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INDUSTRY DEVELOPMENT

Full Refereed Paper

MEASURING THE TECHNICAL COMPETENCE OF REPEAT PUBLIC-SECTOR CONSTRUCTION CLIENTS

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ABSTRACT

A broad based industry survey investigates whether repeat public sector construction clients are technically competent, measured by their in-house innovation performance. The study covered non-residential building and civil work in three Australian States – New South Wales, Victoria and Queensland. Data were collected via a large scale mail survey undertaken in 2004 which covered 38% of key construction organisations in the study population. Descriptive statistical methods are employed to give an indication of the relative level of technical competence held by repeat public sector clients compared to contractors, consultants and suppliers. Such competence is taken to be reflected in a number of innovation indicators. The results show a high level of technical competence held by repeat public sector clients. As the literature reports a relationship between technical competence and innovation leadership ability, this finding has positive implications in terms of industry development potential. This research has immediate benefits in giving the construction industry more confidence in the quality of leadership shown by government clients. It also provides the basis for further research examining the link between the technical competence of clients and industry perceptions of client leadership.

Keywords: Clients, technical competence, innovation, public sector

1.0 INTRODUCTION

Technical competence is defined by Prahalad and Hamel (1990, 81) as the 'corporate-wide technologies and production skills that empower individual businesses to adapt quickly to changing opportunities'. According to Walsh and Linton (2002, 64), this is the most widely used definition in the literature. The focus on adaptability through technologies and skills highlights the role of innovation in underpinning technical competence. Hence, this paper takes an innovation-centred view of technical competence, with it being defined here by four indicators: R&D investment, innovation novelty, adoption of advanced practices, and innovation impact on business effectiveness. These indicators were selected following analysis of the Community Innovation Survey (CIS) which is based on the OECD's 'Oslo Manual' (OECD/Eurostat 1997). The CIS was implemented in 1992, 1996 and 2001 by European Union Member States (similar surveys have also been implemented in Australia, Canada and New Zealand). The survey represents best practice in the design of innovation indicators (Pattinson 2003).

In view of Nam and Tatum's (1997, 259) widely cited research conclusion that technical competence is 'an utmost prerequisite for effective leadership for construction innovation', the research question driving this study is: Are Australian repeat public-sector construction clients technically competent? The results report on an important element of the leadership potential of clients.

2.0 METHODS

The study covered non-residential building and civil work, in the Australian States of New South Wales (NSW), Victoria (Vic) and Queensland (Qld). These three states have the highest Gross State Product across the seven states and territories in Australia (ABS 2005). The less than full coverage of the Australian construction industry was driven by time and cost constraints.

Descriptive statistical methods were employed to give an indication of the relative level of technical competence held by repeat public sector clients compared to other groups in the industry. The industry was defined broadly to include five groups - main contractors, trade contractors, consultants, suppliers, and clients from the public sector who undertake on-going work.

Data were collected via a large scale mail survey covering 38% of key construction organisations in the population. Overall, 1,317 questionnaires were distributed, with 383 useable responses returned, equating to a response rate of 29%, which can be considered a good response for a voluntary mail survey (Saunders et al. 2000, 159; Ling 2003, 642). The high response rate helps to minimise non-response bias, and is partly the result of effective sample and questionnaire design, as described by Sekaran (1992). Statistical testing also indicated no significant difference between early and late respondents, indicating the likely absence of non-response bias. Although the data is the result of self-assessment, which may have biased estimates of technical competence upward, this is unlikely to have impacted the relative performance of respondents, which is the key to the argument presented here.

The sampling unit was at organisational level. Key organisations were defined as government clients, members of eight selected industry associations, and organisations appearing on the pre-qualification lists of clients. The associations chosen for surveying were identified through an industry workshop in Brisbane in 2004 as those that made the most significant contribution to construction projects.

The survey was distributed through the post, rather than electronically via email or the internet. The electronic options were deemed to be sub-optimal for the Australian construction industry, given the relatively poor performance of previous electronic efforts (CRC Construction Innovation 2003). The surveys were sent to the contact person on the industry association membership lists and government agency pre-qualification lists. These people were mainly managers. For the government clients, forms were sent to managers in the civil and building agencies of the three states. The results presented here are from the survey questions on the relative technical competence of clients, compared to the rest of the industry. Table 1 shows key survey data.

Table 1: Key Survey Data

Industry Sector	No. Sent	Useable No. Back	Response Rate	Population Size	Population Definition	Percent Sampled	Sampling Method
All Sectors	1317	383	29%	3476		38%	
1. MAIN CONTRACTORS	300	93	31%	1122		32%	
Non-residential Building Contractors	150	55	37%	740	Prequalified firms	20%	Random
Civil Contractors	150	38	25%	382	Prequalified firms	39%	Random
2. CONSULTANTS	409	130	32%	1549		26%	
Non-residential Building Consultants	150	48	32%	675	Prequalified firms	22%	Random
Civil Consultants	150	52	35%	874	Prequalified firms	17%	Random
Quantity Surveyors	109	30	28%	200	Firm-level association members	55%	Random
3. CLIENTS - PUBLIC SECTOR *	44	23	52%	44		100%	
Civil - Qld	14	Client responses were not coded for location or sector.		14	District Directors	100%	Census
Civil - NSW	6			6	Regional Managers	100%	Census
Civil - Vic.	6			6	Regional Managers	100%	Census
Non-residential Building - Qld	7			7	Key government clients	100%	Census
Non-residential Building – Vic.	11			11	Key government clients	100%	Census
4. TRADE CONTRACTORS	236	74	31%	346		68%	
Electrical and Communication Contractors	172	48	28%	282	Major association members	61%	Census
Air Conditioning and Mechanical Contractors	64	26	41%	64	Major association members	100%	Census
5. SUPPLIERS	328	63	19%	415		79%	
Glass	150	23	15%	222	All association members	68%	Random
Plaster	139	21	15%	139	Plaster/plaster board suppliers/ manufacturers	100%	Census based on 'Yellow Pages'
Asphalt	26	15	58%	26	All association members	100%	Census
Steel	13	4	31%	28	Major association members	46%	Census

3.0 RESULTS AND DISCUSSION

Four technical competence indicators are reviewed here: R&D investment, innovation novelty, adoption of advanced practices, and innovation impact on business effectiveness.

Figure 1: Businesses Investing in R&D, % of Sectoral Respondents, Australian Construction Industry, 2004

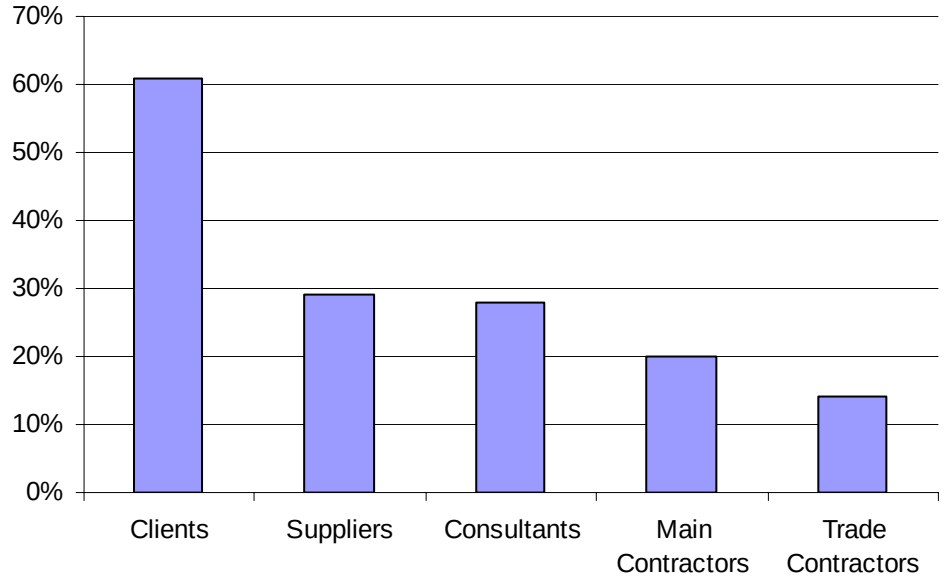


Figure 2: 'New to Industry' Technological Innovation, % of Sectoral Respondents, Australian Construction Industry, 2004

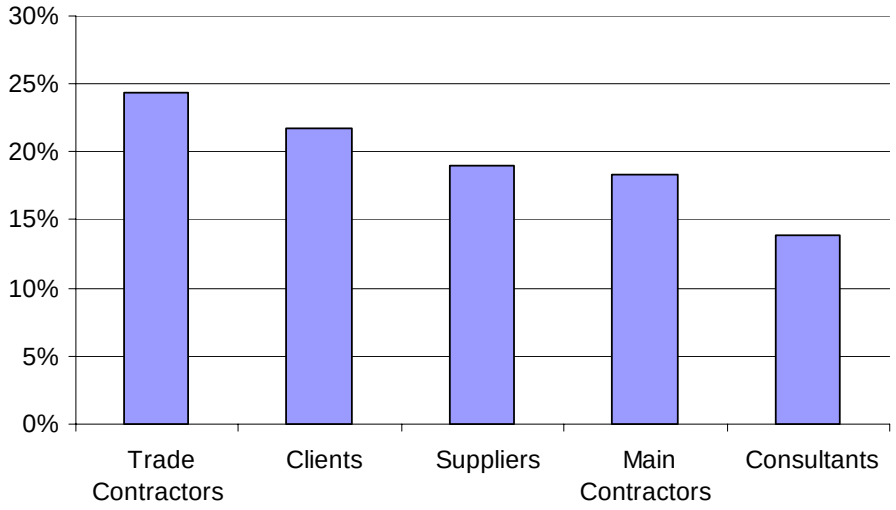
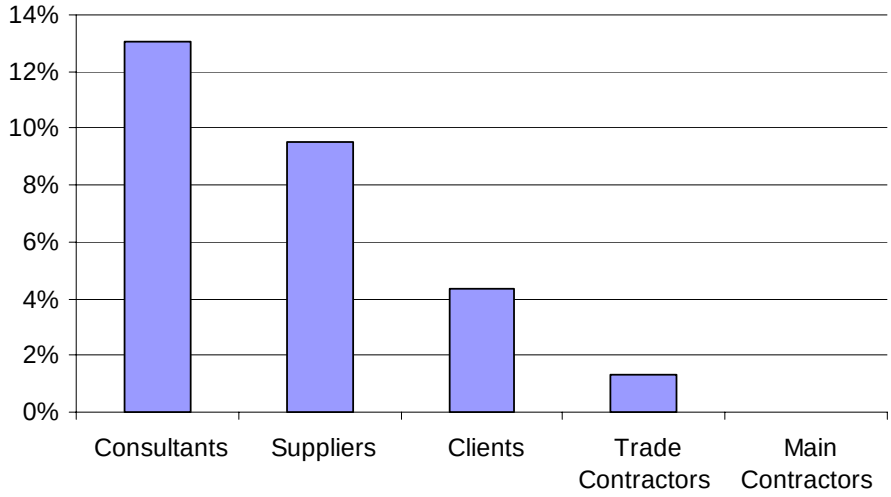


Figure 1 shows that the client sector has the highest incidence of R&D investment, by number of agencies/businesses investing, with at least twice the incidence compared to other sectors (Chi-Sq=23.14; df=4). This may reflect the emphasis placed by Australian government client agencies on technical development, and the reversal in recent years of downsizing in the 1980s/90s. It also arises because the client percentages come off a low base – with there being only 44 client organisations in the survey. Many of these

organisations were district offices in the road sector and the results are in part explained by their trialling and testing activities. The literature contains empirical evidence suggesting such internal R&D programs improve the ability to exploit external knowledge sources (Gambardella 1992, Mowery et al. 1996). Foray (1997) argues that R&D together with 'knowledge openness' improves the pace of innovation across organisations.

Figure 2 shows that trade contractors are more likely to develop innovations that are new to the industry, than clients, although client performance exceeds that of all other sectors. The dominance of trade contractors in this measure may reflect their role in adapting existing broad ideas to fit the specific needs of the construction industry

Figure 3: 'New to World' Technological Innovation, % of Sectoral Respondents, Australian Construction Industry, 2004



Consultants (Chi-Sq=11.23; df=4) and suppliers are more likely to implement 'new to the world' innovation than clients. These results are not particularly surprising, as suppliers are known for their ability to invest in R&D on an on-going basis, compared to project-based organisations, such as contractors, while consultants are paid to generate new ideas. At the same time, clients are also shown to be strong performers.

Compared to trade contractors, suppliers and consultants, it may be that clients invest more in incremental improvements, which have cumulative value without being highly novel. Incremental innovation is considered in the literature to be a key component of technical competence leading to growth opportunities often as considerable as those arising from more radical innovation (Thorburn and Langdale 2003).

Figure 4: Average Number of Advances Adopted, by Sector, Australian Construction Industry, 2004

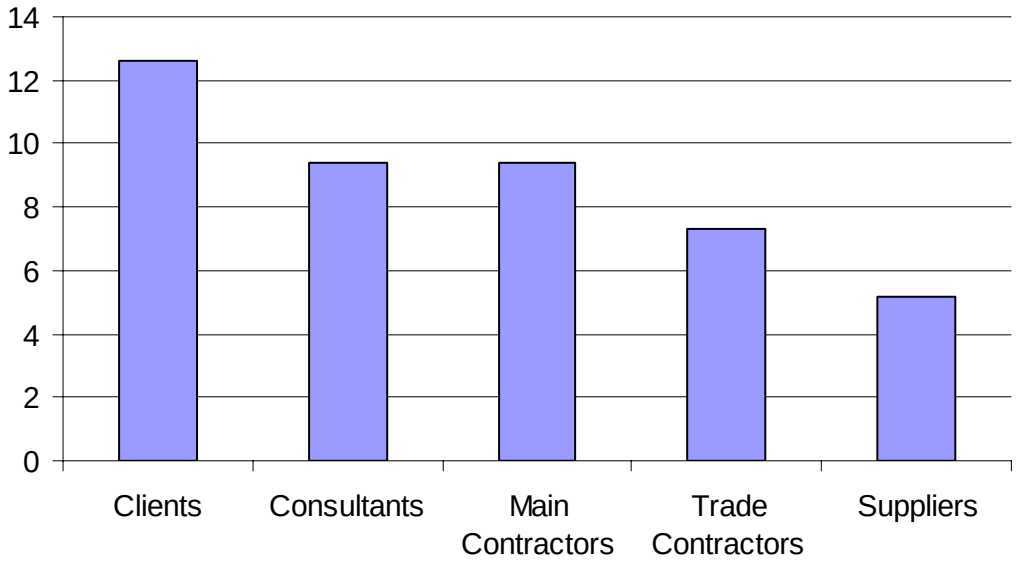


Figure 4 is based on 20 technologies and advanced practices in the construction industry that were listed in the survey, as shown below:

Table 2: Technologies and Advanced Practices Listed in Survey

3-D CAD
Alliance contracts
Computer networks (LAN or WAN)
Computerised project management
Computerised systems for estimating, inventory control, modelling, asset analysis, project management, etc
Design and construct contracts
Design/build/fund/operate (DBFO) contracts or public-private partnerships (PPPs)
Digital photography
Documentation of technological/organisational improvements developed by your business
Intelligent systems
Long-term collaborative arrangements with other businesses
Managing contractor
On-line-remote-construction-management
Partnering on projects, or other relationship forms of contract
Quality certification (eg ISO 9000)
Risk-sharing/performance-incentive contracts
Staff training budget
Web site
Written evaluation of new ideas in order to develop options for your business
Written strategic plan

These advances represent an updated version of those employed by Statistics Canada in their large-scale innovation survey conducted in 1999 (Anderson and Schaan 2001). Their list was modified in view of findings from an expert focus group workshop comprising senior client representatives, conducted in Brisbane, Australia in 2004.

Client performance in terms of the average number of advances adopted exceeds that of the other sectors. This result, in conjunction with clients' strong R&D performance, supports the findings of the absorption capacity literature, that internal R&D capacity provides the capability necessary to successfully adopt and modify innovations that have been developed externally (Cohen and Levinthal 1990).

The survey also measured the impact of each organisation's most successful innovation between 2002 and 2004. Figure 5 shows clients were more likely to have had a significant or great impact from innovation on effectiveness/profitability than other sectors, although only marginally so compared to trade contractors. The finding that trade contractors achieve good results from innovation, yet are the least likely sector to invest in R&D, supports findings in the literature that despite the strong historical focus on R&D, it is only one of many factors that influence innovation outcomes.

The relevant survey question asked businesses about 'profitability', and government agencies about 'effectiveness', as the agencies are not interested in profit. This difference may have biased the client results upward compared to the hurdle presented to businesses, yet the value provided by innovation to clients is significant regardless, with over 20% of agencies reaping a significant or great impact on effectiveness.

In summary, the 'R&D' and 'adoption' innovation measures reveal clients to be the dominant performers compared to the other groups, while the other two measures – 'novelty' and 'effectiveness/profitability' also show strong client performance.

Figure 5: Businesses Achieving Significant or Great Impact on Effectiveness/Profitability from Innovation, % of Sectoral Respondents, Australian Construction Industry, 2004

4.0 CONCLUSIONS

Understanding the level of technical competence held by repeat clients in the construction industry is of great importance to the future of the industry. The predominant view of contemporary analysts in Australia and overseas, from academia and within the industry, is that client leadership is the key to improving industry performance (Gyles 1992; CIDA 1995; Nam and Tatum 1997; NatBACC 1999; Gann 2000; PWC 2002; Cole 2002; CRC Construction Innovation 2004; DISR 2004; Briscoe et al 2004). Technical competence is an important input to effective client leadership (Nam and Tatum 1997).

Such leadership is seen to be essential for greater integration of the supply chain and part of an effective response to the problems confronting the industry. Yet Ivory (2005) cautions us to adopt a critical approach to client leadership. Clients are not automatically good leaders. They need to be willing to assume such a role and they need to be capable of effectively executing it. Both these issues are problematic. Many repeat public-sector clients point to the manufacturing industry and the apparent lack of client-leadership there. Why should they assume such responsibility? The answer lies in the size, complexity and uniqueness of construction projects. In general, construction clients have a lot more power over suppliers than have consumers of manufactured goods; as Nam and Tatum (1997, 263) note:

> Whereas in manufacturing, the buyer's role takes the generally passive form of market demands, in the construction industry the role of the buyer (i.e. owner) is generally more active. Rather than being just buyers of finished products, owners, particularly in the building and heavy sectors of the construction industry, are often major participants in the projects.

Further research may be necessary to convince construction clients that they have a legitimate role to play in industry development.

The second requirement for effective client leadership is that clients are able to assume such a role. A prominent consideration in this respect is the client's level of technical competence (Ivory 2005). The research reported here has shown that Australian repeat public-sector clients (for non-residential and civil work, in NSW, Qld and Vic) have a high level of technical competence compared to other groups in the construction industry. This finding, combined with the established links between technical competence and effective innovation leadership, will benefit government client agencies seeking to protect and extend their resourcing levels. This research also has immediate benefits in giving the construction industry more confidence in the quality of leadership shown by government clients.

The findings of the present study reliably represent the population studied, given the robust sample size, sub-sector distribution and response rate. However, further research would be necessary to investigate client competence in the other Australian states and the residential construction sector. Additionally, it might be interesting to compare technical competence in the civil and building sectors in future work, to draw out differences. The current study also provides the basis for further research examining the link between the technical competence of clients and industry perceptions of client leadership. Finally, the evidence that trade contractors reap significant benefits from innovation, in the absence of significant investment in R&D, may reflect the importance of non-technical innovation and deserves further study.

Readers interested in the drivers of technical competence, particularly when it is defined as innovation capacity, are referred to Manley and McFallan (2005). That study found that investing in research and development, protecting intellectual property and business networking were important to grow competence. Differences between clients, contractors, consultants and suppliers in terms of innovation capacity are examined in Manley (2005), as are linkages between supply chain partners and the research infrastructure. Nevertheless, there is scope for further research on the effectiveness of different means of diffusing outcomes from research institutions to the industry.

5.0 BIBLIOGRAPHY/REFERENCES

ABS (Australian Bureau of Statistics) (2005) Australian National Accounts: State Accounts. ABS Catalogue Number 5220.0. Canberra: ABS.

Anderson, F. and Schaan, S. (2001) *Innovation, Advanced Technologies and Practices in the Construction and Related Industries: National Estimates.* Canada: Statistics Canada/NRRC.

Briscoe, G. H., Dainty, A. R. J., Millett, S. J., and Neale, R. H. (2004) Client-led strategies for construction supply chain improvement. *Construction Management & Economics*, 22(2), 193-201.

CIDA (Construction Industry Development Authority (1995) A Construction Industry Strategy. *Journal of Project and Construction Management*, 1(2).

Cohen W. and D. Levinthal. (1990) Absorptive capacity: a new perspective on learning and innovation. *Administrative Science Quarterly,* 35(1):128-152.

Cole, T. (2002) *Royal Commission into the Building and Construction Industry*. Discussion Papers. http://www.royalcombci.gov.au/ [accessed 2/9/2005].

CRC for Construction Innovation (2004) *Clients Driving Innovation' International Conference*, CRC for Construction Innovation, Gold Coast, Australia, 25-27 October.

CRC for Construction Innovation (2003) Personal communications with research associates and project managers during 2003.

DISR (Commonwealth Department of Industry, Science and Resources, Australia) (2004), *Building and Construction Industries Action Agenda Evaluation Report*, DISR, Canberra

Foray, D. (1997) Generation and distribution of technological knowledge: incentives, norms and institutions. In Edquist, C. (ed) Systems of Innovation: Technologies, Institutions and Organisations. London: Pinter, 64-85.

Gambardella, A. (1992) Competitive advantages from in-house scientific research: The US pharmaceutical industry in the 1980s. *Research Policy*, 21: 391-407.

Gann, D. (2000) *Building Innovation: Complex Constructs in a Changing World*. London: Telford.

Gyles, R. (1992) *Royal Commission into Productivity in the Building Industry in New South Wales*. Research Papers. Sydney: AGPS.

Ivory, C. (2005) The cult of customer responsiveness: is design innovation the price of a client-focused construction industry? *Construction Management & Economics*, 23(8): 861-870.

Ling, F. (2003) Managing the implementation of construction innovations. *Construction Management and Economics, **21***, 635-649.

Manley, K. (2003) Frameworks for Understanding Interactive Innovation Processes, *International Journal of Entrepreneurship and Innovation,* 4(1): 25-36.

Manley, K. (2005) *BRITE Innovation Survey*. Brisbane: CRC for Construction Innovation.

Manley, K. and McFallan, S. (2005) 'The Impact of Business Strategies and Business Conditions on Innovation', *'Creating and Entrepreneurial Economy: The Role of Enterprise and Innovation', International Research Conference*, University of Waikato, Hamilton, New Zealand, 7 – 8 July.

Nam, C. and Tatum C. (1997) Leaders and Champions for Construction Innovation. *Construction Management and Economics*, 15(3): 259-270.

NatBACC (1999) *Report for Government by the National Building and Construction Committee*. http://www1.industry.gov.au/library/content_library/BC-NatBACC.pdf [accessed 2/9/05).

OECD/Eurostat (1997) *Proposed Guidelines for Collecting and Interpreting Technological Innovation Data (Oslo Manual)*. Paris: OECD.

OECD (2000) *A New Economy? The Changing Role of Innovation and Information Technology in Growth*. Paris: OECD.

Pattinson, W. (2002) *Developing a Strategy for Innovation Statistics/Establishing User Requirements*. Background Paper, Australian Bureau of Statistics, Canberra.

Prahalad, C. and Hamel, G. (1990) The core competence of the corporation. *Harvard Business Review*, 3: 79-91.

PWC (PriceWaterhouseCoopers) (2002) *Innovation in the Australian Building and Construction Industry – Survey Report*. Canberra: Australian Construction Industry Forum.

Sekaran, U. (1992) *Research Methods for Business*. New York: John Wiley & Sons, Inc.

Thorburn, L. and Langdale, J. (2003) *Embracing change: Case studies on how Australian firms use incremental innovation to support growth.* Sydney: Australian Commonwealth Department of Industry, Tourism and Resources, Advance Consulting and Evaluation, Macquarie University.

Walsh, S. and Linton, J. (2002) The measurement of technical competencies. *The Journal of High Technology Management Research*, 13: 63-86.