



FEASIBILITY OF LUMP SUM CONTRACTS IN THE OIL AND GAS INDUSTRY OF ALBERTA

Haines, Danny^{1,5}, Sadeghpour, Farnaz², O'Toole, Jacqueline³ and Jergeas, George⁴

¹ Department of Civil Engineering, University of Calgary, Canada

² Department of Civil Engineering, University of Calgary, Canada

³ Department of Civil Engineering, University of Calgary, Canada

⁴ Department of Civil Engineering, University of Calgary, Canada

⁵ dhaines@ucalgary.ca

Abstract: Construction in the Alberta oil and gas industry experiences particularly substantial schedule and cost overruns. Cost overruns on large Alberta-based projects have been found to be, on average, 533 percent higher than similar projects executed in the United States. Despite studies showing that the use of lump sum contracts can have a considerable impact on controlling costs, most construction projects in Alberta's oil and gas industry continue to use cost reimbursable contracts. A better understanding of industry practitioner's perceptions can enable a successful shift to lump sum contracts. The objective of this study is to determine the interest of industry practitioners in using lump sum contracts for oil and gas projects in Alberta, and also their perceptions of the barriers to its implementation. A total of 240 industry practitioners from Alberta with an average of 19 years of experience were surveyed for this study. Respondents represent the perspectives of owner, engineer and contractor companies. Responses are presented in summary format and are further analyzed for correlation using inferential statistics. The results push forth the idea that lump sum contracting is best suited for use at distinct phases of project execution. Results from this study provide an insight into practitioner's assessments of the industry and can be used as a first step in preparing companies and industry as a whole to make the shift to lump sum in Alberta. These findings could thus improve the cost and schedule performance of construction projects in the oil and gas industry of Alberta.

1 INTRODUCTION

The conventional oil and gas industry represents a large investment in Alberta, with over \$115 billion invested from 2004-2009 (AED, 2011). An additional \$218 billion is expected to be invested in new oilsands capacity over the next 25 years (AED, 2011). Despite this increase in investment, the performance and effectiveness of the construction industry has been in decline for the past three decades (Business Roundtable, 1989; Dozzi and AbouRizk, 1993; Hewage and Ruwanpura, 2006). Cost overruns on large Alberta-based projects have been found to be 533 percent higher than similar projects executed in the United States (COAA, 2009). In recent studies of oil industry mega project overruns in Alberta, inappropriate contracting strategies is listed as one of the reasons for cost overruns on Alberta mega projects (Jergeas & Ruwanpura, 2008). In a Construction Owners Association of Alberta (COAA) study of project overruns, projects executed in Alberta primarily used cost reimbursable contracts for their construction phase (COAA, 2009). It was proposed that cost reimbursable usage, the typical Alberta oil and gas contract type used, is likely contributing to the large cost overruns being experienced (COAA, 2009, Jergeas, 2008).

Cost reimbursable contracts compensate the contractor for the cost it incurs (time and materials) plus some fee (profit) (Gordon, 1994). All direct expenses for labor, equipment, and materials, as well as, overhead

charges required to properly manage the job are reimbursable (Halpin and Woodhead, 1998). Lump sum contracting on the other hand requires contractors to use specifications and drawings provided by the operating company as the basis for providing a contractual, exact price. This gives the owner the benefit of knowing the total price that will have to be paid to the contractor for the completion of the construction (subject to scope changes as construction progresses) (Marston, 1996).

Cost overruns have become a barrier to the successful development of Alberta oil and gas resources. The amount of construction activity in this sector has strained industry's ability to execute the work effectively and has led to serious concerns about low productivity, along with cost and schedule overruns (COAA, 2009). Several recent Alberta natural resources related mega projects, primarily in the oilsands, have experienced final construction costs that have exceeded the original estimated budget by as much as 30-70 percent (AEDA, 2004). Some studies have even found that it was not uncommon for natural resources mega projects to experience cost overruns of up to 100 percent (Jergeas, 2008).

Shifting away from cost reimbursable was identified as one of the top ten areas for construction productivity improvement, as perceived by industry professionals including owners, engineering, and construction contractors in the Alberta oil and gas market (Jergeas, 2009). Studies have identified that project contracts shape the behaviour of the parties involved and thus have a major impact on project success (Von Branconi and Loch, 2004). It was proposed that cost reimbursable usage, the typical Alberta oil and gas contract type used, is likely contributing to the large cost overruns being experienced (COAA, 2009, Jergeas, 2008). Replacing cost reimbursable contracting with lump sum contracting was suggested by this study as a way to mitigate cost overruns in the Alberta oil and gas industry. It is not clear why industry practitioners have not made better use of lump sum contracting.

The objective of this study is to determine the interest of industry practitioners in using lump sum contracts and also their perceptions of the barriers to its implementation. The study will determine the types of industry practitioners who are most amenable to using lump sum. The study will look at which types of companies (owner, contractor or engineer) are interested in using lump sum. It will also determine under which circumstances practitioners believe lump sum can best be leveraged. It will determine which barriers industry practitioners are most concerned about when implementing lump sum and will analyze how these barriers differ among different company types, practitioner experience and company experience.

This study will only examine the opinions of practitioners who are based in Alberta. This fits with the objective of determining the climate within the province in support of its application on local oil and gas construction projects. 240 experts from the Alberta oil and gas industry were surveyed on their experience, their company's experience as well as on their perceptions of using lump sum in Alberta. Results from the study were analyzed using inferential statistics to draw conclusions about the overall opinions of the industry. The study makes no comment on the actual outcomes of implementing Lump Sum, but only industry opinions of the effect. Further work should be completed to investigate these outcomes.

2 LITERATURE REVIEW

Industry practitioners' interest in lump sum and their perceptions of barriers to its implementation both impact whether lump sum is considered a feasible contract type. Research was found in both of these areas which has made for a useful division in the literature review.

2.1 Interest in Lump Sum

A large amount of research has been conducted on the advantages and disadvantages of lump sum contracting practices. This work focusses primarily on the perspectives of Owners and Contractors without much attention having been paid to Engineers. The literature is relatively silent on the opinions of even Owners and Contractors within the Alberta oil and gas industry. This is interesting because of the surprising lack of lump sum contracts in this industry. This study builds upon existing literature to determine the interest of owners, contractors and engineers in Alberta.

2.1.1 Owners

One factor leading to cost overruns on Alberta Oil and Gas construction projects is the cost reimbursable contract strategy and payment structure (Jergeas, 2009). Project cost overruns have created a demand among owners in Alberta for a return to lump sum contracting. A study of key factors influencing the successful execution of projects found that lump sum was a potential solution to cost overruns (Jergeas, 2009).

Indeed, researchers also consider the cost reimbursable contract type undesirable for construction (Navarrete & Cole, 2001) because it creates high cost and schedule risks (Von Branconi & Loch, 2004). Cost reimbursable is subject to abuse by contractors by providing no incentive to reduce cost or avoid cost increases (Halpin and Woodhead, 1998; Bubshait, 2005). Literature suggests that cost reimbursable should be limited to low cost projects, emergency work, and short duration projects because of both the lack of incentives for cost reduction strategies and the lack of deterrents for cost increase (Bubshait, 2005).

While lump sum can effectively transfer almost all risk away from owners (Gordon, 1994), being extremely risk-averse as an owner was seen as a negative trait in much of the research. Attempting to transfer all risk to the contractor typically did not result in lower cost risk to the owner (Espinoza, 2011; Hu et al., 2012; Loots & Henchie, 2007). Further, financial institutes prefer to finance large oil and gas engineering/construction projects that use lump sum contracts as they see their investment better protected by this contract type (Berends, 2007).

In lump sum contracts, cost overruns associated with risk are generally contractually assigned to the contractor (Berends & Dhillon, 2004; Ward et al., 1991). Being generally risk-averse organizations, owners are satisfied with this arrangement as they prefer to mitigate risk by transferring it to the other contracting parties (Berends & Dhillon, 2004; Gordon, 1994; Kashiwagi, 2010). Several papers suggest that in the wider construction industry, responsibility for managing project risk is often borne exclusively by the contractor (Imbeah & Guikema, 2009; Jin & Ling, 2005; Lee et al., 2006), as owners attempt to force the contractor to act as an informal “insurer” to the project (Ward et al., 1991).

2.1.2 Contractors

From a contractor’s perspective, lump sum is not as lucrative as cost reimbursable (Halpin and Woodhead, 1998). Lump sum contracts assign cost overruns associated with risk to the contractor (Berends & Dhillon, 2004; Ward et al., 1991). Because of this, strategies for risk sharing using contractual means have been explored and have been found to influence contractor bidding strategy and contract pricing choices (Cheung et al., 2004; Fang et al., 2004; Laryea & Hughes, 2011). However, there is evidence to suggest that construction industry sees value in optimizing the performance incentives in construction contracts as is provided by lump sum (Berends, 2007).

Contractors were found to be either risk-takers, risk-neutral, or risk-averse depending on the complexity and size of the project, and market conditions. Being a risk-taker was generally interpreted as being a positive trait for contractors (Thevendran & Mawdesley, 2004; Wang & Yuan, 2011; Zhang et al., 2007). Being extremely conservative with respect to risk reduced contractors’ opportunities to gain the potential benefits achieved from effectively managing risks.

In addition to alternative contract types, there has been considerable discussion around using traditional contract types with contract clauses allocating individual risks such as labour, productivity, cost inflation, etc. to those parties best able to influence or bear the brunt of that risk (Krane et al., 2012; Pedwell et al., 1998; Sacks et al., 2009; Seo and Choi, 2008; Song et al., 2012). Some researchers have found that partnering rather than selected risk allocation has greater value than risk allocation (Lehtiranta, 2014).

2.2 Barriers to Lump Sum

The prevalence of cost reimbursable contracting in the Alberta oil and gas industry (COAA, 2009) despite its obvious disadvantages in terms of cost control (Jergeas, 2008) suggest that there may be barriers to its

usage in the industry. Oil and gas construction projects in Alberta are typically fast tracked due to their large size and long duration (Chanmeka 2012). However, such ill-defined, fast tracked projects where scope and specifications are developed over the duration of the project typically use cost reimbursable as opposed to lump sum contracts (Buckingham, 1994; Elliot, 2005).

Lump Sum contracting on oil and gas projects is predominantly used in the Middle East and Asia but is used less frequently in North America (Halari, 2010). This inexperience with lump sum contracting present in Alberta is shown by a pair of case studies to be a significant barrier to project success. A case study of Exxon Mobil's first lump sum mega project in the United Kingdom investigated the causes of its failure. The study suggested that the major reason for the failure was that after thirty years of working in a cost reimbursable culture, Exxon did not understand its role as client in a lump sum contracting environment. They were interfering with project execution in the same manner as they would on a cost reimbursable project (Johnson, 1987). Another study investigated five consecutive projects executed by Saudi Aramco. The study showed that the first project executed under lump sum had growing pains associated with a shift in contracting strategy (Palmer & Mukherjee, 2006).

To successfully shift toward lump sum contract types, it is important to understand the current culture within the industry. This study will investigate this issue through the perceptions of industry interest and identification of barriers to implementation.

3 METHODOLOGY

3.1 Data Collection

Data was collected using a survey instrument which collected information from 240 industry practitioners. The survey method allows for responses to be provided confidentially which important to obtain truthful information (Leedy & Ormrod, 2005) on this potentially sensitive and strategically important topic. Responses were obtained from roughly equal numbers of representatives from owner, engineer and contracting firms as shown in Figure 1a. This even distribution was achieved by inviting participants from each of these three groups until this equal distribution of responses was met. Further, approximately equal numbers of executives, senior managers, project managers and others were surveyed, as shown in Figure 1b. Other roles include those in project engineering, project controls, discipline engineering, business development and contract management. 44% of respondents have over 25 years experience and 80% of respondents have over 15 years experience in the industry further breakdown of this level of experience is shown in Figure 1c.

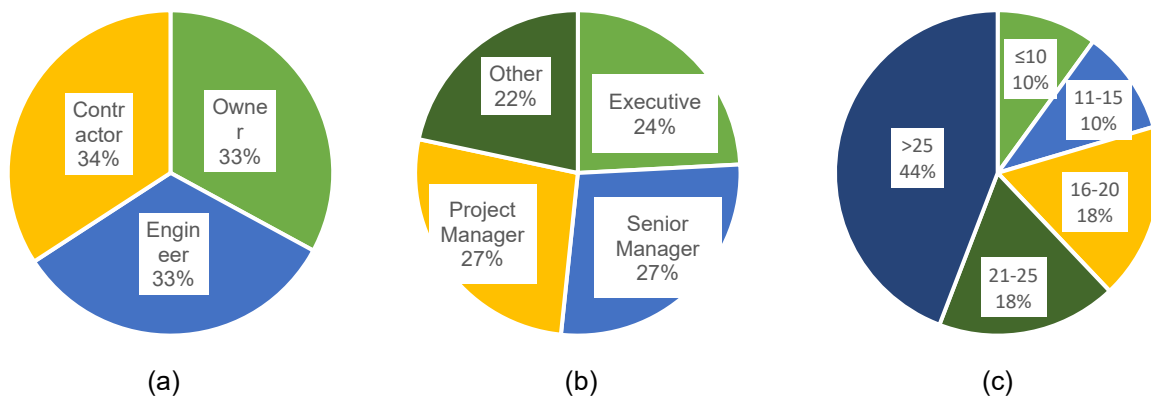


Figure 1: Respondent characteristics

- (a) Type of organization
- (b) Role in organization
- (c) Years working experience

Beyond this basic characteristic data, the survey also asked about respondents' current experience in using lump sum both internationally and locally. 31% of respondents said that lump sum was their most commonly

used contract type locally, contrasted with 75% of respondents who said that lump sum was their most commonly used contract type internationally. Maximum contract values skew larger for international projects which is in line with literature that generally suggests larger projects are poorly suited for cost reimbursable contract types (Bubshait, 2005). Detailed results for these project characteristics are presented in Figure 2.

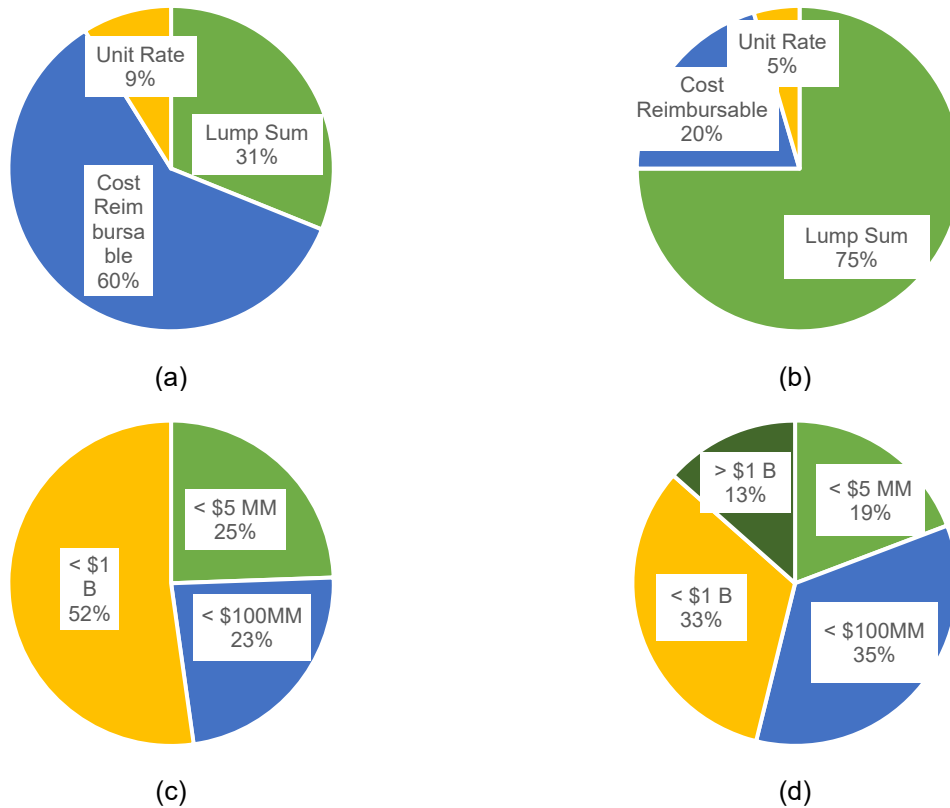


Figure 2: Project characteristics

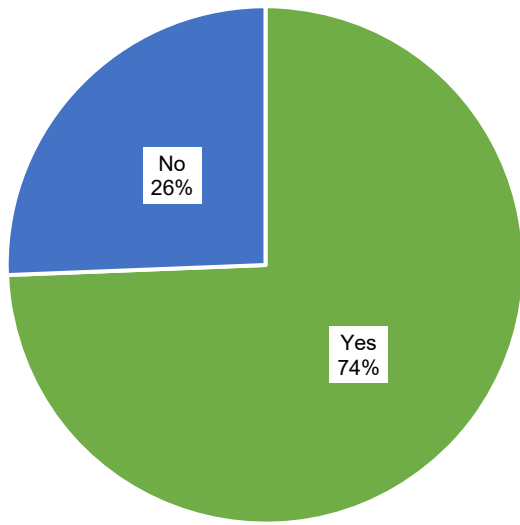
- (a) Most commonly used contract type locally
- (b) Most commonly used contract type internationally
- (c) Maximum dollar value of local project
- (d) Maximum dollar value of international project

3.2 Survey Summary

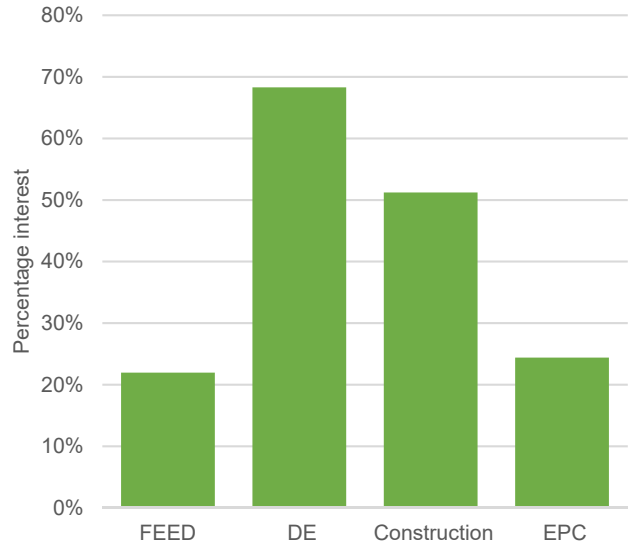
Beyond the descriptive statistics regarding the background and experience of the respondents it was also important for the survey to ask questions about respondents' opinions about their interest in lump sum contracting and their perception of the barriers to its implementation. The following sections summarize the responses to these questions.

3.2.1 Interest in Lump Sum

Survey respondents were asked about their overall preference for lump sum contracts. 74% of all respondents said they would be interested in pursuing a lump sum contract arrangement. Respondents from engineering companies were asked at which stages of the project they would be willing to use a lump sum contract. Only 22% of these respondents were interested in lump sum contracting at the Front End Engineering and Design (FEED) stage, while 68% were interested at the Detailed Engineering (DE) phase. Detailed responses are presented in Figure 3.



(a)



(b)

Figure 3: Interest in lump sum

(a) Interest in lump sum among all company types

(b) Interest in lump sum at different stages of execution for engineering companies

3.2.2 Barriers to Lump Sum

Respondents were asked to rank order their perceived biggest barriers to the use of lump sum contracting in Alberta's oil and gas construction industry. The average ranking of each of these potential barriers is presented in Figure 4. With this ranking system, a lower ranking means a higher proportion of respondents ranked it as a more important concern. Thus, lack of scope definition with an average ranking of only 1.75 is seen as the biggest barrier to using lump sum contracts in Alberta. The local cost reimbursable construction culture was seen as the least important out of the six available responses.

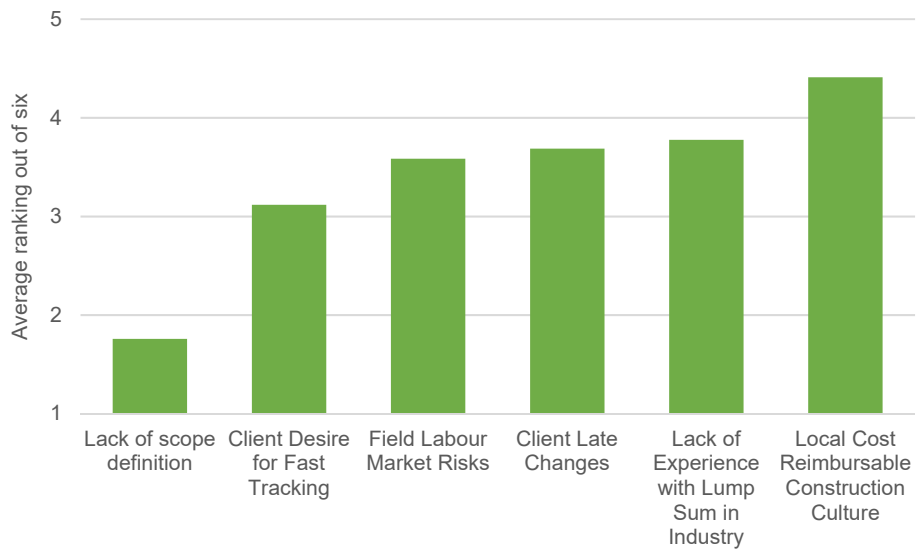


Figure 4: Average ranking of barriers (lower is ranked as more important)

4 SURVEY ANALYSIS

Survey responses were analyzed to understand the industry perception of various issues related to using lump sum contracting in the Alberta oil and gas sector. Data was analyzed for statistical relationships. Four methods of statistical analysis, as appropriate for the type of data, were used to determine correlations between dependent and independent variables. The four methods used were Chi Square Test for Independence, Fisher Exact Test, Independent Samples T-Test and One-Way ANOVA. Significant statistical relationships are detailed in the sections below.

4.1 Interests

Statistical tests were performed to determine the relationship between a company's interest in lump sum (as well as the stage at which they would be interested in lump sum) and various independent variables. These tests were performed against the type of organization, the role in the organization, years working experience, whether or not the company engages in unit rate contracts, whether or not the company has engaged in lump sum contracts in Alberta or internationally as well as the maximum project dollar value completed in Alberta as well as internationally.

Many conclusions can be drawn from the statistically significant inferential relationships developed through this research. It is possible to paint a picture of the type of company interested in lump sum work and at what stage that company could make use of the contract type. Statistically significant results show where opinions of particular respondents are unique compared to their peers. Certainly groups of respondents that are unique provide good opportunities for further investigation, and in some cases provide good opportunities to implement lump sum contracting.

It was found that all three company types (owners, engineers and contractors) were interested in executing work using a lump sum payment type. However, their levels of interest are statistically different from each other ($p < 0.001$). Owners showed the most interest (92%) with contractors showing just slightly less interest (81%), however only 51% of respondents at engineering firms were interested. It should be noted however that a full 68% engineers were interested in lump sum contracting at the detailed engineering phase. There is much less interest among engineering companies (22%) at the Front End Engineering and Design phase.

There is not a strong desire to use lump sum at the FEED stage especially from those who have used lump sum internationally (9%) compared to those who haven't (67%) which is a statistically significant difference ($p = 0.001$). Also, this aversion is shared by experienced respondents who have used lump sum on projects worth over \$100 million ($p < 0.001$) in Alberta. Highly experienced practitioners (those with over 25 years of experience) showed more interest (82%) than those with less than 25 years experience (64%) in using lump sum contracting ($p < 0.001$).

Industry practitioners who had experience using lump sum contracting in Alberta were not prepared to use lump sum contracting at the construction phase (33% vs. 77%, $p = 0.006$). However, among all respondents, those who had performed mega projects (>\$1 billion value) were indeed very interested in using lump sum at the construction phase. Those who had not worked on mega projects were not interested in using lump sum at the construction phase (100% vs 57%, $p = 0.007$). Past users of unit rate contracts were also highly in favour of using lump sum contracting at the construction phase (77% vs 33%, $p = 0.006$).

4.2 Barriers

Inferential statistics were calculated to determine the relationship between respondents ranking of the various barriers to lump sum (field labour market risk, local cost reimbursable construction culture, client late changes, lack of scope definition, client desire for fast tracking, and lack of experience with lump sum in industry) to independent variables (role in organization, type of organization, payment structure used on international projects and local projects, and the payment structure used most frequently).

A lack of experience in the lump sum construction industry was seen as only the 5th most important barrier to its use. Executives were more concerned about this lack of experience (average ranking = 3.1) than project managers (ranking = 4.6, $p = 0.027$). Engineers shared this concern for this lack of experience

(ranking = 3.1), but are contrasted by owners who did not rank it highly (ranking = 4.5, $p=0.001$). Frequent users of unit rate contracts in Alberta did not see this lack of industry experience as concerning (average ranking = 5.2 vs. 3.7, $p=0.025$).

Respondents who used unit rate contracts internationally saw the local cost reimbursable construction culture as a larger barrier (average ranking = 3) to the implementation of lump sum contracts than did those who had used cost reimbursable internationally (average ranking = 5.4, $p=0.032$). Contractors differentiated themselves from owners and engineers by being much more concerned about the client's desire for fast tracking than others (average ranking = 2.5 vs 3.5, $p=0.006$).

Client late changes were seen as a significant barrier to the use of lump sum contracting by both those who use lump sum internationally (average ranking = 3.4 vs 4.9, $p=0.006$) and those who use unit rate locally (average ranking = 2.7 vs. 4.0, $p=0.007$). Lack of scope definition was a major concern among those who use unit rate contracts (average ranking = 1). However, this is not a significant concern for those who frequently use lump sum contracts (average ranking = 2.3, $p=0.002$). The same disproportionate concern for lack of scope definition was found among those who use unit rate locally (average ranking = 1.0 vs. 1.8, $p=0.038$).

5 DISCUSSION AND CONCLUSION

This research investigated the viability of using lump sum contracting in the oil and gas industry of Alberta through surveying 240 practitioners experienced in the industry. Overall, 74% of respondents said they would be interested in using lump sum contracting on future work. The study used inferential statistics to identify which particular groups of practitioners were disproportionately interested in using lump sum and also to identify which barriers could be seen as the most important to overcome. Both the levels of interest and importance ranking of barriers suggest that lump sum should be considered after a sufficient amount of planning has taken place so that accurate bids can be prepared.

5.1 Summary of Interest in Lump Sum

This research showed that all participants (owners, contractors and engineers) showed significant interest in using lump sum contracting in Alberta. Overall, 74% of respondents were interested in using this contracting type. The most experienced individuals in the industry (over 25 years' experience) showed the most interest in using this contract type ($p<0.001$).

The level of company's lump sum experience in Alberta and internationally had impacts on when engineering companies were most comfortable using lump sum contracts. Those who had used lump sum in Alberta in the past were not interested in using lump sum for the construction phase ($p=0.006$). Further, experience with higher dollar value lump sum projects in Alberta was correlated with lower interest in early phase lump sum work ($p<0.001$).

Those with international lump sum experience were less interested in lump sum at the FEED phase than others ($p=0.001$). But whether companies had used lump sum internationally or not, these engineering companies were all more interested in lump sum at the detailed engineering phase than at the FEED phase. This interest in lump sum at the detailed engineering phase was even stronger among those who had not performed lump sum internationally ($p=0.038$). Working on higher dollar value lump sum projects internationally was associated with an increased interest in using lump sum at the detailed engineering phase ($p=0.002$). Performing larger lump sum projects internationally was also associated with an increased interest in using lump sum for construction ($p=0.007$). These respondents who were experienced on very large international lump sum projects were also interested in lump sum for full EPC ($p<0.001$).

Having used unit rate contracts offered more interesting insights into which phases lump sum contracts could be applied to. Companies who typically use unit rate contracts were not interested using lump sum at the detailed engineering phase ($p<0.001$) but were highly interested in using lump sum at the construction phase ($p=0.006$).

5.2 Summary of Barriers to Lump Sum

The two most important barriers as ranked by respondents could be seen as related, showing a very significant concern among Alberta oil and gas practitioners. A lack of scope definition and the client's desire for fast tracking are both issues that are related to owners' desire for increasing the speed of project delivery. Even those who use unit rate identified the lack of scope definition as a significant concern. Projects must be specified clearly before lump sum contracts can be used. Contractors were especially concerned about the client's desire for fast tracking, as they would be the ones to suffer if design changes were made after the issuance of a lump sum contract.

Client late changes is a related barrier that was seen as important by those who are experienced lump sum users both locally and internationally. Certainly, this issue must be resolved or mitigated somehow before lump sum is used in Alberta. A lack of experience in the industry and the local cost reimbursable construction culture are related barriers to lump sum implementation in Alberta. Executives, engineers and users of unit rate contracts internationally shared views of the importance of these barriers. Those who had used unit rate contracts in Alberta were less concerned as they are part of a culture that is closer to lump sum contracting than cost reimbursable. This culture will be hard to change in Alberta, but perhaps unit rate contracts can be used to gently push the culture in that direction.

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