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Measuring new product success: an empirical investigation of Australian SMEs

Xueli Huang[a,*], Geoffrey N. Soutar[b,1], Alan Brown[a,2]

[a]Faculty of Business and Public Management, School of Management, Edith Cowan University, Pearson Street, Churchlands, WA 6018, Australia
[b]Graduate School of Management, University of Western Australia, Nedlands, WA 6907, Australia

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Abstract

New product development (NPD) has long been recognised as one of the corporate core functions. However, measuring new product success has remained elusive. This paper attempts to examine several conceptual issues underlining the measurement of new product success and the measurement practice adopted in Australian small and medium enterprises (SMEs). The sample included 276 SMEs from two most innovative industries: chemical and machinery industries. Results have indicated that four factors underline the commonly used success measurement: financial performance, objective market acceptance, subjective market acceptance, and product-level measures. These four factors are related to each other and can be used to well predict the overall measurement. The most frequently used specific measures in Australian SMEs are customer acceptance, customer satisfaction, product performance, and quality.
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1. Introduction

Innovation has long been recognised as crucial to organisational success and as an important field of research inquiry. Over the past three decades, there has been a significant research effort that has investigated many aspects of innovation, reflecting its importance. One of the most important themes in innovation research has been an attempt to identify the factors that are associated with new product success (e.g., Cooper, 1979b; Cooper & Kleinschmidt, 1987, 1993a; Maidique & Zirger, 1984). However, such identification requires an understanding of new product success, as different definitions of "success" can produce different results (Craig & Hart, 1992).

Measuring new product outcomes from innovation is also crucial to our understanding of the organisational behaviours related to, and the resource allocation provided to, new product development (NPD). Organisational theory has long suggested there is a relationship between performance and outcomes and between performance and effort. Performance–outcome expectancy theory suggests people are motivated to perform well if they believe their performance can create a positive outcome, while effort–performance expectancy theory argues that, if people can reasonably expect their efforts to lead to a desirable level of performance, they will be more motivated to perform (Vecchio, Hearn, & Southey, 1992). It might be expected, therefore, that managers would undertake NPD activities that would help their organisation achieve desired outcomes and that they would be willing to allocate resources to such activities if this was the case. If we know the outcomes managers expect from NPD, their NPD behaviours and resource allocation should be explainable and predictable. This expectation has been the underlying foundation for many NPD studies.

Although the importance of measuring new product success is widely recognised, its treatment remains elusive, partly due to the multidimensional nature of such success, the different levels of analysis that can been examined (Griffin & Page, 1993), and the multiple stakeholders who look for different things in the NPD process (Lipovestsky, Tishler, Dvir, & Shenhar, 1997). This has resulted in the use of a large number of measures in the assessment of new product performance (Griffin & Page, 1993). While several

* Corresponding author. Tel.: +61-8-9273-8641; fax: +61-8-9273-8754.
E-mail addresses: x.huang@ecu.edu.au (X. Huang), gsoutar@ecel.uwa.edu.au (G.N. Soutar), a.brown@ecu.edu.au (A. Brown).
[1] Tel.: +61-8-9380-7885; fax: +61-8-980-1072.
[2] Tel.: +61-8-9273-8371; fax: +61-8-9273-8754.

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classification schemes (Cooper & Kleinschmidt, 1987; Griffin & Page, 1993; Hart, 1993; Hauschildt, 1991) have been suggested, there has been little effort to clarify the concept of new product success or to synthesise and empirically test such classification schemes. Moreover, as most new product measures have been developed from the study of larger firms, the question as to whether these measures can be applied to small and medium enterprises (SMEs) remain unanswered. The present paper attempts to fill these gaps as its objectives are to:

(1) Investigate the success measures used in Australian SMEs.
(2) Examine empirically the structure of the success measures suggested by Griffin and Page (1993) in an SME environment, by looking at the number of dimensions and their interrelationships.
(3) Determine how each dimension contributes to perceptions of overall success.

2. A literature review

Research into new product success is still in a preliminary state, despite the research effort that has been devoted to NPD over the last three decades. A fundamental problem when measuring new product success is the meaning of such success, as it has not been well defined. The interpretation of success is affected by the interest groups involved in NPD, such as R&D, marketing, and production. Thus, success can be a value-laden concept. These problems have been aggravated by the fact that little theoretical work has separated success indicators and determinants. For example, is customer acceptance an indicator or a determinant of new product success? Moreover, the existence of different levels of indicators (e.g., project, program, and company) and multiple types of indicators or determinants has complicated the use of success measures. The time perspective of new product success also increases the difficulty of selecting relevant and meaningful measures (Cooper, 1979a; Maidique & Zirger, 1984).

NPD research has often measured new product success opportunistically. That is, some researchers have operationalised success based on the availability of data. This has resulted in a number of suggested success measures (Cooper & Kleinschmidt, 1993b). In addition, most suggested measures are noncumulative and atheoretical, making comparisons difficult or impossible. This may be because a new product's impact on an organisation can be multilevel and multidimensional (Cooper & Kleinschmidt, 1987), complex and dynamic (Hart, 1993), subtle and, sometimes, only perceivable in the long term (Maidique & Zirger, 1984).

One approach to tackling the problem of conceptualising success is to derive its structure in terms of levels and dimensions. Several studies have used a "what's there" approach to derive new product success dimensions, either conceptually or empirically. For example, Cooper and Kleinschmidt (1987) empirically identified three new product performance aspects, which they termed "financial performance," "market impact" and "opportunity window" dimensions. These three dimensions are project-level factors that describe the financial success of a new product, the extent to which a new product presented new opportunities, and the impact of a product in its marketplaces.

Hart (1993) argued that both financial and nonfinancial success measures can be used, as can direct and indirect measures. She identified three project-level success dimensions, which she termed "beating the competition technologically," "beating the competition to market," and "providing a technological breakthrough." After reviewing new product success research, Hauschildt (1991) suggested that success could be measured from both technical and economic perspectives and that multiple criteria were needed if a correct assessment was to be made.

While a large number of success measures have been used, two consistent perspectives have emerged. Many researchers have argued that new product success should be measured using multiple criteria and that success can be gauged at different levels. The most widely used success measures have been developed at a project level, although it has been recognised that such measures can also be examined at an organisational level. However, a crucial question remains as to the measures that should be used to capture the various criteria.

A special task force that was set up by the Product Development Management Association (PDMA) attempted to address this question. The task force collected 46 measures from 77 publications and also gathered 34 measures that "were used" and 45 measures that "people would like to use" from a survey of 50 practitioners attending two PDMA conferences (Griffin & Page, 1993). While the task force identified 75 different measures, 16 common measures were found and these were considered to be core success measures. The 16 measures were grouped into four dimensions (three at a project level and one at an organisation level), using a structure developed by group consensus and a factor analysis of a small number of experts. The four suggested

Table 1
Dimensions of new product success measurement at the project level

Author	Dimensions
Cooper and Kleinschmidt (1987)	(1) Financial performance (2) Market impact (3) Opportunity window
Hauschidt (1991)	(1) Economic (2) Technical
Hart (1993)	(1) Beating competition technologically (2) Beating the competition to market (3) Technological breakthrough
Griffin and Page (1993)	(1) Customer acceptance (2) Financial performance (3) Product-level measures

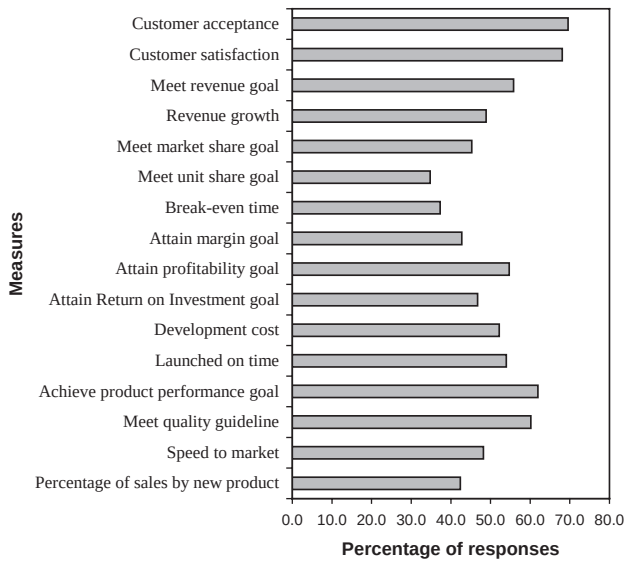

Fig. 1. Frequency of new product success measures used in SMEs.

dimensions were "customer acceptance measures," "financial performance measures," "product or technical measures," and "organisation-level measures." Table 1 shows the success dimensions identified by previous research, including the detailed organisational and program-level dimensions suggested by Griffin and Page (1993, 1996).

As noted, the 16 core measures identified by Griffin and Page (1996) are listed in Fig. 1. The first 15 questions measure new product success at a project level, while the last item ("percentage of sales by the new product") is an organisational-level measure. Griffin and Page argued that the usefulness of project-based success criteria depended on an organisation's new product strategy and that the most frequently used project-level criteria were "customer satisfaction," "met profit goals," and "customer acceptance."

Although the 16 core measures of new product success were initially suggested in 1993, little research has been undertaken to investigate the structure of the suggested dimensions and their use or their contribution to overall new product success. Many important questions remain unanswered. For example, can the results of a study of large firms be applied to SMEs? Which dimensions are most helpful in predicting perceptions of overall success? The present paper attempts to answer these questions by reporting the results of a study that examined these issues using a sample of Australian manufacturing SMEs. The next section outlines the research approach undertaken to find answers to the questions raised.

3. The present study

These new product success issues were examined through the analysis of data obtained from a mail survey that was sent to a sample of SMEs in Australia's chemical and machinery industries. The subsequent subsections outline the questionnaire that was developed to obtain the needed data, the sample selection processes used, and the data collection process undertaken.

3.1. The questionnaire

The 16 core PDMA measures suggested by Griffin and Page (1993), which were shown in Fig. 1, were included as part of a large scale of survey of NPD in Australian manufacturing SMEs. Respondents were asked to select their most recent new product and to indicate whether they had measured the success of that project. If so, they were asked about the success measures used to make such an assessment and how well they thought the new product had performed on the 16 core measures, using a five-point scale that ranged from "well below average" to "well above average." Because the last item is an organisation-level measure, we asked the respondents to compare it with the average percentage of sales by other new products developed. This is also a subjective measure. Respondents were also asked about their perception of the product's overall success [ranging from 1 (*very unsuccessful*) to 5 (*very successful*)]. To gain further insight into how the SMEs evaluated new product success and to identify other potentially important determinants of success, an open-ended question was included that asked why respondents rated the success of their new product in the way they did. A number of questions also requested information about respondents and their organisations.

3.2. The sample

The sample was drawn from Australia's chemical and machinery industries (ANZSIC 25 and 28). These two manufacturing industries were selected as they are the most active in product innovation (Australian Bureau of Statistics, 1998) and account for most manufacturing R&D expenditure (61% in 1994–1995) (Industry Commission & Department of Industry Science and Technology, 1997). It has been estimated that there are approximately 15,000 organisations in these two Australian industries (Australian Bureau of Statistics, 1998; Industry Commission & Department of Industry Science and Technology, 1997). The present sample was selected from a database developed by Dunn and Bradstreet, which had been found to be useful in previous research (Atkins & Lowe, 1997; Atuahene-Gima, 1996; Wagar, 1998). The population of interest included organisations that employed fewer than 200 people and operated in the chemical or machinery industries. A search of the Dunn and Bradstreet database found 10,320 such organisations, suggesting the database contained about 70 % of all firms in the two industries. Due to budget limitations, a total of 3440 organisations were chosen for the present sample by randomly selecting every third such organisation in the database.

3.3. Data collection

The questionnaire was initially pretested on a small pilot sample of 10 SMEs, resulting in some minor changes to the questionnaire. The revised questionnaire was mailed to the selected organisations, resulting in 440 useful returned questionnaires. Among the returns, 276 firms indicated that they had developed a new product in the 5 years prior to the survey and these firms were defined as innovative, based on the Australian Bureau of Statistics' (1998) definition. The effective response rate from the *innovative* organisations was 27%, based on the percentage of innovative organisations in these two industries (Australian Bureau of Statistics, 1998). The response rate is comparable to those obtained in other surveys of SMEs (e.g., Sullivan & Kang, 1999). The results discussed in the present paper were based on the responses from the 276 innovative respondents.

A majority of respondents (62%) were from the machinery industry, which is in line with the relative number of organisations in each industry (Industry Commission & Department of Industry Science and Technology, 1997). Most respondents (80%) were CEOs, although 20% were functional managers, including some who were responsible for marketing, R&D, production, and engineering.

4. Findings and discussion

4.1. Measuring new product performance

As mentioned in the previous section, respondents were asked whether they measured new product success. A significant percentage (81%) did; a percentage that was slightly higher than the 76% reported by Griffin and Page (1993). The frequencies with which the 16 PDMA criteria were used are shown in Fig. 1. The most frequently used criteria were *customer acceptance* (70%), *customer satisfaction* (68%), *achieving product performance goal* (62%), and *meeting quality guideline* (60%). The first two are "customer acceptance measures," while the last two are "product-level measures," according to Griffin and Page's classification scheme. It is interesting that the most commonly used measures are nonfinancial, project-level criteria.

The least frequently used items were *meet unit share goal* (35%), *break-even time* (37%), *percentage of sales by new product* (42%), and *attain margin goal* (43%), which reflect a combination of the profit margin and sales volume of the new product developed. Thus, all of these four measures are related to sales volume. A potential explanation is that SMEs tend to target niche markets. Consequently, large sale volumes are often unattainable and, therefore, success criteria based on sales volumes are less relevant to SMEs.

The frequencies with which the other measures were used ranged from 56% (*meet revenue goal*) to 45% (*meet market share goal*). The more frequently used financial performance item was *attaining profitability goals* (55%), supporting Griffin and Page's (1996) results.

4.2. The dimensions of new product success

Griffin and Page (1993) identified a five-factor structure of new product success, but classified the 16 core measures into four factors, primarily through a qualitative feel of their data. However, no further test of this factor structure has been undertaken. Consequently, a factor analysis was undertaken on the 15 project-level items. The 16th item, which measured the percentage of an organisation's sales obtained by all new products, was not included as it is an organisational-level outcome. The principal components analysis found four factors with eigenvalues greater than one that explained 73% of the variance in the data, with all communalities above .60, except development costs. The varimax

Table 2
The results of factor analysis of new product measurement

Measures	Factor 1: Financial performance	Factor 2: Objective customer acceptance	Factor 3: Technical measures	Factor 4: Subjective customer acceptance	Communality
Customer acceptance	.16	.21	.10	**.85**	.81
Customer satisfaction	.13	.26	.12	**.85**	.83
Meet revenue goal	.46	**.58**	.10	.22	.61
Revenue growth	.34	**.71**	.04	.26	.69
Meet market share goal	.30	**.79**	.16	.16	.76
Meet unit share goal	.28	**.83**	.13	.11	.80
Break-even time (*R*)	**.90**	.14	.10	.11	.84
Attain margin goal	**.89**	.25	.11	.15	.88
Attain profitability goal	**.83**	.38	.18	.12	.88
Attain return on investment goal	**.80**	.38	.12	.12	.81
Development cost (*R*)	−.18	.34	**.51**	−.03	.41
Launched on time	.14	.09	**.85**	−.05	.74
Achieve product performance goal	.16	.04	**.63**	.43	.62
Meet quality guideline	.16	−.06	**.66**	.46	.67
Speed to market	.17	.12	**.76**	.08	.63

rotated factor loadings, shown in Table 2, suggested that these four factors provided a very good explanation of the original 15 items.

The factor loadings were similar to those found by Griffin and Page (1993). Factor 1 was related to financial performance as the four financial items had high and similar loadings on this factor (above .80). The five "technical measures" loaded onto Factor 3, with loadings varying from .51 to .84, suggesting that all made a contribution to technical success. The other six items loaded onto two factors, rather than the one suggested by Griffin and Page and this needs some explanation. Factor 4 was related to two items that asked about *customer acceptance* and *customer satisfaction*. These items are subjective and perceptual measures that are not financially oriented.

Using Griffin and Page's (1993) terms, the remaining four items, which loaded onto Factor 2, were financially based measures of market or customer acceptance. They were less frequently used than were the subjective acceptance measures. A possible explanation is that, as these four items are revenue or market share oriented, sophisticated research may be needed to obtain such data. As planning and market research are little used in Australian SMEs (Huang, Soutar, & Brown, 2002), it is not surprising that such criteria are used less often. As the two factors (Factors 2 and 4) seemed to tap separate aspects of customer acceptance, they were included separately in the subsequent analysis.

4.3. The success dimensions and their contributions to new product success

Summated scales were calculated for the four factors and their mean scores, standard deviations, and alpha reliabilities (Cronbach & Meehl, 1959) are shown in Table 3, together with the same statistics for the organisation-level success measure that was also included in the survey. The alpha reliabilities varied from .76 to .95, suggesting the four measures were reliable and can be used with confidence in the present study (Nunnally, 1978).

Table 3 also shows the overall product performance in the sample. Corresponding to the frequencies of the success measures used by the respondents, *nonfinancially based customer acceptance* has scored highest among all the factors, suggesting that SMEs not only use the measures in this factor frequently, but they have also done well in the area.

Table 3
Average score for each factor and alpha reliability

Factor	Mean	S.D.	α
Nonfinancially based customer acceptance	4.20	.72	.86
Financially based customer acceptance	3.55	.85	.87
Financial performance	3.53	.84	.94
Technical measures	3.73	.77	.76
Firm-level measure	3.39	.93	N/A
Overall success	3.58	1.18	N/A

Table 4
Correlation coefficients between factor scores and overall success

Factor	1	2	3	4	Firm level	Overall success
Financial performance	1.00					
Objective market acceptance	.66	1.00				
Product-level measures	.37	.37	1.00			
Subjective customer acceptance	.32	.45	.36	1.00		
Percentage of sales by new product	.52	.56	.49	.28		
Overall success	.56	.55	.52	.41	.52	1.00

Similarly, *technical measures* that are frequently used by SMEs have a relatively high score compared with *financially based customer acceptance* and *financial performance*.

The correlations between the four project-level success dimensions, the organisation-level item, and the overall success score are shown in Table 4, which suggest several important aspects of new product success in SMEs. Firstly, it seems that the dimensions are correlated, which was expected because of the nature of the measurement. However, the explanatory power ranged from 8% ($.28^2$) to 44% ($.66^2$), suggesting the measures tap different aspects of success and underlining the importance of using multiple measures to get an overall picture of new product performance. Table 4 also suggests that the organisation-level success measure is correlated with the four project-level success dimensions. Thus, project-level measures, if selected properly, can be used as organisational-level proxies.

A regression analysis was used to examine the relationship between the four project-level measures and perceived overall success. The results, shown in Table 5, suggest that the four dimensions all influence the overall success of a new product, as their regression coefficients were statistically significant well beyond the .05 level. While all of the dimensions impacted positively on managers' perceptions of overall success, customer acceptance had the greatest impact. Some prior research found that customer acceptance and satisfaction were the most important criteria in assessing new product performance (Griffin & Page, 1996; Lipovetsky et al., 1997) and the present study suggests that this is also true for SMEs. The adjusted R^2 was .46, suggesting the success measures used explained almost half of the variance

Table 5
Regression of the overall success against four measurement factors

Factor	Percentage of sale[a] (Standardised β)	Overall success[b] (Standardised β)
Financial performance	.18*	.193*
Objective market acceptance	.35***	.191**
Product-level measures	.31***	.180**
Subjective customer acceptance	− .04	.347***

[a] R=.66, R^2=.43, adjusted R^2=.41.
[b] R=.69, R^2=.47, adjusted R^2=.46.
* $P<.05$.
** $P<.01$.
*** $P<.001$.

Table 6
Comments for rating overall new product performance

Measurement	*N*	Example
Nonfinancially based customer acceptance	58	"Customer acceptance has been very full," "the customers love our pro ducts," "strong response from potential customers"; The product "is accepted well in the market place," "accepted quickly"; "the customers are happy with the product"
Financially based customer acceptance	55	"Production at 75% total capacity in 12 months," "it provided increased sales," "increase market share," "achieved budgeted sales," "helped hold reasonable market share without reducing price," "obtained 50% of market share"
Financial performance	11	"Met all financial return criteria," the product is "profitable"
Technical measures	48	"Very positive response from customer regarding performance," "high quality of product," it "reduces costs," it "meets performance required," "technically product is very good," "low cost and better quality at the same time," "new product design"
Offering competitive benefits	18	"No competitors," "no other product on this market," "outperform competing products by a factor of 4," "it is a better product than that of our competitors"
Market development	10	"Fulfilled a hole in the market," "Created new market niche"
Others	4	"Substituting imported products," "won award"

in Australian SMEs managers' perceptions of new product success, supporting the earlier contention that they are "core success measures" (Griffin & Page, 1993).

The open-ended question asked why the respondents rated the success of the new product in the way they did. A great majority of the managers included such comments (87%), which were content-analysed and some typical comments are shown in Table 6.

Table 6 suggests that respondents used financially based and nonfinancially based customer acceptance and technical measures when determining new product success. However, organisations also used other measures, including "competitive benefits" and "market development," which could be usefully added to the set suggested by Griffin and Page (1993). Based on the frequencies with which such measures are used, these dimensions could be as important as dimensions that measure financial performance.

5. Conclusions and implications

The present paper examined the structure of new product success and how Australian SMEs measure such success. Several conclusions can be drawn based on the findings presented in the previous section. First, new product success is multidimensional, with four dimensions being used by the sample of Australian SMEs. These dimensions were *subjective customer acceptance*, *objective customer acceptance*, *financial performance*, and *technical performance*.

Second, while these dimensions were correlated, their intercorrelations suggested that the factors measure different aspects of success. These two conclusions suggest several managerial implications. First, firms should use multiple criteria when measuring new product performance. The measures that represent various aspects of success seem to be *customer satisfaction*, *profitability*, *revenue*, and *product performance*. A successful product may need to perform well on all dimensions of criteria. Understanding this is crucial to new product management for, as is well known, "what is measured is managed." Second, these dimensions are correlated. The magnitudes of the correlation coefficients suggest that the most distinguished components are *financial* (financial performance and objective market acceptance) and *nonfinancial* (subjective customer acceptance and product-level measures). Management needs to be aware of the relationships between the factors and to select success measures at the outset of the new product project.

Making the structure of success explicit enhances our understanding of the determinants of new product performance. Each success factor may have a different set of determinants and moderating variables. Researchers may concentrate on specific hypotheses that link determinants and success measures. The closer the link, the better our understanding of how such a successful performance can be achieved is likely to be.

A third conclusion is that *customer acceptance*, *customer satisfaction*, *achieving product performance goal*, and *meet a quality goal* are the most frequently used success criteria used by Australian SMEs. All of these measures are nonfinancial. This suggests Australian SMEs consider the quality and performance of a new product and its market acceptance to be primary measures of new product success, while financial measures seem to be of secondary concern. One important implication is that there may be a hierarchical structure to success, with nonfinancial measures seen as fundamental, while financial measures are at a higher level. Anecdotal evidence suggests that many of the new products developed by SMEs perform well technologically, but not so well financially. The success measures used by SMEs may explain this phenomenon. The challenge for SMEs is to set financial and nonfinancial goals for their new products, to measure these goals and to allocate appropriate resources to achieve them.

Finally, the managers surveyed believed that *customer acceptance and customer satisfaction* contributed most to the overall success of a new product, although the other three factors also contributed to success. This suggests that understanding customers is very important to the new product success of SMEs. Traditionally, staying close to customers

has been a competitive advantage for SMEs and the present research suggests this is still felt to be true. To be successful, however, SMEs need to go beyond this. Good market research may be needed when developing new products, as such research can provide needed information about customers' needs, thereby improving new product performance. Further, SMEs need to understand how and to what degree customer acceptance leads to profitability.

6. Limitations and areas for future research

In considering the conclusions of the present study, it is important to be mindful of some limitations. First, the organisations surveyed were in Australia's two most innovative manufacturing industries. Future research should include organisations from less innovative industries. Second, the present study concentrated on SMEs. The inclusion of larger organisations would enable a comparison of new product success measurement across these two types of organisations. Third, the individual project selected might not represent the set of new products launched by the organisation or the measures used to determine their success. Future research that examined a set of new product launches in a smaller number of organisations would help to determine if such measures change between launches and, if so, what causes such changes.

Fourth, the present study used a key informant approach to obtain the data, which may impact on the reliability and validity of the data. However, most respondents (about 80%) were CEOs or owners, who met the guidelines for studies of this kind suggested by Mitchell (1994). Fifth, this research used a cross-sectional approach in studying measures used for NPD. It is still not clear how these measures can be affected by industry cycle and macro-economic environment; for example, if financial measures are used more widely in economic downturn than rapid growth period. A longitudinal study taking into these factors can enhance our understanding in these areas. Finally, the data were obtained from Australian organisations. It is worth noting that most new product success studies have been undertaken in the United States. Although the present study suggests that the "core" success measures suggested by the PDMA (Griffin & Page, 1993, 1996) are used in a non-American environment, future research across a number of other innovative countries would help to determine if the success dimensions and their relationships with new product success are general, or culturally or economically specific.

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