benchmark data, or could involve long term 'action research' where the model is used to help organisations evaluate and improve their IPPM capabilities. Either type of study would be expected to provide feedback to further develop and improve the OLMM.

An important area for further testing of the OLMM is its ability to help organisations balance exploration and exploitation projects. The findings suggest that the introduction of an IPPM capability may lead to an imbalance, where exploitation projects are favoured over exploration projects. The findings also show how the IPPM capabilities at the case organisations have been adjusted to address and correct the imbalance. Future research could aim to better understand the aspects of the IPPM capability that can help organisations balance their project portfolios and to incorporate these findings in the OLMM to help guide practitioners.

In addition, although the OLMM is focused primarily on outcomes and learning capabilities, activity-related items may enhance the model's usefulness. It may be beneficial to include supplementary entries to enable organisations to get more input on the types of activities they might use to best achieve the listed outcomes. Extensions to the model could also be developed to help organisations determine the types of learning activities, for each capability area, that have been shown to help organisations develop and evolve their IPPM process.