Demonstrating the Benefits of Construction Innovation

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Stream: D: Strategic Innovation Processes and Performance

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Abstract

The construction industry needs to achieve greater efficiency and effectiveness. However, change is not readily embraced by the industry. This resistance to change compromises innovation performance, and negatively impacts client and industry goals. One of the key reasons for relatively poor construction industry performance is scepticism about the potential benefits of innovation, particularly among small and medium-sized businesses. This paper investigates the links between innovation and project performance, with a view to demonstrating the benefits that can be achieved. It offers case study evidence of the tangible, monetary benefits of innovation to businesses. The paper is based on innovation case studies in the Australian construction industry undertaken in 2003. It concludes with a discussion of the distribution of innovation benefits and the impact on incentive structures. In future research the results will be interpreted more widely, by undertaking a comprehensive integrative analysis of existing academic literature on construction innovation benefits.

Keywords

Innovation benefits, innovation drivers, construction industry culture, innovation case study

INTRODUCTION

Since the early 1990s the construction industry has been under increasing pressure to improve efficiency and effectiveness. The drivers of industry improvement that emerged last decade still

apply pressure today. These drivers include the emergence of more demanding clients as public sector resources shrink, the challenges of increasingly global competition, and the demands of strict environmental legislation (Seaden 2001, 3).

Yet, concerns about the industry's performance remain. In Australia, productivity is still less than the all-industry average and client satisfaction levels are an on-going problem (Cole Royal Commission, 2003, 3).

This paper, with its goal of demonstrating the benefits of innovation and changing attitudes to innovation in the industry, responds to the opportunity for improvement, and to the lack of existing research on construction innovation benefits.

There is a very considerable literature on the broad topic of construction innovation drivers and their operation in a variety of countries (see Blayse and Manley 2004), with the contributions of four authors standing out: Seaden (e.g., 1996), Winch (e.g., 1998), Slaughter (e.g., 1998; 2000) and Gann (e.g., 2001). These authors appear to most effectively mobilise expertise based on both the construction industry literature and the innovation literature. However, despite the significant contributions of these authors, there remains an opportunity to contribute to the literature by exploring construction innovation benefits, using Australia as a case study.

The exploratory case study research described in this paper provides input into future studies on the net benefits of innovation and associated economy-wide impacts. Related issues surrounding successful implementation of construction innovation are also beyond the scope of the current paper; they were, however, examined as part of the overall research project, and interested readers are referred to Manley and Blayse (2003).

METHODOLOGY

A case study program was adopted in response to the research questions:

> What are the benefits arising from construction innovation on recent projects in the Australian commercial building and road sectors?
>
> Who captures those benefits?

The resources available to the case study program dictated that six case studies could be undertaken over nine months, between April and December 2003. The case studies were nominated by industry partners associated with the research project, and only examples which could demonstrate measured benefits arising from innovation were eligible for inclusion in the program. The innovation examples showing the greatest benefit to a construction project were selected for study. These best practice examples covered innovation arising from the contractor, consultant, client and supplier sub-sectors.

The case study program focused on construction innovation on projects in the Australian states of Queensland, New South Wales and Victoria. The focus on construction 'projects' arose because most readily identifiable innovation takes place in that context. The focus on the three states was driven by the fact that they account for 80% of Australia's construction activity (Cole Royal Commission, 2002, 16).

The case study program was limited to the engineering and commercial building sectors of the industry, reflecting the focus of the stakeholders (industry partners) in the research project. These

sectors are also the most innovative when measured by R&D expenditure (McFallan 2002, 19), and they are therefore likely to provide good examples of the benefits to be gained from innovation.

The case studies were based on semi-structured interviews, and background documentation including award submissions, academic papers, magazine articles, internal reports and workshop presentations. Each case study involved multiple interviews covering representatives of at least two different organisations on the construction project being analysed. Each interviewee was a senior technical or management representative, and the range of interviewees covered all types of industry participants including clients, contractors, consultants and suppliers. Altogether, 20 interviews were undertaken; 17 under face-to-face conditions, and three by telephone.

The types of innovation studied involved both original innovation (that is, previously unseen developments) and adoptive innovation (that is, the use of advanced developments for the first time by a particular business). ‘Adoption’ of existing innovation by a business for the first time, is increasingly considered a valuable form of innovation (DITR 2003, 15). Adoption activity can be seen as ‘incremental’ innovation, which diffuses the benefits of more ‘radical’ innovations. Further, both technological and organisational innovations were researched.

The Discussion section of this paper draws on the six case studies undertaken, however the space limitations of this paper dictate that only one of the case studies can be reviewed here. This is the Port of Brisbane Motorway Study, which was the most extensive study undertaken.

CASE STUDIES AND INNOVATION BENEFITS

Most of the innovations examined on the six case studies involved the adoption of advanced technologies or practices on a particular project. These innovations were new to the project team, without necessarily being new to the world or even Australia, however it was found that they resulted in significant benefits. The diffusion of existing advanced technologies and practices would seem to offer important opportunities for growth.

Case Study: Port of Brisbane Motorway

The Port of Brisbane Motorway (POBM) Alliance was formed to deliver five kilometres of four-lane motorway and 12 major new bridges, to carry an expected 8,000 trucks per day by 2011, for a Total Cost Estimate (TCE) of $A112 million. The project was completed early and under the TCE, after a one-year construction program. The motorway was opened in December 2002.

Alliances are an innovative form of project delivery, with Australia leading the way in applying the approach to building and road projects. The POBM Design and Build road project alliance in Queensland appears to be the first alliance of this type employed internationally. It follows from the successes of smaller road construction alliances undertaken in Queensland, the first building project alliance internationally on the successful Australian National Museum project in Canberra, and the longer-running successes of project alliances in the gas and oil industry.

The key innovation on the POBM project was the formation of an alliance to deliver the motorway. The Request for Proposals (Queensland Motorways, 2000, 10) described the features of the alliance:

> Unlike traditional forms of contract where risk is allocated to different parties, under a true project alliance, the Alliance Participants take collective ownership of all risk

associated with delivery of the project, with equitable sharing (in fixed pre-agreed ratios) of the ‘pain’ or ‘gain’ depending on how the outcomes compare with pre-agreed targets. The risk/reward arrangements are designed so that exceptional performance will deliver excellent outcomes for all parties while poor performance will result in poor outcomes for all parties. This underlying commercial alignment is consistent with a ‘no blame/best for project’ alliance philosophy that focuses all parties on achieving common objectives, so as to attain a ‘win-win’ result.

These features led to harmonious project relationships and hence the pursuit of opportunities for improved project performance that would not otherwise have been explored. Innovation on the POBM project centred on the alliance itself, but also involved a number of associated developments, which were facilitated by the alliance structure. These innovations included:

- three-dimensional Global Positioning System (GPS) to control machinery – adopted for the first time on a construction project in the southern hemisphere;
- third party certification for safety, quality and environment – using integrated management systems to achieve triple-certification for the first time on an Australian road project;
- slip-formed, reinforced bridge barriers – adopted for the first time in Queensland;
- water quality design – winning an Australian award; and
- elevated tri-level motorway interchange – the first designed and constructed in Queensland.

The benefits of the innovations adopted under the POBM Alliance were extensive. The main measured benefits included those set out in Table 1.

Table 1: The Benefits of Innovations on the POBM

Project Cost	10% saving on the TCE – this amounted to a saving for the client of $A13.4 million, $A5.5 million of which was delivered as additional project scope.
Time	Delivered six months ahead of expectations, representing a 30% reduction in time required for completion.
Traffic Management Costs	10% reduction in traffic management costs compared to recent South East Queensland projects – traffic management costs on the POBM constituted 2.3% of construction costs, compared to an average of 2.6% across similar projects.
Lost Time Injury Frequency Rate (LTIFR)	40% improvement in the LTIFR, which for the Alliance package on the POBM was 3.5, compared to an average rate for the main contractor's civil projects of 5.9 over the past three years – this result has been assisted by innovations such as 3-dimensional GPS, which reduces the rate of injury to 'stringers' interacting with earthmoving machinery.
Direct Bridge Costs	Saved up to 30% in direct bridge costs compared to industry averages.
Earthworks/Drainage/Pavements	All delivered at the lower- to mid-region of the range of costs associated with a sample of major urban road projects

in South East Queensland.

These measured benefits sit alongside a number of other significant project achievements flowing from the innovative alliance structure, many of which are difficult to quantify. For example, the project was completed with no residual contractual issues or risk of litigation and no requirement to allow further contingencies for these issues. This meant less dependence on programming resources for activities other than those focussed on 'getting the project built'. This outcome was despite the emergence of several construction related issues which, under a traditional delivery method, would most likely have led to extra cost and/or delays.

DISCUSSION AND CONCLUSIONS

The six innovation case studies, particularly the POBM study described here, show the extensive benefits that can derive from innovation, whether the innovation is 'new' in a global sense, or whether it involves a business adopting an existing advanced practice or technology for the first time. In fact, the case studies reveal that businesses reap substantial benefits from adopting and extending innovations developed by others; a process known as adoptive or incremental innovation. This is in keeping with the findings arising from the Australian Prime Minister's initiatives to map Australia's science and innovation capacity, which show that incremental innovation is a key driver of business success across a range of industries (Thorburn and Langdale 2003).

The case studies demonstrate that incremental innovation is often driven by market-pull factors, frequently involving non-technological activity, such as linkages with global experts; relationships with manufacturers and clients; or building trust between project stakeholders. The

POBM study demonstrates the last point very clearly, with cooperative relationships arising from joint sharing of risk and reward across all project partners. Radical innovation, on the other hand, tends to be driven by technology-push factors. The distinction underlines the relative importance of organisational skills (which are mostly associated with incremental innovation), compared to technical skills (which are mostly associated with radical innovation), for the majority of innovation undertaken in the building and construction industry.

Similarly, although the case studies undertaken by the BRITE project illustrate the long-term benefits flowing from large-scale formalised research and development (R&D) programs, they more often provide evidence of the importance of non-R&D innovation activity. The POBM study provides a clear example, with its emphasis on organisational change. This finding is in keeping with growing evidence nationally and internationally, and across industries, that R&D and non-R&D innovation activities are both important in improving business performance. It also adds weight to the calls frequently made for a rethinking of the Australian Government's R&D tax concession, with its narrow definition of eligible expenditure.

The case studies focused on innovation in the context of building and construction projects. The project-based nature of production within the building and construction industry adds a complication which is absent from other industries – although an innovator may see an opportunity to improve project performance, benefits flowing back to the innovator may be harder to see. This can reduce innovation in the industry. However, the case studies show that innovation history is increasingly taken into account by clients in awarding work, potentially leading to less industry concern about the distribution of project benefits and greater reward for 'best-for-project' thinking.

Clearly, further research is required internationally to investigate the *net* benefits of construction innovation and the economy-wide implications of such activity, while readers interested in the implementation processes underlying successful construction innovation are referred to Manley et al (2004). The next phase of this research will involve interpreting the results more widely, by undertaking a comprehensive integrative analysis of emerging academic literature on the topic of construction innovation benefits.

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