

CONSTRUCTION CHALLENGES IN REMOTE AUSTRALIAN LOCATIONS

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The Australian construction industry has similar characteristics to many construction industries around the world. However, Australia's construction industry needs to service a country with a large percentage of remote and isolated areas. These remote and isolated areas have recently seen major demand for construction works in a large part due to the current resources boom. Remote construction projects introduce many challenges not witnessed in urbanized locations. Therefore, this research aims to identify the main challenges facing Australian construction contractors in remote locations. Construction projects in general are complex and require a high degree of management. In remote areas this is seen as being intensified. Hence, this research sets out to highlight the contributing factors to the problem. It surveyed industry practitioners in relation to construction in remote areas. Likert and ranking scale methods were used in questionnaires with 75 returned. The results were analysed and discussed based on measuring collective participant response to the issues. The findings confirmed that there are major challenges associated with remote construction activity. Significant issues were found to reside within the areas of human resources, production, cost management, infrastructure and communications. Some reasoning of issues and courses of action were also offered. Remote construction activity within Australia is expected to further increase in coming years so it is hoped that the findings will be useful to industry practitioners. Whilst the research is based within the Australian construction industry the findings are thought to relate to other countries and industries facing similar challenges in the geographical context.

Keywords: construction activity, remote locations.

INTRODUCTION

Construction within Australia has evolved into a reasonably sophisticated form of business. Weippert *et al.* (2003) contend that the Australian construction industry requires numerous people in design, contracting, consultancy and supply to be involved in many projects causing the industry to be unique and highly fragmented. Furthermore, the undertaking of construction works presents numerous challenges. It is held that these are amplified when working in remote locations. This study aims to identify these construction challenges within Australia's remote regions. The following gives some background to the problem.

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The Australian Industry

The construction industry contributes significantly to Australia's development and is a major sector within the country's economy. The construction industry is the fifth largest employer in Australia providing employment to 995,000 people. It is also a significant economic contributor with recent estimates counting over \$67 billion towards national Gross Domestic Product (ABS 2008a). This makes it the fifth largest sector in the country, in terms of its contribution to Gross Domestic Product (ABS 2008b).

In recent times, construction activity has been on the rise largely due to the resources boom with ever increasing demands for raw and processed materials from internal and external clients (Leschorn 2006). A great amount of this construction activity takes place in remote areas throughout Australia. For example, current remote projects in development include the Karratha Mineralogy Iron Ore project (Western Australia), the Olympic Dam expansion (South Australia) and the Bowen/Surat Basins projects (Queensland). These are resource projects that involve billions of dollars of capital expenditure in construction, housing and infrastructure. Unfortunately, their locations present contractors with many problems many of which are unique to construction projects. These problems include skills shortages, resource allocation, fly in/fly out issues, staff personal issues, productivity issues and required infrastructure (Mansfield and Odeh 1991, Houghton 1993, Storey 2001, Gent 2004, Bandias and Vemuri 2005, Dainty *et al.* 2005, McIllwraith 2005, Hoyle 2007, Mojahed and Aghazadeh 2008, Emmerson 2008). These problems are further discussed in the section below.

Despite the size of the Australian continent, the country has a relatively small population which is largely urbanized and concentrated in major metropolitan centres. Populations within regional and remote areas can be quite sparse. For example, approximately two thirds of South Australia has a population density of between two and forty-eight dwellings per one hundred square kilometers which is partly due to the inhospitable, arid environment that a significant portion of central Australia represents (Argent *et al.* 2005). Notwithstanding the small regional population, a significant amount of construction activity is occurring within these areas of Australia.

Construction Forecasting Council (2010) figures suggest that as much as \$24 billion worth of construction work was undertaken in regional areas during 2008/2009. Whilst this figure is for "regional" areas, and not specifically remote areas, it does provide some indication of construction activity within the context of the study. This authoritative body also forecasts that work across regional Australia will increase to \$33 billion dollars by 2018. Despite the Global Financial Crisis, the strong resurgence in demand for Australian resources suggests that forecasted figures might even exceed expectations. As such, the Australian construction industry needs to respond to the increased demand for their services in these locations.

Remote Area Issues

There are many and varied issues confronting remote construction work. Firstly, communities closest to the remote work are major facilitators for construction activities. Their stakeholders include mining companies, contractors, suppliers, retailers, banks, residents and government agencies to name a few (Newcombe 2003). However, regional communities are often not capable of undertaking the task required even though the economic gains of these large projects suggest that these communities have a vested interest in their success (Olander and Landin 2005).

It has been pointed out that the outlook is positive for the construction industry in Australia. However, record low unemployment and demand from the mining industry has led to substantial skills shortages in general, at a managerial and trade level (McIllwraith 2005, Hoyle 2007, Emmerson 2008). Beyond the challenge of attracting and retaining skilled workers for city based projects, contractors face significant challenges attracting workers to rural, regional and isolated projects. Dainty *et al.* (2005) contend that in times of local economic buoyancy firms experience difficulty allocating resources to remote sites. They also found that staff members are generally unwilling to relocate until the buoyant stage of the cycle ends. Furthermore, Chittleborough *et al.* (2007) surmise that there is a relationship between the aging population profile and skills shortages. This aspect compounds matters in remote locations.

When skills and labour are not available at the source the use of Fly-In/Fly-Out (FIFO) commuting for remote and isolated projects is quite often used. Houghton (1993) does not see FIFO arrangements as a new development. He contends that as early as the 1940s, workers were transported to offshore oil platforms using helicopters and FIFO is also known to have been used in remote areas of the former Soviet Union. In Australia, the practice is used extensively particularly in the resource rich remote areas of Western Australia and South Australia. Storey (2001) suggests that there are numerous advantages for firms who choose commute operations as an alternative to establishing permanent infrastructure for their operations. Of particular note is the paradigm shift in the cost-benefit towards FIFO arrangements. However, the social implications of FIFO operations can be significant and further complicate strategic decision making when staffing projects. For those who work in FIFO arrangements, family and fatigue issues are cited as the biggest disadvantages (Gent 2004). Berry *et al.* (2007) found the construction industry has a high instance of at-risk alcohol abuse. Moreover, both Houghton (1993) and Storey (2001) argue that FIFO contributes to higher instances of substance abuse, domestic violence and parenting issues.

Productivity within remote construction activity is also seen to have issues. Mansfield and Odeh (1991) and Mojahed and Aghazadeh (2008) cite lack of motivation due to homesickness or excessive alcohol consumption as a significant influence on construction productivity. Furthermore, delays and or shortages within materials and equipment create concerns for project success (Sambasivan and Soon 2006). If construction companies face supply problems in urbanized areas then remote locations potentially fare worse. Deane (2005) points to appropriate material management systems and notes their importance to project success. Extreme environments can also impact productivity. Hancher and Abd-Elkhalek (1998) indicate it is difficult to assess costs of lost productivity due to incidences such as hot-weather.

Burns *et al.* (1999) report that Australia generally has a high ratio of infrastructure to population. This is due to having a small population spread over a large land mass. A study on remote communities in Northern Australia indicates that the government believes that infrastructure and communications play a key role in the development of these regional communities (Bandias and Vemuri 2005). These communities ultimately influence remote projects. With communications, Brilakis (2007) contends that effective data communications between the work site and decision making office can be critical for the success of the project. This could be an area of concern for some remote projects.

Previous literature indicates that there are many potential concerns for construction companies operating in remote locations. Key issues would appear to exist within human resources, skills and labour availability, production, procurement and related cost issues, and the need for adequate infrastructure and communications. These issues will direct the empirical research to assess the current situation in respect to Australian remote projects.

RESEARCH METHOD

The research aim is to identify current issues on remote Australian construction sites. To identify these issues the chosen research method needs to collect data from as many participants as possible to be representative of the situation. Bryman and Bell (2007) contend that a representative sample is required so that what is discovered is applicable in a general sense. Furthermore, the aspect of convenience for participants is quite important when dealing with busy managers. Hence, it was thought that a well distributed broad based questionnaire survey that participants can do at their own time and speed was needed to satisfactorily collect data.

The literature pointed to many issues of concern on remotely located projects. The questionnaire survey was based around many of these issues. Moreover, the previously reported issues were analysed and found to be capable of categorization. Hence, the questionnaire grouped directed questions into the areas of *Human Resources, Production and Cost Management, and Infrastructure and Communications*. This was based on understandings thus far. The survey mainly used a rating scale format but one ordinal scale question was included.

The rating scale method used a Likert form of questioning. Cohen *et al.* (2007) contend that a rating scale method, such as the Likert type, makes them a very attractive and widely used instrument in research due to the greater subtlety which is inherently built-in. A five point scale namely strongly disagree, disagree, don't know, agree, and strongly agree was used. Relevant remote area construction issues were raised and participants were asked to rate them. Rating the issues identifies the level of concern within each. The collected numbers were converted into percentages which is believed to be sufficient for identification purposes. The ordinal scale question ranked eight issues that concern remote area construction work. The rankings were calculated with each issue expressed as a percentage of the overall total. Hence, the results show the perceived importance of attitudinal objects by participants (Super Survey 2010). This will be useful to the research's overall objectives.

The research participants came from top and mid tier construction contractors in Australia. Only contracting companies with experience in remote construction projects were approached. These specialized in general construction, civil works, engineering and subcontracting. The participants occupied mainly managerial and supervisory roles. Graneheim and Lundman (2004) contend that to shed new light on a particular research question, participants that have various relevant experiences should be chosen. The selected participants are thought suitable and in fact could be considered expert in their fields. Their collective experience and knowledge is considered very important to this research.

Table 1: Likert Scale Results for Human Resources Issues

Human Resources Issues		SD D (%) A SA				
		SD	D	DK	A	SA
1	Your company is currently experiencing difficulty attracting and retaining skilled or any other workers.	1.3	16.0	5.3	60.0	17.4
2	Skilled labour problems are more acute for projects in remote locations.	0.0	16.0	6.7	56.0	21.3
3	Given the current high level of construction activity, city based companies are constrained by labour shortages when vying for remote work.	0.0	14.6	12.0	66.7	6.7
4	Companies are in direct competition with the mining industry to attract and retain labour.	0.0	9.3	8.0	60.0	22.7
5	Firms prefer FIFO to permanently relocating staff.	1.3	24.0	21.3	46.7	6.7
6	There is a high level of acceptance to work in a remote location by employees who are offered FIFO compared to "permanent" relocation.	0.0	10.7	10.7	69.3	9.3
7	There is a higher level of employee turnover for companies who offer FIFO than those companies that relocate families on a "permanent" basis.	1.3	13.3	41.4	40.0	4.0
8	Companies prefer longer work cycles for FIFO employees.	1.3	14.7	12.0	64.0	8.0
9	Employee alcohol/drug use is higher when working in remote regions.	0.0	22.7	17.3	53.3	6.7
10	Working in remote locations has a negative impact on an employee's family life.	0.0	2.7	5.3	58.7	33.3

Table 2: Likert Scale Results for Production and Cost Management Issues

Production and Cost Management Issues		SD D (%) A SA				
		SD	D	DK	A	SA
1	The availability of materials and equipment has a considerable effect on productivity on remote area projects.	0.0	1.3	2.7	58.7	37.3
2	The skills of your workforce plays an important role in the productivity level in remote locations more so than in city locations.	0.0	21.3	2.7	54.7	21.3
3	Remote area climate does affect productivity and it is important to take this into account.	0.0	1.3	1.3	64.1	33.3
4	Alcohol abuse has a serious affect on productivity in remote locations.	0.0	13.3	8.0	44.0	34.7
5	The difficulty in procuring materials and equipment causes major problems for projects.	0.0	13.3	2.7	65.4	18.6
6	It is felt that procuring materials and equipment needed for projects is becoming more difficult.	0.0	17.3	5.3	66.7	10.7
7	Your strategy of material and equipment procurement differs between city and remote construction projects.	1.3	24.0	9.3	57.4	8.0
8	Delivery times for materials and equipment is a problem on remote projects.	0.0	12.0	5.3	64.0	18.7
9	An engineer should supervise and report on vital material and equipment deliveries on remote construction projects.	2.7	20.0	4.0	49.3	24.0
10	Your company is continually updating our cost knowledge base when tendering for remote projects.	0.0	4.0	9.3	70.7	16.0
11	Pricing for work in remote locations is more difficult than city locations.	0.0	20.0	2.7	62.7	14.6

The questionnaire survey collects important data that will provide meaningful and valid results. Ticehurst and Veale (2000) describe validity in terms of how well data captures the essence of a particular situation. It is believed that the adopted research method assembles data that accurately reflects the current situation on remote construction activity in Australia.

RESEARCH RESULTS

The survey was designed to identify issues facing construction contractors working in remote regions of Australia. A total of 130 questionnaires were sent out. The response to the survey was 75 of 130 (58%) questionnaires returned which is considered sufficient. As previously indicated the survey was broken down into the areas of *Human Resources*, *Production and Cost Management*, and *Infrastructure and Communications*. The Likert Scale results are condensed into the tables below. The five point scale is annotated as SD – strongly disagree, D – disagree, DK – don't know, A – agree, and SA – strongly agree. The percentages have been rounded off as appropriate. Further below a histogram chart is provided which ranks the challenges in order of perceived importance. Discussion of all results follows in the next section.

Human resources issues in Table 1 show a significant level of concern in the areas of personal recruitment, fly in/fly out (FIFO) arrangements and social effects.

Table 2 provides the results for the area of production and cost management. Significant issues do exist in productivity, procurement and costing for remote locations.

Table 3: Likert Scale Results for Infrastructure and Communications Issues

Infrastructure and Communications Issues		(%)				
		SD	D	DK	A	SA
1	The lack of certain infrastructure affects your decision to work in remote locations.	1.3	24.0	2.7	68.0	4.0
2	There is planning for future infrastructure developments and they will be sufficient.	1.3	25.3	45.4	28.0	0.0
3	The government should be solely responsible for infrastructure.	8.0	65.3	8.0	14.7	4.0
4	Communication is a significant problem when working in remote locations.	1.3	33.3	2.7	52.0	10.7
5	Your company invests in the latest technology to minimize communication issues when working in remote locations.	0.0	13.3	6.7	66.7	13.3

Infrastructure and communications issues continued the trend with many companies having problems in relation to this area. The findings are shown above in Table 3.

As mentioned the survey also set out to rank the perceived challenges of construction work in remote locations. The issues correspond with those in the above sections.

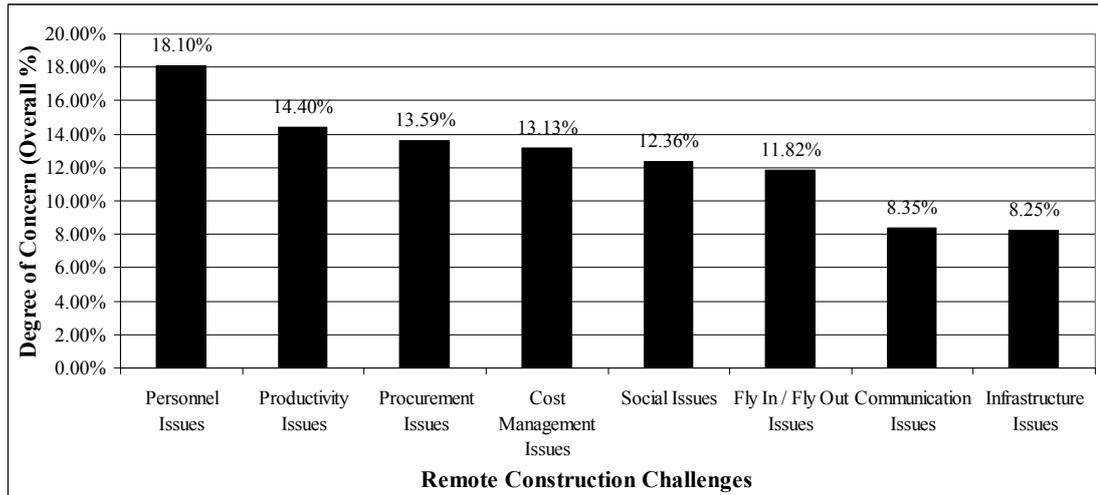
These are personnel, fly in/fly out and social issues under *Human Resources*; productivity, procurement and costing issues under *Production and Cost Management*; and general infrastructure issues under *Infrastructure and Communications*. The results are shown in Figure 1.

The above tables and figure provide substantial data in respect to the current situation. This will form the basis for the discussion of results within the next section.

RESULTS DISCUSSION

The above findings provide the research with a means of identifying the level of concern with issues. This section discusses the results and links the findings to the literature particularly in relation to the current Australian experience.

Figure 1. Ranking of Challenges in Remote Construction Work



Human Resources

Current issues surrounding skilled labour shortages corresponds with that reported by the likes of McIllwraith (2005), Hoyle (2007) and Emmerson (2008). Over three quarters of respondents believe that they are generally experiencing difficulty attracting and retaining skilled workers. More importantly, the results do confirm that the current skilled labour problem is more acute in remote areas. Also, a large percentage of participants agreed that labour shortages constrain city based contractors from vying for remote area work. Furthermore, the findings clearly show that this situation is exacerbated by mining industry competition for available labour.

Promotional strategies espousing the benefits attached to remote area construction might be effective in improving staffing rosters. The results showed that companies preferred FIFO operations to permanently relocating staff. Storey (2001) did suggest that there are advantages within FIFO arrangements. Also, very many survey respondents indicated that employees were more likely to accept working in remote locations if employers offered FIFO instead of "permanent" relocation. However, a large number of respondents thought that labour turnover was higher on projects where FIFO arrangements were used in lieu of relocation. Note though that many indicated that they didn't know if this was the case. It was also found that the employer preference is for extended work cycles for FIFO employees. This preference for stretching out work periods could possibly affect productivity, cost and worker welfare. This is thought comparable for those working on offshore oil platforms who Houghton (1993) pointed out as early users of FIFO arrangements.

Social issues present other problems for remote construction work. It appears these types of issues do generally compare with that reported within the literature. For example, survey participants indicated very strongly that working in remote locations has a negative impact on an employee's family life. If this is the case it surely warrants more attention from employers. Furthermore, on the issue of substance abuse many respondents agreed that employee alcohol consumption is higher when working in remote locations. Possibly employers could take the lead in providing/promoting healthy recreational activities as part of their recruiting and retaining strategies.

Overall, respondents ranked personnel issues as the greatest challenge when working in remote locations as shown in Figure 1. These are held to include issues of skilled labour shortages and competition for labour on remote projects. The results indicate

that recruiting and retaining staff in remote Australian locations is of greatest concern at this time. Social and FIFO issues were ranked lower but still need consideration.

Production and Cost Management

It was found that workforce skills are of more importance to productivity levels in remote locations than in city locations. Geographical factors perhaps make contractors concerned about acquiring, training and supporting employees to keep productivity at good levels. Difficulty in accessing materials and equipment in remote areas also has a considerable effect on productivity and sourcing options need attention at project planning stages. Furthermore, climatic factors in remote areas were very strongly linked to reduced productivity evidenced by major support from respondents. The literature raised hot weather as an issue. Possible solutions include shading covers, night work and increased fabrication off site. The aforementioned alcohol abuse also appears to carry concerns for productivity in remote locations.

The findings indicate that there are problems in procuring requirements for projects and the situation is becoming increasingly difficult. Also, the findings show company procurement strategies do differ between city and remote projects. Delivery times appear to create further problems. The need for appropriate material management systems was mentioned by Deane (2005) in the literature. Respondents seemed to agree that a dedicated person to monitor the progress of deliveries could assist. As such, this is a possible course of action to improve delivery times and production schedules albeit at additional cost. In respect to cost management it is evident that companies have to continually update their cost knowledge bases. Cost information designed specifically for remote works would seem important and should be pursued. The types of specific costing issues could include those within remote area preliminaries, mobilization/demobilization, accommodation, inclement weather downtime, site allowances, and delivery and productivity. These are thought typical for remote construction work but many items could also apply to other projects such as mining explorations, offshore construction and even disaster relief operations. Finally, many respondents indicated that pricing remote area work is more difficult than city work which seems reasonable. Note that a significant number disagreed.

The productivity issue was ranked highly by survey participants. This is not surprising as respective concerns with accessing materials/equipment, climatic factors and alcohol abuse rated at some of the highest levels in the Likert survey and were well represented in the literature. However, it seems that when it comes to prioritizing respondents were more concerned with attracting staff in the first instance than factors that may lie down the track. Procurement and costing issues were also ranked as areas of concern. Although these issues were not ranked as highly as personnel or productivity issues they carry significant importance to remote projects.

Infrastructure and Communications

Many Australian contractors believe that the lack of current infrastructure affects their decision to work in remote locations. While the literature indicates that Australia has a high ratio of infrastructure to population this is spread quite thinly in regional and remote areas. Furthermore, on the issue of possible infrastructure developments and their sufficiency opinion was clearly split with many others claiming ignorance in respect to this issue. It is thought that contractors planning to work in remote regions need to be up to date with current developments and in some cases possibly lobbying authorities in this regard. The results are also interesting in that they show that a large number of respondents disagree that government authorities should be solely

responsible for infrastructure to service remote areas. Perhaps all stakeholders need to take some ownership in the provision of future infrastructure.

Communication seems to be a significant problem when working in remote areas acknowledging that each location may differ. Brilakis (2007) indicated project communications are critical to success. As such, could newer communication technologies hold some hope for those that are having difficulties? When asked whether respondents' companies invest in the latest technology very many did. With many respondents having access to new communication technologies and there being continued dissatisfaction it is thought that further work is needed in this area.

Infrastructure and communication issues were ranked last within the context of this study. However, as discussed there is still a reasonable level of concern within these areas. Moreover, the issues can be rated and ranked but in the end it is for each contractor to decide the degree of attention warranted by each of the problems. The same could be said for those in other fields that see some relevance in this topic.

CONCLUSION

The research that has been carried out indicates that there are many challenges for contractors working on remote projects. More importantly this research has clearly identified these challenges within the current Australian context. Industry concerns were researched and discussed under the three broad areas of *Human Resources*, *Production and Cost Management*, and *Infrastructure and Communications*.

The difficulty faced by construction contractors when trying to staff their remote sites was one of the major issues highlighted. Furthermore, the personal ramifications of such construction activity came to the fore and needs careful consideration. The production and costing discussion showed climate, delivery times and pricing as potentially problematic requiring reasonable initiative and planning. Problems were also highlighted within the need for adequate infrastructure and communications. The anticipated increase in construction work within remote areas suggests that well directed infrastructure spending could provide benefits to industry and community for years to come. Broader and increasingly strategic outlooks are seen as necessary.

The findings also provide a gauge on current concerns held by Australian contractors operating in the field. Furthermore, the discussion offered comparisons to the literature and some courses of action in respect to the issues raised. Continued research would be useful to study the issues in more depth. This would allow for greater understandings and some possible recommendations, something that this research has not aimed to do. A better understanding of underlying issues will allow for better informed planning and management by affected contractors.

In conclusion, the research set out to identify challenges faced by Australian construction contractors working in remote locations. The many issues raised suggest that remote area projects do pose significant challenges to contractors and further research is recommended. The burgeoning Australian resources sector is presenting great opportunities for the construction industry albeit in remote areas. Hence, some consideration of the findings might prove useful to construction practitioners and possibly other people that work in similarly challenging environments.

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