Full Length Research Paper

Analysis of Modularization Compared to Total Project Cost in Alberta Oil and Gas Projects

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Modularisation is an important area that needs to be effectively addressed in the construction of Alberta oil and gas industry schedule. It is an effective way to get partial construction done. This paper examines modularization of projects executed in Alberta oil and gas industry for effective projects schedule performance. A qualitative research methodology was employed in investigating the modularization used for the Alberta projects. Interviews were conducted with industry practitioners, which contained open-ended questions and data were also collected from COAA/CII database. The research found higher average percentage overall modularization to total project cost of the Alberta oil and gas projects. This method has the potential to contribute to a reduction in cost and schedule overruns and improves project performance. It is concluded that the results of the study will help in leveraging the benefits of modularization that have already been gained by the various oil & gas projects in Alberta to improve project schedule performance.

Keywords: Alberta oil and gas, projects, modularization, costs, performance

INTRODUCTION

Alberta oil sands industry plays a crucial role in Canada’s global economic position and the delivery of energy to the world. In fact, Canada’s oil reserves are second in the world behind Saudi Arabia (OSDG, 2008). Of these reserves, 80 percent are oil sands deposits in reservoirs contain oil that is deeper than 75 meters below the earth surface (Dunbar, 2011). One important area that needs to be effectively addressed in the construction of the Alberta oil and gas industry schedule is modularization. This paper examines average percentage of modularization of Alberta phase 1 and phase 2 projects, average percentage of modularization by project nature and the overall modularization to total project cost of the Alberta oil and gas projects. It reviews literature on modularization and recognizes the uniqueness of heavy industrial projects in Alberta, projects often characterized by their remote locations and challenges posed by severe weather.

Modularisation is an important area that needs to be effectively addressed in the schedule performance. It is a key construction strategy in building Steam Assisted Gravity Drainage (SAGD) projects in Northern Alberta (Alnoor, 2010). According to Alnoor (2010), it is an effective way to get partial construction done in places.
where there is abundant labour, and the modules can be assembled in a controlled environment, thus resulting in a good quality product at lower costs. Harji (2009) had argued that if modularization is to be used as a construction strategy, its planning has to start at the feasibility stage. In addition, the engineering and procurement activities including fabrication, and module assembly time frames have to be precisely integrated in the overall schedule to achieve the desired benefits to cost and schedule.

Literature Review

Modularization is an important aspect relating to SAGD projects and has gained remarkable acceptance in the large oil & gas projects in Alberta (Alnoor, 2010). Transportation planning of modules from yard to the construction site is critical, especially on the highways to Northern Alberta where there are road bans and seasonal weight limitations to transporting heavy hauls (Alnoor, 2010). Despite having to transport the heavy and long modules by road to the construction site at a fairly slow speed modularization significantly lowers the costs of production (Jameson, 2007). In addition, there are advantages of building the modules in a yard. For example, it provides a controlled environment while shortening schedules, a significantly decreased amount of site congestion and logistical issues, and improved safety (Jameson, 2007; Byrne, et al., 2008).

Although modularization has less room for error, it is also used in building large facilities such as nuclear and other power plants, offshore oil & gas platforms, and ships, among other things (Blankinship, 2008; Byrne, et al., 2008). Byrne, et al (2008) suggested that modularization needed to be considered very early or during the planning phases of the project. Byrne, et al. (2008) further argued that in an effort to shorten the schedule, more activities in parallel should be done, and modularization and pre-fabrication are ideal strategies to achieve this objective. Blankinship (2008) suggested cost/benefit analysis needs to be done on using modularization. However, the Alberta construction industry is convinced of the benefits of modularization and has fully embraced it, especially with the cost savings that can be achieved over methods such as stick-building modules at the construction site (Alnoor, 2010). For example, in analysis of a small $70 million hydrotreater project, stick-built construction had higher labour costs and lower productivities over modularization by almost 18%, which resulted in a US$12.5 million savings (Jameson, 2007).

Furthermore, in educating the industry on the merits of modularization, the Construction Industry Institute (CII) had attempted to provide a primer on this topic entitled “Implementing the prefabrication, preassembly, modularization, and offsite fabrication decision framework: Guide and tool” (CII, 2002). While this primer provides basic decision-making tools, such as whether or not to use offsite fabrication, more studies and analyses, as illustrated on Jameson’s project, are required in this area of modularization, particularly in relation to large oil & gas projects undertaken in Alberta. Therefore, a study with an Alberta perspective on the modularization needs to be undertaken. The results of the study will help in leveraging the benefits of modularization that have already been gained by the various oil & gas projects executed in Alberta.

RESEARCH METHODOLOGY

Qualitative methodology is considered to be the most appropriate strategy in the context of this study for collecting data on Alberta capital project performance. Lincoln and Guba (2000) described the qualitative research approach as an enquiry process of comprehending a social or human problem phenomenon based on building a complex holistic picture formed with words, reporting detailed views of informants and conducted in a natural setting. Patton, (1990), Walker (1997) and Creswell (2003, Field, 2005) further described qualitative methodology as explanatory in nature with the principal aim of trying to unearth answers to how? and why? Questions. The method can be used to better understand and gain new perspectives on modularization of projects executed in Alberta in the CII/COAA database. The quantitative approach was not adopted because it would not be sufficient in this case with limited number of oil and gas projects in Alberta. For the purpose of this research, the authors consider qualitative methodology as more suitable to explore the COAA database.

Data Collection

Data were collected from the COAA/CII database for analysis. In the COAA database, 17 industry partners entered and completed 59 projects from 73 initiated projects. The data concerning modularization on the 59 projects were collected from the COAA database. In addition, semi-structured interviews were conducted on Alberta projects. Interviews were conducted with 17 (seventeen) benchmarking managers, benchmarking associates, estimators, project control analysts, engineers. The interview was structured, open-ended, and was conducted face to face with experts in the construction industry and oil and gas fields.

RESEARCH FINDINGS

This section presents statistical techniques and used Box and whisker plots, to analyze projects residing in the
COAA/CII databases. The box and whisker plots also incorporate a variety of test statistics including analysis of variance (ANOVA) techniques, depending on the number of comparison groups and distribution of sample variances (Agresti and Finlay, 1999).

### Average Percent Modularization of phases 1 and 2

Figure 1 provides the distribution of phase 1 and phase 2 projects included in this study in terms of percentage modularization. Notably, the average percent of modularization of phase 1 is 20% and phase 2 is 14.6%. Phase 2 projects have notably less modularization when compared with phase 1 projects. This difference may be due to many pipeline projects in Phase 2 that may have less modularization than other project types. This difference is a significant factor in quantifying performance and should be considered in understanding the analyses presented here.
project cost spent using modularization by project nature. Here, the dataset includes 17 grass roots projects and 7 addition projects with modularization data (there was insufficient data to report for brown field and modernization projects). On average, grassroots projects spent about 17.9% of their total project cost on modularization, compared to 20% spent on addition projects.

**Percent Modularization of Total Project Cost in SAGD Projects in Alberta**

Figure 3 below shows above average percentage (27.72%) of the overall modularization to total project cost of the SAGD project. An important reason for this point is only 15 numbers of projects were found in the COAA database as compare to 26 SAGD projects in oil and gas industry in Alberta.

**DISCUSSIONS OF THE RESULTS**

Alberta-based oil and gas projects are unique projects. They are located in remote locations and are subjected to extreme (northern climate) weather conditions. Often, work camps are built and transportation for large numbers of workers becomes necessary. However, the analyses presented in this sub-section are not intended to quantify these differences, but rather, examine differences in average percentage modularization by project nature, phase 1 and 2 and total project cost. Interestingly, the average percentage of phase 1 is higher than phase 2. Phase 2 projects have notably less modularization when compared with phase 1 projects. The difference could be due to many pipeline projects in phase 2 than phase 1. This also could be as a result of type of contracts in phase 1 as most contract size are big projects while phase 2 are medium size of contracts. The grassroots projects spent about less of their total project cost on modularization when compared to addition projects. However, in analyses, the addition projects have insufficient data, which means the data is confidential because of the 10 data from 3 different projects rule before the data can be analysed.

It can be observed that modularization is now recognized and accepted as an effective construction strategy, especially for building oil & gas projects in Northern Alberta. This is because the areas where most of the Canadian oil sands projects are located, such as Fort McMurray and Cold Lake, are quite remote, which create issues of labour scarcity. Exorbitant amounts of money have to be spent to move, house, and feed the labour force in order to build the SAGD plants. Building modules in areas with abundant labour and transporting them up north can reduce the labour costs significantly; while giving the advantage of constructing the modules in a controlled shop environment where the owners quality standards can be met and possibly enhanced.

**CONCLUSION**
Modularization is a key construction strategy. It is an effective way to get partial construction done in places where there is abundant labour, and the modules can be assembled in a controlled environment, thus resulting in a good quality product at lower costs. Modularization has gained remarkable acceptance in the large oil & gas projects in Alberta. The result shows above average 120 Glo. Adv. Res. J. Manag. Bus. Stud. percentage (27.72%) of the overall modularization to total project cost of the SAGD project. An important reason for this point is only 15 numbers of projects were found in the COAA database as compare to 26 SAGD projects in oil and gas industry in Alberta. Modularization is now recognized and accepted as an effective construction strategy, especially for building oil & gas projects in Northern Alberta. This is because the areas where most of the Canadian oil sands projects are located, such as Fort McMurray and Cold Lake, are quite remote. It is concluded that the results of the study will help in leveraging the benefits of modularization that have already been gained by the various oil & gas projects to improve project schedule performance.

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