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The relationship between construction firm strategies and innovation outcomes

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Abstract: Survey results provide a preliminary assessment of the relative contribution of a range of tactical business strategies to innovation performance by firms in the Australian construction industry. Over 1,300 firms were surveyed in 2004, resulting in a response rate of 29%. Respondents were classified as high, medium or low innovators according to an innovation index based on the novelty and impact of their innovations and their adoption of listed technological and organizational advances. The relative significance of 23 business strategies concerning (1) employees, (2) marketing, (3) technology, (4) knowledge and (5) relationships was examined by determining the extent to which they distinguished high innovators from low innovators. The individual business strategies that most strongly distinguished high innovators were (1) 'investing in R&D', (2) 'participating in partnering and alliances on projects', (3) 'ensuring project learnings are transferred into continuous business processes', (4) 'monitoring international best practice', and (5) 'recruiting new graduates'. Of the five types of strategies assessed, marketing strategies were the least significant in supporting innovation. The results provide practical guidance to managers in project-based industries wishing to improve their innovation performance.

CE Database subject headings:
Construction Management; Innovation; Australia

Introduction

Innovation is an important contributor to economic growth. Although this relationship was contested in the past, innovation is now widely considered to improve the competitive advantage of nations, industries and firms (OECD 2000). Since the early work of influential economists Joseph Schumpeter (1943) and Robert Solow (1956), innovation researchers have generated a vast literature covering a broad range of objectives, perspectives and levels of analysis. Academic and business interest in Australia and elsewhere is burgeoning as it is increasingly accepted that innovation is key to improving performance in both mature and emerging industries. This acceptance is exemplified by the opinion of leading consultants PricewaterhouseCoopers (PWC) that 'the time has come for innovation to enter the main stream of management thinking, to achieve its rightful place alongside financial management and strategic planning as a determinant of firm success' (PWC 2003, i).

However, innovation performance by construction firms is very patchy. Although many firms recognize the value of innovation, many are uncertain about how to improve their performance. One of the best ways to assist these firms is to provide empirically valid information about the strategies used by the most innovative firms. The study reported here was undertaken to provide guidance in this way to construction firms seeking to improve their innovation performance. The construction industry is responsible for shaping the built environment that underpins all social and economic activity, but has received little attention in innovation research compared to other sectors such as the manufacturing industry.

The study reported here was designed to answer the following two questions: Are business strategies identified in the literature as supportive of innovation performance used significantly more often by highly

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innovative construction firms than by less innovative firms? Which of these business strategies are most important to innovation outcomes for firms?

Conceptual Background

Consistent with the authoritative and widely used OECD (2005) definition, innovation is defined here as a new or significantly improved product (good or service), process (production or delivery method), marketing method (packaging, promotion, or pricing) or managerial method (internal practice). There have been three significant published studies of the impact of different business strategies on construction innovation in firms or on projects. The theoretical bases of these were reviewed to inform the structure for the current research. The first previous study, undertaken in Canada in 1999 (Anderson and Schaan 2001; Seaden et al. 2001; Seaden et al. 2003), drew on a large Statistics Canada survey of 2,500 general and trade contractors. Technological and organizational innovation was measured by the extent to which firms adopted a prescribed list of advances. This method, which focuses on 'new to firm' innovation, was developed to address problems in measuring innovation activity in other surveys. Successive revisions of the Oslo Manual (Seaden et al. 2001; Pattinson 2002), which informs the OECD's Community Innovation Survey (OECD 2005), have not resolved shortcomings arising from inconsistent interpretation of the term 'innovation' by respondents and the overly simplistic classification of firms as either 'innovative' or 'not innovative'. The Canadian study avoided these problems by using a firm's adoption of listed advances as the innovation indicator. This is a more fine-grained measure of innovativeness using more clearly defined terms. A similar indicator is used in the current study as part of an innovation index.

The input variables to innovation activity in the Canadian study were business environment and business strategy, and the output variable was business outcomes. The study focused on three types of business strategies: marketing, employees and technology. The current study differs by focusing on a broader range of business strategies and using innovation activity as the output variable.

The second previous study, undertaken in Queensland, Australia, in 2002 (Manley and McFallan 2006), assessed the innovation behavior of firms in the road sector, with an emphasis on business conditions. As in the Canadian study, the contributions of marketing, employee and technology strategies to innovation were assessed using the adoption of listed advances as the indicator of innovation. The current study differs by having a more in-depth focus on business strategies, and considering a broader range of strategies.

The third previous study, of the Dutch construction industry in 2003 (Drejer and Vinding 2006), focused on the contribution of two business strategies – knowledge and relationship strategies – to innovation performance. Neither of these strategies was considered in the Canadian or Australian studies.

This paper builds on these earlier contributions by examining the relative contribution of a more comprehensive range of business strategies to innovation in the construction industry. All five categories of business strategies considered jointly across the three previous studies – knowledge, relationship, marketing, employee and technology strategies – are assessed here for the extent to which they distinguish more-innovative from less-innovative Australian construction firms. The paper also addresses the problems associated with accurately measuring innovation by developing an index of success in implementing innovation.

Innovations are classed as either technological or organizational: the former have a technical or physical character, and typically involve product or process innovation, while the latter are about advanced firm practices, and typically involve marketing or managerial innovation. The OECD (2005) also ranks the novelty of innovations, distinguishing between those new to the firm, market and world. This study covers technological and organizational innovations of all degrees of novelty.

There is a growing consensus about how innovation processes contribute to improved business outcomes for construction firms, with key researchers identifying similar features in their interactive models (e.g. Winch 1998; Seaden et al. 2003; Sexton and Barrett 2003; Manley and McFallan 2006; Hartman 2006). These models all emphasize the existence of important feedback loops between various innovation stages, whilst recognizing two main types of innovation drivers: those external to the firm (environmental factors) and those internal to the firm (strategies, capabilities, characteristics). The current study focuses on one category of internal innovation drivers: business strategies.

The classification of strategy types adopted here is empirically informed and tactically orientated, derived from information about the activities of construction firms. It differs considerably from most classifications found in the general management literature (see summary by Galbraith and Schendel 1983), which are focused on the bases for strategic positions, e.g. varieties, needs, access (Porter 1996), or on broader generic strategy choices, e.g. cost, leadership, differentiation, focus (Porter 1980), or on patterns of organizational behavior, e.g. defender, reactor, analyzer, prospector (Miles and Snow 1978; Citrin, Lee and McCullough 2007). Instead, the classification here is based on key management functions within construction firms, concerning (1) employees, (2) marketing, (3) technology, (4) knowledge and (5) relationships.

In this study 'strategies' are defined as the planned processes used by firms to improve core competencies and facilitate innovation (Burgelman et al. 2004). The concept of 'core' competency was primarily developed by Prahalad and Hamel (1990), who define it as the 'corporate-wide technologies and production skills … that empower individual businesses to adapt quickly to changing opportunities'. According to Walsh and Linton (2002), this is the most widely used definition in the literature. An organization's core competency can be viewed as a bundle of key intangible assets, including management skills, organizational routines, knowledge bases, and networking linkages (Malerba and Marengo 1995; Barney et al. 2001). The role of business strategies is to grow these intangible assets and facilitate innovation (Burgelman et al. 2004).

Research Methodology

A large-scale innovation survey of the Australian construction industry was undertaken in 2004. It was designed to assess innovation levels, types, drivers, obstacles and impacts. The survey included questions about business strategies, the main focus of this paper.

The construction industry was defined to include general and trade contractors, consultants, suppliers and clients. This is a broader definition than used in the Canadian survey, which dealt exclusively with general and trade contractors (Seaden et al. 2003). The study population was key construction firms in the most populous Australian states of New South Wales, Victoria and Queensland. Key firms were defined as those appearing on the pre-qualification lists of government road and building client agencies or as members of eight selected industry associations identified by local government agencies as making the most significant contribution to construction projects (concrete suppliers declined to participate). The study focused on the commercial building and civil engineering sectors (excluding residential building).

The surveys were sent directly to the sample population by government agencies and industry associations working with the researchers. Survey forms were distributed through the post, rather than electronically, to ensure the results were not biased against firms that did not use email systems. The surveys were sent to the contact person, mainly senior managers, on the government agency pre-qualification lists and the industry association membership lists. In all, surveys were distributed to 1,317 (38%) of the total survey population of 3,476 firms. Although a census was beyond the scope of the study, the sampling rate is high, and generated 383 useable responses, a response rate of 29%. The high sampling and response rates support robust results. The rates per sector of the population are shown in Table 1.

Table 1. Respondents to the survey by sector

Industry Sector	Number of firms in population	Proportion of firms in population	Number of firms in sample	Sampling rate	Number of completed survey forms returned	Response rate
All Sectors	**3476**	**100%**	**1317**	**38%**	**383**	**29%**
Main contractors	1122	32%	300	27%	93	31%
Trade contractors	346	10%	236	68%	74	31%
Consultants	1549	45%	409	26%	130	32%
Clients - public sector	44	1%	44	100%	23	52%
Suppliers	415	12%	328	79%	63	19%

The survey contained questions about 23 business strategies in five categories: (1) employees, (2) technology, (3) marketing, (4) knowledge and (5) relationships. The categories encompassed all of those considered in the three studies discussed earlier (Seaden et al. 2003; Manley and McFallan 2006; Drejer and Vinding 2006). The 23 individual strategies listed in Table 1, and the 19 innovative advances listed below, were identified in these earlier studies and/or by senior managers participating in industry workshops held in Brisbane, Australia, in 2002 and 2004. The 23 strategies were considered to represent best practice in supporting the innovativeness of construction firms.

Survey data gathered on the strategies were cross-referenced with a measure of innovativeness. Innovation is notoriously difficult to measure (Smith 2005), whether using the OECD definition or others (Slaughter 1998; Blayse and Manley 2004). To minimize bias arising from different understandings of innovation, three different approaches were combined to give an overall innovation index score. The three survey questions used for index development provide output indicators of a firm's effectiveness in implementing innovation, and build on existing indexes, such as PWC (2002). The index measures: (1) the degree of novelty of each firm's technological and organizational innovations between 2001 and 2003 (based on similar questions in OECD/Eurostat 2005); (2) the impact of each firm's most successful innovation on profitability (based on a particular case of innovation, as trialed by the Australian Bureau of Statistics, ABS 1997); and (3) the adoption of listed technological and organizational advances by each firm (following the Canadian example as reported in Seaden et al. 2003). The index is a combination of the following scores:

Novelty Score: Respondents who had implemented at least one technological or organizational innovation between 2001 and 2003 scored one point for each type. A further three points were awarded if at least one of these innovations was new to the world, two points if new to Australia, or one point if new to the industry.

Impact Score: This was derived from respondents' answers to a question about the impact of the firm's most successful innovation between 2001 and 2003 on profitability. A linear five-point scale was used to weight the profitability impact, ranging from one point for 'no effect' to five points for 'great improvement' ('one' rather than 'zero' was the minimum, to allow scores to be standardized).

Adoption Score: This was derived by summing the number of technological and organizational advances each firm adopted, from 19 listed in the survey, namely (1) *technological advances*: computer networks (LAN or WAN) website; computerized systems for estimating, inventory control, modeling, asset analysis, project management, etc; 3-D CAD; digital photography; office-to-site video links or video conferencing; on-line-remote-construction-management; intelligent systems; and (2) *organizational advances*: quality certification; staff training budget; written evaluation of new ideas; documentation of technological/organizational improvements; written strategic plan; risk-sharing/performance-incentive contracts; design and construct contracts; design/build/fund/operate contracts or public-private partnerships; and managing contractor contracts.

The index covers both technological and organizational innovations, of varying degrees of novelty. It was important for comprehensiveness that the index covered both types despite the potential for overlap between some of the organizational innovation variables and the business strategy variables. The statistical significance of these potential overlaps was tested using correlation analysis, comparing the scores achieved by each respondent under the index with scores achieved under a version of the index that excluded the organizational innovation variables. Both parametric (Pearson's correlation) and non-parametric (Spearman's Rank correlation) results indicate there is a strong positive relationship between the two sets of scores (parametric 0. 98; non-parametric 0. 94), with $p<0.001$. This confirms the robustness of the results based on the index inclusive of organizational innovation variables.

Further, Cronbach's Alpha test was applied to the survey questions used to create the innovation index, to assess reliability. All scores were between 0.6 and 0.7, which indicates consistency in the responses and confirms the suitability of these measures as the basis for index development.

The index was used to score and rank the innovativeness of each survey respondent, and to assign each to one of three groups: high innovators, middle innovators and low innovators. Sensitivity analysis helped define the groups, with three index models trialed: an additive model, a multiplicative model, and a weighted multiplicative model.

The models were applied to each respondent and the results compared for consistency, with the top and bottom quartiles drawn out for sensitivity assessment based on observed patterns in the data. Each of the models resulted in the same composition of the ‘high innovators’ group of 87 respondents, the ‘low innovators’ group of 87 respondents, and the ‘middle innovators’ group of 209 respondents. This consistency, combined with the results of reliability analysis, confirms the integrity of the classification of respondents.

A series of Chi-squared tests were carried out on all relevant survey responses to determine whether differences in strategy use between high and low innovator groups were statistically significant. These two groups were also compared using descriptive analysis.

The strategies were ranked by the degree to which they distinguished high innovators from low innovators by both percentage-point differences and uptake ratios. The results of each of these ranking methods were triangulated through sensitivity analysis, to assess the reliability of rankings.

Results and Discussion

There are many significant differences in business strategy use by high and low innovators in the Australian construction industry, as the comparison using chi-squared statistics, percentages, differences and uptake ratios in Table 2 shows. This was expected given that the strategies had been identified in previous studies as supportive of firms' innovation efforts.

Table 2. Comparing use of business strategies by high and low innovators, percentage, difference, uptake ratio and chi-squared statistic, Australian construction industry, 2004

Strategy Type	Percentage of high innovators using strategy	Percentage of low innovators using strategy	Difference in % points	Uptake ratio (rounded up)	ChiSq
Employee Strategies					
Recruiting experienced employees	88%	53%	35	2/1	0.000
Using multi-skilled teams	82%	29%	53	3/1	0.000
Recruiting new graduates	82%	13%	69	6/1	0.000
Participating in apprenticeship programs	*71%*	*43%*	*28*	*2/1*	*0.033*
Actively encouraging your employees to seek out improvements and share ideas	97%	64%	33	1/1	0.000
Providing or supporting training programs for your employees	93%	40%	53	3/1	0.000
Technology Strategies					
Enhancing your business's technical capabilities	92%	51%	41	2/1	0.000
Investing in research and development (R&D)	60%	2%	58	30/1	0.000
Protecting your business's intellectual property	67%	25%	42	3/1	0.000
Participating in the development of industry standards and practices	74%	25%	49	3/1	0.000
Marketing Strategies					
Building relationships with existing clients	*85%*	*79%*	*6*	*1/1*	*0.128*
Delivering products/services which reduce your clients' costs	76%	40%	36	2/1	0.000
Attracting new clients	*77%*	*67%*	*10*	*1/1*	*0.074*
Providing a broader range of services to your clients	64%	40%	24	2/1	0.001
Increasing your market share	56%	26%	30	2/1	0.000
Knowledge Strategies					
Actively monitoring international best practice	63%	9%	54	7/1	0.000
Maintaining a formal system for transferring project learnings into our continuous business processes	62%	6%	56	10/1	0.000
Measuring how well our changes have worked	53%	22%	31	2/1	0.000
Actively monitoring advances in related industries that might be applicable to our business	52%	18%	34	3/1	0.000
Relationship Strategies					
Rewarding staff for maintaining networking linkages with strategically useful industry participants	39%	7%	32	5/1	0.000
Pursuing partnering on projects	71%	8%	63	9/1	0.000
Pursuing alliance projects	64%	6%	58	11/1	0.000
Maintaining long-term collaborative arrangements with other businesses	66%	21%	45	3/1	0.000

A statistically significant difference of $p<0.001$ was found for all business strategies except 'participating in apprenticeship programs' ($p=0.033$), 'building relationships with existing clients' ($p=0.128$), and 'attracting new clients' ($p=0.074$). Thus, 20 business strategies have been confirmed as important predictors of a firm's innovation performance at the 99.9% confidence level. One of the three not confirmed, 'participating in apprenticeship programs', was however significant at the 95% confidence level, with 71% of high innovators and 43% of low innovators using the strategy. The comparatively lower participation in apprenticeship programs by high innovators (compared to other strategies) is explained by their much greater focus on in-house training, which is undertaken by 93% of high innovators, but only 40% of low innovators.

On the other hand, 'building relationships with existing clients' is important to both high and low innovators, with 85% and 79%, respectively, using the strategy. This finding emphasizes the importance of repeat work to *all* construction firms within the survey population. Both groups of innovators similarly placed a high level of importance on 'attracting new clients', with 77% and 67%, respectively, using the strategy.

There are six strategies that most strongly distinguish high from low innovators. They were ranked in the top six by percentage-point differences and uptake ratios (although in a different order).This commonality of high ranking was lost when comparing subsequent rankings derived from each method. The six key strategies identified through this sensitivity analysis are (1) investing in research and development (R&D), (2) pursuing alliance projects, (3) maintaining a formal system for transferring project learnings into continuous business processes, (4) pursuing partnering on projects, (5) actively monitoring international best practice, and (6) recruiting new graduates.

The relative value of all the strategies distinguishing high from low innovators is considered in more detail in the following sections, with reference to Table 2.

Employee Strategies

Employee strategies are very important to high innovators. Of the top seven strategies, used by more than 80% of high innovators, five are employee strategies. Only one of the six employee strategies was used by less than 80% of high innovators. The two employee strategies most commonly used by high innovators, and the two most popular strategies overall, are 'encouraging employee ideas' and 'training employees'. This is consistent with other studies (Barlow 2000; Love et al. 2002). The employee strategy that most clearly separates high and low innovators is the recruitment of new graduates, with high innovators showing stronger interest by 69 percentage points. Indeed, this strategy shows the greatest percentage point difference, over all the strategy types, between high and low innovators.

High innovators are least interested in participating in apprenticeship programs (although the usage rate is still high, at 71%). These two findings could be related. Apprenticeships are associated with established rather than emerging knowledge, while new graduates probably have greater exposure to cutting-edge technical developments and greater development of problem-solving skills; characteristics which help explain the strong interest of high innovators in new graduates.

Technology Strategies

The gap between high and low innovator usage rates is roughly the same across all technology strategies. Similarly, the rate of usage across strategies by each group is fairly consistent. High innovators are consistently more interested in activities that support technological innovation than low innovators. One possible explanation is that low innovators focus on organizational innovation (particularly management processes) to the exclusion of technological innovation. Although some research shows that organizational innovation can be just as critical to a firm's success as technological innovation (Hardie et al. 2005), there is evidence to support the widely held view that technological innovation plays the lead role in driving growth (Bowns et al. 2003), especially in combination with organizational innovation (ABS 2007). The findings here support Bowns et al. (2003) on the value of technological innovation.

Marketing Strategies

Differences in usage rates showed great variability across the individual marketing strategies. High and low innovators placed similar value on relationships with new and existing clients, but had more divergent levels of interest in client costs, market share and services provided to clients, with low innovators being much less interested in these strategies.

The similar levels of focus on attracting/retaining new/existing clients may conceal differences in the *types* of clients targeted by the two groups. Firm innovation may be influenced by the level of client sophistication, competence and 'demandingness' (Nam and Tatum 1997; Barlow 2000; Gann and Salter 2000; Kumaraswamy and Dulaimi 2001; Seaden and Manseau 2001; Manley 2006). Innovation is fostered, for example, when clients demand outcomes that exceed business-as-usual. The more demanding and experienced the client, the more likely it is that innovation is stimulated in the projects commissioned (Barlow 2000; Manley 2006). It may be that low innovators do not target demanding clients. Indeed, Table 1 shows that low innovators have less interest in reducing clients' costs than high innovators, which is contrary to clients' priorities (Egan 1998; Fairclough 2002; DISR 2004) and suggests that the clients of low innovators are not particularly demanding.

Marketing strategies stand out in the sensitivity analysis results for their absence in the list the top six differentiating strategies. The survey results thus indicate that marketing strategies are the least important strategy type; however, it may be that the survey has failed to pick up important subtleties.

Knowledge Strategies

There are large differences in use of knowledge strategies by high and low innovators. Two of the four strategies involve use of external knowledge sources: those located internationally and those in related industries. Research shows that the benefits of geographical proximity do not overshadow the value for firms of international or inter-industry networking and monitoring of ideas to push the boundaries of best practice (Davenport 2005). Indeed, recent studies have shown that it is very important for construction firms to maintain links with external sources of knowledge such as these (Miozzo and Dewick 2002; Keast and Hampson 2007).

The other two knowledge strategies involve reflective behaviors. The reflective strategy of 'transferring project learnings into continuous business practices' was originally emphasized by Gann and Salter (2000), who suggested that project-based firms often struggle to learn between projects, and have weak internal processes to store and re-apply innovative ideas. The second reflective knowledge strategy is 'evaluating the impact of changed business practices', a critical part of building effective internal knowledge bases.

Relationship Strategies

There are also large differences in the use of relationship strategies by high and low innovators. The 'pursuing partnering contracts' and 'pursuing alliance contracts' strategies have the second and third largest difference in usage rates across all strategy types, at 63 and 58 percentage points respectively. One tempting explanation is that low innovators, which are often small firms (Cohen and Klepper 1996; ABS 2006), are precluded from procurement processes by their size. However, key clients within the survey population are known to be encouraging small firms to participate in project partnering and alliancing, so this is unlikely to be the case here.

Conclusions

The comparison here of business strategy use by high and low innovators has confirmed that most of the 23 business strategies tested are important to firms' innovation performance in the construction industry. The only three business strategies that did not significantly distinguish high and low innovators at the 99.9% confidence level were 'building relationships with existing clients', 'attracting new clients' and 'participating in apprenticeship programs', although the latter was significant at the 95% confidence level. The other two strategies, both involving marketing strategies and clients, appear to be important to the business sustainability of all construction firms, regardless of their interest in growth through innovation.

Implications for Managers

To improve innovation performance, managers should review the business strategies assessed here and focus on

those most likely to enhance their particular core competencies. In selecting and pursuing appropriate strategies, firms also need to consider their innovation objectives and market circumstances, keeping in mind the important role played by the following six individual strategies in supporting innovation: (1) investing in research and development, (2) pursuing alliance projects, (3) maintaining a formal system for transferring project learnings into continuous business processes, (4) pursuing partnering on projects, (5) actively monitoring international best practice, and (6) recruiting new graduates.

Of the five strategy types, marketing strategies are the least important differentiators of innovation performance. They do not appear amongst the six key strategies identified by sensitivity analysis, and they account for the two strategies amongst the 23 individual types with the lowest difference in usage rates between high and low innovators.

Implications for Academics

The academic implications of the current study can be described by comparing it with the three previous empirical studies in this area. Firstly, the study confirms the main finding in Manley and McFallan (2006) that 'recruiting new graduates' is critical to supporting innovation activity within construction firms. In that study, this business strategy was one of only three out of 18 strategies that were significant in differentiating between high and low adopters of technological and organizational advances in the road sector (that study identified fewer significant business strategies than the current study because the distinction between high and low adopters was less pronounced than the distinction between high and low innovators here). In the present case, the strategy of 'recruiting new graduates' was employed by six times more high innovators than low innovators.

Secondly, results here are congruent with those of the Canadian study (Seaden et al. 2003). Despite different statistical measures and definitions, both studies found that most of the employee, marketing and technology strategies listed here are significant in predicting innovation activity. Having been confirmed as important to innovation in two different industrial contexts, these strategies should be the focus of academic effort to further unravel their relative value and interrelationships.

Thirdly, the Dutch study (Drejer and Vinding 2006) provides an opportunity to compare results regarding knowledge and relationship strategies. They found that 'firms that have formalized routines for transferring knowledge from project to firm level' are 1.7 times more likely to be innovative than other firms (Drejer and Vinding 2006). This is similar to the finding here that 'maintaining a formal system for transferring project learnings into continuous business processes' is important to innovation performance. High innovators were 10 times more likely to use the strategy than low innovators. The consistency of these findings emphasizes the importance of integrating project learnings for improving innovation performance in project-based industries.

The other relevant result of the Drejer and Vinding (2006) study is that firms that evaluate and diffuse knowledge between projects (through the strategy described above) *and* engage in inter-organizational partnering are more likely to be innovative than firms that do not combine these strategies. This result points to the importance of effective networking between firms, such as that provided by project partnering and alliances. This is supported by the current study, which found that for every low innovator pursuing project alliancing or partnering there were eleven and nine high innovators, respectively, doing the same thing.

The consistency with the three earlier studies confirms the reliability of this study's results as well as their international applicability. This study was more comprehensive than previous studies in assessing the innovation contribution of a broader range of strategy types. The results highlight the importance of technology, relationship, knowledge and employee strategies compared to marketing strategies. The current study has also successfully trialed a new measure of a firm's innovativeness, and developed a functional typology of tactical business strategies to complement the pattern-based formulations that currently dominate the management literature.

The results of this study provide insight into the types of business strategies that most clearly drive innovation, enhancing the conceptualization of interactive innovation models. They provide a more comprehensive understanding of business strategy as an internal driver of innovation processes in a project-based environment than that available in the established literature.

Limitations and Future Directions

The broad definition of the construction industry employed here covers five heterogeneous sectors, namely general contractors, trade contractors, consultants, clients and suppliers. The results in this paper are based on an aggregation of data from these sectors, which constrains their value. Future research will explore the findings for each sector individually, improving validity.

Another limitation relates to the fact that business strategies support innovation performance in part through their contribution to a firm's core competency. In the current study, with the focus limited to strategy inputs and innovation outcomes, it was assumed that firms applied their business strategies against a background of equal competencies. As this ignores the diversity of firm competencies, the consequences of relaxing the assumption made here should be explored. The nature of links between strategy and competency warrant attention, including the impact of firm size on both these variables.

The five types of business strategies assessed here are likely to be strongly interconnected. Indeed, the Dutch study found a high degree of interdependence between knowledge and relationship strategies (Drejer and Vinding 2006), which is consistent with other studies (Barlow and Jashapara 1998; Powell 1998; Manley 2003; Keast and Hampson 2007). It is recommended that the interrelationships between different types of business strategies is investigated to improve understanding of which combinations maximize innovation activity and business outcomes.

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