INNOVATION ADOPTION BEHAVIOUR IN THE CONSTRUCTION SECTOR: THE CASE OF THE QUEENSLAND ROAD INDUSTRY

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ABSTRACT

This paper examines 'imitative' innovation, which involves the adoption of innovations that are new to a particular business, rather than new to the world. The paper is based on a survey of over 200 participants in the Australian road industry, in the state of Queensland. The survey covered clients, contractors, consultants and suppliers. Innovation directions and levels were measured via adoption patterns, based on a list of technologies and advanced practices presented in the survey questionnaire. The research investigated innovation rates, types, success, impact, drivers, strategies, and obstacles.

The paper commences by exploring the term 'innovation', before describing and analysing empirical data from the study. The evidence presented points to the:

- importance of innovation to business success;
- importance of people-centred/non-technical innovation processes;
- role played by inadequate resources and perceived risk in impeding innovation activity;
- importance of clients in 'driving' innovation activity; and
- the usefulness of active evaluation systems in maximising the benefits of innovation.

INTRODUCTION

Peter Drucker, the famous business analyst once said, 'Innovation is the key instrument of entrepreneurship… Innovation is the act that endows resources with a new capacity to create wealth' (1985, 149). Australia's Prime Minister recently stated that innovation represented the opportunity to introduce 'fresh ideas that enhance virtually every aspect of our lives' (Commonwealth Government of Australia 2001, iii). These are both very accurate observations. But as many studies have shown,

innovation processes are far from straightforward. Using a case study of the Queensland road industry, this paper examines key elements of innovation adoption processes and methods to improve innovation performance.

But first, what is meant by the term 'innovation'? In simple terms, innovation is a process of continual improvement. It results in new or significantly improved goods, services or practices. There are two main sorts: technological – involving the application of engineering and scientific concepts; and organisational – involving managerial and business practice improvements. These two sorts of innovation can be accomplished in two main ways – an organisation can adopt existing innovations, or develop new ones. Introducing *existing* advances and *original* development activity are equally important. Both forms are crucial to improved organisational and industry performance.

By focussing on 'imitative innovation', otherwise known as 'innovation adoption', attention is directed to innovations that are new to a particular organisation, without being new to the industry, or indeed the world. This sort of innovation activity is by far the most prevalent in any industry, as it is a less risky form of improvement than original innovation. The diffusion of innovations through adoption behaviour is essential to the maximisation of benefits flowing from original innovation. Hence, the focus of this paper.

METHODS

This paper is based on a 2002 survey of all the participants in the Queensland road industry. The study population comprised 335 organisations, split into four sub-groups:

1. clients – Queensland Department of Main Roads (DMR) district offices, and local governments;
2. contractors – private and public sector;
3. consultants; and
4. input suppliers – product suppliers and others.

The population list was derived from industry and professional association membership lists, together with DMR pre-qualification lists. The population comprised all the organisations for whom the Queensland road and bridge industry is of major importance. Questionnaires were sent to every organisation in the population, by standard mail.

The four core groups can be further disaggregated to 11 sub-populations as shown below:

Table 1: Respondents by Sector

Sub-Sector	Number of Surveys Distributed[1]	Number of Respondents	Response Rate
Clients			
Local governments	125	77	62%
DMR District Offices	14	12	86%
Contractors			
Private contractors	68	37	55%
RoadTek (public contractors)	15	15	100%
Consultants	59	39	66%
Input Suppliers			
Product Suppliers			
Cement Suppliers	6	6	100%
Asphalt Suppliers	6	5	83%
Binder Manufacturers	3	3	100%
Other Suppliers			
Extractive Industry	18	9	50%
Hire Firms	14	4	29%
Equip Distributors	7	1	14%
Total	**335**	**208**	**62%**

The overall response rate was 62 per cent, which can be considered exceptional for a voluntary mail survey. Saunders et al. (2000, 159) note that response rates for postal surveys can be as low as 15-20 per cent, and that 30 per cent is a reasonable rate. The high response rate for the present study appears to be, in part, due to general industry interest in innovation issues.

The representation of each sub-sector in the sample roughly matched their representation in the industry, except for bias against *equipment distributors* and *hire firms*. High response rates were achieved for all but these two sub-sectors, which had trouble identifying with the industry.[2]

Of the 208 respondents, half were public sector organisations (including clients) and half were private sector organisations. This even split was the result of chance rather than design.

The questionnaire covered innovation rates, types, success, impact, drivers, strategies, and obstacles. The focus was on adoption of existing innovations, comprising technologies and practices. The survey questions mainly related to a specific technology or practice that respondents nominated as being their most successful.

This paper gives an overview of innovation behaviour; readers interested in more detailed study findings are referred to the full report, Manley (2003).[3]

[1] Covering total populations of key players.
[2] Potential respondents from these sub-sectors explained that the road and bridge industry was not a big customer of theirs – or at least not directly.
[3] Among other things, the report examines the impact of context, such as business environment and business strategies, while also disaggregating findings by sub-sector.

RESULTS AND DISCUSSION

Adoption Rates

Respondents to the survey were asked to select the technologies and advanced practices they had adopted from a prescribed list of up to 46 types.[4] Fourteen per cent of respondents, or 30 organisations, used more than three-quarters of the technologies and advanced practices listed.

The most popular adoptions are shown in Table 3.1.

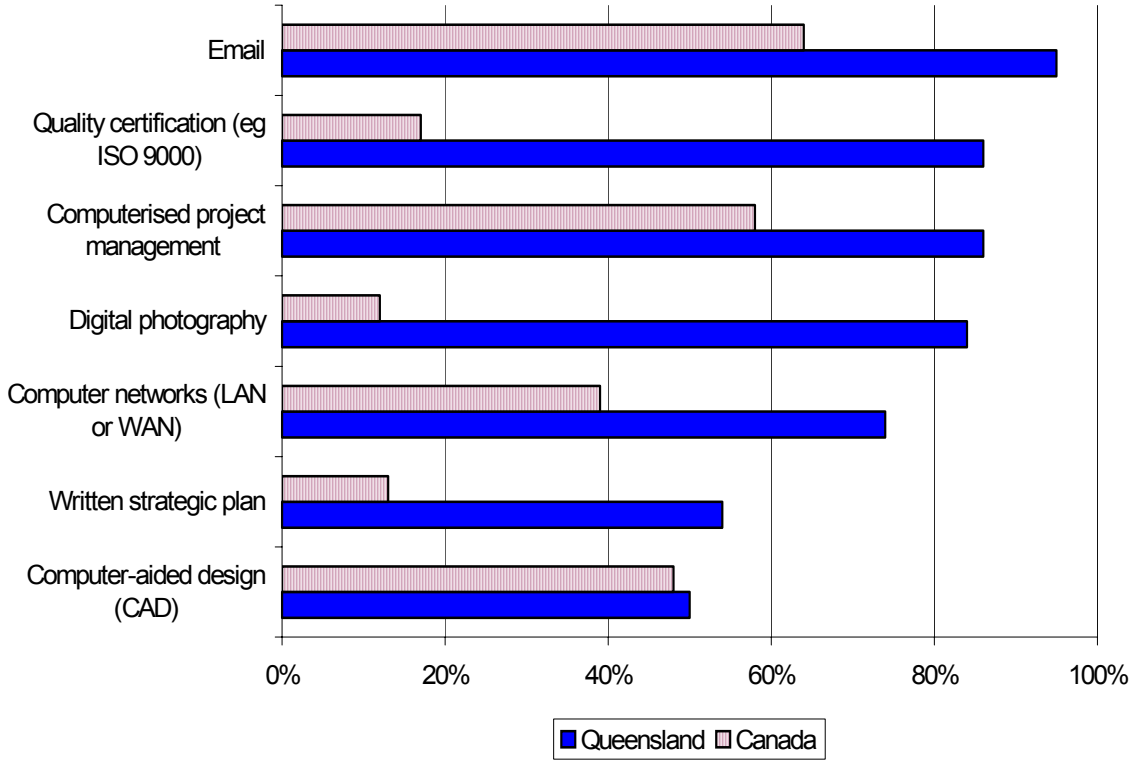
Table 2: Top Ten Technologies and Practices Used by Respondents

Technology/Advanced Practice	Percent Respondents Queensland
Email	97%
Computer networks (LAN or WAN)	85%
Staff training budget	85%
Quality certification (eg ISO 9000)	85%
Geotextile fabrics	84%
Digital photography	81%
Written strategic plan	77%
Web site	76%
Computer-aided design (CAD)	74%
Computerised project management	67%

These technologies and practices were used by more than three-quarters of the sample, except for *CAD* and *computerised project management*. These results can be compared with a Canadian study by Anderson and Schaan (2001). Results from that study, based on a 1999 Statistics Canada survey of the engineering construction sector, showed much lower adoption rates than the Queensland study, as shown in Figure 1. The Queensland results shown are for contractors only, to match the scope of the Canadian study. The Canadian results are for contractors in the entire engineering sector, which includes not only roads and bridges, but also relatively high-tech oil, gas, and industrial projects, for instance. The broader coverage of the Canadian results should have biased their innovation rates *upward*.

[4] The total number of technologies and practices listed for the 180 non-suppliers was 46; for the 28 suppliers in the sample there were 20 listed, except for equipment distributors, for which there were only 14.

Figure 1: Queensland/Canada: Compared Adoption Rates for Commonly Listed Technologies and Advanced Practices[5]



Note: Canadian data was drawn from Anderson and Schaan (2001), based on a sample of 1,800 establishments, compared to 208 organisations in the Queensland study. The Canadian study only considered organisations with revenue greater than $50,000 (Canadian). There was no size threshold in the Queensland study; therefore there are likely to be more smaller organisations in the local study, biasing adoption rates downward.

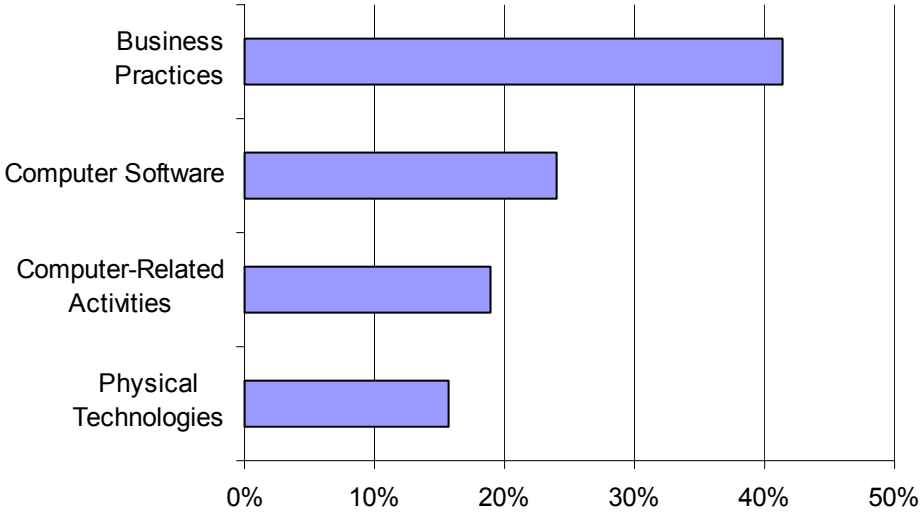
Queensland's adoption rates were higher than Canada's for all commonly listed technologies and practices, and *substantially* higher in most cases. The *extent* of Queensland's dominance is unlikely to be explained merely by the three year time difference. The evidence suggests that contractors in the Queensland road and bridge industry may be more innovative than contractors in the Canadian engineering construction industry, though more rigorous comparison is required in order to draw robust conclusions. The Queensland usage rate for digital photography was seven times higher than that in Canada, five times higher for quality certification, four times higher for written strategic plans and nearly twice as high for computer networks. Queensland's usage rate for CAD was only slightly higher, indicating that, given the time difference, Canada is likely to be more advanced in this area.

[5] The technologies and advanced practices shown are those that were listed in both surveys. Different survey contexts meant that the lists were very different.

Most Successful Adoptions

Respondents were asked to nominate their one most successful adoption of a technology or advanced practice. The responses were allocated into broad categories of technologies and practices, as shown in Figure 2.

Figure 2: Broad Technologies and Practices Contributing Most to Organisation Success, by % of Respondents



Notes: Physical technologies are materials, products, plant and equipment. Computer-Related Activities include: email, internet and computer networks.

The dominance of *business practices* points strongly to the importance of non-technical improvements in innovation processes. *Business practices* include quality assurance systems, human resource practices, strategic plans, relationship management, on-going collaborative arrangements with other organisations, financial systems management, and health/environmental considerations. These 'soft' factors comprised a significant class of successful innovation.

This finding is consistent with previous studies which have concluded that business practice innovations, otherwise known as organisational innovations, are particularly important to business success. This importance is partly due to the role that business practice innovation plays in supporting technological innovation. 'Organisational change almost always leads to or is accompanied by new products, improved quality, or the adoption of a more efficient process of production or delivery' (Hamdani 2001, 34).

Further, business practice innovation is more important in service industries, such as construction, than in the manufacturing industry (Hamdani 2001, 2002). This is particularly so given the challenges faced by the construction industry, in Australia and overseas (eg. Gyles 1992; Egan 1998; Cole 2002; Fairclough 2002). In order 'to cope with new challenges [in the construction industry] … firms have had to resort to

organisational [business practice] innovations both internally and through their relations with other firms' (Miozzo and Dewick forthcoming 2002, 3).

Impact of 'Most Successful Adoptions'

Table 3 gives an indication of the extent to which respondents believed that their *most successful* adoption benefited their organisation.

Table 3: Impact of Most Successful Adoption

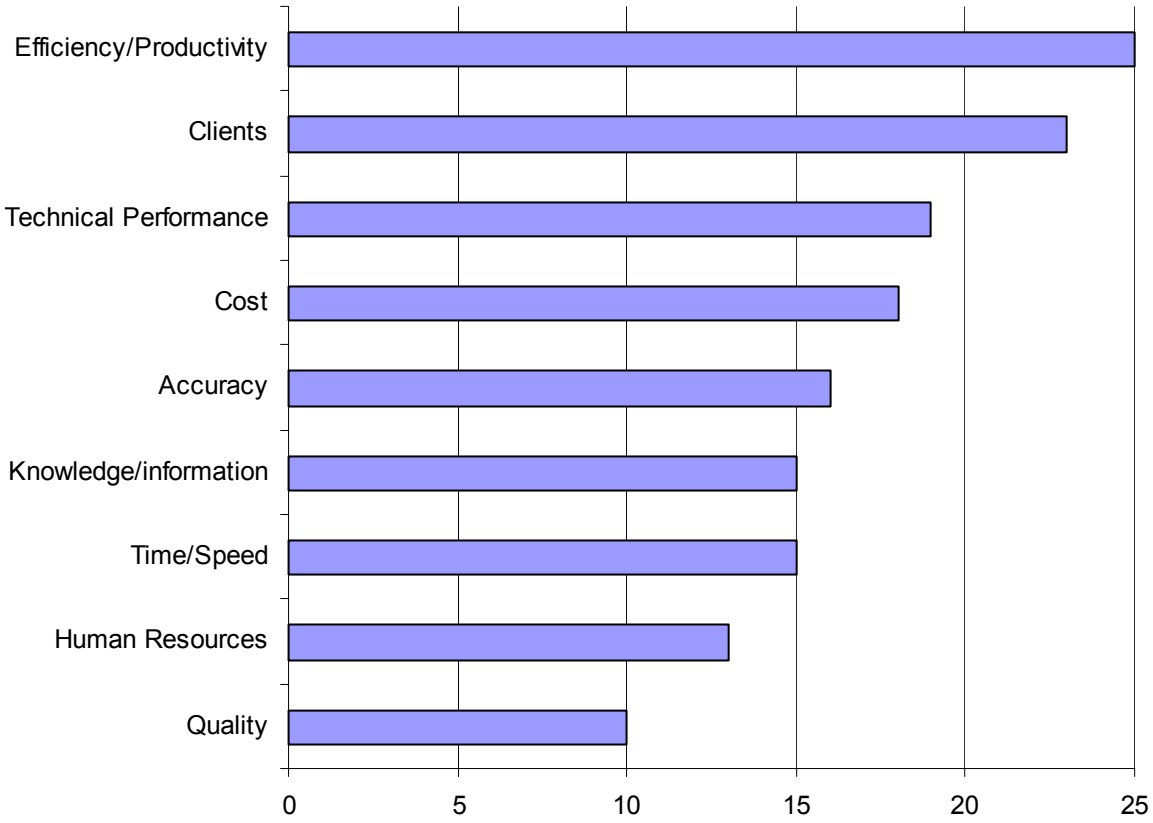
Importance to Organisation	Number of Respondents	Percent Respondents
Very Low	1	1%
Low	4	2%
Moderate	37	21%
High	102	58%
Very High	32	18%
All Categories	**176**	**100%**

Three-quarters of respondents rated their most important adoption as having a *high* or *very high* impact on improving the effectiveness of their organisation. This supports evidence in the literature attesting to the importance of innovation in economic growth (eg. Hobday 1995; US Commerce 1994; Fagerberg 1987).

Drivers Behind Adoption of Technologies and Practices

Respondents were asked to nominate the main reason for adoption of their most successful technology or practice. Results revealed a very broad range of motivations, with 23 types of 'drivers' nominated by at least five respondents. Figure 3 overleaf shows the nine categories of response nominated by at least 10 respondents.

Figure 3: Reasons for Adoption of Most Successful Technology/Practice, by Number of Respondents

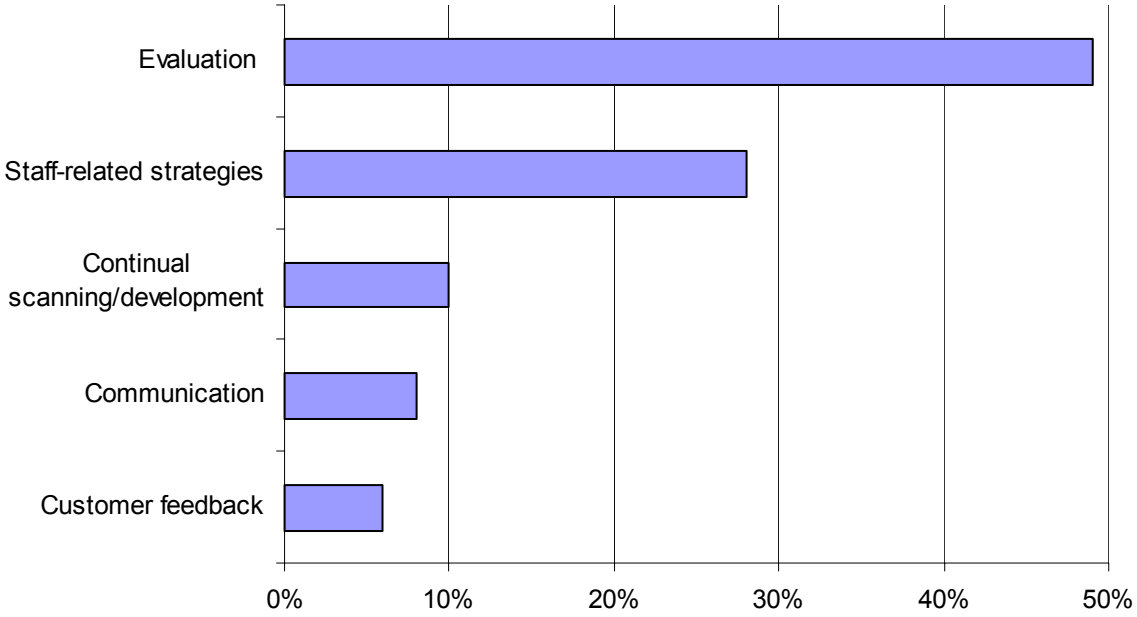


The most common driver was *efficiency/productivity*, nominated by 15 per cent of respondents to this question. Combining the financial performance drivers reveals that nearly one in four respondents nominated *efficiency/productivity* or *cost*. *Clients* was the second most important driver, nominated by 14 per cent of respondents. This is an important finding, confirming the pivotal role clients can play in promoting innovation along the supply-chain by demanding ever more innovative outputs.

Strategies Used to Maximise Benefits from Adopted Technologies and Practices

Respondents were asked how they ensured their adoption of technologies and practices added maximum value to their organisation. Responses showed that there were two clearly dominant strategies used to gain the most benefit from adopted technologies and practices, as Figure 4 reveals. The five strategies were each nominated by at least 10 respondents.

Figure 4: Top Strategies Used by Respondents, by % of All Responses



Evaluation was employed by nearly half of the 155 respondents to this question, while *staff-related strategies* were employed by over one-quarter. Evaluation primarily comprised reviewing and monitoring activity, while staff-related activities primarily involved training staff, encouraging feedback from staff, attracting the best staff and making staff feel valued. Together, communication and related strategies, such as relationship building, customer feedback and marketing, were employed by nearly one in five respondents.

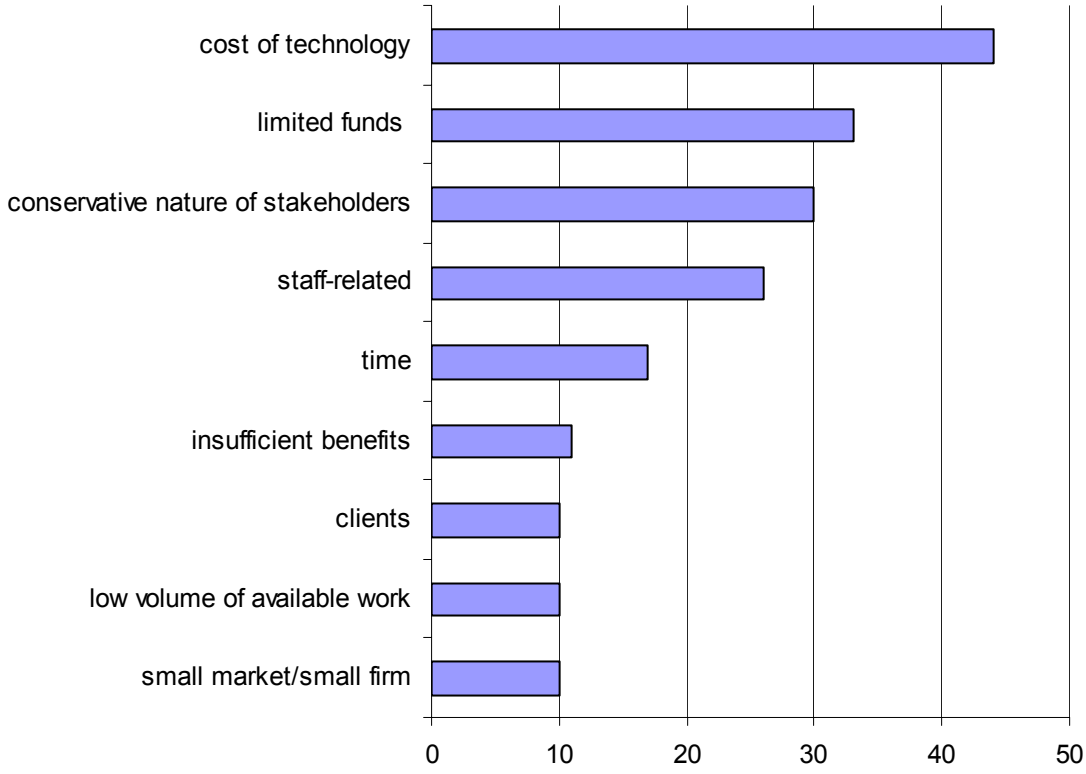
Forty-nine per cent of respondents used various techniques to evaluate the impact of innovation on organisation performance. This is similar to a PricewaterhouseCoopers finding, in their 2001 innovation survey of the building and construction sector in Australia, that 52 per cent of respondents 'measured innovation' (2002). These figures are not strictly comparable, but they do indicate similar trends. It is significant that roughly half of the road and bridge sector, as with the broader building and construction sector nationally, does *not* evaluate innovation performance.[6]

Obstacles to the Adoption of Technologies and Practices

Respondents were asked to nominate the biggest obstacle they had encountered to adopting more technologies or practices. Figure 5 shows the types of obstacles that were nominated by at least 10 respondents. As might be expected, the dominant obstacles were financial.

[6] Interviews associated with the current research project indicated that many organisations are seeking guidance to develop effective methods to gauge the impact of innovation. An Australian study will soon be initiated to investigate organisations with active evaluation systems to determine best practice approaches to the measurement of innovation outcomes. This is the CRC for Construction Innovation Project 12 based at Queensland University of Technology, due to commence in 2003.

Figure 5: Key Obstacles to Adopting More Technologies and Practices, by Number of Respondents



Nearly one-half of all respondents to this question noted financial constraints (cost/funds/money) as a significant obstacle to innovation. There was a marked difference in the way financial constraints were expressed by the private and public sectors. Nearly one-third of private sector respondents noted *cost* as the biggest obstacle to innovation, compared to only 18 per cent of public sector respondents. The latter group was much more likely to perceive obstacles in terms of funding constraints, with over one-quarter expressing financial problems in this way, compared to only 10 per cent of private sector respondents. This finding reflects the very different environments for innovation in the public and private sectors (see Manley 2001).

Nearly three-quarters of the respondents nominating the conservative nature of stakeholders as a significant obstacle were from the public sector. This is consistent with findings from Manley (2001, 30) showing that public sector innovators operate in a highly constrained environment which is dominated by risk-averse bureaucratic attitudes. In fact, studies of public sector innovation in Canada and the United States have found this factor to be the most significant obstacle to innovation in the public sector, more constraining than inadequate resources (Borins 2000).[7]

[7] Note that the perception of 'inadequate funds' in the public sector is, in itself, very likely to have arisen from a risk-averse culture.

CONCLUSIONS

The evidence presented in this paper points to the importance of: innovation to business success, particularly people-centred/non-technical innovation; clients in 'driving' innovation activity; and active evaluation systems in maximising the benefits of innovation.

Although there are significant obstacles to maximising innovation performance, related mainly to perceived risk and inadequate resources, the findings of the current study suggest that inventive means of circumventing limitations exist. These will be explored in detail in a related research project to be completed in 2005.

Again, readers interested in more detailed findings are referred to Manley (2003).

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