Proceedings of the 11th Annual Conference
of Asia Pacific Decision Sciences Institute
Hong Kong, June 14-18, 2006, pp. 621-630.

PROJECT PORTFOLIO MANAGEMENT AND ENTERPRISE DECISION MAKING: BENCHMARKING PRACTICES AND OUTCOMES

Catherine P Killen*, Robert A Hunt**, Elko J. Kleinschmidt***
*Faculty of Engineering, University of Technology Sydney (UTS), Australia,
**Centre for Management Innovation and Technology,
Macquarie Graduate School of Management (MGSM), Sydney, Australia,
***De Groote School of Business, McMaster University, Hamilton, ON, Canada
c.killen@uts.edu.au, robert.hunt@gsm.mq.edu.au, kleinsc@mcmaster.ca

ABSTRACT

Effective decision making within the innovation project portfolio process is increasingly important to organizational survival. Large sums are invested in innovation projects, however a significant proportion of these do not result in successful new products. Project Portfolio Management (PPM) methods aim to ensure that project decisions are made so that resources are most effectively allocated. PPM decisions should ultimately improve success rates and increase the value of the innovation portfolio to the organization. This paper presents the results of research into innovation PPM practices and new product success levels. The benchmarking study used a research survey to collect information about PPM decision-making methods, attitudes, satisfaction levels, portfolio performance and new product success levels. The results show that PPM practices in Australasia and North America are surprisingly similar indicating that the findings in one region are likely to be relevant in the other. New product success measures correlated highly with established PPM processes in Australasia suggesting that improving PPM practices could boost innovation performance. The selection of the right number of projects for organizational resources was confirmed as one of the biggest PPM challenges. Financial and strategic methods and criteria dominate PPM decision making, however strategic methods and portfolio maps have the strongest positive influence on portfolio performance measures.

Key words: New Product Portfolio Management, Project Portfolio Management, Innovation, Strategy

INTRODUCTION

The survival of organizations competing in today's rapidly changing environment is reliant on a continual stream of successful new products and services. Product life spans and technology life cycles have been steadily decreasing, leading to quicker obsolescence of products and the need for more frequent introductions of new products. The percentage of current sales that are from products that have been newly introduced within the last three years has been steadily increasing and is now estimated to be about forty percent [4]. Large sums are invested in new product projects, however a significant proportion of these do not result in successful products. Research studies indicate that between one-third and two-thirds of new product introductions fail to achieve commercial success [4] [14] [31]. An important area of innovation research looks for ways to improve the success rate of new products.

Much of the traditional research in this area has focused on decision making, policy and practice within the scope of individual new product projects. Project management methods have become a standard part of innovation processes and a variety of tools are available for the management of individual innovation projects. Another important area for research on organizational innovation takes a higher perspective and looks at the decision processes used in the management of an organization's entire portfolio of new product projects. Project portfolio management is a rapidly developing field for innovation research and practice, and awareness and application of PPM practices is growing. The rise in PPM interest and research is shown in the increasing rate of publications focusing on 'project portfolio management'; for example, citations in one major journal database have risen from two in 2000-2001 to thirty-five in 2004-2005. [12].

DEFINING PROJECT PORTFOLIO MANAGEMENT

Portfolio management (PM), or project portfolio management (PPM) are terms used for the methods employed by organizations to ensure that resources are most effectively allocated among projects. "Portfolio management ... is a

dynamic decision process wherein the list of active [projects] is constantly revised." [6, p.3] The PPM process involves evaluation, prioritization and decision-making for both new projects and existing projects.

Management of individual projects is an important part of the overall PPM process. PPM decisions consider all projects and rely on credible, current and accessible project data - however PPM is much more than managing many projects at the same time [22]. Although PPM is an enterprise-wide function, and the term 'enterprise portfolio management' (EPM) is often used interchangeably with PPM, it is important to define the difference between PPM and EPM. EPM denotes a project management-based activity that is focused on the enterprise-wide management of multiple projects. In contrast, "PPM is literally above and beyond project management because it spans all the way from the vision of those in the executive suite, through project management, to the realization of benefits to the enterprise and its successful competitive positioning" [33, p.xi].

Levine [22] views PPM as a bridge between the operations management and project management, or as a strategic hub at the centre of strategic, operations and project functions. Project portfolios can be configured at many levels within the organization such as enterprise-wide, divisional or business unit levels. Often decisions are made within a portfolio that contains certain types of project such as basic research projects, corporate change projects, IT or infrastructure projects. New product development (NPD) and innovation project portfolios are of particular interest due to the increasing importance of innovation to organizational success, and significant PPM research has been focused in this area. The research project outlined in this paper focuses on PPM methods for innovation (or NPD) projects specifically, at both enterprise and business unit levels. The PPM processes and decision-making methods used for other types of portfolios are very similar to the innovation PPM methods outlined in this survey [25].

Literature Review - Project Portfolio Management and Decision making

PPM is a complex balancing act that requires making strategic decisions, allocating resources, evaluating risks and assessing current projects while making new product project selection decisions. PPM methods have been developing and evolving over the past three decades. A variety of approaches have been applied – each with a slightly different emphasis but all have attempted to improve the resulting new product success rates and maximize the value of the project portfolio.

Commonly used PPM tools include financial or economic models, scoring models and checklists, behavioral approaches, decision support systems and mapping approaches [6]. Some early PPM methods attempted to develop formulaic solutions through mathematical models and optimization techniques, however these are not widely used due to the complex nature of the environment [3]. PPM experts now recognize that there is not any single model or PPM tool that will suit all situations. Hybrid or composite approaches are popular – these encompass a variety of tools and methods that can be combined as needed [3]. Current PPM research aims to improve understanding and guide decisions related to selecting the appropriate tools to achieve organizational goals.

Aggregating Projects into Portfolios for Holistic Decision Making

Management of the individual new product process is an important part of the overall PPM process. To demonstrate the more holistic nature of PPM compared with individual project management, Cooper et al [6] use the analogy that the individual project processes deal with the 'fingers' and that portfolio management deals with the 'fist'. Ausura [2] also emphasizes that it is not enough to just consider proposed new product projects. He stresses that all projects at every stage of the product development cycle must be considered in a total portfolio. Matheson and Menke [23, p43] point out that "One of the most important [factors] is the interaction of the projects in the portfolio ... each project is part of an overlapping, interconnected whole - with a variety of critical dependencies." Project decisions made at the portfolio level are able to consider the interaction between projects as well as the relationship between the project portfolio and organizational aims.

In their influential book, Revolutionizing Product Development: Quantum leaps in speed, efficiency and quality, Wheelwright and Clark [32] proposed the Aggregate Project Plan (APP) as a key construct in a framework for product development. One of the primary purposes of the APP is to establish the type and mix of projects that should comprise an organization's development portfolio over time. This type of aggregation of project resource requirements into a project planning and decision-making framework forms the basis for many current PPM processes.

Linking individual project and portfolio processes

The importance of structured decision making and decision points within the NPD process has been established and project management methods and new product management methods like the Stage-Gate® process are valuable aids to the development of new products. To evaluate the portfolio of projects during the product development cycle, a 'gated' process like the Stage-Gate® process is an important part of the PPM process. Gates are points in the new product process where the project is evaluated against set criteria and decisions are made about whether to continue resourcing

the project. Cooper, Edgett and Kleinschmidt [7] found that 'best practice' companies implement tough gate requirements and integrate PPM into the gating process. The combination of project-based gates and portfolio-based decision making enables them to determine the right mix, balance and number of projects to deal with the challenge of maximizing the value of the portfolio and to ensure that it reflects their business' product innovation strategy.

Methods to aid PPM decisions

The value of the portfolio is often measured in financial terms, and a variety of scoring models, checklists and optimization methods are used [6]. Financial metrics like Internal Rate of Return (IRR), Net Present Value (NPV) or Expected Commercial Value (ECV) are commonly applied. Hatfield [16] suggests that the Economic Value Added (EVA) financial metric is more than just another financial metric. EVA treats product development as a strategic capital cost rather than an expense and therefore gives a more accurate measure of value creation and destruction. Hatfield believes that "EVA provides an excellent tool for R&D portfolio management" [16, p45].

An effective new product portfolio requires the proper balance between risk and return. A portfolio map can be used to point to the different strategies that are appropriate for projects in different quadrants of the grid [23]. There are many types of product and technology portfolio mapping approaches (for examples see [1], [6]). Many are adaptations of the four-quadrant strategy models introduced by the Boston Consulting Group and GE in the 1970s.

Portfolio maps usually involve diagrammatical matrix-based tools based on placing the key dimensions of the problem on two main axes. These tools have the advantages of being simple and flexible, and are particularly useful for communicating concepts among a multifunctional group [24]. The power of matrix-based portfolio tools can be extended by developing a series of portfolio matrices to provide integrated data involving multiple dimensions [27]. Portfolio maps also provide an excellent means of linking and balancing internal and external factors affecting the decision-making process. Project positioning in relation to important factors such as 'internal competitive advantages' and 'benefits to customers' is able to be clearly displayed in the two dimensions on a portfolio map [24]. The linking of customer benefits with internal company capabilities is particularly relevant for innovation portfolios – as an innovation depends upon the customer's acceptance of the new product as well as the organization's capability for development. Furthermore, Daneels and Kleinschmidt [7] show that there are two dimensions to innovation; the newness to the market and the newness of the technology. Portfolio maps provide an ability to view the two dimensions of innovation to clearly display the contributions of both dimensions to the overall innovativeness of the offering and to assist innovation project portfolio decision making.

In their paper on "Formulating R&D portfolios that Account for Risk", Ringuest, Graves and Case [28] point out that portfolio maps are information display models, not decision models, and fail to account for risk-mitigating effects of incorporating projects into an existing portfolio. Ringuest et al suggest that improved methods of new product project selection and management are required. They propose a new improved model for practical PPM and project selection that may provide a more reliable and rigorous approach to decision making. By incorporating concepts developed by Shalit and Yitzhaki [29] for stock market portfolios, and calculating risk-adjusted returns in the model, Ringuest et al's research shows high correlation with evaluations of experienced R&D managers. It is suggested that this model can supplement or support organizations' internal deliberations. Another approach to dealing with uncertainty and risk is presented by Faulkner [13] who advocates an "Options Thinking" approach for the evaluation of R&D projects. Options analysis can have advantages over traditional discounted cash flow methods, particularly when 'intangible benefits', 'uncertainty', and 'possibilities for benefits from spin-offs' may affect project outcomes.

Quality decision making for PPM

Matheson and Menke [23] believe that quality decision making is the cornerstone of developing an effective portfolio strategy. They maintain that a high quality decision is one that is made with the following six elements: An appropriate frame or perspective must be established; Creative and achievable alternatives must be generated; Meaningful and reliable information must be developed; Clear trade-off values must be established; Logically correct reasoning must be applied and a Commitment to action must be developed. Whatever PPM method is used, the application of decision quality principles at the portfolio level can help to ensure that the best decisions are made.

Cooper and Edgett [5] reinforce the importance of quality decision making and the necessity of obtaining good data for decision making. One of the biggest problems highlighted in their research is that companies regularly attempt to complete too many projects. This sets up a vicious cycle, which if unrecognized or left unchecked, may lead to disaster. Having too many projects stretches resources, and discretionary activities (such as voice of the customer analysis, market assessment and other data collection and information activities) are hastily completed if at all. Without reliable data, management finds it especially hard to make decisions to kill projects. The company ends up with too many poorly performing projects, resources that are stretched further and data quality that suffers more. In this way, too many projects leads to a downward spiral of poor data and decision-making quality. Thus the lack of good data on

projects is both a result and a cause of too many projects.

Balancing Portfolio Risk
Ding and Eliashberg [11] also highlight the risk imposed by funding too many proposed alternative projects, however when pursuing "really new" product development, they caution against limiting the number of projects too early in the design cycle. They show that attempting to capture a business opportunity with multiple approaches can be more successful than narrowing to a single approach too early and that a "parallel" approach can help organizations cope with uncertainties.

Hauser [17] believes that decisions are influenced by performance measures which often encourage risk-aversive behavior. Market outcome measures are not suitable for projects with long-term prospects and decisions made based on these measures are not in the organization's best long-term interests. To encourage the best decisions and performance for applied projects, Hauser advocates the use of organizational 'subsidies' when the incentives of the decision-makers are not aligned with the overall organizational goals. For the best decisions about basic research projects, Hauser recommends the use of measures that encourage the development of innovations that are derived from any source rather than only rewarding original ideas for basic research projects. When only in-house research developments are rewarded, the result is a 'not invented here' syndrome and the number of new ideas is greatly limited. To promote innovation, Hauser recommends rewarding 'research tourism', where successful development of outside research is encouraged and rewarded.

Portfolio Analysis for Action
In their article on "Action-Oriented Portfolio Management", Spradlin and Kutoloski [30] present a 'strategy table' approach to PPM to help focus efforts into the realm of action. The strategy table is designed to generate alternatives where choices will actually be entertained, and to eliminate unnecessary analysis when no alternatives are under consideration. By providing the materials necessary to communicate a recommendation for action, strategy tables help the decision-maker focus on portfolio issues rather than project issues. Spradlin and Kutoloski believe that PPM should not be just portfolio evaluation, but should involve explicit actions and should encourage consideration of alternative courses of action.

North American PPM Practices Benchmarking Studies
Robert Cooper, Scott Edgett, and Elko Kleinschmidt, of McMaster University, Ontario Canada, have conducted extensive and widely published research into NPD PPM practices and performance in the USA and Canada during the past decade. Early research on new product development practices conducted by Cooper and Kleinschmidt [8] [9] highlighted the importance of project resourcing decisions. Further benchmarking studies [6] focused more specifically on the PPM processes as a crucial part of new product programs. In their studies, Cooper et al identified the need for improved methods for innovation project selection and management. Based on their ongoing 'best practice' benchmarking research, the main goals for NPD PPM decisions are identified by Cooper and Edgett [5] as (1) maximize the financial value of the portfolio, (2) create a balance of projects, (3) limit the number of projects to fit with organizational capacity, and (4) ensure that the portfolio reflects the business's strategy.

Literature Review Summary
In summary, PPM methods include many different approaches for making new and ongoing project decisions in an attempt to improve the resulting new product success rates and maximize the value of the project portfolio. The quality of PPM decisions depends upon the availability of good data and the use of a logical PPM process that results in recommendations for action. Benchmarking studies on the NPD PPM methods in North America have identified a need for improved PPM methods and have outlined common PPM goals.

RESEARCH AIMS AND METHOD-THE AUSTRALASIAN

Research Aims
The purpose of the research project outlined in this paper is to provide a benchmark of innovation PPM practices in Australasia that is comparable to the earlier North American research [6] and to extend the earlier research to explore more deeply the relationship between PPM methods used and new product success. The availability of a 'best practice' benchmark of Australasian practices provides an understanding of current processes and enables local organizations to see how they compare with others and to target areas for improvement [26]. This benchmark aims to benefit management by indicating what constitutes 'best practice' and by identifying the critical elements that can lead to success.

Method
A comprehensive survey instrument was developed to capture the NPD PPM practices in use across Australasia. This is

the first research of this type to benchmark Australasian PPM practices. A pilot test of the research instrument was followed by the main phase of data collection which was completed during 2005. The survey focused on PPM for new product development portfolios, and contained eighty-eight questions (some with sub-questions) on the importance of PPM to the organization, PPM structures in the organization, detail of methods used, the performance of PPM methods, and measures of new product success.

Australasia vs. North America

A major portion of the Australasian survey draws upon the earlier survey used by Cooper, Edgett and Kleinschmidt in North America, and the results from these portions of the Australasian survey are compared with the North American data. The Australasian survey has also been extended to include new product success and innovation metrics.

Success Factors

Wideman [23] asserts that a key success factor for projects is the selection of the right projects through an established PPM process. However, 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 [24]. Recently highlighted innovation research challenges include the need to improve methods used to "relate portfolio decisions to future performance outcomes" [18]. The Australasian survey has been designed to work toward this goal. The collection of data on performance measures and results has been significantly expanded and strengthened from the original North American survey to develop a better understanding of the relationship between outcomes and PPM methods. There is no standard set of performance measures to evaluate the success of product development projects. Hauser and Zettelmeyer [19] show that the best metrics for one type of development activity may not be appropriate for others. To account for the diversity of organizations and projects in the Australasian survey, a broad range of performance metrics have been collected. Data on the success rates for new products includes questions on the project pipeline [20], customer acceptance, financial measures, and product and organization level measures [15] [14], industry comparisons, and measures of impact and opportunity development.

PROJECT PORTFOLIO MANAGEMENT BENCHMARK RESULTS

The respondents

Table 1 outlines the profiles of the respondents in the current Australasian and previous North American surveys. Both regions included organizations spread across many different industry groups. The Australasian respondents represented a wider organizational size range, and while the average organization is of similar size, the median organization is significantly smaller in Australasia. Innovation project investment levels are not significantly different in the two regions when calculated for comparable organizational groups.

TABLE 1 – Profile of Respondents to the PPM Practices Surveys

Region	Number of Respondents	Average and Median size of organization	Range from min – max size of organization	Innovation investment -% of turnover – average
Australasia	60	Average 2.37 billion AUD, Median 125 million AUD (approx avg 1.77 billion USD and median 94 million USD)	300,000 – 30 billion AUD (approx 225,000 to 22.5 billion USD)	5.3%
North America	205	Average 1.89 billion USD, Median 400 million USD	3 million – 22 billion USD	4.9%

Summary of Differences between Australasian and North American organizations

There were no significant differences between the North American and Australasian data for the large majority of responses. The level of similarity was significant and surprising and provides justification for hypothesizing that the insights gained from the Australasian survey will be applicable to North America.

In the six sections of the survey containing eighty-eight questions (some with sub-questions), only the following areas showed statistically significant difference between the two regions: Respondents felt that there were more high value projects and spending was more consistent with strategy in North America; Australasia used financial 'hurdles' more

while there was more ranking of projects in North America; and Australasian organizations were more likely to configure project portfolios at the corporate level (69 percent) than North American organizations where nearly half (48 percent) configured portfolios at the individual business unit level only.

Importance of Project Portfolio Management

The importance of PPM to respondents' organizations is listed in Table 2. These results are nearly identical to North American findings and confirm that new products are seen as essential for competitive success in most industries. The results also highlight one of PPM's primary goals - to achieve the 'right number of projects', and one of the biggest challenges – to avoid doing too many projects and stretching resources to a detrimental degree.

TABLE 2 - Importance of Portfolio Management in Australasia
Response Likert scale 1=strongly disagree, 5=strongly agree

Mean Response	Portfolio management is vital in our business....
4.08	... because project selection is important to maintaining our competitive position.
4.00	... because our new product resources, - people, time, and money – are very scarce and we don't want to waste them on the wrong projects.
3.93	... because we want to be focused – not do too many projects for the resources we have available.
3.80	... because project selection is closely linked to business strategy in our business.
3.45	... 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.
3.34	... because strategy begins when you start spending money – resource allocation to projects is how strategy gets implemented.
2.55	... because we are relatively risk adverse/conservative; so we must be very careful in project selection so as to have no failures.

Overall Portfolio Performance Measures

The next two sections outline the measurement of PPM performance relating to PPM goals and identifiy organizations with 'top' and 'poor' PM processes and compares these with the average for 'all businesses'. The section on "Innovation Portfolio Outcomes" outlines the new product success level measurements and compares these outcomes with the level of PPM process performance.

Six measures of portfolio performance.

The performance of the PPM process was defined by six measurements which represent the primary desired outcomes of a PPM system as shown in Figure 1. While some organizations score highly on these measures, the distribution of performance results is very broad. From the six performance measures, a single performance metric was developed to allow analysis of overall performance on PPM goals. This performance metric and the six component measures have been developed, tested and applied in earlier PPM studies in North America (6). The use of the same performance metric in the Australasian study allows direct comparison with the data from the North American studies and reveals outcomes that are nearly identical (e.g. Figure 1 is nearly identical to Exhibit 6.2, Cooper et al, 2001:149). This strong similarity indicates that the performances and challenges for PPM do not vary significantly across these two regions.

Figure 1 displays the six measures of portfolio performance for three groups of respondents; the average of 'all' businesses, the 'top performers' (top 20 percent% performance metric scores), and the 'poor performers' (bottom 20 percent). The average results show that there is much room for improvement in the management of new product portfolios. The only significant differences with the North American data is that North American organizations believe their portfolio contains more high value projects than Australasian organizations (3.78 compared with 3.3 on the five-point scale) and that their spending is more consistent with strategy than reported by Australasian organizations (3.68 compared with 3.25). Figure 1 shows the broad spread of portfolio performance and further highlights the importance of strategic alignment and value maximization for effective PPM performance. Also reinforced is the repeated concern that too many organizations attempt too many projects.

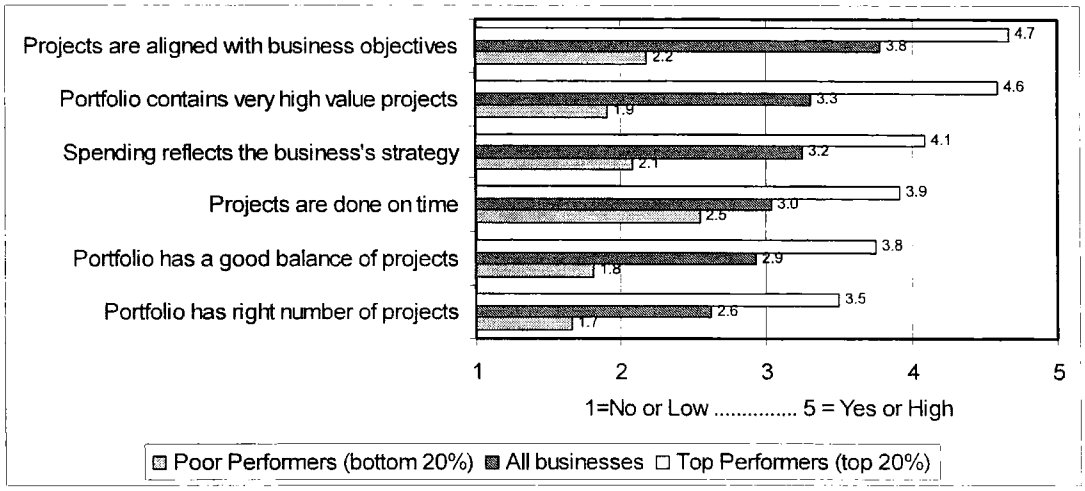

FIGURE 1: Australasian Portfolio Performance Results on Six Key Metrics
Performance metrics are ordered by mean scores. Significance level between top and bottom performers (.001)

Five additional measures of overall portfolio performance
For the Australasian survey only, data was also collected on five additional performance measures in order to evaluate PPM tools on innovation outcomes related to reaching new markets and developing technological capabilities. Figure 2 shows how the 'top', 'average' and 'poor' PPM performers (as defined in the previous section) compare on the five new metrics. The difference between the 'top' and 'poor' performers is particularly prominent in the success measure and on the measure of the ability of the new product program to enable businesses to enter new markets indicating a relationship between PPM performance and successful innovation.

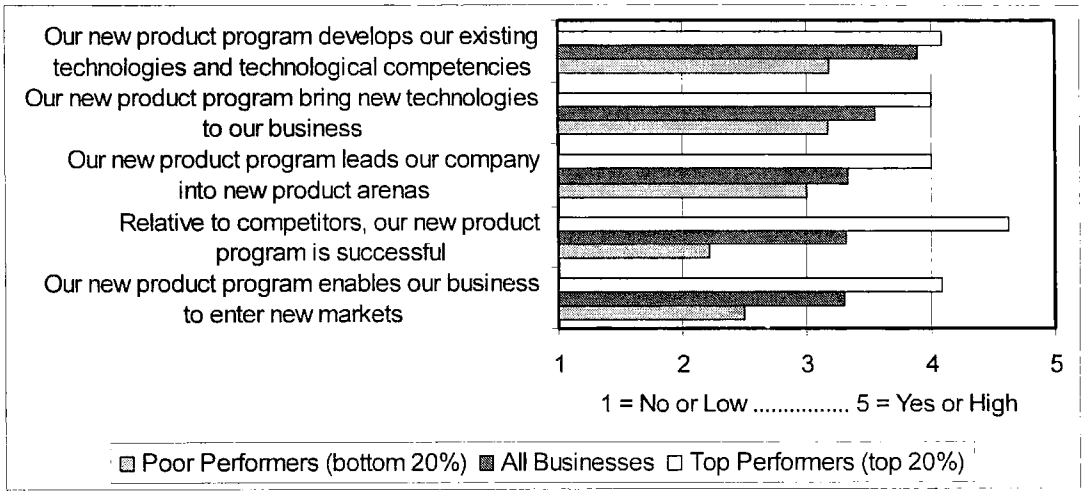

FIGURE 2: Australasian Portfolio Performance Results on Five New Metrics
Performance metrics are ordered by mean scores
significance level between top and bottom performers in order (.09, .09, .07, .000, .000)

Innovation Portfolio Outcomes - New Product Success Measurements
While Figures 1 and 2 chart the spread of the performance metric measures across the 'top' and 'poor' and the 'average' of all businesses in terms of PPM goals, they are not a direct measure of the resultant success of the new product program. In order to more directly measure new product success rates, respondents in the Australasian survey were asked to provide information about the success rates for launched new products and the percentage of projects that are abandoned or 'killed' before launch.

Figure 3 compares the new product success rates with the organizations' PM performance categories defined earlier. The 'top' performers in the portfolio performance metric also achieved the highest results for the new product success metrics, indicating a possible causal relationship between PM performance and the resulting new product success.

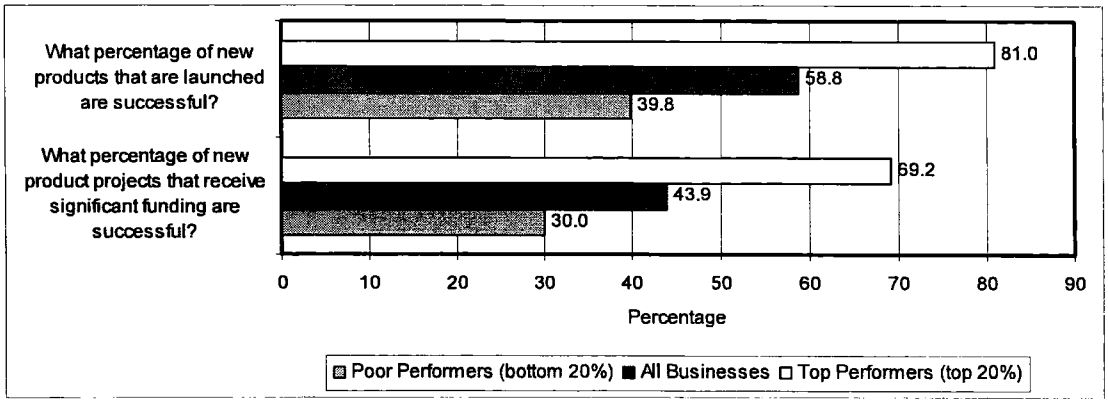

FIGURE 3: New Product Success Rates in Australasia.
(Statistically significant at .001 and .013 levels)

The correlation between PPM performance and new product success is significant (0.630 Pearson correlation at 0.000 significance for launched products, and 0.467 (0.002) for all funded projects), however the results must be considered with caution keeping in mind the size of the data sample and the diverse range of industries represented [24]. Even so, the correlation between PPM metrics and new product success is a promising finding for PPM applications in Australasia and is likely to be relevant to North America and other markets. This finding encourages organizations to focus on establishing and refining their PPM processes, and represents an important start in an area of innovation research that warrants further attention and refinement [18].

Innovation Portfolio Methods and Portfolio Performance

Nearly 50 percent of Australasian organizations surveyed have established their PPM methods within the past two years and 45 percent used a formal method. On average, the Australasian respondents used two of the five methods listed in detail on the survey. The use of each method has been correlated with PPM performance measures to determine which methods may be linked to success.

Financial methods were used for project selection by 77 percent of respondents. The use of financial methods correlates with good alignment of spending with strategy. However, a negative correlation is shown with the ability of the new product program to bring the company into new product arenas. This is the only significant negative correlation shown between the use of a PPM method and one of the performance measures. The choice of type of financial methods is one of the few areas where the North American data differs significantly from the Australasian data. Sixty-seven percent of the Australasian organizations that used financial methods used a hurdle rate or other criterion to make a Go/Kill decision and 41 percent ranked projects against each other. In North America these figures were 50 and 60 percent respectively, representing a stronger emphasis on ranking projects in North America.

Business strategy methods were used in the PPM processes of 56 percent of Australasian organizations. The use of business strategy for resource allocation correlated positively with several performance measures; alignment with strategic objectives, enables our business to enter new markets, spending reflects business strategy, balance in the portfolio, portfolio contains high value projects, and brings new technologies into our business.

Portfolio Maps are used by only 25 percent of the Australasian organizations surveyed. The data on portfolio performance indicates a positive correlation between the use of portfolio maps and several performance measures; balance in the portfolio, develops existing technologies and technological competencies, alignment with strategic objectives, portfolio contains high value projects, and spending reflects business strategy. Of particular interest is the measure that is significantly positively correlated with the use of portfolio maps, but not correlated with any other method – the development of existing technologies and technological competencies. Given the low usage of portfolio maps, there is considerable scope for increased use and possibly better portfolio outcomes, however further investigation would be required to determine the nature of these correlations.

Most portfolio map users regularly charted two or three different scenarios. Seventy-eight percent of portfolio map users employed some version of 'risk versus reward' chart. Many of the portfolio maps did not include financial measures. Nearly half of portfolio map users develop charts displaying technical newness, risk or difficulty measures versus customer impact or market advantage measures. The same proportion of organizations detailed the use of some type of portfolio map focused on customer and competitive measures. These individualized maps also included aspects such as resources, technical ability and maturity.

Twenty-seven percent of respondents use a scoring model and fourteen percent of respondents use a checklist method. The use of these methods did not correlate with the outcomes of any of the performance measures.

When multiple portfolio methods are used, the dominant method will have the strongest effect on portfolio decisions. Although 77 percent of organizations used financial methods, they are the dominant method in only about half of these (39 percent). Strategic Planning Methods dominate decision making in 36 percent of organizations and Scoring Models and Checklists dominate in nine percent and six percent. For more detail on the Australasian benchmark findings see the working paper [12].

DISCUSSION AND CONCLUSIONS

This research project has highlighted the importance of PPM and the fact that new products are seen as essential for competitive success in most industries. A literature review of PPM methods provides an overview of the types of methods used for PPM and highlights the fact that no single method is likely to suit all situations. Most PPM processes combine methods in a hybrid or composite approach for portfolio decision making. The holistic nature of PPM methods is emphasized - in contrast with individual project management methods, PPM methods include new project selection decision making as well as decisions related to ongoing projects. There are similarities among PPM methods for different types of project portfolios, however this research project focuses specifically on portfolios of projects for the development of new products.

New product PPM decision-making practices in Australasia and North America were found to be very similar, indicating that the findings in one region are likely to be generally applicable in the other. In both regions, average PPM performance was not strong, but some organizations employed highly effective PPM practices. New product success measures correlated highly with PPM performance indicating a possible causal relationship between the use of PPM methods and new product success. This suggests that for better innovation outcomes, management should place a priority on developing and improving PPM processes and decisions. This insight from the Australasian study is a very promising finding that may also apply to North America and other developed nations. However, keeping in mind the size of the data sample and the diverse range of industries represented, further research in either Australasia or North America will be required to more fully understand the relationship.

The application of the main PPM tools is analyzed to determine whether there is any correlation with positive outcomes. The analysis confirms previous findings and emphasizes that one of the biggest challenges for PPM is to find better methods to select the right number of projects for organizational resources; none of the methods studied contribute positively to this PPM goal. Strategic methods and portfolio maps have the strongest positive influence on several aspects of portfolio performance while the use of financial methods only correlates with positive performance on one PPM measure. The only significant negative correlation is between the use of financial methods and 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 some 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 PPM processes, this research indicates that financial methods may not be the best dominant portfolio method to use.

REFERENCES

[1] Albright, R.E., and Nelson, B., Product and Technology Mapping Tools for Planning and Portfolio Decision Making, Chapter 15 in Belliveau, P., Griffin, A., Somermeyer, S.M., Eds., *The PDMA Toolbook 2 for New Product Development*, John Wiley and Sons, Inc., Hoboken, New Jersey.

[2] Ausura, B. (2002), Recapturing true life cycle portfolio management; The path to more successful product development, *Current Issues in Technology Management* 6 3, 1-6.

[3] Coldrick, S., Longhurst, P., Ivey, P., Hannis, J., (2005), An R&D options selection model for investment decisions, *Technovation* 25 185-193.

[4] Cooper, R.G, (2005), "Section 7: PPM Applications: New Product Development" in Levine, H., A., *Project Portfolio Management: a practical guide to selecting projects, managing portfolios, and maximizing benefits*, John Wiley and Sons, Inc, San Francisco.

[5] Cooper, R. G., and Edgett, S. J., (2003) "Overcoming the crunch in resources for new product development," *Research Technology Management*, 46, 3, May-June 2003, 48-58.

[6] Cooper, R.G., Edgett, S.J., & Kleinschmidt E.J, (2001), *Portfolio Management for New Products*, 2nd ed, Perseus Press, Cambridge Mass.

[7] Cooper, R.G., Edgett, S.J., & Kleinschmidt E.J, (2002), Optimizing the Stage-Gate Process: What Best-Practice

Companies Do – II, *Research-Technology Management*, Nov-Dec 2002, 45, 6, 43-49.
[8] Cooper, R.G., & Kleinschmidt E.J, (1995a), Benchmarking Firms' New Product Performance and Practices, *Engineering Management Review*, Fall 1995, 23, 3, 112-120.
[9] Cooper, R.G., & Kleinschmidt E.J, (1995b), Benchmarking the Firm's Critical Success Factors in New Product Development, *The Journal of Product Innovation Management*, 12 5, November 1995, pages 374-391.
[10] Daneels, E., and Kleinschmidt, E. J., (2001), Product innovativeness from the firm's perspective: Its dimensions and their relation with project selection and performance, *Journal of Product Innovation Management*, 18 357-373.
[11] Ding, Min, and Eliashberg, J. (2002), Structuring the New Product Development Pipeline, *Management Science*, 48 3, 343-363.
[12] EBSCO, (2006), Business Source Premier database on EBSCO Host (www.search.epnet.com) accessed 20 March 2006.
[13] Faulkner, Terrence W. (1996), Applying 'Options Thinking' to R&D Valuation, *Research Technology Management* 39 3, 50–56.
[14] Griffin, A., (1997) PDMA Research on New Product Development Practices: Updating Trends and Benchmarking Best Practices. *Journal of Product Innovation Management* 14 (6), 429-458.
[15] Griffin, A., and Page, A., (1996), PDMA Success Measurement Project: Recommended Measures for Product Development Success and Failure, *Journal of Product Innovation Management*, 13, 478-496.
[16] Hatfield, G. R., (2002), R&D in an EVA World, *Research-Technology Management*, Jan-Feb 2002, 45, 1, 41 – 47.
[17] Hauser, J.R. (1998), Research, Development, and Engineering Metrics, Management Science 44 (December), 1670–89.
[18] Hauser, J, Tellis, G H, Griffin, A, (2005), Research on Innovation: A Review and Agenda for *Marketing Science*, March 25, 2005.
[19] Hauser J R, and Zettelmeyer, F (1997), Metrics to Evaluate R,D&E, *Research Technology Management*, 40, 4, (July-August), 32-38.
[20] Hertenstein, J H and Platt M B, (2000), Performance Measures and Management Control in New Product Development, *Accounting Horizons*, 14 3, 303-323.
[21] Killen, C.P., Hunt, R.A., Kleinschmidt, E.J., (2005) MGSM Working Papers in Management: Portfolio Management Practices in Australia, Macquarie Graduate School of Management Working Paper Series – WP 2005-10, available at www.mgsm.edu.au.
[22] Levine, H., A.,(2005), *Project Portfolio Management: a practical guide to selecting projects, managing portfolios, and maximizing benefits*, John Wiley and Sons, Inc, San Francisco.
[23] Matheson, J E, Menke, M. M. (1994), Using decision quality principles to balance your R&D portfolio, *Research-Technology Management*, May-Jun 1994, 37, 3, 38-43.
[24] Mikkola, J.H., (2001), Portfolio Management of R&D Projects: Implications for innovation management, *Technovation* 21 423-435.
[25] Maizlish, B, and Handler, R., (2005), IT Portfolio Management, Step by Step: Unlocking the business value of technology, John Wiley and Sons, Hoboken, New Jersey.
[26] Product Development Management Association (PDMA) (2005), NPD Glossary. http://www.pdma.org /library/glossary.html, accessed February 27 2006.
[27] Phaal, R., Farrukh, C.J.P., Probert, D.R., (2006), Technology management tools: concept, development and application, *Technovation* 26 336-344.
[28] Ringuest, J. L., Graves, S. B., and Case, R. H., (1999), Formulating R&D portfolios that Account for Risk, *Research-Technology Management*, Nov-Dec, 42, 6, 40-43.
[29] Shalit, H. and Yitzhaki, S. (1994), Marginal Conditional Stochastic Dominance, Management Science, 39, 5, 670-684, cited in Ringuest, J. L., Graves, S. B., and Case, R. H., 1999, Formulating R&D portfolios that Account for Risk, Research-Technology Management, Nov-Dec, 42, 6, 40-43.
[30] Spradlin, C. T., and Kutoloski, D. M. (1999), Action-Oriented Portfolio Management, Research-Technology Management, March-April, 42, 2, 26-32.
[31] Tidd, J., Bessant, J., and Pavitt, K., (2005), *Managing Innovation: Integrating Technological, Market and Organizational Change, 3rd Ed*, John Wiley and Sons, Chichester.
[32] Wheelwright S.C and Clark, K B (1992), *Revolutionizing Product Development*, the Free Press, New York.
[33] Wideman, M., (2005), Foreword in Levine, H., A.,(2005), *Project Portfolio Management: a practical guide to selecting projects, managing portfolios, and maximizing benefits*, John Wiley and Sons, Inc, San Francisco.