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Innovation performance and its impact on profitability among different sectors in the Australian construction industry

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ABSTRACT

The BRITE (Building Research Information Technology and Environment) project was established by the Australian Cooperative Research Centre for Construction Innovation to encourage innovation in the construction industry. While innovation is generally perceived to be broadly beneficial, there has been little formal study of its occurrence or impact in Australian construction or of the factors which foster an innovative atmosphere within an enterprise. In order to benchmark innovation performance, the BRITE project conducted a survey in 2004 into the nature, incidence and variety of technological and organisational innovations in various sectors of the industry. With some exceptions, the survey found that clients and consultants engaged in significantly higher levels of innovation than did suppliers, main contractors or trade contractors. Within the industry sectors those organisations classified as high innovators favoured the adoption of advanced management practices and had formal evaluation systems in place to judge their progress. They reported significant positive impacts on their profitability from innovation and can therefore provide instructive examples for the rest of the industry to follow.

Keywords: construction innovation, innovation performance, profitability effect, innovation blockers, industry sectors

INTRODUCTION

It is important to recognise that innovation in construction is not confined to new technological inventions. Innovation has been defined as a "non-trivial improvement in a product, process or system which is novel to the company developing or using it" (Slaughter 2000). Thus innovation may range through such things as management or organisational programs, incremental or evolutionary systems development, iterative design and production processes

or entirely new construction materials or components. An innovation may be new to the world, new to the country, new to the industry or new to the organisation adopting it. For the survey the adoption of an improvement from another industry and applied to the construction industry is included whether or not substantial changes need to be made to the idea in its new setting. The absolute frequency of individual innovation events is difficult to judge because the innovation process may involve several stages each of which could possibly be regarded as an innovation in itself. For this reason it was considered more useful to concentrate on the measurable benefits of innovation and whether or not it is deemed to have occurred rather than seeking to quantify its rate of occurrence.

The importance of innovation to the construction industry at all levels is now widely accepted. Innovation has frequently been found to have strong links with economic performance and growth (Gann 2003). Ideas can be generated in any of several ways, but the creative process requires certain favourable conditions if it is to produce realisable improvements. Such realisable or measurable benefits are necessary if an innovation is to be regarded as successful. The connection between innovation and profitability has been acknowledged by diverse sources (Flynn et al. 2003; Steele and Murray 2004; van der Panne et al. 2003). The BRITE Survey tested, among other things, the strength of the relationship between innovation and profitability.

SURVEY INFORMATION

The full BRITE Innovation Survey Report 2004 is available at <http://www.brite.crcci.info/publications/index.htm>. A comprehensive description of the survey methodology and a copy of the questionnaire are included in the survey report. The study focussed on the commercial building and civil engineering sectors and did not include residential construction. Organisations approached to complete the questionnaire were drawn from public sector construction and roads agencies, plus their pre-qualification lists for contractors and consultants, together with the membership lists of eight industry associations. Consequently the questionnaire respondents were likely to be dominated by medium sized enterprises and are unlikely to have included the very small or 'micro' section of the industry. The survey sample was drawn from 3,500 organisations in the states of New South Wales, Queensland and Victoria. One third of this population was sampled. The surveys were sent by mail and addressed to individuals at senior management level. 383 completed surveys were received for what is considered to be an acceptable overall response rate of 29%.

Information was collected on the respondents' perceptions of the determinants of innovation in the industry. Innovation was specifically defined to include both technological and organisational improvements. Incremental as well as radical or breakthrough changes were both regarded as innovations. Innovations were further classified as 'new to the organisation', 'new to the industry', 'new to the country' and 'new to the world'. After analysis of the survey response, respondents were classified as high, medium or low innovators according to an index compiled from the degree of novelty and profitability of their innovations, along with the

number of advanced managerial practices adopted and the level of investment in research and development. Perceptions of the principle drivers and blockers to innovation were the subject of further questions in the survey. Rates of adoption of advanced management practices, as well as technological and human resources strategies were also recorded.

INNOVATION AND RESEARCH ACTIVITY

The survey reported a 'new to industry' rate of technological innovation of 18% which is a comparable result to an economy-wide rate of 17% for a recent New Zealand study (Statistics New Zealand 2004). Measuring innovation rates is problematic because of the differences in the way innovation events can be defined. The New Zealand study was considered a useful comparator because it relied on basic assumptions quite similar to those of the BRITE survey.

The degree of innovation novelty was classified according to whether the reported change was new to the organisation, new to the industry generally, new to the country or new to the world. Overall 25 respondents or 6% of the total reported 'new to the world' technological innovations. 17 of the 25 were consultants, indicating that these were the key source of high level technical innovation. Interestingly, consultants were also the group with the highest percentage reporting no technological innovations indicating that the consultant group was diverse in its makeup and was involved in different sub sectoral areas. No main contractors reported 'new to the world' innovations but they did report high levels of 'new to the country' innovation and this is indicative of their local competitive focus. 10 respondents or 2.6% reported 'new to the world' organisational innovations. Consultants produced half of these high level organisational innovations and main contractors, by contrast, again listed none. These are self reported assessments and not all sectors are likely to keep a close watch on international developments in their field. Main contractors and trade contractors, in particular, seem to have largely focussed on organisational comparisons with their local competitors rather than national or international developments and this is what might reasonably have been expected. More respondents reported no organisational innovations than reported no technological innovations (31% as against 25%). It is possible that technological innovations are easier to recognise and therefore more readily acknowledged.

Widely regarded as a key indicator of technological innovation is commitment to Research and Development (R&D) (Fraser and Zarkada-Fraser 2001; Gann 2000). The BRITE survey found that while one-quarter of the industry invests in R&D, the actual performance of R&D is much lower. The industry tends to rely on research done by organisations lying outside its formal boundaries. These are typically the CSIRO and university research organisations, as well as, the Co-operative Research Centre for Construction Innovation. Perhaps as a result of this outsourcing, industry sectors varied in their awareness of the Australian Government's R&D tax concession, although in all sectors the awareness of the scheme was low.

The survey reported a very low successful claim rate of 15%. The very high 'don't know' response (49% of all respondents) about eligibility for R&D tax concessions (see Figure 1 below) may indicate lack of knowledge of the scheme, high compliance and verification costs and concerns about strictly administered program guidelines. Consultants, suppliers/manufacturers and trade contractors all reported 'don't know' rates of over 50%. The discrepancy between the reported level of R&D and the successful claiming of the tax concession indicates problems with either the administration or the publicising of the tax concession. The BRITE Project has brought this finding to the attention of the appropriate government and industry bodies.

Insert Figure 1 – Ability to claim R&D tax concessions

INNOVATION DETERMINANTS

Another significant finding from the BRITE Survey is that a key determinant of innovation outcomes can be found in the range of business strategies adopted. The strategies surveyed were identified from an extensive literature review (Blayse and Manley 2004) and from industry workshops held in Brisbane. They included: Actively encouraging your employees to seek out improvements and share ideas; Recruiting experienced employees; Recruiting new graduates; Participating in apprenticeship programs; Providing or supporting training programs for your employees; Use of multi-skilled teams; Enhancing your business's technical capabilities; Introducing new technologies; Investing in research and development (R&D); Participating in the development of industry standards and practices; Protecting your business's intellectual property; Delivering products/services which reduce your clients' costs; Increasing your market share; Building relationships with existing clients; Attracting new clients; and Providing a broader range of services to your clients. All sectors other than clients reported adopting more than half the strategies listed and clients were slightly under half. This is probably due to some of the strategies not being relevant to large public sector clients who are not normally concerned with market share or the delivery of products.

Insert Figure 2– Sector adoption of business strategies

A significant positive correlation was found between the number of business strategies employed by a firm and the number of advanced practices adopted, in other words, organisational innovation. The advanced practices listed were once again identified from a literature review and workshops. They consisted of: Long-term collaborative arrangements with other businesses; Quality certification (eg ISO 9000); Staff training budget; Written evaluation of new ideas in order to develop options for your business; Documentation of technological/organisational improvements developed by your business; Written strategic plan; Computer networks (LAN or WAN); Web site; Computerised systems for estimating,

inventory control, modelling, asset analysis, project management, etc; 3-D CAD; Computerised asset analysis (eg. HDM4); Computerised project management; Digital photography; Office-to-site video links or video conferencing; On-line-remote-construction-management; Intelligent systems; Alliance contracts; Risk-sharing/performance-incentive contracts; Design and construct contracts; Design/build/fund/operate (DBFO) contracts or public-private partnerships (PPPs); Managing contractor arrangements; and Partnering on projects, or other relationship forms of contract.

A correlation was also found between the use of formal evaluation programs to monitor innovation value and high level technological and organisational innovation. However, only 15% of respondents were currently using such programs. This identifies a suitable area of action for those organisations seeking to raise their level of innovation performance.

There was some consistency across industry sectors with regard to the principal drivers of innovation within the industry. 'Improving efficiency/productivity' and 'responding to client/customer needs' were considered the most important drivers by all five sectors. Similarly, 'reducing cost' and 'reducing time' were given low significance for innovation by all groups. This does not mean that reducing cost and time were unimportant to the respondents but that they were not of themselves the issues that drive the search for innovation. In terms of obstacles to innovation, consultants were more likely to see the cost of the initiative as an obstacle (particularly the high innovators) while contractors in general saw 'conservative stakeholders/clients' as a major obstacle. Trade contractors were more likely to see 'time' as an obstacle and suppliers indicated there were other obstacles they had to deal with.

Insert Figure 2 – Main Innovation Drivers per Sector

Insert Figure 3 – Main Innovation Obstacles per Sector

On the matter of sources of innovative ideas, suppliers were less likely to gather ideas or information about new technologies or advanced practices for their business from previous projects and, like trade contractors, they were more likely to source ideas from suppliers than were other sectors. Clients were more likely to gather ideas or information about new technologies or advanced practices for their business from conferences/workshops and in-house staff (See Table 1). Trade contractors, perhaps not surprisingly, saw their trade associations as a significant source of innovative ideas. It may be concluded therefore that professional and trade associations are a suitable avenue for spreading information ideas throughout all industry sectors and especially those that are currently under-performing.

Insert Table 1 – Innovation Sources by Sector

The sectors varied considerably in their attitudes to the important business strategies listed in the survey questionnaire. Clients were more likely to invest in R&D and recruit new graduates than the other sectors. Indeed almost all clients who responded to this part of the survey said that they had training programs in place for their workforce. Trade contractors were most likely to be involved with apprenticeship training and consultants least likely. This is a consequence of the traditional delivery in Australia of trade and university education through separate systems. It may be that future training systems could develop that are hybrids of the two current systems but at the moment such systems are structurally difficult because of varying Federal and State government responsibility.

Clients were somewhat more likely than other sectors to support most of the business statements listed in the survey. This result was statistically significant. The business statements listed were: We have robust relationships with key organisations in the industry; We actively monitor international best practice in our field; We actively monitor advances in related industries that might be applicable to our business; We have a formal system for transferring project learnings into our continuous business processes; When we make changes, we measure how well the changes have worked; We reward staff for maintaining networking linkages with strategically useful industry participants; and We have a formal system to encourage staff to share ideas. Rewarding staff for maintaining linkages with other industry participants was an under-utilised policy throughout the industry. This is something that managers might like to consider as a precondition for innovative practice.

The client sector was more positive about the industry's capacity for innovation than were the other sectors. They were less likely to label other industry groups as blockers of innovation (see Table 2). Clients considered that 'funders' were more likely to encourage innovation than block it. All other groups disagreed. Clients displayed a more positive attitude to main contractors than trade contractors did. Main contractors, in turn, were unimpressed with trade contractor's innovation performance. A certain level of mutual distrust appears to exist between these groups. All sectors exhibited a tendency to nominate other groups as encouragers of innovation more frequently than they nominated blockers. In general, sectoral attitudes appear to be largely positive towards the role of the differing groups within the industry.

Insert Table 2 – Perceived Encouragers and Blockers of Innovation by Sector

The results on advanced business practices, business strategies and business statements illustrate the breadth of the data collected by the survey. Detailed analysis of these results is being undertaken for future papers.

IMPACT ON PROFITABILITY

In total 93% of respondents reported a positive impact on profitability resulting from their most successful innovation in the past three years. Almost half of these experienced a 'moderate

improvement' in profitability (see Figure 5). This effect was spread fairly evenly throughout the different industry sectors with no significant differences between the sectors. It is possible that the effects of innovation produce other positive outcomes that are not immediately reflected in the organisation's 'bottom line'. Increased market share, for example, may take some time to result in a profitability impact due to costs related to expansion. Extrapolating from those respondents who did report 'significant' or 'great improvement in profitability' the survey results indicate that businesses may be able to increase their profitability by: adopting a greater number of advanced practices; implementing a formal innovation strategy; or employing a greater number of knowledge strategies.

Insert Figure 5 – Profitability effect of most successful innovation

CHARACTERISTICS OF HIGH INNOVATORS

High innovators across all sectors had a number of characteristics and practices in common. These include: placing a significant value on employee, technology and knowledge strategies; using a broad range of sources of innovation ideas; having a formal innovation evaluation program; relying on research institutions for innovative ideas; recruiting new graduates; capturing project learnings for ongoing reference; reducing client costs; and monitoring international competition. Businesses wanting to improve their innovation performance should therefore consider adopting similar behaviours to those of the high innovators within their sector. This is the most significant finding that can be gleaned from analysis of the survey response.

SECTORAL DIFFERENCES

Clients were over represented in the survey's high innovator group. This result was influenced by the fact that many of the client groups surveyed were large public sector repeat clients. This was due to the fact that in Australia the government sector clients account for most of the road industry and a significant portion of the commercial building industry. There were also a greater than expected number of suppliers in the low innovator group. This is contrary to the findings of some innovation literature which generally sees suppliers as drivers of innovation (Arditi et al. 1997; Abd El Halim and Haas 2004; Kangari and Miyatake 1997).

Insert Figure 6 - Level of innovation performance by sector

The innovation index which was used to define each sector's performance was based on four measures. These were the degree of innovation novelty, the impact of innovation on profitability, the level of adoption of advanced practices and the importance placed on investing in R&D. The client and consultant sectors on average performed positively on the innovation index. Main contractors on average performed poorly on level of innovation profitability and on number of advanced practices adopted but otherwise their average ratings

were positive. Suppliers/manufacturers and trade contractors as a sector performed below the industry as a whole on those factors which made up the innovation index. Nevertheless there were some high innovators among each industry sector and the practices of these high innovators are able to provide instructive examples for the low innovators in each sector.

CONCLUSION

The importance of fostering innovative practice in the construction industry has been widely acknowledged. The optimum way of encouraging innovation is, however, likely to vary with the industry sector being considered and the uptake of any innovations is also likely to be variable. Despite the variability in innovation performance between the industry sectors, recurring patterns do indicate common ground among those organisations regarded as successful innovators. Determining the characteristics of these high level innovators was one of the principal motives behind the BRITE survey.

The identification of the strategies already in use among high innovators is an aid in lifting the performance of the industry generally. Survey results lead to several indicative strategies for the improvement of innovation performance in the various sectors of the Australian construction industry. These are particularly useful for those sectors currently lagging in innovation performance. Contractors, suppliers and others who wish to improve their innovation performance may benefit from following some of the practices shown by the survey to be already in place in high innovator groups. These include:

- Raising general organisational skill levels with employee training programs and through the recruitment of new graduates;
- Maintaining a strong focus on profitability and therefore enabling an atmosphere where innovative activity can thrive;
- Actively monitoring developments within the industry at the appropriate level, locally and/or internationally;
- Having formal systems in place to capture project based learnings for ongoing use within the organisation;
- Providing a supportive atmosphere for staff who generate new ideas;
- Putting in place formal evaluation procedures to gauge the success of advanced technologies and practices as well as any negative repercussions they may have;
- Increasing both direct and indirect investment in R&D;
- Fostering linkages with research institutions and universities;
- Adopting a broad range of technology, knowledge and human resources strategies; and
- Surveying a wide spectrum of sources of innovation ideas.

The adoption of such innovative strategies needs to penetrate to all levels of the industry if the effect is to be significant and lasting.

Several messages can be drawn from the BRITE survey sector analysis. Government agencies can be of considerable assistance in fostering the innovation process. By acting through the medium of industry associations they can assist skill development. This would be particularly useful because low innovator groups were shown in the survey to be largely dependant on trade and industry associations for new ideas. Greater resourcing of education and training is also likely to assist in lifting innovation performance given the strong association between the spectrum of knowledge sources used and level of innovation performance. More effective targeting of tax and other measures to encourage R&D is indicated as requiring attention, given the current low uptake of these schemes in the construction industry.

Extrapolating from the survey results, another important finding is the primacy of general industry profitability in producing an atmosphere conducive to innovative practice. Sectors of the industry where financial security is least reliable were also least likely to innovate or to create high level innovations. At the risk of stating the obvious, constrained resources tend to result in defensive practices and risk aversion. This in turn leads to an avoidance of new ideas and a stubborn adherence to current practice. Well-placed confidence in the success and security of the industry is therefore seen as a prerequisite for innovative practice. Continued industry profitability, equitable distribution of the gains made through innovation and a regulatory system which allows for new solutions are all significant factors in the creation of an 'innovation-friendly' construction industry throughout all sectors.

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| | Clients | Consultants | Contractors | Suppliers/ Manufacturers | Trade Contractors |
|------------------------------------|---------|-------------|-------------|-----------------------------|----------------------|
| In-house staff | 87 | 73 | 66 | 59 | 64 |
| Previous projects | 57 | 39 | 42 | 13 | 45 |
| Professional or trade associations | 39 | 45 | 42 | 40 | 54 |
| Suppliers | 39 | 17 | 18 | 41 | 51 |
| Conferences/workshops | 70 | 40 | 37 | 35 | 36 |
| Clients or customers | 26 | 35 | 37 | 38 | 34 |
| Technical support providers | 48 | 29 | 28 | 21 | 30 |
| Research Institutions | 22 | 14 | 10 | 8 | 3 |
| Journals/magazines | 13 | 38 | 34 | 27 | 34 |
| Consultants | 43 | 20 | 28 | 10 | 15 |
| Overseas sources | 4 | 24 | 19 | 27 | 15 |
| General contractors | 9 | 6 | 9 | 6 | 4 |
| Trade contractors | 0 | 5 | 12 | 22 | 9 |
| Competitors | 4 | 18 | 30 | 22 | 27 |

Table 1– Innovation Sources by Sector (%)

| | Clients | | Consultants | | Contractors | | Suppliers/ Manufacturers | | Trade Contractors | |
|---|---------|----|-------------|----|-------------|----|-----------------------------|----|----------------------|----|
| | + | - | + | - | + | - | + | - | + | - |
| Large/repeat clients | 48 | 26 | 63 | 13 | 52 | 22 | 54 | 16 | 69 | 5 |
| One-off clients | 30 | 22 | 32 | 25 | 24 | 25 | 30 | 21 | 22 | 28 |
| Main contractors | 61 | 9 | 43 | 17 | 46 | 12 | 49 | 14 | 30 | 32 |
| Trade contractors | 22 | 13 | 20 | 18 | 24 | 25 | 40 | 13 | 35 | 16 |
| Manufacturers | 30 | 9 | 38 | 7 | 44 | 9 | 60 | 6 | 55 | 5 |
| Other suppliers | 17 | 4 | 18 | 6 | 22 | 6 | 35 | 3 | 38 | 5 |
| Architects | 30 | 13 | 66 | 5 | 55 | 6 | 57 | 8 | 43 | 23 |
| Building designers | 48 | 4 | 45 | 10 | 44 | 11 | 48 | 8 | 39 | 22 |
| Engineers | 78 | 4 | 60 | 12 | 52 | 13 | 41 | 24 | 35 | 27 |
| Quantity surveyors | 13 | 13 | 27 | 20 | 12 | 29 | 22 | 19 | 14 | 28 |
| Developers | 52 | 0 | 38 | 19 | 41 | 17 | 29 | 19 | 36 | 24 |
| Project managers | 70 | 4 | 40 | 19 | 30 | 22 | 37 | 16 | 35 | 22 |
| Funders | 48 | 9 | 10 | 32 | 15 | 24 | 11 | 30 | 15 | 28 |
| Insurers | 9 | 30 | 1 | 51 | 5 | 35 | 8 | 48 | 7 | 35 |
| Letting agents | 0 | 13 | 7 | 22 | 6 | 17 | 8 | 27 | 8 | 27 |
| Organisations that set industry standards | 35 | 22 | 22 | 28 | 26 | 27 | 22 | 32 | 31 | 27 |
| Government regulators | 48 | 26 | 63 | 13 | 52 | 22 | 54 | 16 | 69 | 5 |

Table 2 – Perceived Encouragers and Blockers of Innovation by Sector (%)

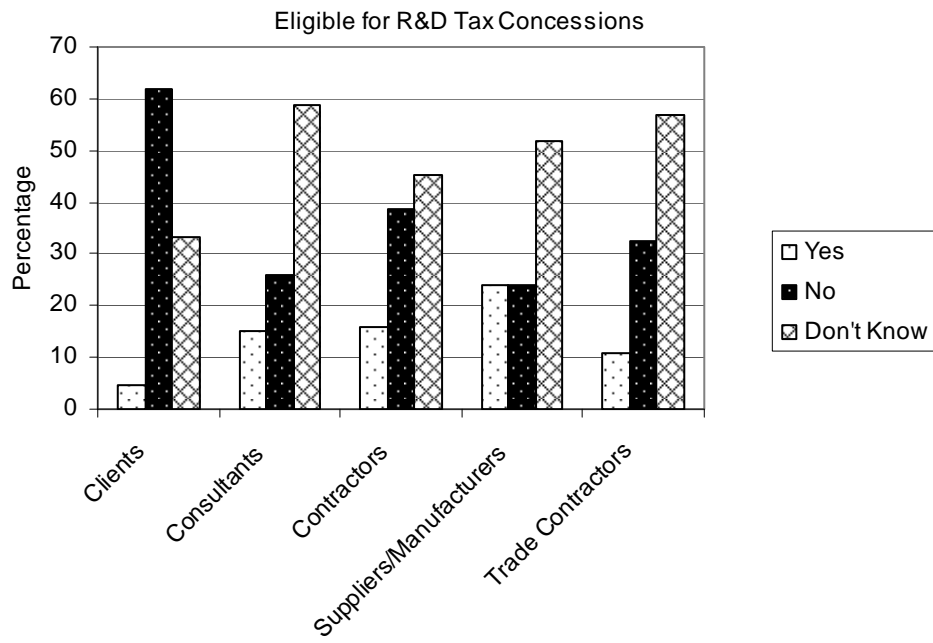


Figure 1 – Ability to claim R&D tax concessions



Figure 2 – Sector adoption of business strategies

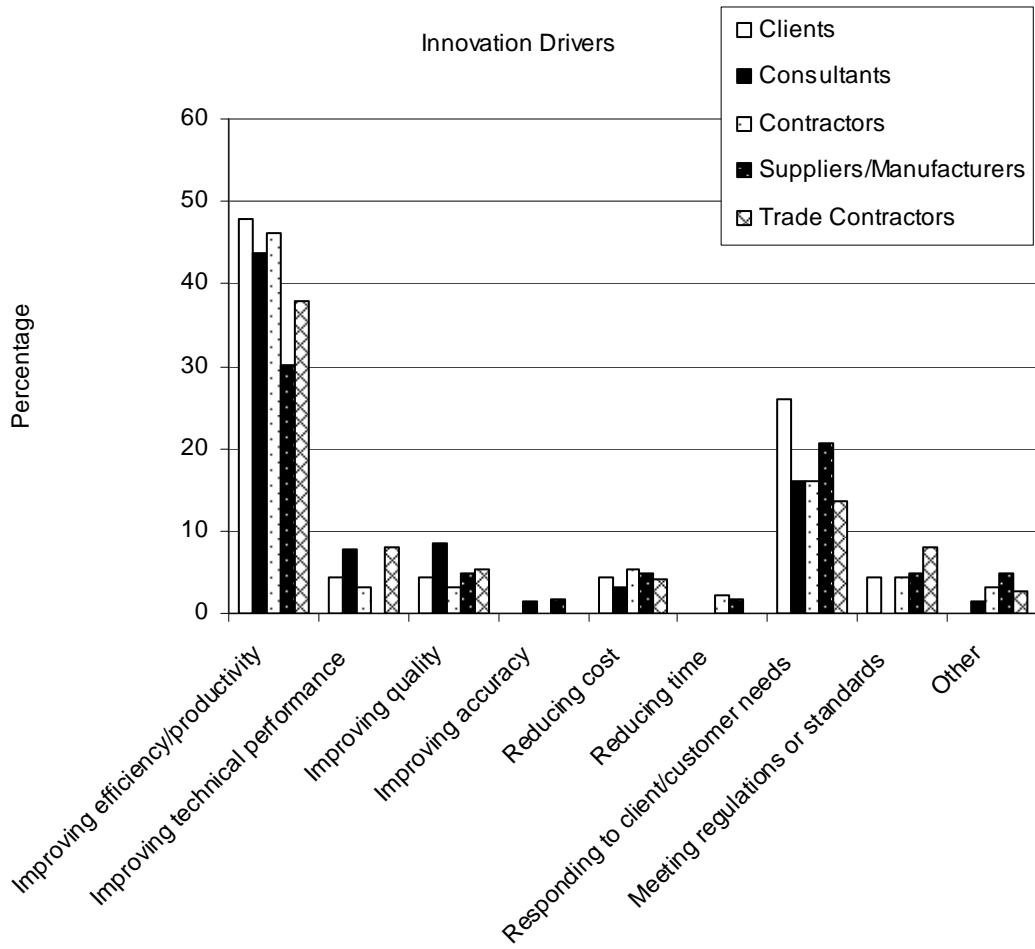


Figure 3 – Main Innovation Drivers per Sector

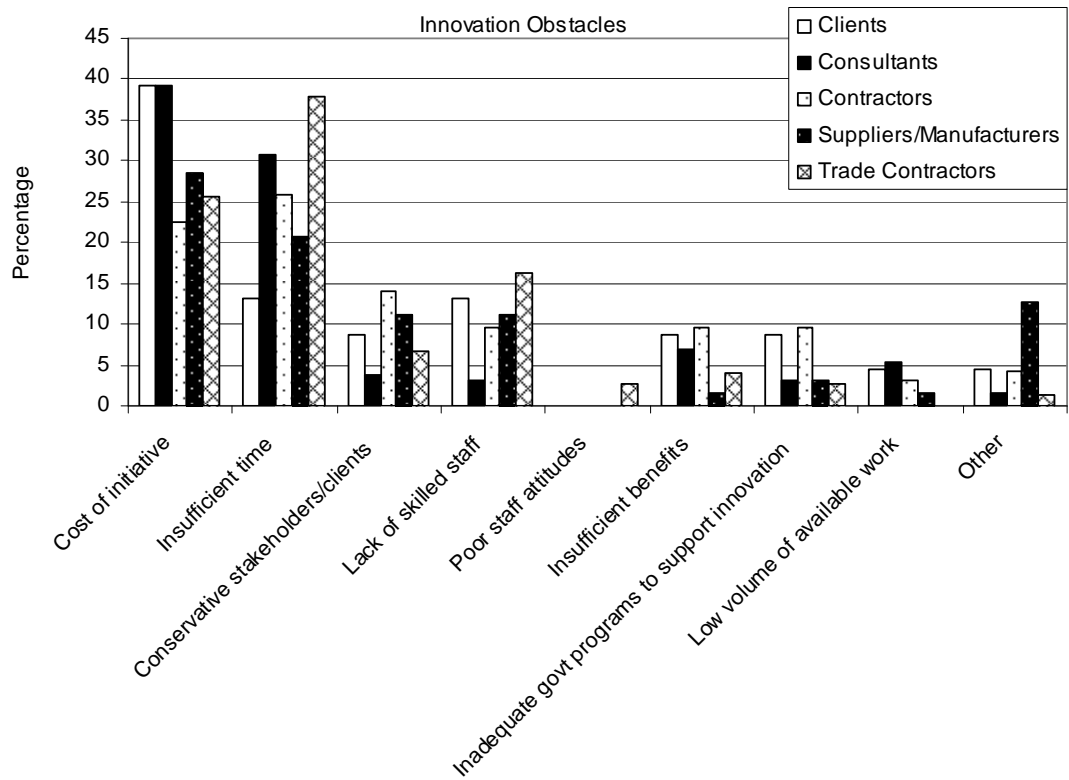


Figure 4 – Main Innovation Obstacles per Sector

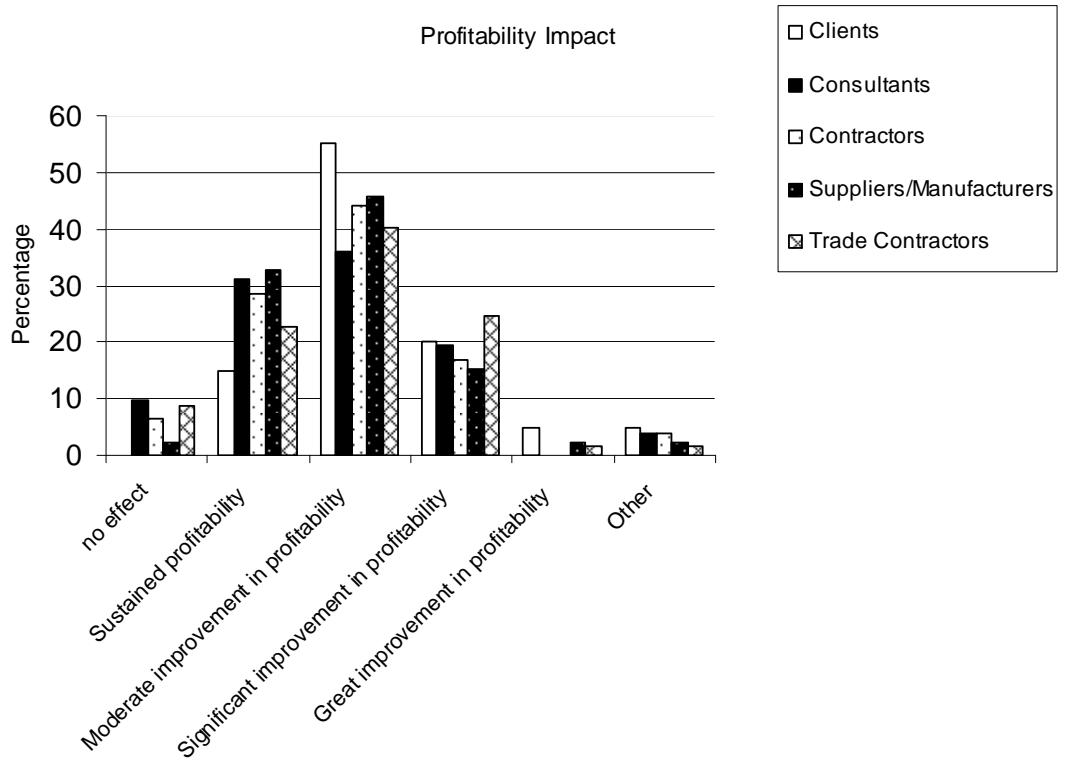


Figure 5– Profitability effect of most successful innovation

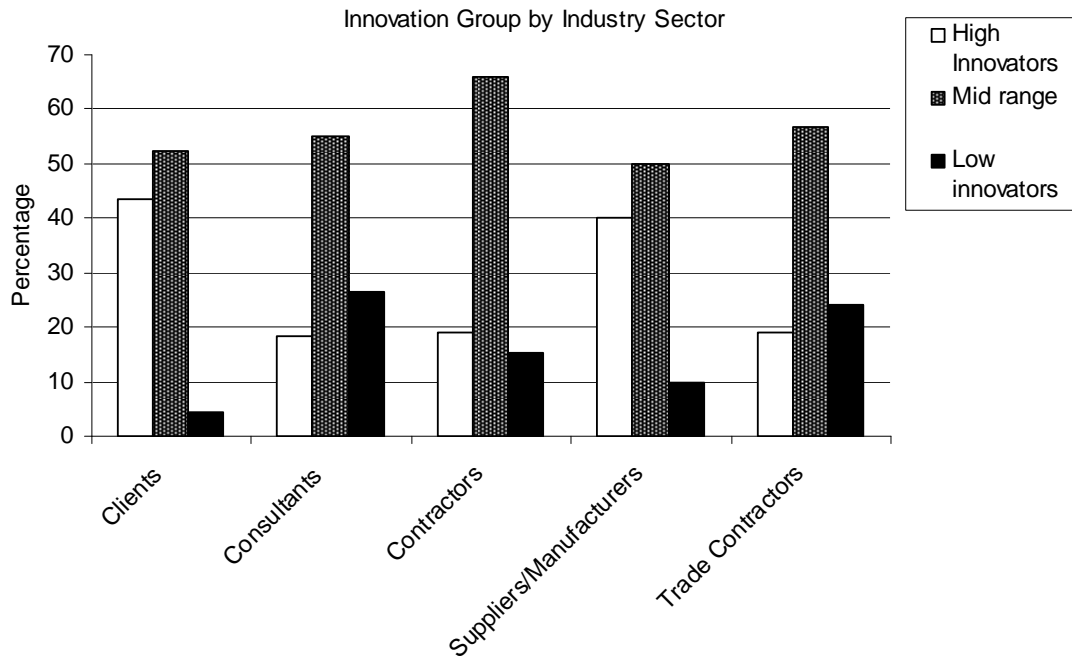


Figure 6 - Level of innovation performance by sector