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New Product Performance: What Distinguishes the Star Products

by
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Abstract:

Better new product performance is important for the survival of the firm. Based on a three-dimensional performance space, 110 new products launched from 55 Australian firms are grouped into five performance clusters. Performance groups from 'Stars'—the winning group to—'Dogs'—the worst performance group. The five groups could be well explained by the impact constructs. 'Stars' did what one expects for winning projects (product advantage, homework, cross-functional team, reasonable risk level, etc.), 'Dogs' were identified as doing nearly everything wrong. The Australian results were tested against international findings and concurred fully. Managerial implications are detailed.

Keywords:

NEW PRODUCT DEVELOPMENT (NPD); NPD SUCCES DIMENSIONS; NPD SUCCCESS FACTORS; NPD OUTCOME CLUSTERS; INTERNATIONAL COMPARISON OF NPD FACTORS.

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1. Introduction

New products are vital to the success and prosperity of the modern company. Facing new technologies, increasing and global competition, and dynamic market needs, Australian companies must either succeed at product innovation or risk failing as businesses. Thus an understanding of what makes new products successful—what practices and characteristics distinguish the winners—is essential in order to provide the management insights needed in the decades ahead.

What are the critical driving factors that underlie successful product developments in Australia? The last two decades have witnessed numerous studies into new product successes and failures throughout the world in an attempt to uncover what makes a winner. Indeed, many characteristics and practices have been found that discriminate between successful and unsuccessful new products. But much of this research has tended to view new product performance on a *uni-dimensional continuum*, usually financial performance (e.g. profitability). While short-term profitability is one goal, there are other ways of looking at a new product's performance—for example, time-to-market, or the product's overall impact on the company (e.g. platform for growth).

The goal of the current study is to uncover what distinguishes successful new products from failures in industrial product firms, and by so doing provide management insights into more proficient product development. To achieve this goal, we look at a large number of Australia new product projects, and identify which projects were most successful. But a *number of measures* of new product performance are employed, rather than just the single measure continuum.[1] By comparing the *best* projects to the *rest*, the distinguishing characteristics and best practices are identified. We then investigate in detail each project type and probe what drives their performances, and what makes for new product success, when *success is measured in different ways.*

1.1 Background

Identifying new product success factors has become an important research direction, as investigators probe commercial new product projects in order to discover what discriminates between winners and losers. For excellent reviews, see Montoya-Weiss and Calantone (1994) and Cooper (1996).

One concern with the majority of these success/failure investigations is that they tend to treat new product performance as a *single dimension*—usually, financial performance. This is simplistic, however; indeed the measurement of new product performance has a *multi-dimensional flavour* (Montoya-Weiss & Calantone 1994; Cooper 1996). New products can be successful in a variety of ways: they can have a major impact on the firm; they can be seen as great 'technical' successes; they can have a significant impact in the market by achieving a high market share; and even speed-to-market and the ability to reduce cycle time is being used as a proxy for success in some fast-paced companies. While many of these success measures are no doubt interrelated, there are some important differences; for example, it may be possible to have a fast-to-market product which is not too

1. This method or approach was first reported in Cooper and Kleinschmidt (1995), and updated in Cooper and Kleinschmidt (1999). Parts of this section are thus taken from Cooper and Kleinschmidt (1995, 1999).

profitable; or a product with a high return on investment that has a rather modest impact on the firm overall; and so on.

It is important to consider different types of new product success, and indeed move towards a *typology* of performance scenarios. First, new product success can be measured in a multitude of ways. Many previous studies, however, have taken a rather singular approach to the measurement of success. Further, these different measures of success are not the same thing—they are somewhat independent of each other. Thus the success factors reported in the majority of studies are *only valid for that particular measure of success considered*, for example, immediate profitability. Therefore, if other types of 'success' or performance are desired—for example, impact on the firm, or time-to-market—then these may have quite different drivers.

The current investigation addresses this issue by looking at new product success in different ways and by identifying five unique types or groups of projects in terms of their performance. First, we consider a variety of performance measures, including profitability, time efficiency and time-to-market, impact on the company, opening up new opportunities, market share and even technical success. We develop a multi-dimensional Performance Map, where new product projects are *mapped according to their performances* on these different measures. We then *cluster projects* into groups on this map and identify *five different types* of projects, each characterised by its own type of performance, for example, 'Stars' versus 'Dogs' versus 'Steady Winners'. Each project type is investigated in detail to see what differentiates it from the others; in so doing, *different determinants of success* are uncovered, depending on *what type of successful project* one considers.

2. A Conceptual Framework

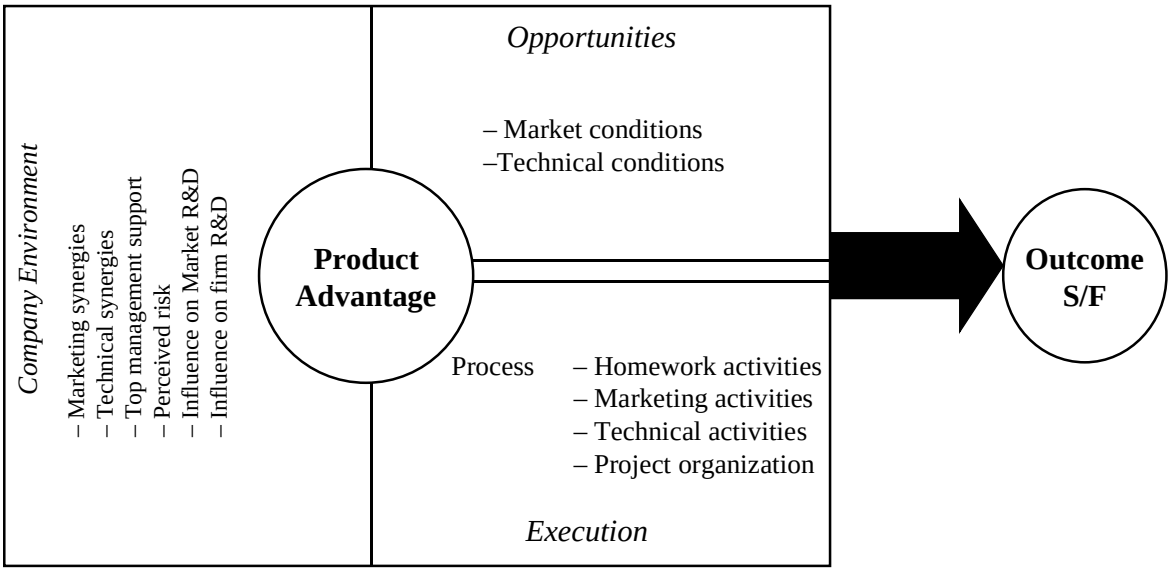
The conceptual model used in the current study is based on one originally developed in the 1970s (Cooper 1979a, p. 124; Cooper 1979b, p. 93), and which has been tested and refined over the years by numerous researchers (de Brentani 1991; Sanchez & Elola 1991; Cooper & Kleinschmidt 1993a,b; Song & Parry 1994). (For a comprehensive literature review of many of the new product success/failure studies that have employed this model and research methodology, see Montoya-Weiss & Calantone 1994). The model, outlined in figure 1, postulates that new product success is in part determined by the nature of the commercial entity (e.g. whether the product has competitive advantage), which in turn is determined by the new product or innovation process (activities that occur during the project). The nature of the project (e.g. perceived risk) influences the process. Finally, this project and process take place within an internal and external environment, namely a company and the marketplace. Characteristics of both environments influence the innovation process and ultimate outcome of the project (e.g. the existence of certain company resources and competencies within that can be leveraged to advantage in the project; and various factors that capture the attractiveness of the marketplace).

Thirteen blocks of variables, identified from this model, are proposed as drivers of new product performance (fig. 1), and are categorized into three broad groups plus product advantage:

1. execution of the development of the project (the bottom block of fig. 1);
2. company environmental variables (the left block of fig. 1); and
3. opportunity variables (the top block of fig.1).

Figure 1

A Conceptual Model or Framework For the Study —Factors that Lead to Success



2.1 Product Advantage

1. Product Advantage

   Rationale: *Product advantage* and its elements—value-for-money, relative product quality, superior end-user benefits, etc.—have been found to be decisive to the financial performance of new products in previous studies (Maidique & Zirger 1984; Cooper & Kleinschmidt 1987; Cooper & Kleinschmidt 1993a; Montoya-Weiss & Calantone 1994). Product advantage is linked to 'execution', 'opportunities' and 'firm environment': product superiority is the result of a well-executed new product process, and at the same time tied to the setting, for example the nature of the market and synergies (Cooper & Kleinschmidt 1993b, p. 90).

2.2 Execution

2., 3., 4. The New Product Process—Quality of Execution of Key Activities

Rationale: The activities which comprise the new product process—whether done or not, and their *quality of execution*—are strongly associated with project outcomes (Cooper & Kleinschmidt 1993a; Rothwell, Freeman, Horsley, Jervis, Robertson & Townsend 1974; Maidique & Zirger 1984; de

Brentani 1991; Montoya-Weiss & Calantone 1994). Three constructs are defined here, namely quality of execution of:

a. *homework, up-front or pre-development activities*—those activities which precede the development phase of the project, such as initial screening, preliminary market and technical assessments, market studies, and business analysis;

b. *marketing tasks*—such as market analysis and studies, customer tests, test marketing, and the launch; and

c. *technical tasks*—such as technical assessment, product development, in-house testing, pilot/trial production, and production start-up.

5. Project Organisation

Rationale: How those who, undertake the project are *organised*—the team, team leadership, accountability, etc.—has an impact on new product success (Maidique & Zirger 1984; Johne & Snelson 1988; Larson & Gobeli 1988; Dwyer 1990).

2.3 Company Environmental Variables

6., 7. Marketing Synergies, Technical Synergy

Rationale: Building on one's *in-house technical and marketing strengths, skills and resources* (rather than seeking new opportunities far from one's skill and resource base) is one of the keys to success (Peters & Waterman 1982; Maidique & Zirger 1984; Abernathy & Clark 1986; de Brentaini 1991; Montoya-Weiss & Canantone 1994; Song & Parry 1994). The notion here is to leverage one's core competencies and to attack from a position of strength.

8. Top Management Support

Rationale: Whether or not top management supports the project certainly has an impact on the project's progress (Montoya-Weiss & Calantone 1994). Some earlier studies (Rothwell 1972; Rothwell et al. 1974, p. 258) and others (Maidique & Zirger 1984) showed that success was higher when there was a high level of top management support for the project (Utterback, Allen, Holloman & Sirbu 1976). However, some more recent studies have only found 'soft' support for the impact on success rates, with some findings indicating that top management support failures almost as frequently, according to one study (Cooper & Kleinschmidt 1993b, p. 90). Because of its conceptual importance and some support, this construct is included in this study.

9. Perceived Risk

Rationale: This is a new construct. The argument can be made that projects that have high perceived risk when the projects begin should have a lower level of success rates (Song & Parry 1994; Kleinschmidt & Cooper 1997, p. 28; Rosenthal & Tatikonda 1993, p. 13). This construct includes measures of perceived risk, magnitude of customer problem and whether the required product features were easy to identify at the beginning of the project.

10. The Firm's Power over the Technology Development

    Rationale: This new construct is based on the premise that projects that rely on technology that is greatly influenced and controlled by the firm should lead to successes. The firm sets the standards and the factors that make a great 'product advantage', and by having control over main customers development, may be able to leverage their new products better (Kleinschmidt & Cooper 1997, p. 28).

11. Customer Influence

    Rationale: By working closely with their main customers (i.e. being greatly controlled in their developments), the new product should fit customer requirements better and thus result in a better, more successful product (new construct).

2.4 Opportunities

12. Market Conditions

    Rationale: Previous research has identified *market size, growth and need level* as success ingredients (Porter 1985; Cooper & Kleinschmidt 1987, p. 215; Song & Parry 1994). For this study, 'market conditions' measures, although related to previous definitions, look at market conditions represented by how stable, predictable and simple the market for the project was (Montoya-Weiss & Calantone 1994, p. 397).

13. Technological Conditions

    Rationale: The argument follows the rationale for market conditions—the level of technology stability, predictability and complexity of the project will influence the successful outcome (Fisher, Blackmon & Woodward 1992; Song & Parry 1994; Kleinschmidt & Cooper 1997, p. 28).

From these 13 blocks of variables, constructs or major themes, 54 variables or measures were identified (see app. A). Note: the 'competitive situation' has not been included because in other major studies this factor has not been found to be significantly correlated to outcome at all (Cooper & Kleinschmidt 1993b, p. 90; Montoya-Weiss & Calantone 1994, p. 397).

3. How the Research was Done

A total of 110 new industrial product projects—68 commercial successes and 42 failures from 55 firms—provided the data for the study. The research method used is based on the NewProd studies, developed by Cooper (1979a) and refined over the years by numerous researchers—see Larson and Gobeli (1988). First, a list of Australian companies was developed, firms known to be active in product development. Next, these firms were contacted to seek their participation in this new-product investigation. In each firm, typical new product projects were selected for in-depth discussion and review: a commercial success and a failure, but which had been on the market long enough for company management to know whether the

product was a commercial success or failure (usually 2 years or more). Success and failure were defined from a financial standpoint: whether or not the product achieved profits above or below the minimal acceptable return for that company. Personal interviews were conducted in each firm with the manager(s) most knowledgeable about this project.

The interviews were based on a detailed, pre-tested questionnaire. The conceptual model or framework in figure 1 provided the main areas of focus (or blocks of variables) for the questionnaire. Within each block, 54 specific characteristics were developed—see appendix A. These characteristics were gauged on 0–10 Likert-type scales with anchor phrases. From these, the 13 major themes or constructs were developed (simple averages across the characteristics within each block or theme). These constructs proved to be very robust: internal consistencies were high (Cronbach alphas), and minimum item total correlations exceeded 0.4 for 11 of the 13 constructs—see appendix A.

Ten performance measures were also captured, again on 0–10 scales except for the success rate. Finally, some additional information regarding project risk, management expectations, and use of outside sources of information was also obtained. Firms which participated were from a wide variety of industries: the breakdown of firms and projects by industry is given in table 1.

Table 1

Industry Profile of Projects in the Australian Sample

Industry	No. of Firms	Percent of Firms
Electronics	20	18.3
Machinery	10	9.0
(Tele) Communications	2	1.8
Electrical	9	8.1
Heavy Machinery	3	2.7
Precision Mechanical Part	9	8.1
Automotive	6	5.4
Mechanical Parts/Products	40	36.9
Food Industry	2	1.8
Chemicals	9	8.1
Total	110	100.0%

4. The Data

Data were collected on 110 actual new product projects: 67 commercial successes and 43 failures in 55 Australian industrial product companies (moderate to higher technology industries). These projects were gauged on each of the 54 characteristics, as defined above and on the 13 constructs or themes.

There were also ten performance gauges measured (Cooper & Kleinschmidt 1987; Griffin & Page 1993, p. 241; Cooper & Kleinschmidt 1995, p. 439), namely:

1. *Success rate:* whether the product was considered (by their companies) to be a financial and commercial success or not—a 'Yes/No' answer. These Yes/No scores, when considered across a group of projects, yield the success rate.
2. *Return rating:* degree to which the new product project met, exceeded or fell short of the minimal acceptable return-on-investment for this type of investment (a 0–10 scale, where 10 = 'far exceeded the minimum criterion' and 0 = 'fell far short').
3. *Meeting sales objectives:* degree to which the product exceeded (or fell short of) the company's sales objectives for it (a 0–10 scale, where 10 = 'far exceeded objectives' and 0 = 'fell far short').
4. *Meeting profit objectives:* the degree to which the new product exceeded the company's profit objectives for it (same scale as point 3).
5. *Time efficiency:* how speedy and time efficiently this project was undertaken (0–10 scale, where 10 = 'fast, very time efficient' and 0 = 'slow, inefficient, time wasted').
6. *On-schedule project:* the degree to which the project stayed on-schedule (0–10 scale, where 10 = 'stayed on schedule' and 0 = 'fell far behind schedule').
7. *On budget project:* the degree to which the project remained within budgeted costs (similar 0–10 scale to point 6).
8. *Access to new markets:* whether or not the project provided access to new markets for the company (a 0–10 scale, where 10 = 'opened up new markets' and 0 = 'did not').
9. *New product windows:* whether or not the project paved the way for new product possibilities for the business (similar 0–10 scale to point 8).
10. *Technical success rating:* the degree to which the new product was considered to be a technical success (0–10 scale, where 10 = 'great technological success').

5. The Performance Map: The Five Performance Types

A Performance Map was constructed from the ten measures of performance. Table 2 reveals how the projects performed on each of the ten performance metrics. Note that all metrics are on 0–10 scales, except success rate (shown as a percentage). Projects score fairly well on average, with mid-range scores on these 0–10 gauges. But there is a large distribution in performance, with a handful of projects doing exceptionally well and others doing quite poorly. The existence of these major differences in performance begs the question: what is it that characterises the winners, and sets them apart from the losers?

In order to identify the exceptional projects, both good and bad, a Performance Map was constructed. Here's how. A review of the performance measures in table 2 reveals that these ten measures are likely interlinked. Therefore, factor analysis was undertaken to reduce these performance measures to their underlying dimensions. Three clear, easy-to-interpret *performance factors* emerged from the analysis (see loadings in table 3):

Table 2
Performance Metrics

Metric	Means	Standard Deviations	Proportion of Firms Scoring	
			Poor (0, 1, 2)	Good (8, 9, 10)
Success Rate	0.62	0.49	42 Failures	68 Successes
Return Rating	5.35	2.87	20.9%	21.8%
Meeting Sales Objective	5.35	2.98	24.5	25.5
Meeting Profit Objectives	5.12	2.93	21.8	23.6
Time Efficiency	5.58	2.92	18.0	28.8
On-Schedule	5.52	3.09	18.9	36.0
On-Budget	4.47	2.04	13.5	9.9
Access to New Markets	5.57	3.41	26.1	38.7
New Product Windows	5.64	3.42	24.3	38.7
Technical Success Rating	4.49	3.36	36.0	27.0

Note: all metrics are 0 to 10 Likert-type scales except for the 'Success Rate' (percent; success = 1, failure = 0).

Table 3
Factor Loading on Performance Metrics

Performance Metrics	Factor Loading		
	Factor 1: Financial Performance	Factor 2: Efficiency	Factor 3: Window-of-Opportunity
Success/Failure (yes/no: yields success rate %)	0.859	0.212	0.239
Return Rating (0–10)	0.910	0.207	0.159
Sales Objective Rating (0–10)	0.895	0.193	0.230
Profitability Rating (0–10)	0.896	0.236	0.157
Time-Efficiency Rating (0–10)	0.255	0.885	0.090
On-Schedule Rating (0–10)	0.113	0.959	0.041
On-Budget Rating (0–10)	0.341	0.557	0.116
Access to New Markets Rating (0–10)	0.177	0.085	0.877
New Product Possibility Rating (0–10)	0.132	0.009	0.877
Technological Success Rating (0–10)	0.172	0.087	0.656

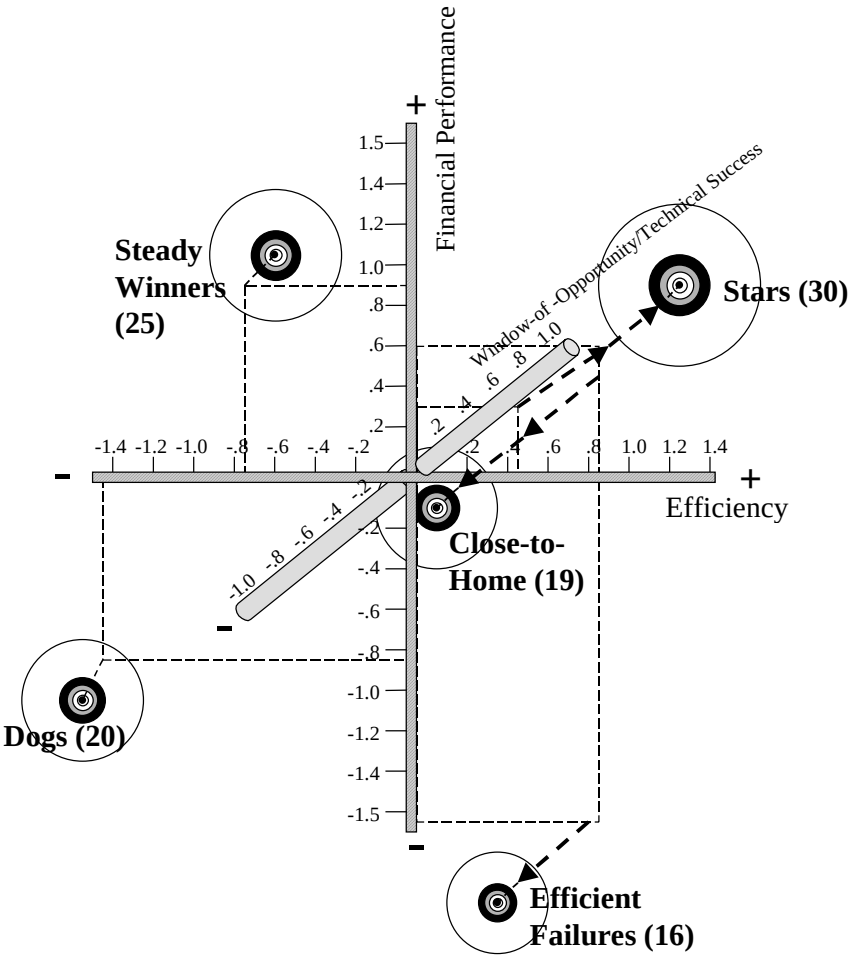
Note: Factor analysis done via Varimax rotation WIN SPSS routine. This three-factor solution is selected based on Scree test and Eigenvalues > 1.0. The factors explained 78.1% of variations in the data. Eignevalues of the three-factor solution before rotation are 4.67, 1.97 and 1.17.

1. *Financial performance.* The first factor captures how well the 110 projects did from a financial standpoint: whether they were financial successes, their returnon investment, whether they met their sales objective, and their profit rating (vertical or *Y*–axis).
2. *Efficiency.* This next factor portrays the efficiency and time performance of projects—whether they were done on time and in a time-efficient manner (horizontal or *X*–axis). Not surprising, being on budget also loaded here.
3. *Window of opportunity*. This final factor indicates whether the project opened up new windows of opportunity for the business—for example, access to new markets, or paved the way for other new products (*Z*–axis). The technical success rating also loaded here.

These three performance factors become the *X*, *Y* and *Z*–axes of the Performance Map (fig. 2), on which we locate the 110 projects (there are too many projects to show all of them on this map).

Figure 2

Performance Map—The Five Performance Clusters Relative to the Three Performance Dimensions



Note: The size of the circles show the relative number of projects in the cluster.

Projects were then grouped or clustered into categories, based on their similarities in terms of these three performance factors (see app. B for more details on the cluster analysis). The clustering level—that is, the number of clusters or groups—was chosen to yield a balance between parsimony and explanation. A five-cluster solution was selected: it yielded the highest explanation (best ANOVA results versus the original performance factors) and a balanced distribution of cases across clusters. Figure 2 shows the locations of the five clusters on the Performance Map, while table 4 shows the values of the each of the five clusters in terms of the ten performance measures.

Table 4

How the Five Clusters Perform

Metric	Mean					
	Stars (30)	Steady Winners (25)	Close-to-Home (19)	Efficient Failures (16)	Dogs (20)	All Projects (110)
Success Rate	96.70*	92.00*	73.70*	6.25(–)	5.00(–)	61.80%
Return Rating	6.86*	7.08**	6.89*	1.75(–)	2.30(–)	5.35
Sales Objectives Rating	7.06*	7.16*	6.89*	1.56(–)	2.05(–)	5.35
Profitability Rating	6.80*	6.72*	6.57*	2.00(–)	1.70(–)	5.12
Time Efficiency Rating	7.40**	4.08*	7.89***	6.62**	1.30(–)	5.58
On-Schedule Rating	7.30**	3.68*	8.21**	7.31**	1.40(–)	5.52
On-Budget Rating	4.93*	4.52*	5.73**	4.25*	2.60(–)	4.47
Access to New Markets	8.50**	6.48**	2.52(–)	2.62(–)	5.15*	5.57
New Product Possibilities	8.53***	6.36**	2.89(–)	3.50(–)	4.60(–)	5.64
Technological Success	7.40**	4.52*	2.31(–)	3.25	2.90	4.49

Note: Based on Duncan Multiple Range Tests ($p < 0.05$). All ten performance metrics related to cluster membership (ANOVAs: $p < 0.0000$).

* significantly higher values;

(–) significantly lower values;

** means significantly higher than a * cluster; and

*** means significantly higher than a ** cluster, etc.

The five performance types or clusters on the Performance Map are (see table 4 and fig. 2):

1. *Stars*—These projects are the clear winners. They have a stunning 96.7% success rate, the best of any group. Their return on investment is tied for the best, they meet their sales objective (also tied for best), and they are rated as very profitable (best of all groups). These projects are also efficient ones—time efficient, on schedule and on-budget, tied for best—and are undertaken in a short 13.7 months on average. And these projects open up new windows of opportunity—new markets and new products—and are rated the best in terms of technical successes. All in all, a very enviable performance. Coincidentally Stars represent the largest cluster of projects: 27% of the sample.

2. *Steady Winners*—These projects we characterise as 'steady-slow but sure', and yield the second best results. They achieve very positive financial results—a high success rate (92%); the best return on investment; and are tied with Stars for best in meeting sales objectives and profitability rating. Additionally, steady winners, to some degree, open up new windows of opportunity for the business—new markets and new products, second only to Stars (yet significantly less). But the technological success rating is only mediocre, which might explain why they fare relatively poorly in terms of time efficiency, on-time performance, and on-budget performance, and take 18.8 months on average to undertake. These slow but sure projects account for 23% of the sample.
3. *Close-to-Home Projects*—This smaller group of projects (17% of sample) are characterised as 'conservative, stay close-to-home' projects. They are the least venturesome in terms of opening up new windows for the firms—no access to new markets, nor opening other new product possibilities. Further, they are not rated great technical successes, the lowest of all groups. But they are very time efficient, are done very quickly (only 8.7 months), and boast on-time performance (tied for best). And they are the best in terms of staying on-budget. Financially, these projects achieve modest-to-good performance—a middle-of-the-road 74% success rate, but very good scores for return on investment, meeting sales objectives, and profitability rating (tied for best).
4. *Efficient Failures*—This group of projects feature an abysmal success rate (94% failed!), but they got there efficiently. They are tied for best on all three efficiency metrics—time efficiency, on-time performance, and staying on budget—yet still take 14.5 months to do. But financial performance is dismal: tied for lowest for return on investment, meeting sales objectives, and profitability rating. They also fail to open up new windows of opportunity: no access to new markets or new products, almost tied with Close-to-Home projects here. Fortunately this is a relatively small group of projects (only 15% of sample).
5. *Dogs*—These projects fare the worst on most performance metrics. They fail 95% of the time. Their other financial measures—profitability rating, meeting sales objectives, and return on investment—are tied for worst. They are by far the worst in terms of efficiency—time efficiency, and on-time and on-budget performance—even below the slow-moving Steady Winners above, taking 23.4 months to do. These projects are anything but a technological success, but do manage to open up some new windows of opportunity (new market, new products), but only in a very modest way. Dogs represent 18% of the sample.

6. What Distinguishes the Stars from the Rest

What are the distinguishing characteristics of each of the five performance types of projects? And what separates the Stars from the others? Table 5 shows some of the characteristics that help explain why Stars are stars and Dogs are the big losers.

Table 5
Characteristics of Projects for the Five Clusters

Constructs	Means					Means All Projects (110)	Duncan (0<0.05)	ANOVA Significance
	1. Stars (30)	2. Steady Winners (25)	3. Close-to-Home (19)	4. Efficient Failures (16)	5. Dogs (20)			
Project Advantage	8.14**	6.79*	5.92	5.39(–)	4.60(– –)	6.40	1 > 2, 3, 4, 5 2 > 4, 5;3>5	0.0000
Home Work Activities	8.10*	7.45*	5.44(–)	4.55(–)	4.40(–)	6.67	1, 2 > 3, 4, 5	0.0000
Project Team Organization	8.31**	7.17*	6.59	6.65	5.41(–)	6.99	1 > 2, 4, 3, 5 2 > 5	0.0000
Perceived Risk at Start	5.75*	3.97(–)	2.98(– –)	4.60	6.10(**)	4.76	5 > 4, 2, 3 1 > 2, 3; 4 > 3	0.0000
Technical Activities	7.91*	8.30**	7.48*	6.74(–)	4.52(– –)	7.44	2 > 4, 5 1, 3, 4 > 5	0.0001
Influence on Firm R&D	7.31*	7.90**	6.61	6.52	5.33(–)	7.20	2 > 3, 4, 5 1, 3, 4 > 5	0.0001
Marketing Activities	8.53**	7.11*	5.73	3.73(– –)	4.73(–)	6.53	1 > 3, 5, 3 2 > 5, 4	0.0004
Influence on Market R&D	6.76*	5.78	5.76	5.10(–)	5.33(–)	6.86	1 > 4, 5 2, 3 > 5	0.0004
Marketing Synergy	6.88*	8.06*	7.72*	7.13*	5.52(–)	7.08	2, 3, 4, 1> 5	0.0008
Mgmt Support	7.86*	7.26	6.43(–)	6.95	6.11(–)	7.02	1 > 3, 5	0.02
Market Conditions	5.58*	3.84(–)	4.10(–)	4.35	4.82	4.65	1 > 3, 2	0.02
Technical Conditions	5.36*	4.21(–)	3.75(–)	4.37	4.80	4.61	1 > 2, 3	0.04
Technical Synergy	7.18	7.34	8.31(*)	6.89	6.25(–)	7.20	3 > 5	ns

Note: * means significantly higher value;
(–) significantly lower; and
ns means not significant.
Based on Duncan Multiple Range tests ($p < 0.05$). For more details see Duncan column. These constructs and the variable that comprise them are outlined in appendix A.

Note that 54 different characteristics were measured which comprise 13 major themes or constructs (see 'How the Research was Done' and app. A, for a complete list of project characteristics). Of the 13 constructs hypothesised to impact on performance (fig. 1), nine are strongly and significantly linked to cluster membership (i.e. significant differences between cluster means; based on oneway ANOVAs; $\alpha < 0.001$). Another three are significantly linked ($\alpha < 0.05$), but the link is not as strong. One construct is not significantly related to the five clusters. The drivers of new product performance—those factors that separate the big winners from the losers most strongly, where 'winners' are defined on a variety of measures (the three performance metrics with their underlying variables)—are (in order of impact[2]):

1. Gaining competitive advantage via product superiority: a superior product, offering unique benefits to users; higher quality, with excellent price/performance characteristics and easy-to-explain benefits (see app. A for a complete list of the items that comprise each construct).
2. Undertaking solid up-front homework before development gets underway: initial screening; preliminary market and technical assessments; market studies, concept development and concept testing; and business analysis.
3. The quality of the project team: a dedicated, committed team leader; a cross-functional, multi-disciplinary team accountable for the project from idea to launch and dedicated team members (a high proportion of their time is spent on the project).
4. Perceived risk at the start of the project: a medium level of risk combined with some difficulties determining customer problems and identifying the product's features at the beginning are Star qualities. However, too much perceived risk is detrimental (see 'Dog' group).
5. Proficient execution of technical activities: technical assessment; product development; internal product testing; trial production and production start-up.
6. Customer influence: where the developing firm is closely aligned with customers—they have considerable influence over the developing company's technology, product and even promotion and distribution.
7. Proficient execution of marketing activities: preliminary market assessment; concept development and concept testing; customer field trials and market launch.
8. Company influence over customers: where the company that develops the product has impact over general R&D activities in the market; attracts technological competent allies and considerably influences its main customers in terms of their technology and their products.
9. Marketing synergy or leveraging the company's resources in the area of marketing research and marketing intelligence, selling, distribution and promotion and technical support. Note that technical synergy is not of significance for this sample of products (R&D, manufacturing, and fit with the plant).

2 Based on significance levels; see table 5.

The winners also had better top management support (more direct support for the project, more unity amongst senior management and more direct investment specific for the project), aimed their projects at somewhat more challenging markets (more dynamic markets, less predictable and more complex), and used more challenging technology (less stable and predictable and less simple). As mentioned above, technical synergy did not significantly differ across the performance groups on a general level.

Consider now the five performance types or cluster of projects, and some of their characteristics that differentiate them (see table 5; differences between cluster types on all 54 characteristics are too numerous to show here but are listed in app. A).

6.1 Stars

Stars are simply great products: unique superior products, with excellent price/performance characteristics, offering unique benefits to customers and benefits that are easy to explain. Such superior products are also higher quality ones than competitors' products. Product superiority stands out as the number one distinguishing feature of Star projects. But note, that product superiority is defined in the eyes of the customer.

So how do these project teams arrive at such stellar new products? For one thing, Stars stand out in terms of the up-front homework undertaken and the quality of marketing actions built in. In particular, the fuzzy front end or homework phase of the project—those activities that precede Development—is superbly executed: initial screening; preliminary market assessment; preliminary technical assessment; detailed market studies; and building the business case. Some of these up-front actions are marketing ones, but overall the marketing activities are proficiently undertaken, from beginning to end of project: the preliminary and detailed market studies; customer tests or field trials of the product; and the market launch itself. Technical activities are also well-executed: the technical development of the product; preliminary technical assessment; internal tests; and trial production. Superlative up-front homework, a dedication to marketing actions and voice of the customer, sharp early product definition and solid technical work combine to explain why star products boast such strong competitive and product advantage.

Organisationally, Stars are also model projects. They are strongly supported by senior management: management is committed to the project; management views it as important and they make the necessary investment. Further, the project team is organised in an ideal way: there is a strong, committed project leader; the team is cross-functional; team members are dedicated to this project (a high percentage of their time is allocated to it); and they are accountable for the project from beginning to end.

Some other characteristics of Star projects:

- they are aimed at markets considered to be the most challenging; they use the most challenging technology; and they are thought to be somewhat riskier projects;
- they feature the second shortest time to market (second only to close-to-home projects); and

- the project is in a market or industry sector where the company can influence its customers; however, customers also influence the firm considerably in these markets—a mutual influence pattern, more so than for other project types.

6.2 Steady Winners

Steady Winners are also successful—the second best of the five groups and are particular strong on financial performance. What distinguishes their performance is how inefficient they are: 18.9 months to market; behind schedule; time inefficient; and over budget.

Steady Winners share many of the same positive attributes as Stars, but most often place second on each attribute:

- very strong technical activities—the strongest of all groups;
- product advantage: superior products; unique customer benefits; good price/performance characteristics; but not very innovative products;
- solid up-front homework; and
- proficient cross-functional teams with moderate management support.

Where these projects differ from Stars is their fit with the business. Overall, they feature the greatest synergy with the base business of all project groups—that is, they are able to leverage the business' core competencies, notably in marketing research, selling, distribution and promotion, and technical support.

A second difference concerns customer power/influence over the development activities of the firm. Steady Winners are projects where the customer has great influence (the highest of all groups) over the company's R&D, which products or technology to use for the project, and in particular (the significantly highest level) how to promote and distribute the new product. On the other hand the firm with such a project has a very low level of impact on the customer's R&D in this area. Part of the situation here might be that these are markets/sectors where the customer exerts a strong influence over the company, much more so than for other project types—the company is in a reactive mode, simply responding to customer requests.

Additionally, these Steady Winners are seen as low risk ones, they utilise unchallenging technologies and they are targeted at unchallenging markets.

In spite of the above these projects are almost as good as Stars in many respects. However, activities such as up-front homework, project team organisation and marketing activities could have been executed more proficiently. This may help explain the significantly lower efficiency results. The non-challenging market and technology for the project, in turn, may be related to the significantly lower level of opportunities for opening new market/product windows (compared to Stars).

The message is that if firms can find low risk projects that have high market synergies (fit the base business in terms of marketing resources), then they can expect significant financial rewards. However, the non-challenging market and technology combined with little investment in the project including the absence of a dedicated team (compared to Stars) seems to add many months to the project's time frame.

6.3 Close-to-Home Projects

These projects have a 73.7% success rate (one in four projects is a failure) and are very quick hits and efficiently undertaken. What distinguishes these projects is that they are essentially extensions, modifications or refinements to existing company products:

- they are the lowest risk of all project types;
- they boast the shorted time to market (8.7 months); and
- they feature high marketing synergy with the base business—marketing research, selling, distribution, advertising and technical support services.

But these are smaller, less challenging projects:

- markets and technologies are thought to be simple and predictable (not much of a challenge);
- they are not innovative products at all (the least innovative of all five groups) and are very familiar products to the company (the most familiar of all groups); and
- investments requires and made by senior management are minimal (the least of all groups).

Perhaps because they are smaller, low risk and familiar projects, relatively little up-front homework is undertaken. Market-oriented activities (preliminary market assessment, concept development and testing, market launch) are relatively weak. Finally, product advantage is also lacking.

These 'minor projects' are popular, and results are generally positive. But with more attention to up-front homework and market-oriented activities, perhaps results could be even better. More on these Close-to-Home projects later in the article.

6.4 Efficient Failures

Efficient failures are a small group of projects overall, but represent more than one-third of the failures in the study. They have a very high failure rate (94%) but are quite time efficient. So what makes them failures? Simple: they lack most of the key ingredients that make Stars so successful:

- Efficient Failures have the distinction of having the most poorly executed marketing activities:
  - the weakest of all groups in terms of customer work: concept development; concept testing; and field trials with the customer. Launch is also the most deficient of the five groups;
- they also feature very weak up-front homework; and
- they boast minimal product advantage—no unique customer benefits; no better than competitors' products; not particularly high quality products.

Other characteristics of these Efficient Failures are just about average.

The message is clear: pay lip-service to the marketing activities; ignore the voice of the customer; and do a lack-lustre job on the up-front homework and the result is predicable—another product failure.

6.5 Dogs

The big losers in the study are the Dogs: they have the highest failure rate (95%) and account for 45% of all failures in the study. And even worse than Efficient Failures above, these Dogs take forever to get to market (23 months) and are rated as both very unprofitable and inefficient (behind schedule, over budget).

What distinguishes the Dog projects, and what lessons can be learned here? Dogs have just about everything going against them.

- The team organisation is extremely weak—there is no dedicated team leader; the team is not cross-functional; the team is not accountable from beginning to end of project; and the team lacks dedicated members and this is combined with the weakest top management support. In addition, these projects are perceived at having the highest risk at the start of the development;
- Project synergy with the base business is missing, the lowest of all project types. For example, the project does not leverage the business's R&D nor is there a good fit with the company's selling, distribution, promotion and technical support resources and abilities;
- Quality of execution is sub-standard across the board:
  - technical activities are very deficient—the worst of all groups. For example, preliminary technical assessment, the actual development of the product, internal product tests, pilot or trial production and production start-up are all rated the weakest of all project types;
  - market-oriented activities are also weak (just slightly better than the Efficient Failures); and
  - up-front homework is very poor (tied for worst with Efficient Failures).

- The lack of synergy (inability to attack from a position of strength) coupled with the poor team structure may account for the sub-standard quality of execution; and
- Finally, the resulting products have the least product or competitive advantage of all project types: these products are no better than competitors'; their quality is mediocre; they offer no unique benefits; their price/performance characteristics are weak; and they are not innovative. Once again, weaknesses here might be explained by the lack of synergy, poor team structure and sub-standard quality of execution.

Dogs are easy to explain, but sometimes not so easy to avoid. Recognise the pitfalls: the problems begins with a lack of synergy with the base business (attacking from weakness) coupled with poor team structure. Add to this sub-standard quality of execution across the board and a product with no or few advantages and one has all the ingredients for a dismal failure.

7. Comparing the Results to Other Studies

The results from this Australian study parallel closely those derived from a previously-undertaken major international study (Cooper & Kleinschmidt 1995).

For example, like the current study, the international study also identified five performance groups or clusters of projects, but on a two dimensional performance map. And the clusters of projects were indeed very similar to the Australian clusters. This striking parallelism lends support to the universality of the underlying model and success factors we identified.

Just how close are the two studies? Both the conceptual model used in the Australian study, and the variables measured, are based on those in the international study, thereby permitting direct comparison. However, the Australian study included a few more performance measures, and also some additional measures of project characteristics. The major differences, however, are the samples: the international study focuses on projects in the chemical industry—typically large multinational corporations with annual sales in the billions of dollars—in both Europe and North America; whereas the Australian study looks at quite a different industry (across many industries, see table 1 for details), and the companies are much smaller (average annual sales: US$38 million).

The results of the two studies are remarkably similar in spite of the obvious differences in the sample make-up. When the factor analysis was repeated on the Australian data, but this time using only the performance measures found in the international study, two independent performance factors were identified. Both the factor interpretations and the factor loadings are almost identical to the international study (see table 6).

Table 6

Factor Loadings-Comparison of International Study with Australian Results

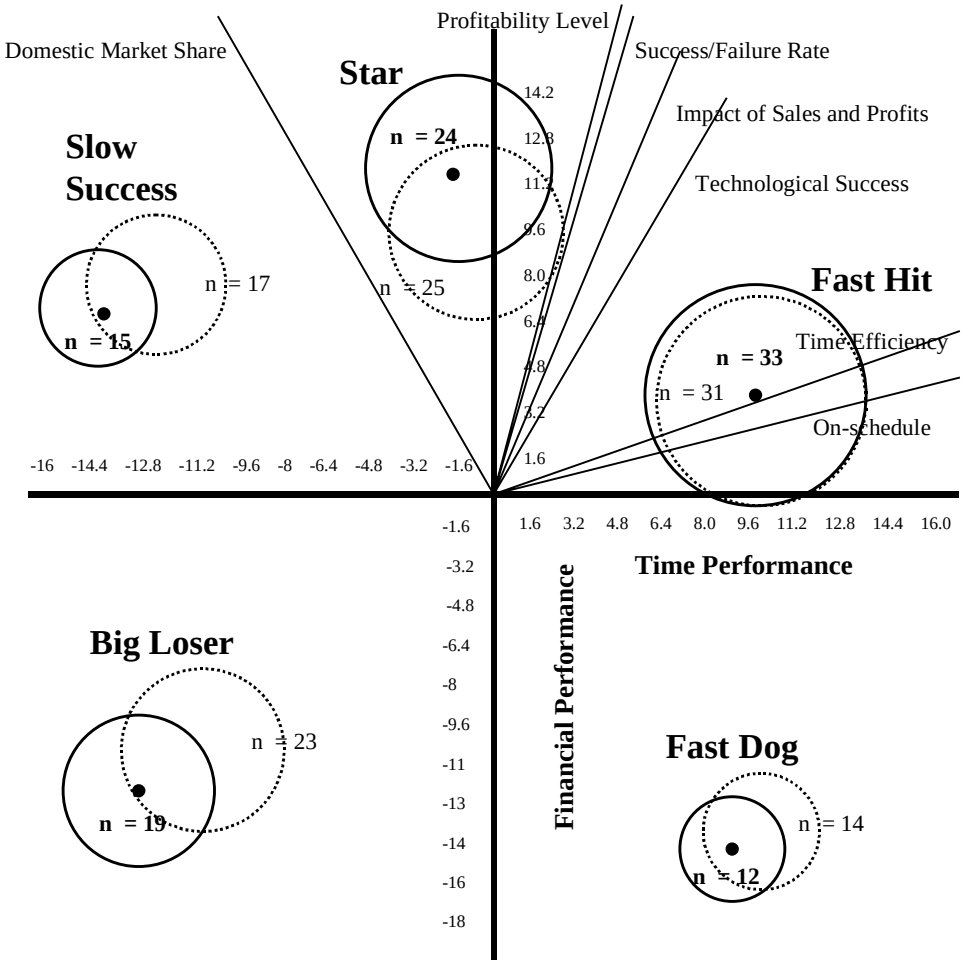
	Factor Loading			
	Factor 1 Financial Performance		Factor 2 Time Performance	
	Chem. *	Aust. **	Chem. *	Aust. **
Success/Failure	0.833	0.885	0.232	0.226
Profitability	0.844	0.901	0.351	0.244
Technological Success Rating	0.719	0.455	0.010	–0.028
Current Domestic Market Share	0.628	–	–0.010	–
Sales Objectives Ratings	0.769	0.917	0.237	0.232
Profitability Rating	0.769	0.885	0.237	0.282
Time Efficiency Rating	0.178	0.244	0.859	0.934
On-Schedule Rating	0.051	0.111	0.892	0.954

Note: * donates results for the 1991 study of projects from international chemical companies; and
** project results from the 1995 Australian data collection.

When the Australian projects were re-clustered on this two-dimensional performance map, the clusters identified were found to be very comparable to those in the international study. Figure 3 shows the cluster locations for the two different studies. Note that not only are the locations similar, but even the proportion of

Figure 3

Performance Map—The Five Performance Types for the Two Samples and Their Location Relative to the Two Performance Dimensions (vectors show the 7 performance measures)



Note: Solid circles represent clusters from the international study, dashed circles are Australian clusters.

projects within each cluster is similar between the studies. (App. C reconciles some of the shifts that occurred when moving from two-factor map to a three-factor performance map in the Australian clustering solution).

The conclusion is this: the underlying model, concepts and interpretation of this research are very stable and generalisable. The success factors in product innovation are universal ones: what makes for success in large chemical corporations in Europe and North America also applies for smaller firms across manufacturing sectors in Australia.

8. The Special Case of Close-to-Home Projects

Close-to-Home projects merit special attention. They are the only cluster that *has a significant proportion of failures and successes*. One quarter of all projects are failures for this cluster, though as a cluster does quite well on time efficiency and financial performance. A previous study showed that close-to-home projects—projects that are not innovative for the company—do very well financially (Kleinschmidt & Cooper 1991, p. 240). On average, the Australian results concur.

Now consider the *failures versus the successes* within this Close-to-Home cluster. Please remember; firms in this study had pre-identified projects as a success or failure. This formed the first of the 10 performance measure 'success rate.' The three performance metrics or dimension used for forming the five performance types or clusters do not identify individual projects as success or failure. In this cluster, *successes* do well financially and *failures* perform significantly lower. Further, failures stand out as being extremely poor at opening any window of opportunity (e.g. 'access to new markets' is a very low 0.80 for failures v. a still low of 3.14 for successes; the values are 1.20 v. 3.50 for 'new product possibilities' and 1.20 v. 2.71 for 'Technological success'; most detailed values are not shown here but are available from the authors).

Some notable differences between the failure and successful projects within this Close-to-Home cluster are:

- failure projects lack an effective cross-functional team effort: the team is not dedicated at all (a part-time effort—scale value of 1.0 v. 6.21 for successes on a 10 point scale); the team does not carry the project from beginning to end; and the multi-disciplinary aspect is mediocre (value of 5.8);
- failure products have many fewer benefits for customers than do successes (for example 'having a superior product' scored 3.60 for failures v. 6.25 for successes and the values for 'clear benefits' and 'superior price/performance' are 5.80 v. 4.20 v. 7.21 respectively); and
- top management supports differed also significantly: failures scored 6.60 versus 9.07 for successes on 'management support' and 1.80 versus 4.21 on 'made investments specific for this project'.

The conclusion is that Close-to-Home projects, on average do very well financially. This concurs with similar findings in other studies (e.g. see Kleinschmidt & Cooper 1991) that indicate that such projects have excellent financial pay-back, and are also done efficiently. But such projects do not create a window for new opportunities—new products or new markets. And a significant number of these projects lack a true cross-functional team effort, most often, they result in failure. One reason for this is that management may be deluded into believing that, being close-to-home initiatives, a cross-functional team is not really needed for these projects . . . perhaps the project isn't deemed important or adventuresome enough to mandate a team effort. A dedicated team is never assembled, and the project flounders. So the message is this: Just because a project is in familiar territory, don't think that success can be achieved without a cross-functional team and not aiming for a solid product advantage.

9. Conclusions

There are nine major messages for managers of new product initiatives:

1. *Product advantage is the number one success factor* (based on ANOVA significance values (and highest *F* values—not shown here), see table 5, construct 'Product advantage' and appendix A, #1 details, again ANOVAs and *F* values (available on request) for the individual variables making up the construct as well as the means of each cluster and resulting Duncan splits). This is the strongest discriminator between the winners and losers in the study. Yet product advantage is lacking in about half the cases studied; and these projects performed much more poorly on average. The quest must be for real product advantage: this means building in superior price/performance characteristics; superior benefits for customers; and higher relative product quality, however the customer defines quality (items in app. A). While technological prowess sometimes is the *door* to arriving at this superior value product, often the *key to this door* lies with the customer: understanding what a *benefit* is; what *superior performance* is; what *quality* really means; and what *customer value* (price /performance) depends on.
2. *Up-front homework is fundamental to success* (based on ANOVA and Duncan results, see table 5 (second highest *F* value, not shown) and app. A, #2). Devoting the time, money and effort to the up-front homework or pre-development tasks and executing these in a quality fashion, is fundamental. The *Stars* provide the example. Good homework means proficiently executing those tasks which precede the Development phase, that help shape, define and justify the project, namely: the initial screening; the preliminary technical and market assessments; and the detailed market studies (concept development and testing, see app. A). Homework pays off in terms of higher success rates and profits (see *Stars* and *Steady Winners*).
3. *Organise around a true cross-functional team* (table 5, construct 'Project Team organisation' and app. A, #5, ANOVA, Duncan and *F* values (not shown)), much like the teams uncovered in the *Stars*. This means a *cross-functional team* from different functions or departments in the company; who devote a *considerable proportion of their time* (dedicated) to the project; who are *accountable for all facets* of the project from beginning to end (continuous); and who are a team with an identifiable, *strong project leader* who champions and drives the project.
4. *Focus on markets, sectors or situations where you exert influence over your customer* (table 5, construct 'Influence on market R&D'). This means that the developing company can influence its main customers technology and their products, as in the case of *Star* projects. And try to avoid situations where you exert little influence, while your main customers control you in terms of technology, products and even promotion. This was the situation faced by *Efficient Failures* (see app. A, #10 and #11, means, ANOVAs and Duncan splits). By contrast, projects where the main customers have considerable influence and impact on the firm's R&D activities (table 5, construct 'Influence on firm R&D' and app. A, #11), influence products and technologies used by the firm, and may even impact on the firm's promotion and distribution set conditions for better performance if this is combined with

being able to exert influence over your customers (at least to some degree; see *Steady Winners*, table 5, Duncan results). Close co-operation, where customers and the developer firm work closely together and influence each other, certainly makes for more successful projects (*Stars*, table 5, means and Duncan results and app. A, #10 and #11).

5. *Don't avoid projects where you perceive of risks at the beginning but be careful* (see table 5, construct 'Perceived risk at start' and app. A, #9). Projects with a perceived level of risk at the beginning, some difficulty determining customer problems and identifying required features are part of the profiles of projects of *Stars* and *Dogs.* So don't exclude such projects automatically if you aim for *Stars*. How you treat these difficulties will make the difference.
6. *Quality of execution is key. Marketing excellence* must be an integral facet of every new product project. By marketing excellence we don't just mean a strong, well-targeted launch (see construct 'Marketing activities', table 5). We mean quality of execution of marketing tasks from idea generation right through to launch (app. A, #3 lists the activities linked to success which were a measure of how well the activities were done). This begins with the preliminary market assessment and the detailed market studies (define the product concept, and do a concept tests to gauge customer reaction). Customer tests of the product (field trials) and a quality market launch are also key. Indeed quality of execution of these marketing tasks is one of the three common denominators of our two winners, *Stars* and *Steady Winners* (see table 5 and app. A, #3, ANOVAs, mean values and Duncan splits). Similarly, quality of execution of technical activities is vital. This means doing a first class job on the preliminary technical assessment, the development of the product itself, internal tests, trial production and production start-up, as was the case with our success scenarios, *Stars*, *Steady Winners* and *Close-to-Home* and a significantly weaker aspect of *Dogs* (app. A, #4 shows the details).
7. *Synergy—the ability to leverage or exploit one's core competencies, skills and resources—improves the odds of success* (see construct 'Marketing synergy' in table 5 and details in app. A, #7). The goal is to attack from a position of strength, in particular from marketing synergies—building from your company's marketing research and information base, selling, distribution, promotion and technical support. But synergy is not as critical as some of the other factors above (see 'Technical Synergy' and ANOVAs and Duncan splits in app. A, #6). Indeed, *Star* products boasted only moderate synergy, but the other two winners *Steady Winners* and *Close-to-Home* projects feature high synergy. One message is that leveraging existing resources is a plus (in particular for *Steady Winners);* but perhaps this should not be the overriding concern when selecting which projects to undertake, that is, when trying to choose Stars.
8. *These success factors, and indeed the underlying model and measures used, are universal.* The results of this study parallel remarkably well those of an international study done in the chemical industry that employed almost identical research methodology (see section 'Comparing the Results to other

Studies' and table 6). Moreover, the conclusions of the study mirror those of countless other studies that compared new product successes and failures (see Maidique & Zirger 1984; Cooper 1996).

9. *Close-to-Home projects generally yield positive financial and efficiency performances* (see table 4, means and Duncan splits). However, because these projects are so familiar, don't overlook important success factors. These projects require support from top management and a solid team that stays with the project and has a sharp eye on creating a solid product advantage (see section 'The Special case . . .').

Product leadership—creating and developing superior new products—is a critical goal for Australian businesses if they are to survive and prosper in the years ahead. The research reported in this article shed some light on the success factors that underlie Australian product innovation, and identify the key messages for management. The next step for management, is to review their product innovation process and practices and then move towards implementing a systematic approach—for example, a stage-and-gate new product process (Cooper 1998) combined with effective project selection and portfolio management (Cooper, Edgett & Kleinschimdt 1998)—in order to build these success factors into their modus operandi.

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Appendix A

54 Individual Construct Variables and Cluster Means

	1. Stars (30)	2. Steady Winners (25)	3. Close-to-Home (19)	4. Efficient Failures (16)	5. Dogs (20)	Duncan	ANOVA	Cronbach Alpha	Minimum Item-Total correlation
1. Product Advantage								0.853	0.549
Superior Product	8.73**	7.44*	5.631	4.931	4.501	1 > 2 > 3, 4, 5	0.0000		
Better Quality	8.03*	6.60	6.52	5.37	4.401	1 > 2, 4, 5; 2, 3 > 5	0.0000		
Unique Product	8.30*	7.60*	5.86L	5.501	5.501	1, 2 > 3, 4, 5	0.0001		
Benefits Easy to Explain	8.16*	7.33*	7.47*	6.62*	4.901	1, 3, 2, 4 > 5	0.0002		
Better Price/ Performance	7.86*	6.44*	6.42*	4.431	4.151	1, 2, 3 > 4, 5	0.0000		
Innovative	7.76*	5.40	3.84	5.50	4.60	1 > 4, 5, 2, 3	0.0001		
New to Company	7.83*	6.16	4.78[a]	7.56[*]	6.90	1, 4 > 3	0.03	not part of construct	
2. Homework								0.853	0.560
Idea Screening	7.19*	6.80	5.82	5.38	3.87[a]	1 > 4, 5; 2, 3 > 5	0.0002		
Preliminary Marketing Assessment	7.19**	6.42*	4.93[a]	5.00[1]	2.93[b]	1 > 4, 3, 5; 2, 4, 3 > 5	0.0000		
Preliminary Techn. Assessment	7.75*	7.47*	7.46*	6.14[a]	5.13[b]	1 > 4, 5; 2, 3 > 5	0.0004		
Concept Development	7.62**	6.88*	5.62	3.20[b]	5.00[a]	1 > 3, 5, 4; 2 > 5, 4; 3, 5 > 4	0.0000		
Concept Testing	7.42*	6.77*	2.83[1]	3.00[1]	4.20*	1, 2 > 5, 4, 3	0.0002		
3. Marketing Activities								0.879	0.6285
Preliminary Marketing Assessment	7.19**	6.42*	4.93[a]	5.00[a]	2.93[b]	1 > 4, 5; 2, 3 > 5	0.0000		
Concept Development	7.62**	6.88*	5.62	3.20[b]	5.00[a]	1 > 3, 5, 4; 2 > 5, 4; 3, 5 > 4	0.0000		
Concept Test	7.42*	6.77*	2.83[a]	3.00[a]	4.10[a]	1, 2 > 5, 4, 3	0.002		
General Customer Tests	7.85*	6.38*	7.10*	4.12[b]	5.00[a]	1 > 5.4; 35, 2 > 4	0.001		
Market Launch	7.21*	7.29*	5.83	4.72[a]	5.81	2, 1 > 4	0.01		
4. Technical Activities								0.841	0.560
Preliminary Techn. Assessment	7.75*	7.47*	7.46*	6.14[a]	5.13[b]	1 > 4, 5; 2, 3 > 5	0.004		

	1. Stars (30)	2. Steady Winners (25)	3. Close-to-Home (19)	4. Efficient Failures (16)	5. Dogs (20)	Duncan	ANOVA	Cronbach Alpha	Minimum Item-Total correlation
Development	8.67*	8.04*	8.25*	7.75*	6.17[a]	1, 3, 2, 4 > 5	0.0004		
Internal Tests	8.20*	8.32*	7.70*	7.14	5.93[a]	2, 1, 3, > 5	0.003		
Pilot Production	7.76*	7.80*	6.66*	7.10*	4.63[a]	2, 1, 4, 3 > 5	0.002		
Production Start-Up	7.30*	8.10*	7.78*	6.80*	3.92[a]	2, 3, 1, 4 > 5	0.0000		
5. Project Organization								0.724	0.445
Strong Leader	9.05*	8.06*	7.78[*]	7.31[a]	6.10[b]	1 > 4, 5 2, 1 > 5	0.0005		
Multi-Disciplinary Team	7.86*	7.28*	6.26	6.50	5.25[a]	1, 2 > 5	0.04		
Continuous Team	9.03*	7.68*	7.47	7.50	5.85[a]	1.2 > 5	0.002		
Dedicated Team	7.33*	5.64[a]	4.84[a]	5.31[a]	4.45[a]	1 > 2, 4, 3, 5	0.01		
6. Technical Synergy								0.802	0.550
Had R&D Skills	7.53*	7.92*	8.15*	6.87[a]	5.65[a]	3, 2, 1 > 4, 5	0.01		
Had Manuf. Skills	7.60	7.60	8.36	7.25	6.65	ns	ns		
Used Existing Production	6.70	6.52	8.42	6.56	6.45	ns	ns		
7. Marketing Synergy								0.842	0.467
Had MR & MI Skills	7.23*	6.96*	7.57*	5.87	4.45[a]	3,1,2>5	0.0003		
Had Selling Skills	6.40[1]	8.45*	8.00*	7.43	5.55[b]	2 > 1, 5, 3 > 5	0.006		
Had Distribution Skills	6.20[1]	8.44*	8.26*	7.62	5.90[a]	2,3>1,5	0.005		
Had Advert. Skills	6.69	7.76	7.26	7.50	6.30	ns	ns		
Had Techn. Support Skills	7.72*	8.12*	7.52*	7.75*	5.40[a]	2,1,3,4>5	0.002		
8. Top Management Support								0.691	0.453
Supported Project	9.24*	8.80	8.42	7.93[a]	7.60[a]	1>3,5	0.03		
Respect Amongst Management for Project	8.72**	7.96*	7.31*	7.93*	5.75[b]	1>3,5; 2,4,3>5	0.0002		
Made Investment in Project	5.62*	5.04	3.57[a]	5.00	5.00	1>3	ns		
9. Risk Taking Level								0.646	0.393
Little Risk at Start	5.66*	5.00*	3.05[a]	6.06*	6.70*	5,4,1,2>3	0.0009		
Minor Customer Problem	5.30*	2.84[a]	3.31[a]	4.00	5.55*	5,1>3,2	0.005		

	1. Stars (30)	2. Steady Winners (25)	3. Close-to-Home (19)	4. Efficient Failures (16)	5. Dogs (20)	Duncan	ANOVA	Cronbach Alpha	Minimum Item-Total correlation
Obvious Features	6.30*	4.08[a]	2.57[a]	3.75[a]	6.05*	1,5>2,4,3	0.0000		
10. Firm Influences Greatly								0.765	0.531
General Techn. Development	7.40**	7.40*	6.21*	5.25[a]	4.15[b]	1,2>4,5; 3>5	0.0003		
Attracts Competent Allies	6.90*	6.32	6.31	6.18	4.90[a]	1>5	ns		
Main Customers R&D	5.66*	3.40[a]	4.66	4.00	2.35[a]	1>2.5	0.01		
Main Customers Products	7.10*	6.00*	5.55	5.00	4.05*	1>4,5; 2>5	0.006		
11. Firm Greatly Influenced By								0.628	0.383
Main Customers for R&D	8.23*	8.20*	7.15*	7.37*	5.50[a]	1,2,4,3>5	0.0007		
Main Customers for Products & Techn. Used	7.46*	7.96*	7.10	6.18	5.75[a]	2>4,5;1>5	0.02		
Main Customers re: Promotion & Distribution of New Project	6.23	7.56*	5.57[a]	6.00	4.75[a]	2>3,5	0.008		
12. Market Condition								0.633	0.273
Stable Markets	6.00*	4.04[a]	4.78[a]	3.75[a]	4.55	1>2,3,4	0.02		
Predictable Market	5.70*	3.44[a]	4.47	4.18	5.10	1>2	ns		
Simple Market	5.56*	4.04[a]	4.05[a]	5.12	4.63	1>3,2	ns		
13. Technology Conditions								0.828	0.6473
Stable Technology	6.46*	4.12[a]	3.42[a]	4.37[a]	5.15	1,>4,2,3	0.001		
Predictable Technology	4.96*	3.52[a]	3.00[b]	4.31	4.75*	1>4,2,3; 5>3	0.03		
Simple Technology	6.06*	4.80[a]	3.94[a]	4.75	4.55[a]	1>2,5,3	0.03		
Dev. Time in Months	13.7[a]	18.9*	8.7[a]	14.5	23.4*	5>1,3; 2>3	0.007	ns	ns

Note:
** significantly (0.05 level) higher than other variable;
* significantly higher than low value variable;
[a] significantly lower than high value variables;
[b] significantly lower than low value variable; and
ns means not significant.

Factor analysis was used to test/define all constructs. All constructs are uni-dimensional factors. Two variables, 'development time in months' and 'degree of newness of the product to the company' are single variables. For more details see Duncan values.

Appendix B

Constructing the Performance Map and Identifying the Groups of Projects—The Details

Factor analysis was used to reduce the 10 performance metrics to major underlying factors or dimensions. The method used was SPSSX factor analysis, principal components analysis with Varimax rotation. Three factors were selected on the basis of eignevalues>1.0 and the Scree test. These three factors form the *X*–, *Y*– and *Z*–axes of the Performance Map (fig. 2).

Next, the 110 projects were grouped into logical clusters on this Performance Map. The clustering routine used was Quick Cluster, an SPSSX routine. This is an agglomerative hierarchical clustering method based on nearest centroid sorting: that is, a case is assigned to a cluster for which the distance between the case and the centre of the cluster (the centroid) is the smallest.

The cluster analysis solution proved to be a very robust one. One-way ANOVAs of the performance metrics across the five groups were significant at the 0.001 level. Additionally, five group discriminant analysis was used to validate the cluster analysis solution, which correctly classified 92% of the cases. Finally, the Jackknife method yielded an 89% correctly classified validation result.

Appendix C

Comparing the International Study to the Australian Results

To compare the two studies, we redid the analysis of the Australian data, but used only those performance measures used in the international study (exactly the same variables). The result was a two-dimensional performance map, instead of three.

How did projects shift when we used two performance factors instead of three to undertake the cluster analysis? Moving from two-dimensions to three-dimensions:

- Of the 23 projects in the Big Loser cluster on the two-dimensional map, the great majority (73.9%) remain as Dogs when a third dimension is included;
- Of the 17 projects in the Slow Success cluster (see the two-dimensional map), more than three-quarters (76.5%) are found in the new cluster occupying the same position, namely Steady Winners, on the three-dimensional map;
- Almost all the Fast Dogs (85.6%) on the two-dimensional map remain in the new cluster, Efficient Failures, on the three-dimensional map;
- Of 25 Star projects on the two-dimensional map, half are found in the new Star cluster and half in the Steady Winners—a rather logical split, given the introduction of the third dimension; and
- The 31 Fast Hit projects also split—roughly half went to the new Star cluster, the other half to the Close-to-Home cluster.