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Industry Perceptions of Lump Sum Contracting is Alberta Oil and Gas Projects

O'Toole, Jacqueline

UNIVERSITY OF CALGARY

Industry Perceptions of Lump Sum Contracting in Alberta Oil and Gas Projects

by

Jacqueline O'Toole

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Abstract

Alberta oil and gas mega projects are experiencing cost overruns of up to 100 percent. Large cost overruns have created an interest in shifting to lump sum contracting. The objective of this study is to investigate the possibility of using lump sum contracting to replace the cost reimbursable contracting currently used on oil and gas projects in Alberta, through identifying industry perceptions of, and the risks associated with this contract shift. Two extensive surveys were conducted with experienced industry professionals. Collected data was statistically analyzed to form a set of conclusions and recommendations. The study provides an understanding of current contracting trends in the Alberta oil and gas industry, and found that there is interest in using lump sum contracts. The perceived risks to lump sum project performance, and proposed mitigations were identified. The study also identified areas where the perceptions of Operating, Engineering, and Construction companies were not aligned and determined that industry practitioners believe that, locally, there is a lack of experience and competency around the management of lump sum projects.

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List of Symbols, Abbreviations and Nomenclature

ANOVA	Analysis of variance
B	billion
DBM	Design basis memorandum
DF	Degrees of freedom
DV	Dependent Variable
Escalation	External factors that cause an increase in project cost: local government requirements, market conditions, inflation, etc.
FEED	Front end engineering and design
IV	Independent Variable
MM	million
Quantities	The number of units of materials, parts, and labour required for a construction project (Potts, 2008)
X^2	Chi square test statistic: measure of how expected results compare to actual results

1 Introduction

1.1 Background

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). A study conducted by the Canadian Energy Research Institute (CERI) has predicted that over the 2000 - 2020 period, oilsands mega projects will lead to an increase of Gross Domestic Product (GDP) that will approach $800 billion growth in Canada (CERI, 2005). It is expected that by 2030, the potential cumulative capital spent on oilsands mega projects in Alberta could exceed $200 billion dollars and production could increase to 5 million barrels of oil per day from the current production of 1.8 million barrels per day (AED, 2004). Sustaining capital expenditures and operating expenditures could total another $500 billion during the same period. These numbers do not include other major capital expenditures such as expenditures in the pipeline industry, where it is predicted that some $10 billion will be spent on new pipeline infrastructure in the near future (AEDA, 2004).

1.2 Motivation and Problem Statement: Cost Overruns on Oil and Gas Mega Projects

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 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). 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).

The industry often defines a mega project as one with construction costs exceeding $1 billion (Jergeas & Ruwanpura, 2008). Many projects in Alberta oil and gas are seeing costs of $8 billion to $14 billion (Jergeas, 2009). Table 1.1 presents the massive cost overruns on four (4) mega projects, as an example.

Table 1-1 - Cost Overruns on Alberta Oil and Gas Mega Projects (Condon, 2006)

Project	Company	Cost Estimate CAD$ billion	Final Cost CAD$ billion	% Cost Overrun
Mildred Lake	Syncrude	1.0	2.0	100%
Millenium	Suncor	1.9	3.4	94%
AOSD – Phase 1	Shell	3.5	5.7	63%
UE-1	Syncrude	3.5	7.5	114%

If this trend of escalating cost continues, it may impact the viability of the Alberta oil and gas industry, which employs thousands of construction workers, engineers, fabricators, contractors, and support staff.

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). 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 COAA study of project overruns, projects executed in Alberta 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). Elliot (2005) indicated that ineffective contractual arrangements, and the lucrative and inefficient project environment created by cost reimbursable contracting, are contributing factors to cost overruns. This study indicated that cost reimbursable usage originally increased in an attempt to accommodate fast tracking of projects.

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). The use of lump sum contracting instead of cost reimbursable was suggested by this study as a way to mitigate cost overruns in the Alberta oil and gas industry. No studies have investigated the industry perception of the possibility of shifting to lump sum contracting in the Alberta oil and gas environment.

1.3 Objectives

The main objective of this study is to investigate the possibility of using lump sum contracting in the Alberta oil and gas industry, through examining industry perceptions of lump sum contracting. The sub objectives to this study are the following:

1. Identify current contracting strategy trends with respect to frequency of use, scope of work, and financial range
2. Determine the perceived effect on and risks to project performance as a result of shifting to lump sum contracts on oil and gas projects
3. Determine the perceptions of industry practitioners concerning the existence of project management experience and competence with lump sum projects in Alberta.

1.4 Methodology

A comprehensive literature review was conducted to identify the potential causes of cost overruns and poor project performance related to contract strategy. The areas of contract risk, contract effect on project performance, effect of shifting contract strategies, stakeholder challenges, and project management competence and experience were investigated. These variables were identified from literature reviews, and the survey instruments were designed to address them.

Semi-structured, preliminary interviews were conducted with senior managers and executives from the oil and gas industry to get a better understanding of the study objective, and to feed the design of the subsequent surveys. Two survey instruments, referred to as the Primary and Secondary survey in this document, were designed to understand the current contracting environment, and the industry perception of the effects of shifting to lump sum contracting and the risks associated with doing so. Both surveys were Mixed Method, consisting of both closed-ended and open-ended questions. Where possible, the open-ended questions were categorized to obtain quantitative results. The surveys were administered to the target group of executives, senior managers, and program and project managers at operating, engineering, and construction companies that operate in the Alberta oil and gas industry. The primary survey was a confidential online questionnaire with questions covering the following four areas:

- Participant demographic information
- Company contracting practice
- Implications of shifting to a lump sum contracting environment
- Organizational-type targeted questions.

The secondary survey was used to clarify themes and questions arising from the primary survey. It was a confidential survey administered during two seminars in Edmonton and Calgary, Alberta to the same target demographic. The secondary survey was divided into three sections:

- Participant demographic information
- Company contracting practice
- Participants' perceptions of the effects of lump sum on major risks, risk sharing, and project behaviours.

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. Quantitative and qualitative data were summarized; the quantitative data was analyzed for statistical relationships and the qualitative data was categorized. 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. The results of this study are presented as summaries of survey data as well as statistical relationships uncovered in the analysis.

1.5 Thesis Organization

The thesis is organized into nine chapters. The remainder of the chapters are organized as follows:

- Chapter Two: Literature Review

Chapter Two presents a review of the current literature surrounding the research topic. The chapter concludes with a discussion of various gaps in the research concerning lump sum contracting use in the Alberta oil and gas industry, thereby providing justification for the research performed in this thesis and providing variables on which the surveys were based.

- Chapter Three: Instrument Design and Data Collection Methodology

Chapter Three discusses the research methodology used in this study. A *within stage, mixed method* research design was selected, with semi-structured interviews and two stages of surveys for data collection.

- Chapter Four and Five: Summary of Survey Data

These chapters present a summary of the quantitative frequency data and complied and categorized open-ended data, from the Primary and Secondary survey responses, respectively.

- Chapter Six, Seven, and Eight: Data Analysis

These chapters present the data analysis methodology and a summary and discussion of all statistically significant findings for the Primary and Secondary surveys.

- Chapter Nine: Conclusions

Chapter Nine summarizes the findings, the discussion, areas for future study, major research contributions, and the limitations and barriers of this study.

2 Literature Review

2.1 Overview: Cost Overruns on Mega Projects

There are a substantial number of studies that explore the reasons behind cost overruns on major construction projects, though there are few that deal specifically with projects in the Alberta oil and gas industry. There is an extensive history of large project cost overruns on international projects (Flyvbjerg, 2014). Table 2-1 provides examples of dramatic project cost overruns on international projects.

Table 2-1 - International Project Cost Overruns

Project	% Cost Overrun
Suez Canal, Egypt	1900
Scottish Parliament Building, Scotland	1600
Sydney Opera House, Australia	1400
Montreal Summer Olympics, Canada	1300
Concorde Supersonic Aeroplane, UK	1100
Troy and Greenfield Railroad, USA	900

One study did assess key factors impacting the performance and productivity of oil and gas projects in Alberta (Chanmeka et al, 2012). The study looked at quantitative data acquired from nineteen oil and gas projects. It determined that poor labour productivity was not the problem; rather that poor application of project management principles was causing the suboptimal performance. A study by the Alberta Economic Development Authority was undertaken because of cost overruns associated with current and planned mega projects in Alberta (AEDA, 2005). The study recommended improved management of project execution as a means of mitigating these cost overruns. The above noted reviews identified contracting strategies and payment structures as one problem area for managing project execution.

It was proposed that the use of cost reimbursable payment structures is likely contributing to the large cost overruns in Alberta oil and gas (COAA, 2009). Elliot (2005) indicated that ineffective contractual arrangements and the lucrative cost reimbursable contracting environment are contributing factors to cost overruns. This study indicates that the lucrative cost reimbursable environment is the result of attempting to accommodate fast tracking of projects.

Flyvbjerg has determined that mega projects are inherently risky due to long planning horizons and complex interfaces (Flyvbjerg, 2006). Considering the subject of risk, Taleb sees large projects as being exposed to extreme event risks with massive negative outcomes that managers tend to ignore and manage incorrectly (Taleb, 2010). These events remain unaccounted for and result in cost overruns that undermine project viability.

Many other studies have identified issues with the upper management at client organizations, including risk-negligence and improper risk management, a lack of accountability, and improper interactions by upper management with client project team members and stakeholders (Flyvbjerg et al., 2003). Although the stage-gated process has been used heavily by most oil and gas companies, it has failed to deliver the expected project execution success and continues to result in economic failure (Walkup and Ligon, 2006). Researchers believe the major areas of failure are a lack of stakeholder engagement/collaboration, poor project management leadership, and a lack of proper contracting and contract management; failures which can effect poor quality decision making.

Having identified several potential causes of project cost overruns, this literature review examines existing research concerning the areas of:

- Lump sum and cost reimbursable contracting strategies
- Risk management on mega projects, including:
    - Factors that affect the perception of the controllability of risk on projects
    - Contract risk allocation
- Impact of shifts in contract strategy:
    - Impact, on project performance, of changing the current contract strategy paradigm
- Impact of contract type on project performance
- Project management and project execution experience

    - Impact on project performance when there are deficient competencies in project management and project execution experience
- Stakeholder challenges on major projects
    - Investigation of Operator Project Manager Empowerment and the effect on project performance.

These areas are grouped under four factors that influence cost overruns on projects:

- Risk Management
- Contract Strategy
- Project Management Experience
- Stakeholder Challenges

The following model in Figure 2-1 is a graphical representative of these factors and their influence on cost overruns.

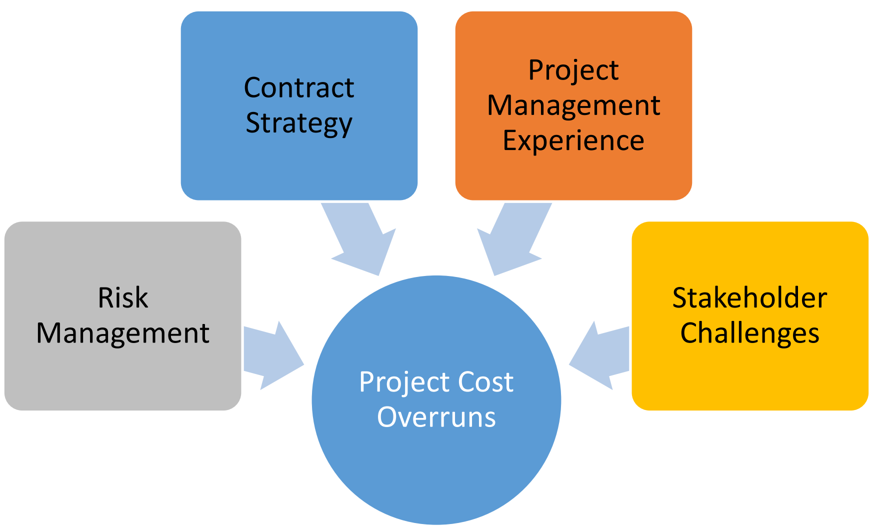


Figure 2-1 – Literature Review Factors Influecing Project Cost Overruns

The following sections will first discuss two contract types and their advantages and disadvantages, and then investigate each of the four factors.

2.2 Contract Types

In this study, the terms payment structures and contracts have been used interchangeably.

2.2.1 Cost Reimbursable

Common contracting strategies used in oil and gas are lump sum and cost reimbursable (Halari, 2010). The majority of major construction projects in the oil and gas industry in Alberta are undertaken in the negotiated contract format often called cost reimbursable (COAA, 2009). This type of contract compensates 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).

Cost reimbursable contracts are typically used on ill-defined, fast tracked projects, where scope and specifications are developed over the duration of the project (Buckingham, 1994). It has been considered by some researchers as undesirable for construction (Navarrete & Cole, 2001) because it implies high cost and schedule risks (Von Branconi & Loch, 2004). A literature search has found that cost reimbursable is very lucrative for the contractor and is subject to abuse (Halpin and Woodhead, 1998). It provides no incentive to reduce cost or avoid cost increases (Bubshait, 2003).

2.2.2 Lump Sum

The lump sum format of contracting 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 proceeds) (Marston, 1996). Using the technical specification package and detailed plans provided by the operating company as an estimate basis, the contractor bids a price which covers all work, equipment, and services required to complete the project.

Lump Sum contracting on oil and gas projects is predominantly used in the Middle East and Asia and is used less frequently in North America (Halari, 2010). From a study of industrial projects in Saudi Arabia, including large oil refineries and large chemical plants, only 3.5 % are completed using a cost reimbursable payment structure, while the majority of other projects are being completed using lump sum contracting(Ganiyu & Shash, 2011). The literature survey found very few studies about the use of lump sum contracting in the oil and gas industry, and even fewer studies about the use of lump sum contracting within the North American or Alberta oil and gas industry.

Some advantages to using lump sum contracting as identified in the literature include:

- It is preferred by financiers (Berends, 2007)
- It clearly allocates responsibility, offers the opportunity to allocate risk to those parties best able to control it, minimizes interfaces, and can work with more overlap between engineering and construction (if lump sum turnkey) (Von Branconi & Loch, 2004)
- It reduces owner management resources (Lang, 1990).

Some potential major disadvantages to using lump sum contracting as identified in the literature include:

- The potential for disputes if risk is allocated incorrectly (Singh, 1997)
- Scope being not clearly defined and open to misinterpretation, resulting in excessive change orders or claims (Berends, 2006).

One of the problem areas leading to cost overruns in Alberta oil and gas projects was identified as cost reimbursable contractual strategy/payment structures (Jergeas, 2009). Local project cost overruns have created a demand for a return to lump sum contracting. This interest in using lump sum as a potential solution to cost overruns was found in a study of key factors for determining the successful execution of projects (Jergeas, 2009).

2.3 Risk Management

A significant volume of research exists around the concept of risk on projects. The mishandling of risk can have huge negative consequences on mega projects. Mega projects are characterized by complexity, uncertainty, large numbers of internal and external interfaces, large numbers of resources required, and long timelines (Florial & Miller, 2001; Capka, 2004; Flyvbjerg, Bruzelius, & Rothegatter, 2003). These characteristics all represent sources of risk. Poor performance of mega projects has resulted primarily from underestimation of the risks associated with costs, delays, contingencies and changes in quality, price, project specifications, designs, exchange rates, and external factors (Jaafari, 2001).These risks have been identified as having a significant effect on the final cost of construction projects (Zaghloul & Hartman, 2003).

2.3.1 Perception of Controllability of Risk

Control of risk is the overarching goal of project managers (Kardes et al., 2013). It has been shown that, if a contractor's perception of the controllability of the risks they are expected to take on with the project is low, the higher the premium for that risk they will include in the project contract price (Zaghloul & Hartman, 2003). Perception of risk, therefore, has a large impact on the final performance and cost of a project. There are few papers that evaluate factors that influence perception of and attitude toward risk on construction projects. The sections below discuss some of the major factors, emphasized in the literature, that influence the perception of controllability of risk.

2.3.2 Trust between Contracting Parties

Trust between contracting parties has been identified a number of times as a factor that influences the perception of controllability of risk (Akintoye & Macleod, 1997; Corts, 2011; Das & Teng, 2004; Kardes et al, 2013; Zaghloul & Hartman, 2003). As these research papers have noted, trust in the construction industry has generally been identified as low between contracting parties. When trust is low, risk is perceived as being high and risk premiums added to the project cost tend to be high. When trust is high, the perception of risk and the premiums added tend to be low.

When trust is low, restrictive, explicit contracts are used, particularly lump sum contracts (Corts, 2011; Corts & Singh, 2004; Kalnins and Mayer, 2004). When trust is high, less restrictive implicit contracts are used, based on cost-plus contracts. There is little research data on the success or failure of moving to implicit contracts.

2.3.3 Project Management Experience

Another factor influencing the perceived ability to control risk is project management experience. Project management experience is seen as very important to the success of a project and will be discussed more substantially in Section 2.4.3. Knowledge and experience were shown to be the top factors influencing the ability to implement effective risk-based decision-making on construction projects (Wang & Yuan, 2011). Advanced project management experience and training can help cope with the risk challenges presented by mega projects

(Merler, Liang, & Dulebohn, 2006). The project management team developing a transparent communication plan to prevent deviation from project goals is an emphasized part of project management ability when managing risk (Remington & Pollack, 2007).

Unexpectedly, there were quite a few studies showing that highly experienced project leaders mistakenly overestimate their ability to influence project risk. Their experience, when confronted with uncertainty, generates overconfidence that leads to an inability to properly evaluate risk, underestimate consequence, and over value positive indicators (Durand, 2003; Simon et al, 2000; Titus, Covin & Slevin, 2011). The higher the uncertainty in a project, such as the uncertainty associated with a mega project, the higher the probability of inappropriately assigning the consequence of a risk. This undervaluing of risk leads to underestimating development costs, which in turn leads to poor project planning (Jorgensen, 2005).

2.3.4 Risk Attitude

Risk attitude in construction management has been studied (Au & Chan, 2005) and linked to decision making behaviour. Risk attitudes, by company type, was discussed in the literature as a factor influencing perception of risk. Attitudes were described as risk adverse, risk neutral, or risk taking. If a given project situation was approached with different risk attitudes, these attitudes would lead to different behaviours and different outcomes (Hillson & Murray-Webster, 2007).

Studies have shown that client organizations are risk adverse or risk neutral. They tend to prefer to transfer risk based on complexity and size of project (Erikson et al. 1978; Halari, 2010; Wang & Yuan, 2011; Zaghloul & Hartman, 2003; Zou et al., 2007). Contractors were found to be risk takers, risk neutral, or risk adverse depending on complexity and size of the project, and market conditions. Being a risk taker was discussed as being a positive trait for contractors in some papers (Thevandran & Mawdesley, 2004; Wang & Yuan, 2011; Zou et al., 2007). Being extremely conservative, with respect to risk, reduced contractors' opportunities to gain the potential benefits achieved from effectively managing risks, rather than avoiding them. Being extremely risk adverse as an owner was seen as a negative trait in much of the research, as attempting to transfer all risk to the contractor typically did not result is lower cost risk to the owner (Espinoza, 2011; Hu et al., 2012; Loots & Henchie, 2007; Zaneddin, 2006).

2.3.5 Internal and External Market Risks

The external economic environment/market greatly influences perception of project risk (Espinoza, 2011). Research differentiates between internal and external risks (Das & Teng, 1999; Janowicz-Panjaitan et al., 2009; Khazaeni et al., 2012). Internal risks are those within the sphere of influence of the project organization. External risks are all other risks outside the sphere of influence of the project organization. Large projects can be greatly affected by external market factors (Bing et al., 2005). External factors are supply and demand risks (labour, material, and equipment), financial market risks, and political, social, and economic risks (Miller & Lessard, 2007; Cavusgil & Deligonul, 2012). External market uncertainty is extremely difficult to predict and therefore it is very difficult to allocate appropriate contingency for such uncertainty. This is why external risks are of such great concern to contractors. If they allocate too little contingency, they may not have the means of mitigating the risk. If they allocate too much, their bid price may be inflated, resulting in not winning the project or escalating the price for the client (Hartman, 1993; Jergeas & Hartman, 1996; Zack, 1996; Zaghloul & Hartman, 2003).

Risk management research on mega projects does not delve very deeply into the methods for managing external uncertainties that lead to unexpected risks. A few sources have proposed methods for estimating required contingency and for incorporating a multidisciplinary reactive team to their risk management strategy to deal with large unexpected risks (Espinoza, 2011; Jorgensen, 2005; Olsson, 2006; Pavlak, 2004; Royer, 2000;).

While much of the research states external risks as a large problem for major projects, some researchers have found internal risks and the project team's strategy for managing these risks, to be a better indicator of project success. Internal risks related to project team organizational decision-making structure pose a larger threat than external risks because they indicate the level of preparedness of the project team for handling external risks (Busby & Zhang, 2008).

Communication strategy, the project teams ability to collaborate, and the level of client interference greatly influence productivity and project outcome (Al-Sobiei et al., 2005; Fu et al., 2012; Holzmann & Spiegler, 2011; Laryea & Hughes, 2011). Many papers identified collaboration and communication as both the risk and solution to project success for construction projects. Attempting to find a balance between communication/collaboration of client and contractor, and disruptive client/contractor interference has influenced procurement practices and contract strategy selection (Aleshin, 2001; De Bakker et al., 2012; Tang et al, 2006).

The organizational/managerial command structure, business strategy, and overall leadership of the companies involved in executing complex mega projects have also been presented as having a large impact on the ability of the project team to identify and respond to external risks (Thamhain, 2013). Overall management of the companies involved can impact the empowerment of the project team to control risk effectively. Little research has been done on how to foster an environment that promotes alignment between the project teams and overall corporate strategies. Shenhar et al. (2007) described a process called strategic alignment to unify the project team and the enterprise objectives through cross functional communication and cooperation. Senior management work to build effective partnerships of respect and credibility, instead of an adversarial relationship, between all project stakeholders within an organization is conducive to early risk detection and management.

2.3.6 Contract Risk Allocation

Literature involving the topic of risk management, devotes considerable time to the discussion of responsibility for risk on a project. Misunderstandings between contracting parties about risk apportionment and accountability cause project inefficiencies, poor project team relationships, and an increase in project cost (Halari, 2010; Hartman & Snelgrove, 1996; Loots & Henchie, 2007). According to the literature, there are three methods for allocating risk:

- Client/Owner assumes all project risk
- Contractor assumes all project risk
- Risks are apportioned and shared between contracting parties.

Client organizations prefer to mitigate risk by transferring it to the other contracting parties as they are generally risk adverse organizations (Berends & Dhillon, 2004; Gordon, 1994; Kashiwagi, 2010).). Several papers indicate the responsibility for managing project risk as being born exclusively by the contractor (Imbeah & Guikema, 2009; Jin& Ling, 2005; Lee et al., 2006), as clients attempted to force the contractor to act as an informal “insurer” to the project (Ward et al., 1991).

In lump sum contracts, cost overruns associated with risk are generally contractually assigned to the contractor (Berends & Dhillon, 2004; Ward et al., 1991). Yet, attempts to completely transfer risk away from client organizations does not appear to reduce their risk and in fact can result in higher project costs. Because of this, strategies for risk sharing using contractual means have been explored and been found to influence contractor bidding strategy and contract pricing choices(Cheung et al., 2010; Fang et al., 2004; Laryea & Hughes, 2011). Alternative contract types, other than the traditional lump sum and cost reimbursable, have been suggested for improved sharing of and collaboration on risk. Joint venture partnering and alliances are the most suggested solutions to risk sharing (Osipova & Eriksson, 2011; Pavlak, 2004; Shen et al., 2001; Tang et al., 2006). Some researchers have found that partnering improves the efficiency of risk management on projects.

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).

2.4 Contract Strategy

2.4.1 Shifting Contract Strategy

With many large oil and gas construction projects struggling to achieve cost and schedule success, there have been a few studies that examine the results of shifting to new contracting strategies to overcome difficulties to achieving project cost and schedule success. Changing contracting strategy away from what was traditionally being used, appears to have had some success within the oil and gas industry. Two case studies about the shift to lump sum mega project execution within Exxon Mobil and Saudi Aramco are particularly interesting. It should be noted that a literature review found very few studies on contracting in the oil and gas industry and even fewer studies specifically on contracting in the North American or Alberta oil and gas industry. The majority of data on contracts, particularly for stock exchange listed companies, tends to be confidential, making it difficult to study and publish results regarding these contracts (Halari, 2010). This section discusses three studies about shifting to lump sum contracting from cost reimbursable and five studies about shifting from lump sum contracting to other contracting strategies.

A case study was conducted, using data gathered from Exxon Mobil's project execution history, on the owner's contract perspective (Johnson, 1987). Exxon had a very positive opinion about its switch to lump sum execution. The study concluded that lump sum offers substantial investment savings to owner organizations under competitive market conditions. Lump sum was found to be advantageous to the owner because of better definition of project cost and thus reduced financial risk.

Another case study looked at Exxon's shift to lump sum and the results of their first lump sum mega project execution in the United Kingdom (UK). Exxon previously used cost reimbursable in the UK and switched to lump sum for construction of their Fawley Refinery in 1983. Due to project execution problems during the construction phase, Exxon terminated the lump sum contractor and completed the project under a cost reimbursable agreement with another contractor. The major reason given for the failure of lump sum on this project was that after thirty years of working in a cost reimbursable environment, 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 (Ward, 2008).The study showed that the shift to lump sum did not immediately change the project behaviours associated with a cost reimbursable construction culture and that project management practices must change with a change in contract type.

Another case study on the owner's perspective was conducted with the Saudi Aramco company and involved analyzing their mega project execution success by examining their five most recent mega projects (Palmer & Mukherjee, 2006). The most recent four projects were delivered under budget and under schedule, while the first of the five projects was not. The ten factors contributing to their project management success were analyzed, with one factor being, effective contractors and contracting strategies. The contracting strategy chosen for these projects was lump sum. The shift to lump sum was a major factor credited with the turnaround in their mega project delivery success. The study also showed that the first project executed under lump sum had growing pains associated with a shift in contracting strategy.

Conversely, there have been studies conducted making an argument for moving away from lump sum contracting on oil and gas projects to cost reimbursable based incentive contracts. Cost overruns were occurring on offshore oil and gas projects, where lump sum contacts were typically used. Problems with lump sum were found to include divergent goals of the owner and contractor companies and that lump sum produced large monitoring and coordination costs (Corts, 2012; Corts & Singh, 2004; Sund & Hausken, 2012). The case was made that these problems could be overcome with cost reimbursable incentive contracts (Bresnen & Marshall, 2000; Osmundsen et al., 2008).

2.4.2 Contract Type

Research indicates that there is a high degree of waste and performance inefficiency common on most construction projects (Serpell et al., 1995; Howell et al., 2001; Koushki et al., 2005; Love and Edwards, 2005). The previous section discussed the project performance impact of shifting to different contacting strategies. This section deals specifically with research on the impact of contract type on project performance.

There are quite varied opinions in the literature regarding the impact of different contract types on construction performance, including the literature from the section above. Much of the split in the literature exists between the traditional lump sum contract type and alternative partnering contract types, such as alliances.

Several studies have determined that lump sum improved construction project performance and improved contractual relationships (Langford et al, 2003; Muller & Turner, 2007; Odeh & Batteinah, 2002; Tenah, 2000; Ward and Chapman, 1994). The studies found that projects executed under lump sum were much more likely to be completed within budget, and had accelerated design and construction timelines. While there is no explicit financial incentive for performance under lump sum, there is a performance incentive because the more efficiently the project is executed, the higher the reward for the contractor (Ward and Chapman, 1994). As well, lump sum requires less management by the client organization and creates a more harmonious working environment between client and contractor (Muller & Turner, 2007). These findings dispute other research, which found that, by transferring risk to the contractor in lump sum, contractors were more highly compensated, thus driving up the overall cost of the project (Begg et al., 2000).

The Odeh & Batteinah (2002) research was interesting because it compared the industry perception of the impact of contracts and contractual relations on project performance. What was interesting to note was that contracts were ranked as an important impacting factor by construction contractors because of concern around clauses that transferred risk to them, while contracts were ranked as unimportant by consultants representing the client. This marks a clear disconnect between the principal and the agent. Contractual relationships (disputes, lack of communication, and project inter-organizational structure), were not of high concern to either party. The paper recommended lump sum design build and construction management contract types to limit owner interference and improve contractual relations.

Another interesting study evaluated project management professionals from both the client and contractor sides of the construction industry on their perception of the importance of project success factors (Muller & Turner, 2007). Fifty-six percent of survey respondents were project managers from North America. The study is highly relevant because it assessed perception of the importance of success factors and assessed perception of actual project success from respondents' experience, and correlated these to contract execution type. A major finding of interest was that professionals who executed projects with lump sum, placed a much higher importance on client/owner satisfaction than professionals who used alliance contracts. Even more interesting was that lump sum was correlated with significantly higher levels of client satisfaction and perceived achievement of project purpose than compared with other contract types, particularly unit rate and alliances. Despite the perceived risks of lump sum, they were found to be consistently more successfully managed than other contract types. Financial institutes still prefer to finance lump sum projects for large oil and gas engineering/construction projects, as they see their investment better protected in this contract type (Berends, 2007). However, Berends' study shows the construction industry sees value in optimizing the performance incentives in construction contracts.

There is also considerable research showing the benefits of alternative forms of contracting. Many recent studies discuss the potential improvements in project performance achieved through alternative contractual arrangements, specifically partnering and alliances (Fisher and Green, 2001; Rahman and Kumaraswamy, 2004). One particular study used economic game theory to model the behaviour of subcontractors in allocating resources to projects (Sacks & Harel, 2007). It was found that unit price and lump sum had productivity waste, from a resource perspective, hidden from the client in unit rate and lump sum contracts, as they are closed book contract types. Partnering was found to improve performance by aligning long-term interests and increasing trust between project participants. Another proposed strategy for reducing post contract award inefficiency and opportunism is having a contract option to switch to a different payment structure during execution (Boukendour, 2007).

Cost reimbursable, without an incentive component, did not seem to be a recommended contract strategy, in recent literature. Papers discussing the lack of support for using cost reimbursable alone, start as far back as 1986, where McAfee and McMillan discouraged its use because without an incentive element, there are not enough control mechanisms in place to achieve required project performance. Cost reimbursable should be limited to low cost projects, emergency work; and short duration projects because of the lack of incentives for cost reduction strategies and lack of deterrents for cost increase (Bubshait, 2005).

2.5 Project Management Experience

The importance of project management/execution experience and skill has been emphasized in the literature. Project managers and construction managers have the responsibility to complete the project within budget, on schedule, and within the organization's limitations (Sears et al., 2008). A competent project manager is vital to the success of a project (Hwang & Ng, 2013) and has direct influence over 34% - 47% of project success (Frank, 2002). Thus, the availability of project management personnel with high levels of experience, qualifications, and leadership skills was found to be the highest ranked factor impacting project performance in a number of studies (Cheung et al., 2004; Enshassi et al., 2012; Iyer and Jha, 2005).

Increasing industry awareness of the direct relationship between competencies in construction project management skills and project success has resulted in the successful organizations putting more focus on their project managers acquiring core project management competencies (Ahadzie, 2007). For many years, studies have investigated what core competencies are critical to project success (Avots, 1969; Belassi and Tukel, 1996; Crawford, 2000; Sayles and Chandler, 1971). Contract and contractor management has been identified as one of the most critical competency areas that can result in cost overruns and time delays (Frimpong et L., 2003; Mansfield et al., 1994). The risk in poor contract management arises from a lack of proficiency in selecting and drafting effective and appropriate contracts (Edum-Fotwe & McCaffer, 2000) and a lack of understanding of the proper management of different contract types of project delivery (Tagaza & Wilson, 2004).

The management of mega projects is particularly difficult and is different than traditional projects. Project managers without the appropriate competencies, with respect to managing these large projects, do not focus enough on the long term strategic view of the project and, therefore, do not achieve the best overall project value creation (Halman and Braks, 1999; Asrilhant et al., 2007; Turner et al., 2009; Turner et al., 2010). They are responsible for providing leadership, managing external stakeholders, and aligning the goals of the project with corporate strategy (Thiry, 2004; Shao, 2010). Studies have shown that many project managers in charge of mega projects have been ineffective at achieving the above objectives (Morris and Jamieson, 2004). A study on decision making by project managers on mega projects identified contract management and procurement as one of four major competency risk areas with significant impact on the long-term value creation of mega projects (Eweje at al., 2012). Experience with selecting the appropriate contract type, developing the contract, and managing the contact after implementation appear to have a large impact on project outcome.

2.6 Stakeholder Challenges

Stakeholders internal and external to the project team, on both the client and contractor side, can have a major influence on project success. On large construction projects, the multitude of different stakeholders involved present significant challenges to both contractors and operators (Doloi, 2009). Literature has shown that different stakeholders can have very different perceptions of the performance criteria that constitute success, and then actual project performance measured against these criteria (Dalcher and Drevin, 2003; Turner et al., 2009). Other research has indicated that the perceptions of project success of stakeholders external to the immediate project team is often poor (Davis, 2004). The sections below discuss major stakeholder challenges that are of interest to this research.

Projects are essentially temporary organizations within a company that have a defined objective, budget, timeline, and customer (Turner & Muller, 2003). Contractors are often project-based organizations (PBOs) in which the main structures and processes exist to generate revenues from projects performed for customers (Hobday, 2000, Lindkvist, 2004, Whitley, 2006). Owner/operator companies use projects for specific, non-routine activities, generally used to create internal change or development (Hobday, 2000). However for some of these companies, as appears to be the case for oil and gas companies that engage in mega projects, revenue is generated from the completed facility, but a major part of cost is related to projects. These types of oil and gas companies are project-oriented organizations (POOs) (Arvidsson, 2009).

Research has found that sources of stakeholder tension in PBOs and POOs are different, meaning that sources of stakeholder tension in contractor and operator companies are different. A main source of tension identified in the research is the organizational structure within the operating company. Business Unit Managers or Line Managers within the operating company are given control over resources such as personnel and capital. The project managers must ask for these resources when they are required. The Business Unit owns the capital for the project and personnel must be shared between the project and 'line'. The sharing of resources leads to role conflict. As well, the Business Unit generates revenue, while projects generate the bulk of the cost, which creates a power imbalance (Arvidsson, 2009; Lewis et al., 2002; Lundin & Soderholm, 1995; Sydow et al., 2004).

A major source of tension in the contractor world is the organization's interactions with external stakeholders (Bengtsson & Eriksson, 2002). On projects, contractors interact with subcontractors, suppliers, the customer (the operating company), and partners, which can lead to conflicts between the contractors' internal requirements and external demands (Pinto & Nedovic-Budic, 2002). The above researchers found external stakeholders to be a larger source of tension for contractor organizations than for operating company organizations.

2.6.1 Operating Company Project Manager Empowerment

The imbalance of power at owner organizations that was discussed above has been discussed in the literature as creating a situation where operating company project managers are not empowered to properly control the projects they manage. Research has shown a mismatch between a project manager's high accountability and his low authority. (Jonas 2010). This issue causes problems within an operating company but not within a contractor company, as the major source of revenue for the contractor is the project and thus project teams have the power within contractor organizations (Arvidsson, 2009).

Empowerment of individuals (Spreitzer, 1995b, 1996; Liu et al., 2007) and teams (Kirkman and Rosen, 1999; Kirkman et al., 2004) in the workplace has been studied and has shown that empowering work environments generate higher quality outputs from individuals and teams (Tuuli and Rowlinson, 2009). The interactions on a project in the operator company between the project manager, line management, steering committees, and team members has been studied frequently in recent years (Anantatmula, 2008; Bryde, 2008; Crawford et al., 2008;

Geoghegan and Dulewicz, 2008; Lechler and Cohen, 2009). The studies have shown that tensions arise between the project and the rest of the operator organization because line and project teams have fundamentally different organizing principles. Employees identify themselves with either the line function or the project function and conflict of interest arises from the competition for resources (Laslo and Goldberg, 2008; Sbragia, 1984). In complex organizations, like POOs, Line/Business Unit managers have more complex, less well defined roles, as it relates to the projects being executed (Larson & Brewster, 2003; Onyemah, 2008).

This lack of role clarity and perceived lack of transparency of the requirements of the project team (Elonen & Artto, 2003), combined with the power imbalance between the line teams and project teams, leads to conflicts of interest, lack of cooperation with, and loss of autonomy for the project team (Laslo & Goldberg, 2008). Research has shown that when project teams are provided more influence and autonomy (empowerment), and support from top management, project performance is substantially better (Kleinschmidt et al., 2007; Wheelwright and Clark, 1992). Turner (2004) studied the owner company conditions under which projects deliver the best results. One of the four conditions for success was that project managers should be empowered and have the autonomy and access to resources to deal with unforeseen circumstances as they see best. They should also be the main source of council to senior management on how the project can best be achieved (Turner, 2004).

Considerable research has focused on what role in project support upper managers have on projects (Bredin and Söderlund, 2007; Carmeli and Halevi-Meyrav, 2009), since in POOs they control the resources. Projects that have power within an organization by having a steering committee of senior management, enables the project to enforce its resource and empowerment requirements through the line management (Lechler & Cohen, 2009). The steering committee has the power to reduce project/line conflicts through convincing and motivating line management to cooperate and collaborate with the project (Laslo & Goldberg, 2008; Thomas & Bendoly, 2009; Xie et al., 2003). Other research has talked about the importance of frequent communication between the project sponsoring upper managers and the project manager. Successful projects had an upper management that actively communicated with the project manager throughout the project whereas unsuccessful projects had senior management that had less involvement (Turner et al., 2009).

Support from upper management appears to be a critical part of empowering project managers and project teams within operating company organizations. However, research has also indicated that upper management project support can have unintended consequences if not implemented correctly. If upper managers become too personally invested in a bad project to make objective decisions, continuation of a project that should be cancelled can occur (Bonner et al., 2002; Ernst, 2002; Markham, 2000). Senior managers can also increase the tension between line and project if they circumvent organizational rules and processes. This leads to a further lack of cooperation and more distrust between line and project teams (Arvidsson, 2009).

2.7 Conclusion of Literature Review

Project cost overruns in the Alberta oil and gas industry has been identified in a number of previous studies. The desire for using lump sum contracting as a potential solution to project cost overruns has also been identified, but only as a periphery conclusion to the study. No studies have been conducted to investigate the current frequency of lump sum usage, for what scopes and financial ranges the industry is willing to consider using lump sum, or to quantify the industry-wide interest in lump sum and what scopes and financial ranges would be of interest. There have also been no studies that have statistically analyzed this information to profile the lump sum interest level and current use level across different segments of the Alberta oil and gas industry (Operating, Engineering and Construction companies), to identify any disconnects between the main organizational groups required to execute a lump sum mega project.

A significant amount of research exists around the sources of risk on mega projects and the impact on project performance of perception of controllability of risk, trust, project management experience, risk attitude, and risk allocation. There have been no studies specifically relating these concepts to how they will affect the feasibility of using lump sum contracting in Alberta oil and gas. The researcher also found no studies on how to properly share or allocate sources of risk on lump sum projects in Alberta oil and gas.

Studies have been conducted internationally on the effect of different contracting strategies, shifting contracting strategies, and project management experience (specifically around contracting) on project performance. Case studies have been investigated on shifting to lump sum strategies in international oil and gas, and the ensuing project performance benefits. Research in this area is very minimal for the Alberta oil and gas environment.

Research has been conducted on the main sources of stakeholder tensions within operating and contracting organizations, but very little information was found that translated these concepts specifically to a lump sum environment or to the Alberta oil and gas environment. The following model in Figure 2-2 demonstrates graphically, the interaction between the study variables identified, the four factors found from literature that influence cost overrun, and the study objective. The study variables will be explained in more detail in the Section 3, Instrument Design and Methodology.

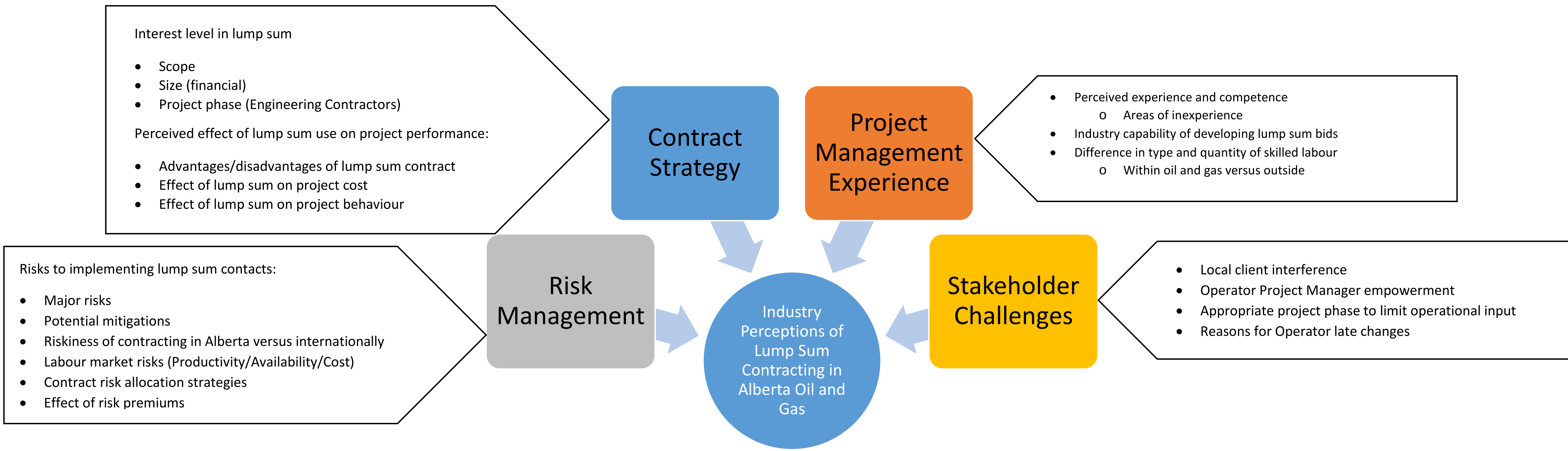


Figure 2-2 – Interation of Study Variables on Research Objective

3 Instrument Design and Methodology

Four factors were found, in literature, which influence project cost overruns: Contract Strategy, Risk Management, Project Management Experience, and Stakeholder Challenges. For this study, variables were derived from literature under each of the four factors.

To address the gap in literature around current contracting trends in Alberta oil and gas, this study will investigate the following:

Contract Trends:

a) Current project contract type use:
    - Locally
        - Scope
        - Size (financial)
        - Frequency

b) Past use of lump sum:
    - Locally
        - Size (financial)
    - Internationally
        - Size (financial)
    - Construction Contractor lump sum use, locally:
        - Within oil and gas
        - Outside oil and gas

To address the gap in literature around industry perceived effect on project performance of using lump sum contracts in Alberta oil and gas, this study will investigate the following:

Contract Strategy:

a) Interest level in lump sum
    - Scope
    - Size (financial)
    - Project phase (Engineering Contractors)

b) Perceived effect of lump sum use on project performance:

- Advantages and disadvantages of lump sum contract in Alberta
- Effect of lump sum on project cost
- Effect of lump sum on project behaviour

To address the gap in literature around perceived risks of shifting to lump sum in Alberta oil and gas, this study will investigate the following:

Risk Management:

a) Risks to implementing lump sum contacts:
    - Major risks
    - Potential mitigations
    - Riskiness of contracting in Alberta versus internationally
    - Labour market risks (Productivity/Availability/Cost)
    - Contract risk allocation strategies
    - Effect of risk premiums

To address the gap in literature around perceived project management experience and competence with lump sum, this study will investigate the following:

Project Management Experience:

a) Perceived experience and competence
    - Areas of inexperience
b) Industry capability of developing lump sum bids
c) Difference in type and quantity of skilled labour
    - Within oil and gas versus outside

To address the gap in literature around investigating stakeholder challenge concepts specifically as they relate to lump sum contracts in Alberta oil and gas, this study will investigate the following:

Stakeholder Challenges:

a) Local client interference

b) Operator Project Manager empowerment
c) Appropriate project phase to limit operational input
d) Reasons for Operator late changes

To investigate industry perceptions of lump sum contracting in Alberat oil and gas, eight main hypotheses were investigated. Industry demographic information and company contract strategy practices were used as independent variables to examine relationships with the dependent variables indentified (listed above) under the four factors. The study proposes that the demographic profile of an industry practitioner and their company contract practices will influence their perceptions of the variables under the four factors. Figure 3-1 shows the eight main hypotheses.

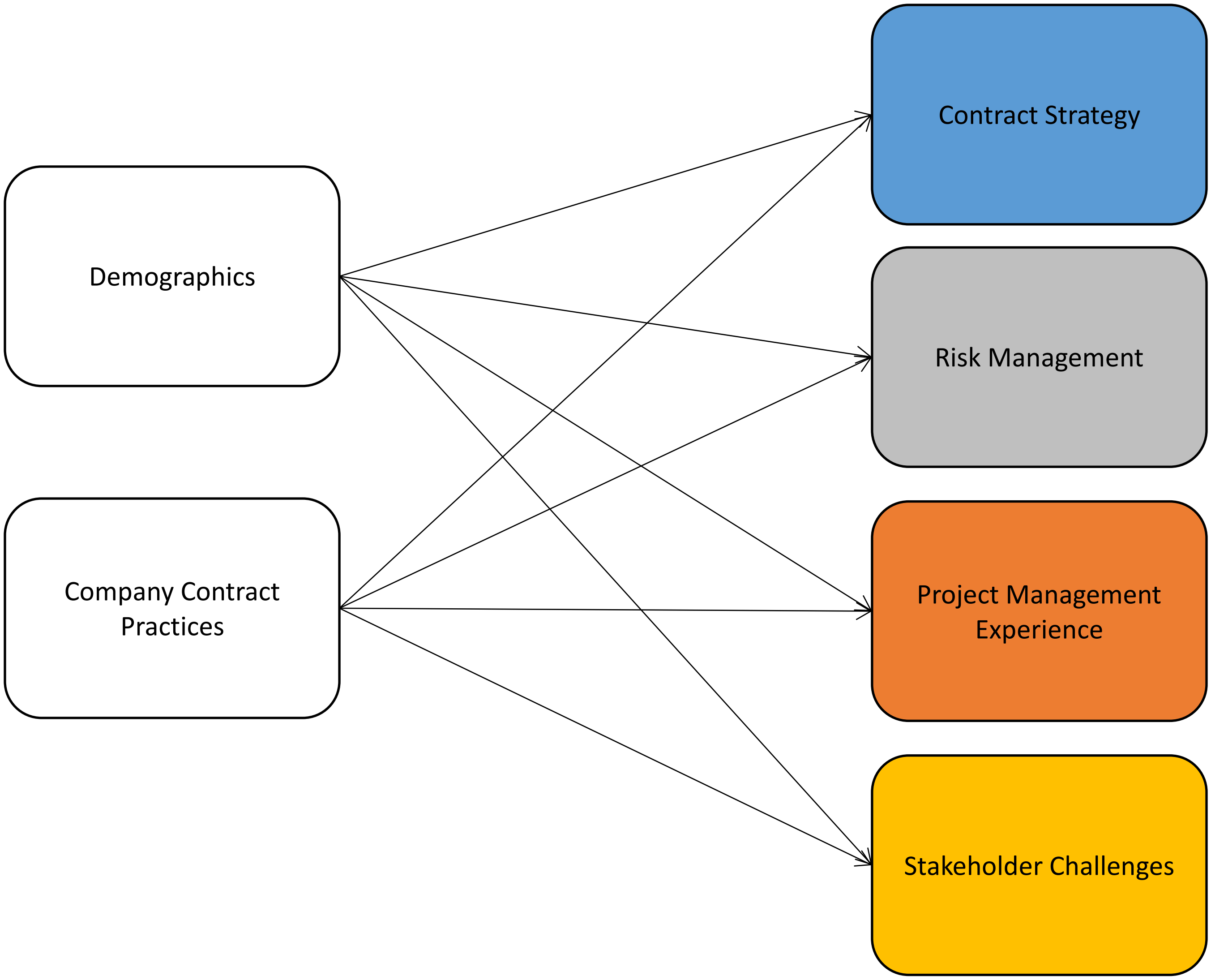


Figure 3-1 – Eight Main Study Hypotheses

The research methodology chosen for this study involved a three-stage process. First, semi-structured interviews were conducted, which were followed by a primary confidential survey, and finally a secondary confidential survey. This investigation was intended to be region and industry specific, so as to gain a greater appreciation for the factors affecting the selected group. The sample group was chosen from the Alberta oil and gas industry and included individuals from Operating, Engineering, and Construction companies. Most participants were based in Calgary, and Edmonton, Alberta.

3.1 Ethical Considerations

This research study follows the ethical requirements of the University of Calgary. Participation was voluntary and confidential. All participants were made aware of the implications of participating in this research study.

3.2 Design of Selected Research Method

The research method chosen for this study was a mixed-model: the mixing of qualitative and quantitative approaches across the stages of the research process (Johnson & Onwuegbuzie, 2004).

Research methodology is categorized into two broad categories: qualitative methods and quantitative methods (Leedey & Ormrod, 2005). Quantitative research is used to:

- Test and validate already constructed theories about how and why phenomena occur
- Test hypotheses that are constructed before the data are collected
- Generalize research findings when the data are based on random samples of sufficient size
- Obtain data to allow quantitative predictions to be made (Johnson & Onwuegbuzie, 2004).

Quantitative data can be collected in a number of ways including: survey instruments with closed-ended questions, structured interviews, participant observation, and organized retrieval of archived information (Lozon, 2008).

Qualitative research is used to:

- Generate hypotheses
- Study data based on the participants’ own categories
- Study a limited number of cases in depth
- Describe complex phenomena
- Identify contextual and setting factors as they relate to the phenomenon of interest (Johnson & Onwuegbuzie, 2004).

Qualitative data can be collected using survey instruments with open-ended questions, unstructured or semi-structured interviews, participant observation, focus groups, case studies, action research, and longitudinal studies over time (Lozon, 2008).

Mixed-method research is the class of research where the researcher mixes or combines quantitative and qualitative research techniques, methods, approaches, concepts, or language into a single study (Johnson & Onwuegbuzie, 2004). Structured interviews and survey instruments with closed-ended questions can be used to collect quantitative data and unstructured or semi-structured interviews and survey instruments with open-ended questions can be used to collect qualitative data (Amaratunga et al., 2002). A strength of the approach is that it can overcome the weaknesses of the individual approaches and form a more complete picture of the theory being studied. A weakness of mixed method is that some details of mixed method remain to be worked out fully by research methodologists (Johnson & Onwuegbuzie, 2004).

The *within stage mixed model* research design is shown in Figure 3.1 below. *Within stage mixed model* research refers to mixing qualitative and quantitative approaches within a research stage (Johnson & Onwuegbuzie, 2004).

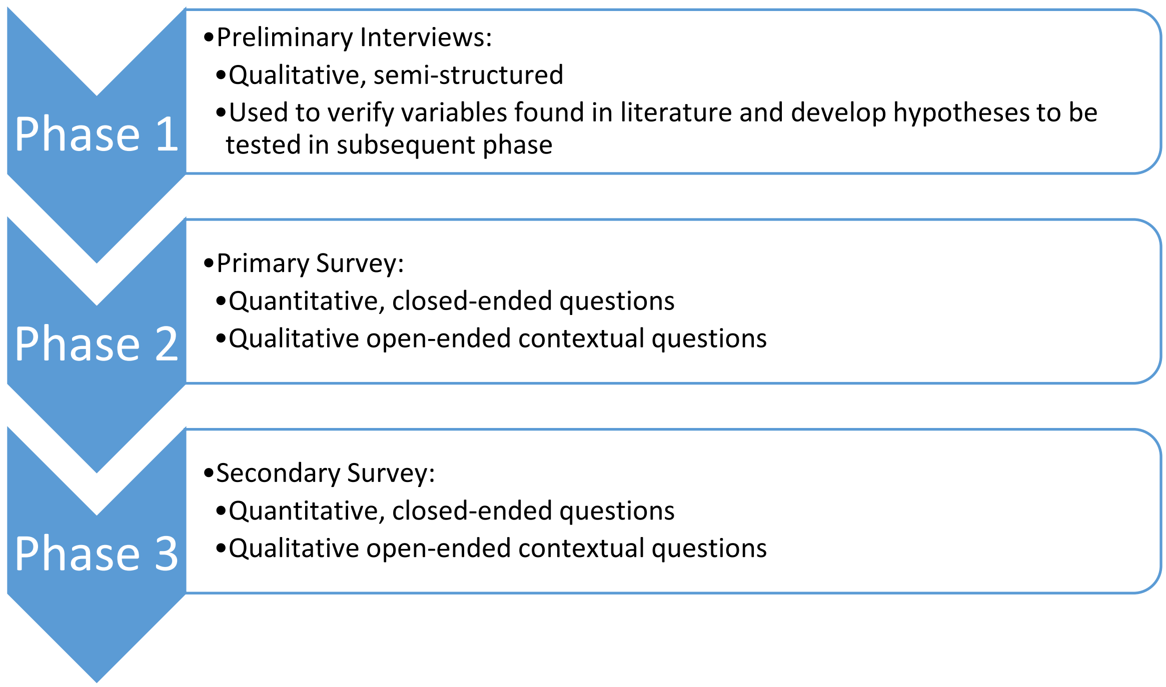


Figure 3-2 - Mixed-Model Research Design

3.2.1 Preliminary Interviews

Data collection can be conducted through several different types of interviews:

- Unstructured
- Structured
- Semi-structured

In unstructured interviews, the interviewee is allowed to discuss the topic with little direction from the researcher. In structured interviews, all interviewees are asked the same questions to gather specific information relevant to the study. Semi-structured interviews are a mix of the two forms with specific questions asked, but with flexibility given to the researcher to investigate themes that reveal themselves through the course of the interview (McClelland, 2005).

For the first phase of the study, semi-structured, qualitative preliminary interviews were conducted with a total of 12 senior managers and executives from Alberta oil and gas Operating, Engineering Contracting, and Construction Contracting firms. Participants were selected for their specialized knowledge of Project Management; their experience with lump sum contracting; and their extensive work experience, both domestically and internationally, in the oil and gas industry. Participants had an average of 31 years' working experience and most were in senior management- or executive- level positions. These individuals were selected as a cross-section of the group who could best shed light on the topic of study. Individuals were identified and contacted by telephone or email to request their participation. The participation was voluntary and all information collected was kept confidential.

The interviews were conducted to help guide and form a basis for the subsequent industry-wide confidential survey that would assess the current understanding of attitudes towards, and barriers to the effective implementation of lump sum contracting. Interview questions were asked regarding the attractiveness of lump sum contracting to their organization, for both Canadian and international projects; perceived barriers to using lump sum in Alberta and possible mitigation strategies; and their opinion about lump sum experience levels in the oil and gas industry. The semi-structured form was chosen because standard, structured interviews in which respondents are presented with predetermined questions specified by the interviewers tend to limit the opportunity for the interviewees to offer alternative views (Mishler, 1986). The same questions were asked of each interviewee to allow for direct comparison of the data, but the participants were encouraged to expand on any points they felt necessary. Steps were taken to ensure validity of the results. The interviewer transcribed the interview at the end of the discussion around each theme question and the transcription was read back to the interviewee to ensure that the paraphrasing captured the intended idea.

3.2.2 Survey Instrument and Administration

A study sample must be appropriate, consisting of participants who best represent or have knowledge of the research topic. (Morse, et al., 2002). To ensure this requirement was met, participants from all three major industry demographics (operators, engineers, and constructors) were invited to participate in the study, to avoid bias from any one group. The surveys were distributed until consistent numbers of each group were achieved. At least 40 companies, of equal numbers of Operating, Engineering, and Construction companies can be verified as having participated in the study. The participant groups for the Primary and

Seconrday surveys were independently collected and share slightly different demographic profiles.

- *Structure of Primary Survey*

Data collection can be conducted through survey instruments. Survey instruments are effective because participants can respond to questions more truthfully than they would in an interview because responses can be provided confidentially (Leedy & Ormrod, 2005). Pre-testing the survey questions with a small group can identify many potential problems (D. Collins, 2003) and ensure that the survey is clear, unambiguous, and directly related to hypotheses being studied.

Common themes and information gathered from the semi-structured, preliminary interviews were used to create an confidential mixed-method survey. The survey consisted of both qualitative and quantitative questions. The quantitative parts of the survey are represented by closed-ended questions and the qualitative parts of the survey are represented by open-ended questions. In the developed survey, most quantitative questions were followed up with open-ended qualitative questions to provide further explanation of the context from which the participant was answering, in order to understand the significance of their response.

The survey tool was chosen because it can be distributed to a larger number of participants than is possible when conducting interviews. Respondents can also respond to questions more honestly and without outside influence, as their responses remain confidential. The survey consisted of four sections with different areas of focus. The first section collected demographic information about the participants, to serve as a reference point when comparing their responses to the third and fourth sections of the survey and to ensure the experiment is context-dependent relative to the respondents. The second section of the survey gathered information about the participant company's current use of payment structure strategies, international operations, and dollar value of lump sum use on projects.

The third section of the survey assessed the participants' views on the effect of lump sum on project cost, company interest in using lump sum, barriers to using lump sum in Alberta oil and gas, and scopes and values of projects where there is an interest in using lump sum. Questions in the fourth section were organizational-type specific (operators, engineers, constructors) and addressed disconnects in opinions discovered in pre-interviews, between the three organizational types. The section asked questions related to operator project management empowerment; reasons for operator late changes; differences in skilled trades requirements between oil and gas projects and projects outside oil and gas, for lump sum construction projects; and interest in using lump sum for different phases of a project.

To test the design and clarity of the survey instrument, it was first reviewed by a third party, industry professional. As a pilot study, it was administered to a classroom of industry professionals taking Advanced Project Management. Following the successful completion of the pilot study, the survey was administered to the target group, via email, directing participants to an online confidential survey. Targeted respondents included executives, program and project managers, and senior managers at Operating, Engineering, and Construction companies. The survey instrument is shown in Appendix 1. The findings of this survey are summarized in Section 4. In this section, the participant answers to open-ended questions are interpreted and extracted into categories based on the frequency of repetition observed. As a result, all categories should be considered independent. In other words one participant can generate multiple categories in one question.

- *Structure of Secondary Survey*

Primary Survey questions that required further clarification and key themes arising from the Primary Survey formed the basis for the Secondary Survey. The Secondary Survey was a confidential survey administered during two seminars, one in Calgary and one in Edmonton. The seminars were open to the target group: members of Operating, Engineering and Construction companies. The individuals were required to be involved in strategic decision-making, contracting, and project/program management. To protect confidentiality, the surveys were collected in plain envelopes and left on a table at the back of the room, upon departure of the participants.

The Secondary Survey consisted of three sections, which collected data on three focus areas. The first section collected demographic information about the participants, to serve as a reference point when comparing their responses to the third section of the survey and to ensure the experiment is context-dependent relative to the respondents. The second section of the survey gathered information about the participant company's current use of payment structure strategies, international operations, and the dollar value of lump sum use on projects. The third section gathered information about the participants' views concerning lump sum risk sharing, the effect of a risk premium in lump sum contracting, lump sum effect on project behaviours, barriers and risks to using lump sum contracting, and client project interference.

To test the design and clarity of the survey instrument, it was first reviewed by a third party industry professional. The survey instrument is shown in Appendix 2. The findings of this survey are summarized in Section 5. In this section, the participant answers to open-ended questions are categorized based on the frequency of repetition observed. As a result, all categories should be considered independent. In other words one participant can generate multiple categories in one question.

3.3 Reliability and Validity of Research Instrument

A semi-structured qualitative pre-interview, a confidential online survey, and a confidential verification survey were used to gather data for research into the feasibility of lump sum contracting in the Alberta oil and gas industry. Several guidelines were used to ensure the consistency of application of the research tools. The same base questions were asked during interviews to collect the same data, although participants were allowed to expand on any themes they felt necessary. All answer content was verified with subjects before it was recorded.

The same surveys were administered to participants of the same target group and there was no time limit on completion of the survey form. The results of the research were analyzed in a consistent manner across the same format of questions. A study sample must be appropriate, consisting of participants who best represent or have knowledge of the research topic. (Morse, et al., 2002). To ensure this requirement was met, participants from all three major industry demographics (operators, engineers, and constructors) were invited to participate in the study, to avoid bias from any one group. The surveys were distributed until consistent numbers of each group were achieved. At least 40 companies, of equal numbers of Operating, Engineering, and Construction companies can be verified as having participated in the study. There was no direct incentive offered to participate, although the participants could chose to receive a copy of the final research results. Since the surveys were confidential, research subjects were able to express their opinions and thoughts without any worry of identification or consequence.

The results were collected directly from the online survey by the researcher, without any third party interference, thus maintaining the integrity of the original responses. For the Secondary Survey the envelopes were monitored for tampering and were only opened the day after the seminar to maintain confidentiality.

The open-ended questions in the Primary and Secondary surveys were posed to initiate exploratory research into the underlying reasons behind the quantitative survey responses. Exploratory research is commonly conducted before enough is known about a concept to suggest an explanatory relationship (Shields & Rangarjan, 2013). In this research, open-ended questions are being used to generate discussion and speculation, and identify areas for future research, rather than being used to draw definitive conclusions. Since the results have not been verified or validated, the results cannot be generalized and may not be representative of the whole population being studied.

3.4 Data Analysis

The data collected from the two surveys was analyzed for relationships between the data. Due to the large amount of data, only those findings that were correlated are discussed in Section 6. The below methods were used for analysis of the statistical significance of the data collected. A significance level of α=0.05 was selected, as is convention (Foster, 2001). The researcher felt that in the study of opinion questions on project management practices, such as this study, there is was no requirement to select a more stringent P-value, such as 0.01. Moderate evidence against the null hypothesis (at 0.05) in favour of the alternative was sufficient.

3.4.1 Chi-Square Test for Independence

The Chi-Square test for Independence was used to examine the relationship between two categorical variables, to determine if the dependent variable is contingent on the independent variable. The chi-squared test statistic is a measure of how expectations compare to results.

The following criteria for using chi-square were met:

- Data in frequency form
- The data must be independent
- The sampling method is simple random sampling.
- The variables are categorical
- The number of respondents in each cell was at least five (5), otherwise a Fisher Exact test was used.
- The researcher had an adequate sample size (at least 10) (Sharp, 1979).

The following hypotheses were being examined:

- H_0: Variable A and Variable B are independent.
- H_a: Variable A and Variable B are not independent

The null hypothesis is that there is no relationship between the two categorical variables. Significance level was selected at P=0.05. If the significance of the analysis is less than the significance level, then the null hypothesis is rejected and it is concluded that a relationship or correlation exists between the dependent and independent variables (Foster, 2001).

3.4.2 Fisher Exact Test

Fisher Exact Test has the same criteria as the Chi-Square except it is used when more than 20% of the cells have an expected frequency count of less than 5.

3.4.3 T-Test

A T-Test compares two means to determine if they are reliably different. For this study an independent samples t-test was chosen because the study was comparing the means of two different groups (Foster, 2001). The following hypotheses were being examined:

- H_0: means between groups are equal
- H_a: means between groups are not equal

Significance level was selected at P=0.05. If the significance of the analysis is less than the significance level, then the null hypothesis is rejected. If there null hypothesis is rejected, there is a difference between the groups. The two-tail significance was used because the study is testing a non-directional hypothesis (Foster, 2001).

The following criteria for the T-Test were met:

- The analysis has one independent, categorical variable that has two levels and one dependent variable
- The distribution of sample means has a normal distribution
- Each group should have approximately the same number of data points (Foster, 2001)
    - This was not the case in some of the variables compared. The potential inaccuracy is noted in that section

3.4.4 OneWay Anova

Analysis of Variance (ANOVA) is a method used to compare the means of two or more groups and check if the means are reliable different from each other (Foster, 2001). One-Way ANOVA is used when the study has one variable with at least two levels or groups. One independent variable, between subjects, Oneway Anova analyses were performed when the study required a comparison of three or more groups of participants that are independent from one another (Foster, 2001). The variables are categorical . A post hoc test, Tukey’s Test, was performed to determine where the significant differences existed between the groups (Foster, 2001).

The following criteria for ANOVA were met:

- The distribution of sample means has a normal distribution

- The samples must be independent
- Outliers have been removed from the data
- Homogeneity of variance (Foster, 2001)

The following hypotheses were being examined:

- H_0: all means between groups are equal
- H_a: not all means between groups are equal

Significance level was selected at P=0.05. If the significance of the analysis is less than the significance level, then the null hypothesis is rejected. If there null hypothesis is rejected, there is a difference somewhere in the groups.

3.4.5 Regression

Multiple Logistic Regression

A multiple logistic regression was performed to predict a dichotomous outcome using multiple categorical variables (Tabachnick & Fidell, 2001). It is used to predict the odds of an outcome occurring, where the outcome is coded as 0 or 1.

Assumptions that were met to use Multiple Logistic Regression were:

- Multicollinearity must not exist
    - Two or more predictor variables must not be highly correlated
- The sampling method is simple random sampling. (Tabachnick & Fidell, 2001).

Ordinal Regression

Similar to multiple logistic regression, ordinal regression is used when your dependent variable is categorical and there is a natural ordering to the coding, for example, a ranking question on a survey (Tabachnick & Fidell, 2001).

3.5 Theoretical Analysis Models

A theoretical analysis model of the surveys for the study was developed from the variables derived from literature and refined from the pre-interviews conducted with senior leaders at each company type: Operators, Engineers, and Constructors. The models show the independent variables' potential influence on (or correlation with) the dependent variables of the study. These models are presented below, in Tables 3.1 and 3.2. For the purposes of this analysis, correlation between the variables is assumed to be:

- Highly correlated: $\alpha \leq 1\%$
- Medium correlation: $\alpha \leq 5\%$

For each compared set of variables:

H_0: Variable A and Variable B are independent

H_a: Variable A and Variable B are not independent.

Table 3-1 - Matrix of Potential Correlations between Variables for the Primary Survey

Factors Influenced

Influencing Factors			Risk Sharing	Effect on Final Project Cost of Risk Premium in Lump Sum	Lump Sum effect of Project Behaviours	Largest Barriers to Lump Sum – Stability of Weather	Largest Barriers to Lump Sum – Cost-Reimbursable Construction Culture	Largest Barriers to Lump Sum – Module Size	Largest Barriers to Lump Sum – Client Late Changes	Largest Barriers to Lump Sum – Lack of Scope Definition’	Feasibility of Lump Sum - Lack of Experience	More Client Input Locally than Internationally	Sufficient Companies Capable of Lump Sum Proposals	Financial Ranges Companies Willing to Lump Sum	Project Manager Empowerment within Operating Companies
			Q12	**Q13**	**Q14**	**Q15**	**Q16**	**Q17**	**Q18**	**Q19**	**Q20**	**Q21**	**Q22**	**Q24**	**ab_Q1**
			DV	**DV**	**DV**	**DV**	**DV**	**DV**	**DV**	**DV**	**DV**	**DV**	**DV**	**DV**	**DV**
Type of Organization	**Q1**	**IV**	H1	H15	H29	H30	H31	H32	H33	H34	H89	H103	H117	H131	H145
Role in Organization	**Q2**	**IV**	H2	H16	H35	H36	H37	H38	H39	H40	H90	H104	H118	H132	H146
Years Working Experience	**Q3**	**IV**	H3	H17							H91	H105	H119	H133	H147
Company Operates Internationally	**Q4**	**IV**	H4	H18	H41	H42	H43	H44	H45	H46	H92	H106	H120	H134	H148
Company Engages in Lump Sum Contracts	**Q5.1**	**IV**	H5	H19	H47	H48	H49	H50	H51	H52	H93	H107	H121	H135	H149
Company Engages in Cost-Reimbursable Contracts’	**Q5.2**	**IV**	H6	H20	H53	H54	H55	H56	H57	H58	H94	H108	H122	H136	H150
Company Engages in Unit Rate Contracts	**Q5.3**	**IV**	H7	H21	H59	H60	H61	H62	H63	H64	H95	H109	H123	H137	H151
Company Used Lump Sum on Past Project – Alberta	**Q8**	**IV**	H8	H22	H65	H66	H67	H68	H69	H70	H96	H110	H124	H138	H152
Project Dollar Value – Alberta	**Q9**	**IV**	H9	H23	H71	H72	H73	H74	H75	H76	H97	H111	H125	H139	H153
Company Used Lump Sum on Past Project – Internationally	**Q10**	**IV**	H10	H24	H77	H78	H79	H80	H81	H82	H98	H112	H126	H140	H154
Project Dollar Value – Internationally	**Q11**	**IV**	H11	H25	H83	H84	H85	H86	H87	H88	H99	H113	H127	H141	H155
Lump Sum Effect on Project Cost	**Q13**	**DV**													
Largest Barriers to Lump Sum – Field Labour	**Q14**	**DV**													
Largest Barriers to Lump Sum – Stability of Weather’	**Q15**	**DV**													
Largest Barriers to Lump Sum – Cost-Reimbursable Construction Culture	**Q16**	**DV**													
Largest Barriers to Lump Sum – Module Size	**Q17**	**DV**													
Largest Barriers to Lump Sum – Client Late Changes	**Q18**	**DV**													
Largest Barriers to Lump Sum – Lack of Scope Definition	**Q19**	**DV**													
Company has Internal Construction Division	**b_Q5**	**IV**	H12	H26							H100	H114	H128	H142	H156
Performed LS in Albertan Oil and Gas	**c_Q3**	**IV**	H13	H27							H101	H115	H129	H143	
Performed LS in Alberta Outside Oil and Gas	**c_Q4**	**IV**	H14	H28							H102	H116	H130	H144	

			Factors Influenced										
			Project Phase at Which Operational/Stakeholder Input Should be Limited	Reasons for Late Changes within Operating Companies	Interest in Lump Sum for FEED Phase	Interest in Lump Sum for Detailed Engineering	Interest in Lump Sum for Construction	Interest in Lump Sum for Full EPC	Performed Lump Sum in Albertan Oil and Gas	Performed Lump Sum in Alberta Outside Oil and Gas	Difference in skilled or unskilled labour required in Oil and Gas VS Outside	Difference in Quantity of Skilled Labour Required in Oil and Gas VS Outside	Opinion of Risk Level in Alberta Oil and Gas Compared to International Oil and Gas
			ab_Q2	**a_Q1**	**b_Q1**	**b_Q2**	**b_Q3**	**b_Q4**	**c_Q3**	**c_Q4**	**c_Q5**	**c_Q6**	**bc_Q1**
			DV	**DV**	**DV**	**DV**	**DV**	**DV**	**IV**	**IV**	**DV**	**DV**	**DV**
Type of Organization	**Q1**	**IV**	H157	H169	H180	H192	H204	H216	H228	H241	H254	H267	H280
Role in Organization	**Q2**	**IV**	H158	H170	H181	H193	H205	H217	H229	H242	H255	H268	H281
Years Working Experience	**Q3**	**IV**	H159	H171	H182	H194	H206	H218	H230	H243	H256	H269	H282
Company Operates Internationally	**Q4**	**IV**	H160	H172	H183	H195	H207	H219	H231	H244	H257	H270	H283
Company Engages in Lump Sum Contracts	**Q5.1**	**IV**	H161	H173	H184	H196	H208	H220	H232	H245	H258	H271	H284
Company Engages in Cost-Reimbursable Contracts'	**Q5.2**	**IV**	H162	H174	H185	H197	H209	H221	H233	H246	H259	H272	H285
Company Engages in Unit Rate Contracts	**Q5.3**	**IV**	H163	H175	H186	H198	H210	H222	H234	H247	H260	H273	H286
Company Used Lump Sum on Past Project – Alberta	**Q8**	**IV**	H164	H176	H187	H199	H211	H223	H235	H248	H261	H274	H287
Project Dollar Value – Alberta	**Q9**	**IV**	H165	H177	H188	H200	H212	H224	H236	H249	H262	H275	H288
Company Used Lump Sum on Past Project – Internationally	**Q10**	**IV**	H166	H178	H189	H201	H213	H225	H237	H250	H263	H276	H289
Project Dollar Value – Internationally	**Q11**	**IV**	H167	H179	H190	H202	H214	H226	H238	H251	H264	H277	H290
Lump Sum Effect on Project Cost	**Q13**	**DV**											
Largest Barriers to Lump Sum – Field Labour	**Q14**	**DV**											
Largest Barriers to Lump Sum – Stability of Weather'	**Q15**	**DV**											
Largest Barriers to Lump Sum – Cost-Reimbursable Construction Culture	**Q16**	**DV**											
Largest Barriers to Lump Sum – Module Size	**Q17**	**DV**											
Largest Barriers to Lump Sum – Client Late Changes	**Q18**	**DV**											
Largest Barriers to Lump Sum – Lack of Scope Definition	**Q19**	**DV**											
Company has Internal Construction Division	**b_Q5**	**IV**	H168		H191	H203	H215	H227					H291
Performed LS in Albertan Oil and Gas	**c_Q3**	**IV**							H239	H252	H265	H278	H292
Performed LS in Alberta Outside Oil and Gas	**c_Q4**	**IV**							H240	H253	H266	H279	H293

Table 3-2 - Matrix of Potential Correlations between Variable for the Secondary Survey

			Factors Influenced																			
			Payment Structure: Major Projects	Payment Structure: Equipment	Payment Structure: Buildings	Payment Structure: Tankage	Payment Structure: International Projects	Payment Structure: Local Projects	Payment Structure Used Most Frequently	Dollar Value of Largest LS Project Performed in Alberta	Interested in Lump Sum if Risk Shared with Other Company	Effect on Final Project Cost of Risk Premium in Lump Sum	Lump Sum Effect on Project Behaviours	Largest Barriers to Lump Sum – Field Labour Market Risks	Largest Barriers to Lump Sum – Local Cost Reimbursable Construction Culture	Largest Barriers to Lump Sum – Client Late Changes	Largest Barriers to Lump Sum – Lack of Scope Definition	Largest Barriers to Lump Sum – Client Desire for Fast Tracking	Largest Barriers to Lump Sum – Lack of Experience with Lump Sum in Industry	Top Labour Market Risk	Sufficient Companies Capable Of Lump Sum Bidding	Reason for Greater Local Client Input
			Q4	**Q5**	**Q6**	**Q7**	**Q8**	**Q9**	**Q10**	**Q11**	**Q12**	**Q13**	**Q14**	**Q16**	**Q17**	**Q18**	**Q19**	**Q20**	**Q21**	**Q22**	**Q23**	**Q25**
			DV	**DV**	**DV**	**DV**	**DV**	**DV**	**DV**	**DV**	**DV**	**DV**	**DV**	**DV**	**DV**	**DV**	**DV**	**DV**	**DV**	**DV**	**DV**	**DV**
Years of Working Experience	**Q1**	**IV**	H1	H4	H7	H10	H13	H16	H20	H24	H27	H38	H49							H60	H71	H82
Role in Organization	**Q2**	**IV**	H2	H5	H8	H11	H14	H17	H21	H25	H28	H39	H50	H93	H94	H95	H96	H97	H98	H61	H72	H83
Type of Organization	**Q3**	**IV**	H3	H6	H9	H12	H15	H18	H22	H26	H29	H40	H51	H99	H100	H101	H102	H103	H104	H62	H73	H84
Payment Structure: Major Projects	**Q4**	**IV**									H30	H41	H52							H63	H74	H85
Payment Structure: Equipment	**Q5**	**IV**									H31	H42	H53							H64	H75	H86
Payment Structure: Buildings	**Q6**	**IV**									H32	H43	H54							H65	H76	H87
Payment Structure: Tankage	**Q7**	**IV**									H33	H44	H55							H66	H77	H88
Payment Structure: International Projects	**Q8**	**IV**						H19			H34	H45	H56	H105	H106	H107	H108	H109	H110	H67	H78	H89
Payment Structure: Local Projects	**Q9**	**IV**									H35	H46	H57	H111	H112	H113	H114	H115	H116	H68	H79	H90
Payment Structure Used Most Frequently	**Q10**	**IV**									H36	H47	H58	H117	H118	H119	H120	H121	H122	H69	H80	H91
Dollar Value of Largest LS Project Performed in Alberta	**Q11**	**IV**							H23		H37	H48	H59							H70	H81	H92

4 Primary Survey Results

The Survey Results sections are organized first by survey and by the order of questions within that survey. This ordering made the data easier to analyze.

The following naming convention is used in the summary of survey results:

- Oil and gas Operating Companies are referred to as 'Operators'
- Engineering Companies are referred to as 'Engineers'
- Construction Companies are referred to as 'Constructors'.

Some survey questions were directed to particular target groups within the respondent sample. Below are the specific target groups from within the sample:

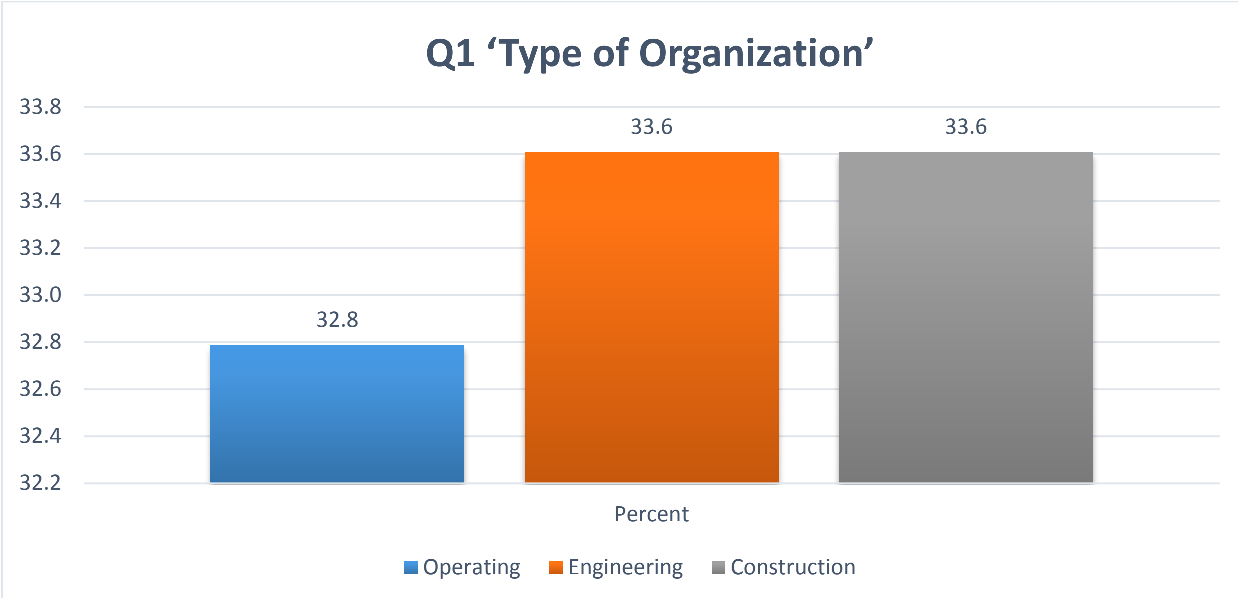
- Operating and Engineering Companies (questions denoted by ab_Qx)
- Operating Companies (questions denoted by a_Qx)
- Engineering Companies (questions denoted by b_Qx)
- Construction Companies (questions denoted by c_Qx)
- Engineering and Construction Companies (questions denoted by bc_Qx)

4.1 Participant Demographic Information

The survey was administered to industry professionals in the Alberta oil and gas industry. Survey participants were asked several demographic identifying questions, including type of organization, years' of work experience, and role in organization. The answers to the questions were used as independent variables in subsequent data analysis.

4.1.1 Type of Organization (Q1)

The organizational distribution of the sample is presented below.



Q1 'Type of Organization'		
Type	**Frequency (N)**	**Percent**
Operating	40	32.8
Engineering	41	33.6
Construction	41	33.6
Total	122	100.0

Figure 4-1 - Frequency Table for Type of Organization (Q1)

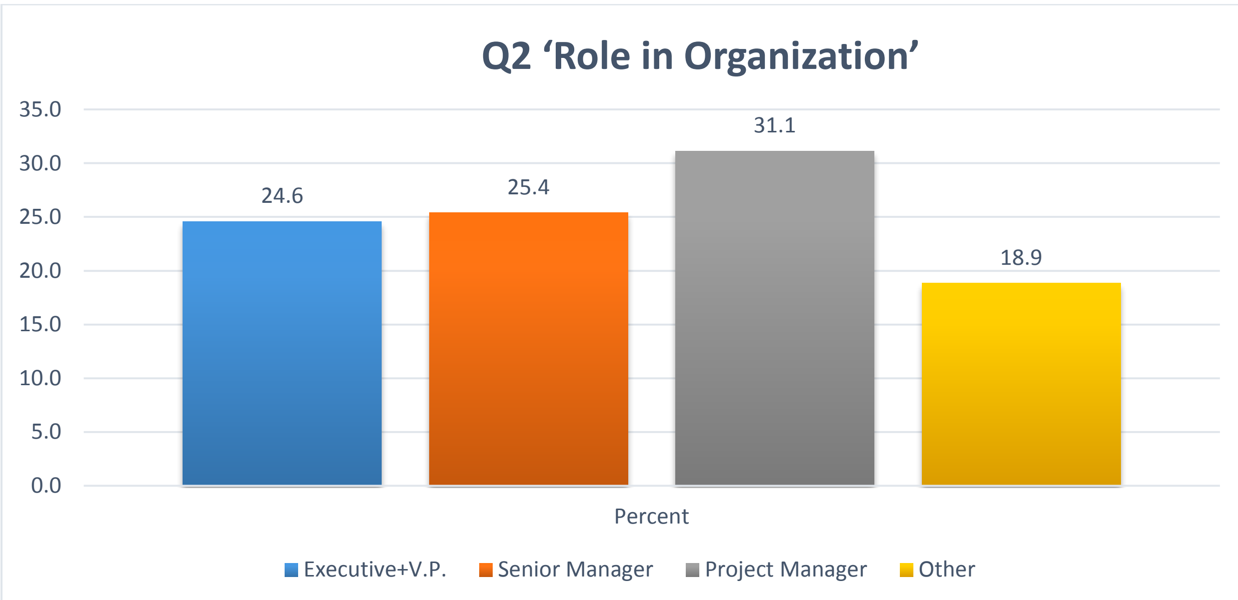
Essentially equal numbers of participants from each of operating (32.8%), engineering (33.6%), and construction (33.6%) companies were recruited to participate in the survey, with a total of 122 respondents.

4.1.2 Role in Organization (Q2)

The responses to the Role in Organization question were categorized into four main groups:

1. Executives & Vice Presidents
2. Senior Managers
3. Projects Managers
4. Other.

Senior Managers included engineering managers and asset managers. Project Managers included program managers, project managers, and construction managers. The 'Other' category included engineers in project engineering (not in lead positions, without direct reports), project controls, discipline engineering, business development, and contract managers.



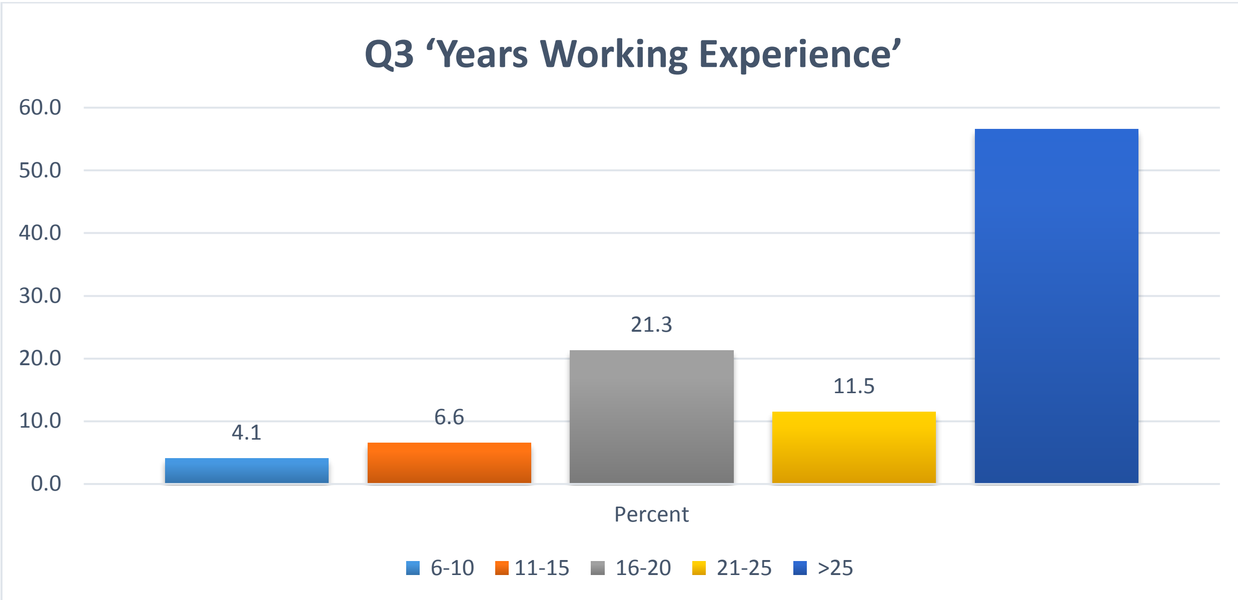
Q2 'Role in Organization'		
Role	**Frequency (N)**	**Percent**
Executive + V.P.	30	24.6
Senior Manager	31	25.4
Project Manager	38	31.1
Other	23	18.9
Total	122	100.0

Figure 4-2 - Frequency Table for Role in Organization (Q2)

The highest percentage participation was from the Project Manager group, whose participation, at 31.1%, was slightly higher than the participation of Executives (24.6%) and Senior Managers (25.4%). The smallest group was 'Other' at 18.9%. These results indicate a high proportion of senior-level survey participants, with 50% of respondents at a senior manager and higher level.

4.1.3 Years Working Experience (Q3)

The years' working experience of the participants are presented below.



Q3 'Years Working Experience'		
Years	**Frequency (N)**	**Percent**
6-10	5	4.1
11-15	8	6.6
16-20	26	21.3
21-25	14	11.5
>25	69	56.6
Total	122	100.0

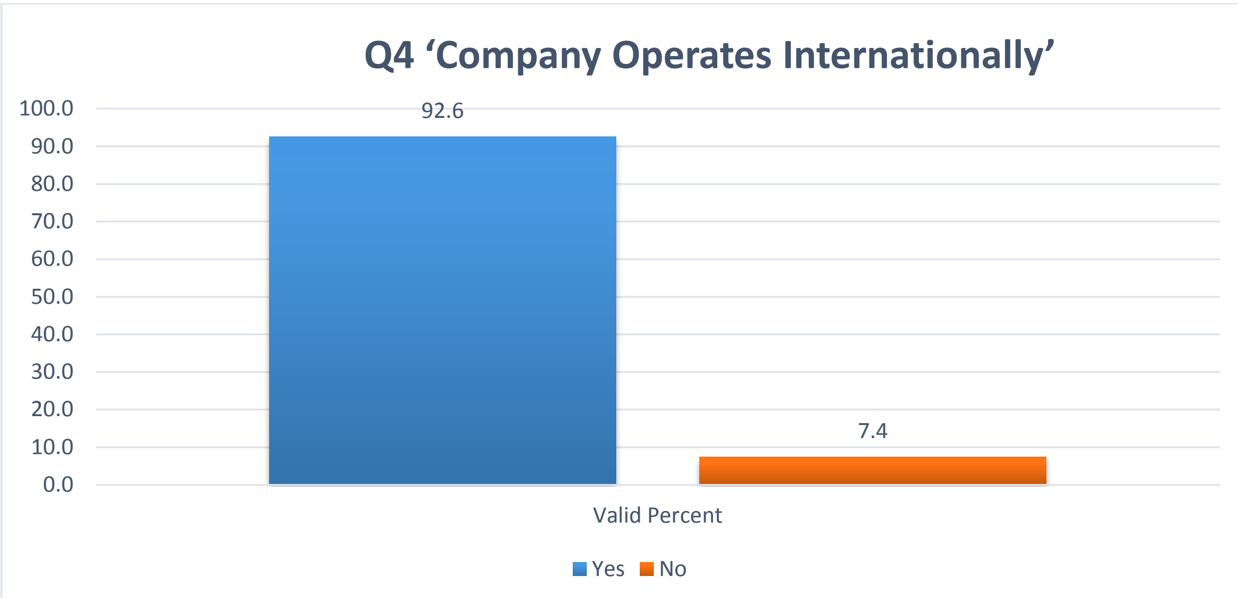
Figure 4-3 - Frequency Table for Years Working Experience (Q3)

The largest percentage of respondents in the sample had over 25 years' working experience (56.6%). Since 68% of the sample had greater than 20 years' working experience, the sample was considered to contain a high proportion of senior, knowledgeable respondents. Only 10.7% of participants had 15 or less years' experience.

4.2 Current Contract Trends

Survey participants were asked company contract practive information about their current companies, to be used as additional independent variables for subsequent data analysis.

4.2.1 Company Operates Internationally (Q4)



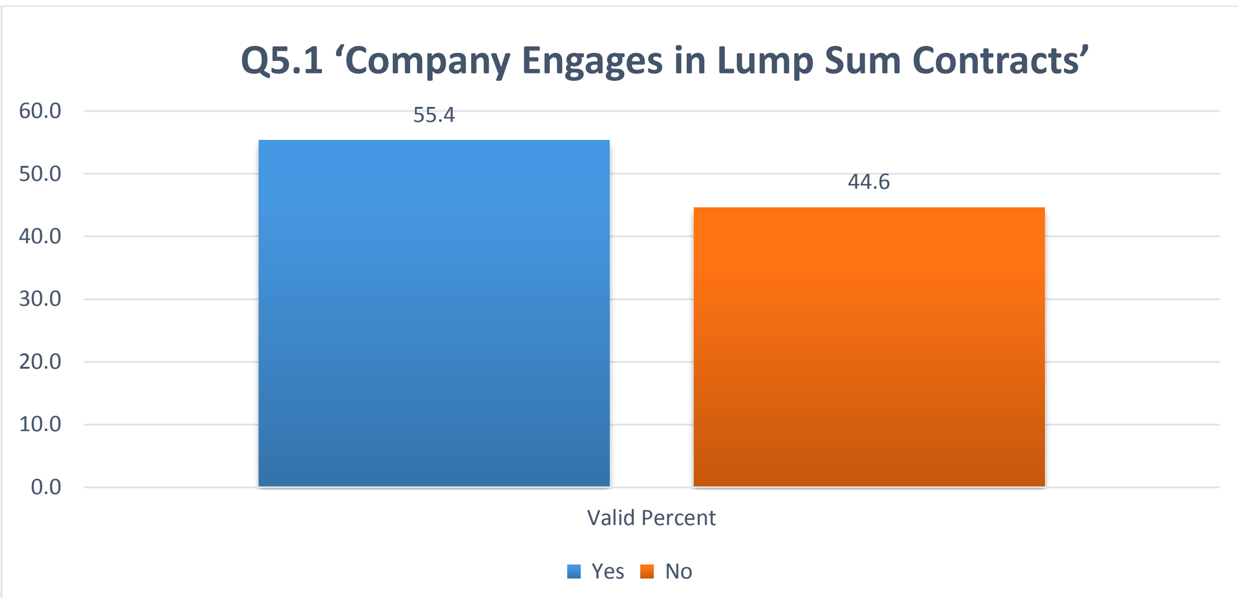
Q4 'Company Operates Internationally'			
Response	**Frequency (N)**	**Percent**	**Valid Percent**
Yes	112	91.8	92.6
No	9	7.4	7.4
Total	121	99.2	100.0
Missing	1	0.8	0.0

Figure 4-4 - Frequency Table for Company Operates Internationally (Q4)

The majority of respondents (91.8%) worked for a company that operated internationally; 7.4% worked for companies that did not operate internationally; and one respondent declined to answer.

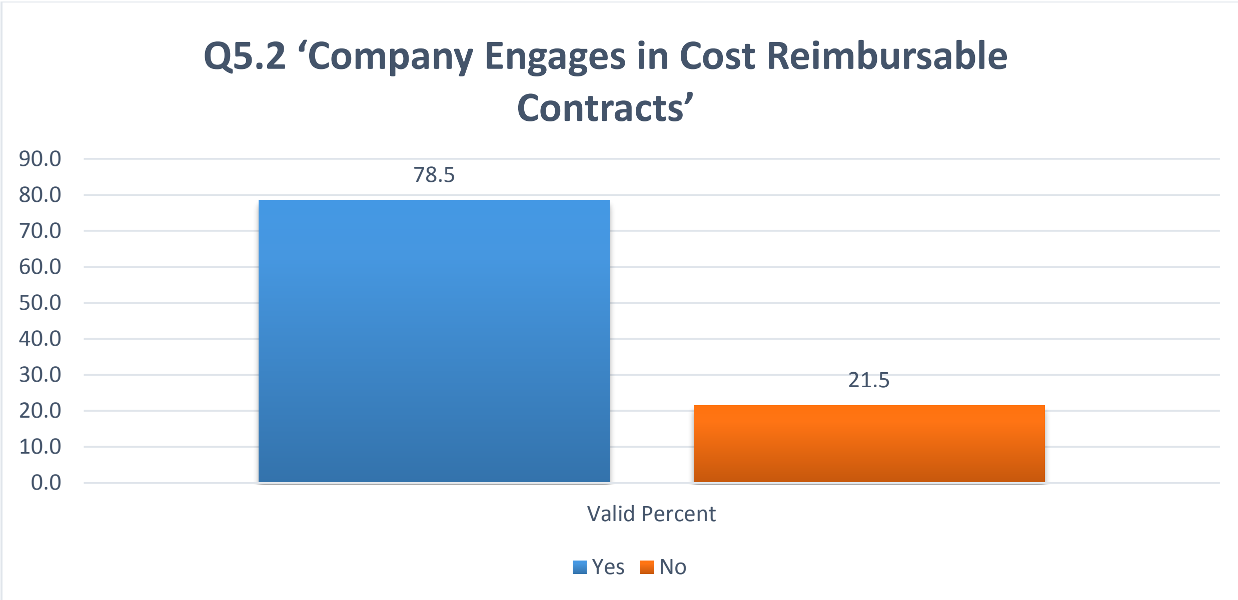
4.2.2 Typical Payment Structure Strategies (Q5.1, Q5.2, & Q5.3)

Survey participants were asked to identify the typical payment structure strategies their current companies engaged in. Respondents were permitted to identify all structure types used. An open-ended answer section contextualized their responses by allowing respondents the opportunity to explain what portions of work particular contract types were being used for. Three payment structure types were identified by respondents: Lump Sum, Cost Reimbursable, and Unit Rate. For the analysis, these three payment types were identified as Q5.1, Q5.2 and Q5.3, respectively.



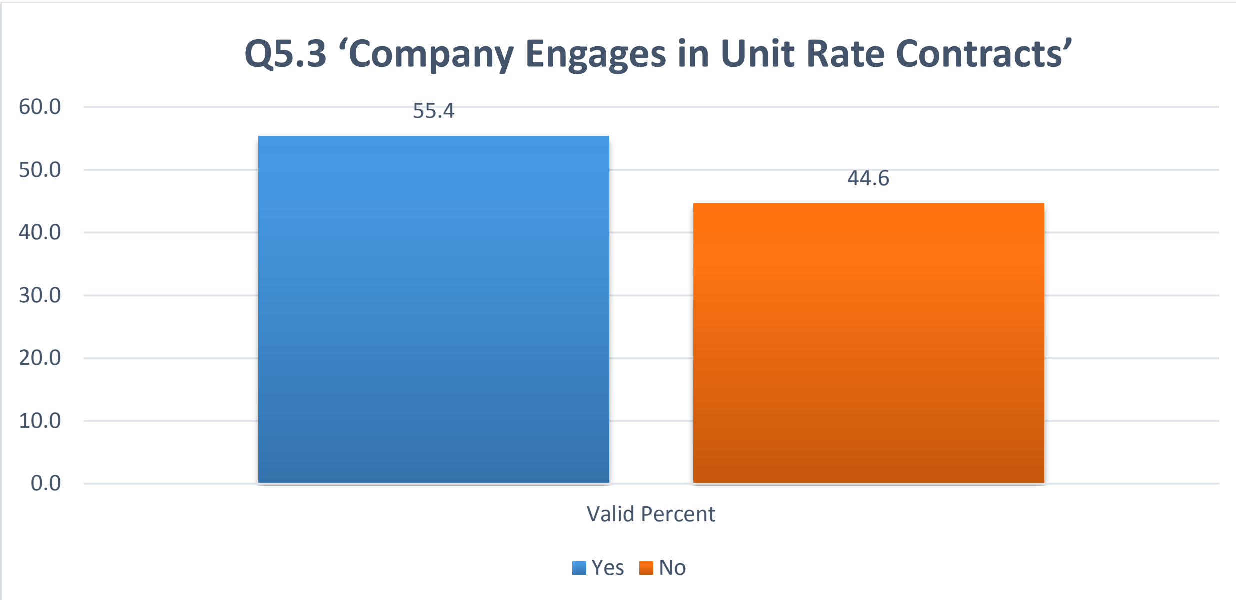
Q5.1 'Company Engages in Lump Sum Payment Structure'			
Response	**Frequency (N)**	**Percent**	**Valid Percent**
Yes	67	54.9	55.4
No	54	44.3	44.6
Total	121	99.2	100.0
Missing	1	0.8	0.0

Figure 4-5 – Company Engages in Lump Sum Contracts



Q5.2 'Company Engages in Cost Reimbursable Payment Structure'			
Response	**Frequency (N)**	**Percent**	**Valid Percent**
Yes	95	77.9	78.5
No	26	21.3	21.5
Total	121	99.2	100.0
Missing	1	0.8	0.0

Figure 4-6 - Company Engages in Cost Reimbursable Contracts



Q5.3 'Company Engages in Unit Rate Payment Structure'			
Response	**Frequency (N)**	**Percent**	**Valid Percent**
Yes	67	54.9	55.4
No	54	44.3	44.6
Total	121	99.2	100.0
Missing	1	0.8	0.0

Figure 4-7 - Company Engages in Unit Rate Contracts

One respondent chose not to answer this question. The most heavily employed payment structure was cost reimbursable, with 77.9% of respondents' companies engaging in some type of cost-plus structure. Lump Sum and Unit Rate were tied, with 54.9% of companies using these two particular types of contracts. Though the data shows that companies are using payment structures other than cost reimbursable quite frequently, this result might be slightly skewed with respect to Alberta oil and gas. It appears that cost reimbursable is being used for the larger dollar value portions of local work. Engineers noted that lump sum was being used internationally rather than locally and for portions of a project rather than a whole project. Operating company participants had similar responses, replying that lump sum was being used only for equipment (tanks, buildings, etc.) and for selected portions of the project versus the whole project scope. Constructors seemed to prefer lump sum and unit rate for fabrication, and cost reimbursable for site construction work, with lump sum being preferred internationally.

Qualitative Responses

Table 4-1 below presents the categorized responses, by company type, explaining the circumstances under which the company used lump sum contracts:

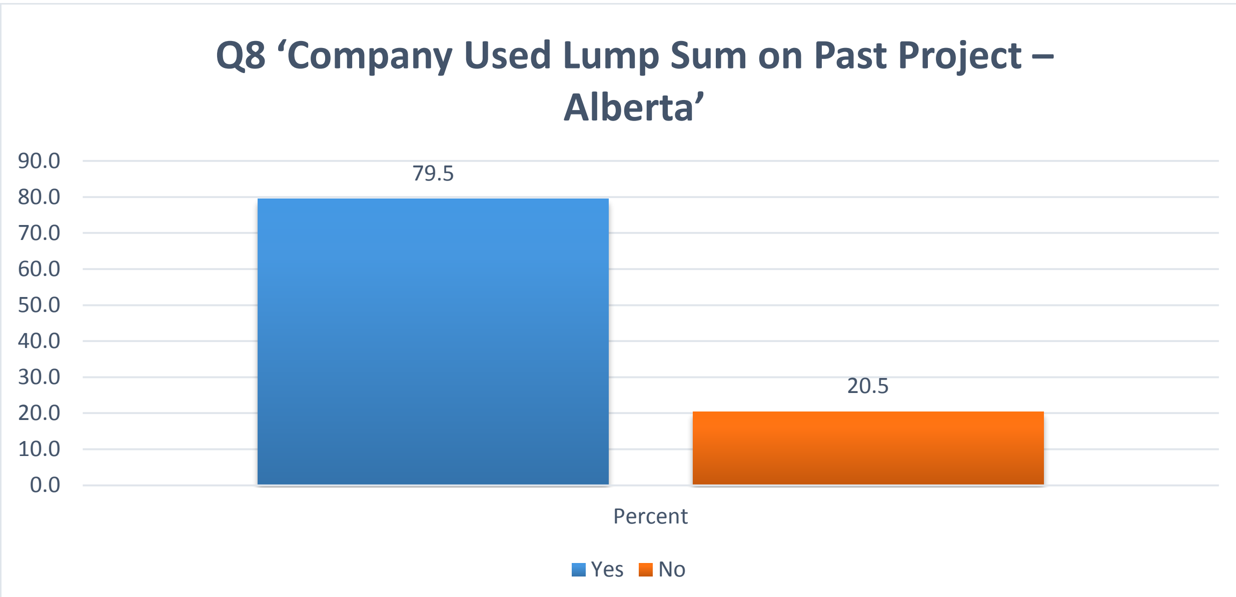
Table 4-1 - Scopes of Work Currently Executed under Lump Sum

Lump Sum Structure Use	**Operator**	**Engineer**	**Constructor**
1. Lump Sum for: • Equipment • Tanks • Buildings	25		
2. Lump sum use introduced recently	9		
3. Limited Lump sum use locally, only for construction		6	
4. Lump sum for shop fabrication only			15
5. Lump sum for international work only		30	15

Payment structure type was identified as an area of examination for the Secondary Survey instrument, to further define what portions of work are being performed using lump sum.

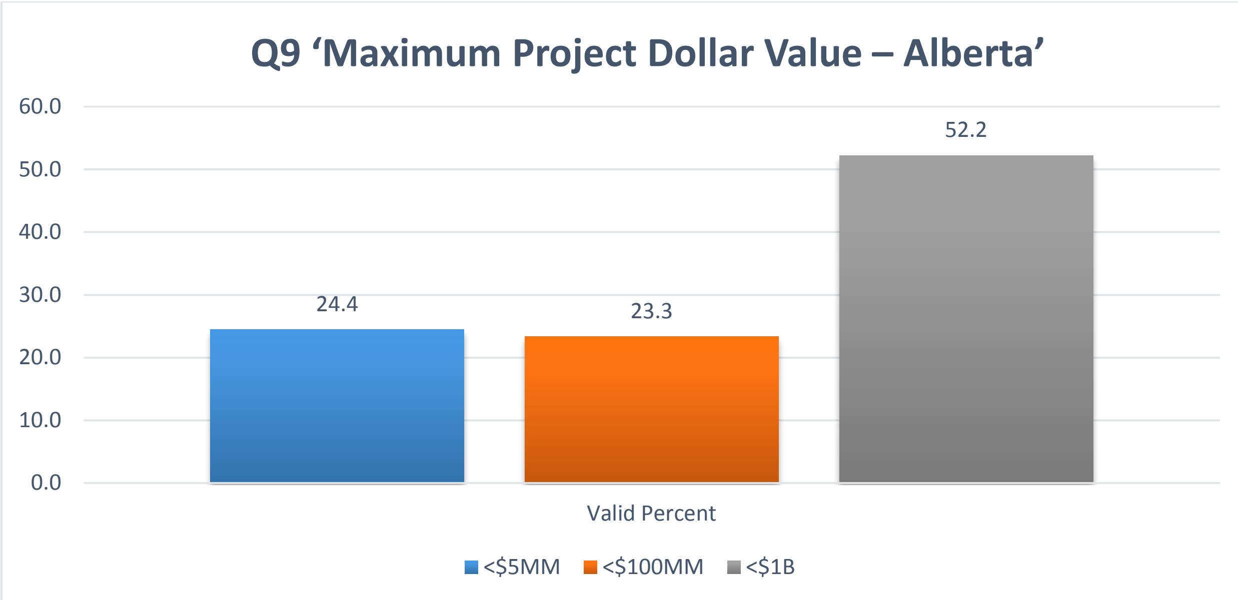
4.2.3 Company Use of Lump Sum on Past Projects (Q8-Q11)

Participants were asked if their companies have used lump sum contracting in Alberta (Q8) and if their companies have used lump sum contracting Internationally (Q10) and the maximum dollar value in each market (Q9 & Q11). One respondent chose not to identify if their company had worked internationally.



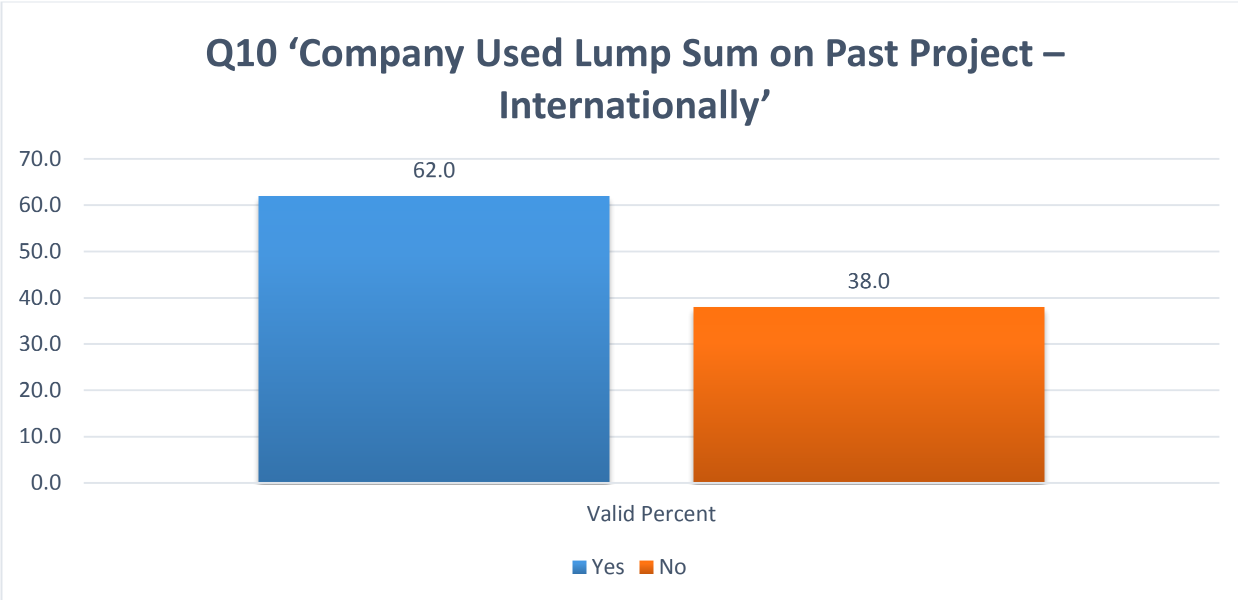
Q8 'Company Used Lump Sum on Past Project – Alberta'		
Response	**Frequency (N)**	**Percent**
Yes	97	79.5
No	25	20.5
Total	122	100.0

Figure 4-8 - Frequency Table for Company use of Lump Sum on Past Projects: Alberta



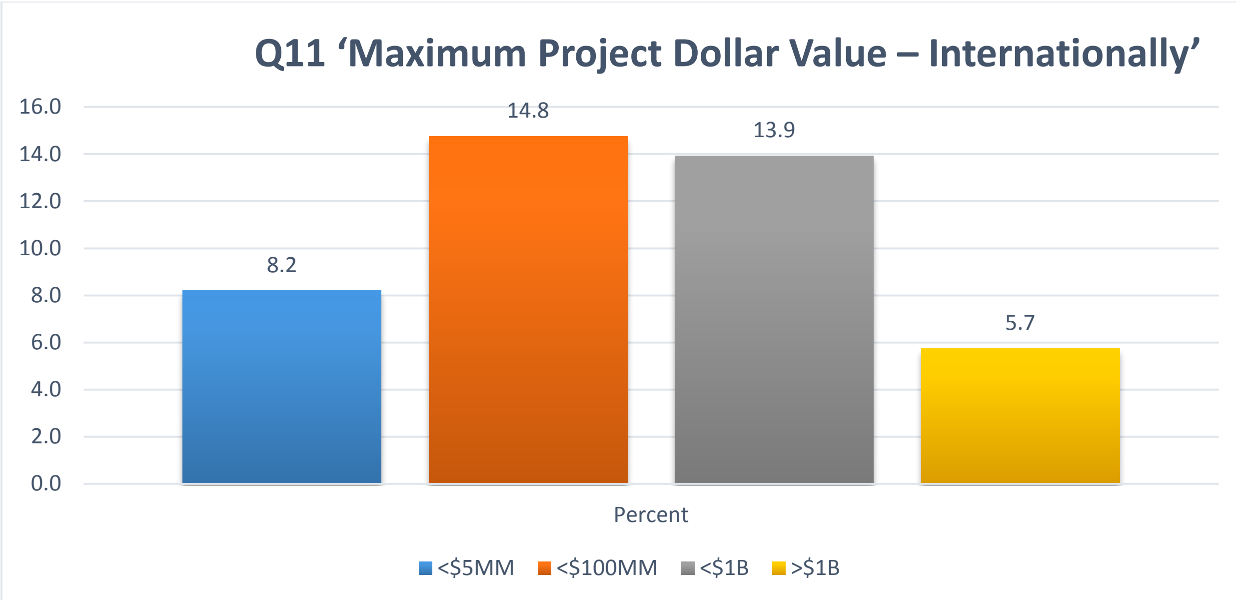
Q9 'Project Dollar Value – Alberta'			
Dollar Value	**Frequency (N)**	**Percent**	**Valid Percent**
<$5MM	22	18.0	24.4
<$100MM	21	17.2	23.3
<$1B	47	38.5	52.2
Total	90	73.8	100.0

Figure 4-9 - Frequency Table for Maximum Project Dollar Value: Alberta



Q10 ‘Company Used Lump Sum on Past Project – Internationally’			
Response	**Frequency (N)**	**Percent**	**Valid Percent**
Yes	75	61.5	62.0
No	46	37.7	38.0
Total	121	99.2	100.0

Figure 4-10 - Frequency Table for Company use of Lump Sum on Past Projects: Internationally



Q11 'Project Dollar Value – Internationally'		
Dollar Value	**Frequency (N)**	**Percent**
<$5MM	10	8.2
<$100MM	18	14.8
<$1B	17	13.9
>$1B	7	5.7
Total	52	42.6

Figure 4-11 - Maximum Lump Sum Project Dollar Value: Internationally

More participant companies have used lump sum in Alberta (79.5%) than internationally (61.5%). When examined by company type, operating companies (80% compared with 62%) and construction companies (100% compared with 46%) in the survey group had used lump sum locally more frequently than internationally. Engineering company respondents were the opposite with 78% having used lump sum internationally versus 59% having used it locally.

Table 4-2 - Frequency Table for Use of Lump Sum by Company Type

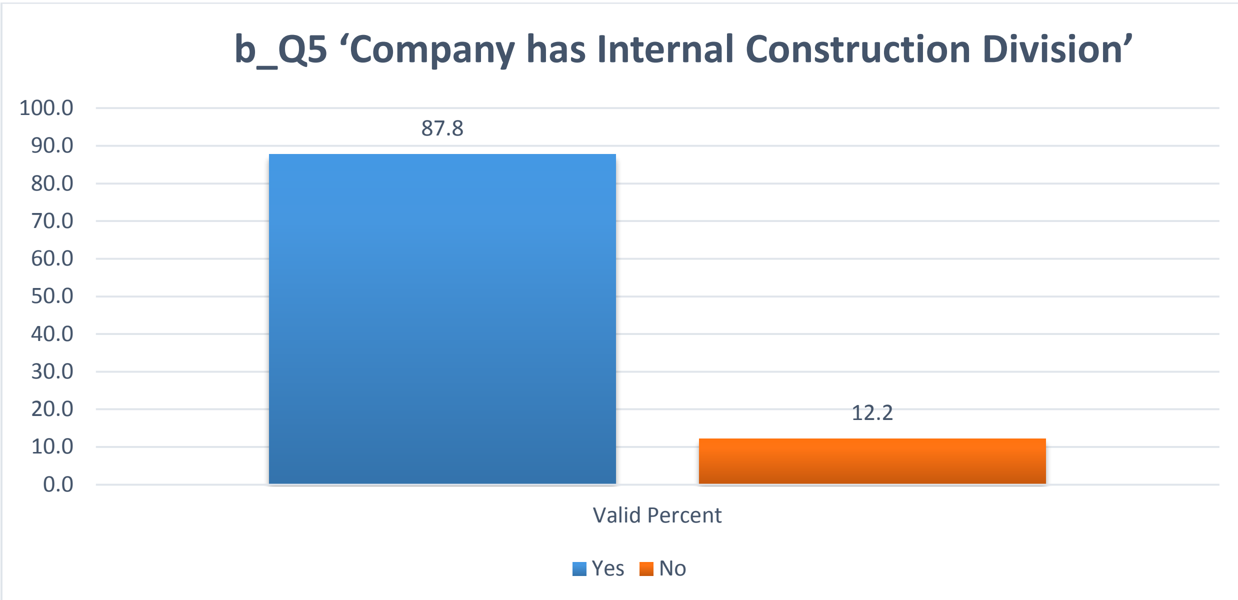
Company Type	LS Locally	LS Internationally
Operating	80%	62%
Engineering	59%	78%
Construction	100%	46%

Some respondents chose not to answer questions about maximum project dollar value, often stating this information was kept confidential. Thirty-two participants (9 Op., 22 Eng., 1 Con.) did not answer the Alberta dollar value and seventy (21 Op., 21 Eng., 28 Con.) did not answer the international dollar value. Data was collected from participants who did respond. The low response rate makes it difficult to draw conclusions about the full respondent population.

Of the participants who responded 'Yes' to using lump sum in Alberta, the highest percentage of respondents (52.2%) indicated their companies had performed projects in the $100MM - $1B range, while the remaining participants' responses were almost evenly split between projects of less than $5MM (24.4%) and projects in the $5MM - $100MM range (23.3%). Of the participants who responded 'Yes' to using lump sum internationally, the highest percentage of respondents had used lump sum on projects in the $5MM - $100MM range (34.6%) and the $100MM - $1B range (32.7%). Internationally, a small percentage of respondents had performed lump sum on projects greater than $1B (13.5%). With the exception of one operating company respondent, all 'Yes' responses for lump sum projects greater than $1B were engineering company respondents, potentially indicating that this group may be the most experienced with large scale lump sum projects. The highest dollar value internationally for construction companies was $5MM-$100MM, suggesting those who responded to this question may be the least experienced internationally with large dollar value projects.

4.2.4 Engineering Company has an Internal Construction Division (b_Q5)

87.8% of Engineer participants were found to have an internal construction division.



b_Q5 'Company has Internal Construction Division'		
Response	**Frequency (N)**	**Valid Percent**
Yes	36	87.8
No	5	12.2
Total	41	100.0

Figure 4-12 - Frequency Table for Engineering Companies having an Internal Construction Division

4.3 Contract Strategy

Contract strategy, in this research, deals with the respondents' perceived effect of lump sum use on project performance.

4.3.1 Company Use of Lump Sum on Past Projects (Q8-Q11)

Qualitative Responses

Respondents to Q8 through Q11 were asked to identify if there were any factors that make international projects more conducive to effective use of lump sum contracts compared to projects in Alberta.

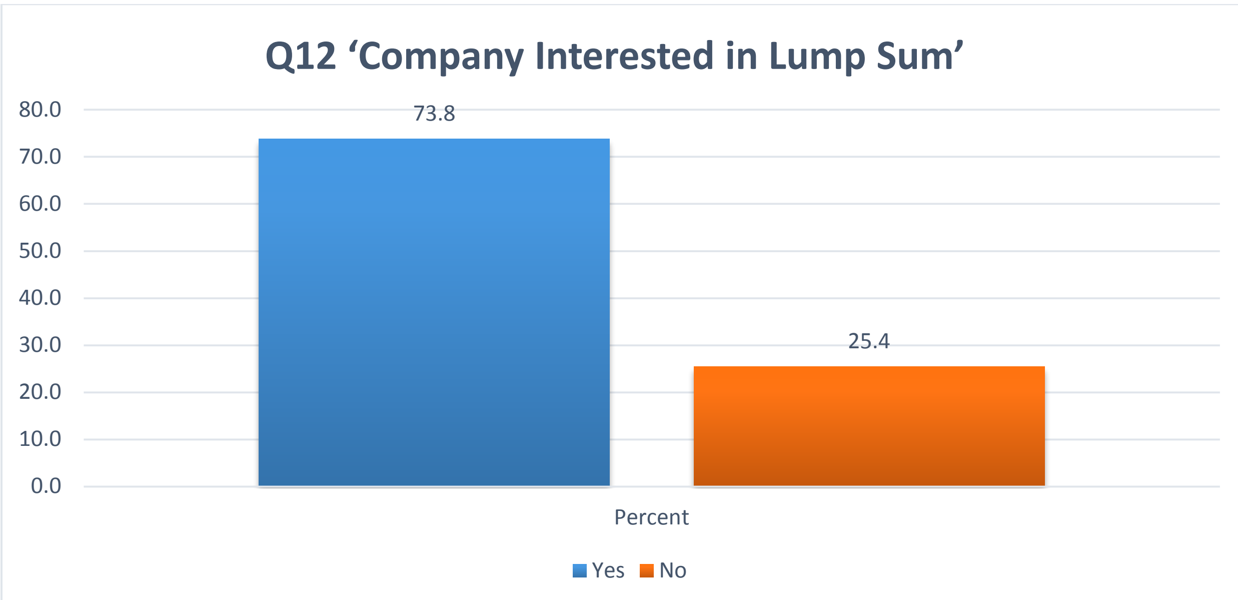
Table 4-3 - Factors that Make International Oil and Gas more Conducive to Lump Sum Projects

Factors Conducive to International Lump Sum	Operator	Engineer	Constructor
1. Low labour and supervision cost		4	
2. Constructors willing to take the risk on labour productivity (no cost reimbursable construction culture)		4	
3. No restrictive labour market (no unions, local content laws, etc.)		4	
4. Constructors willing to employ lump sum		4	
5. Fewer client late changes • Scope is frozen by the client prior to handover to engineer		6	
6. Owner more thoroughly defines scope of work	7	3	
7. Owner involvement is characterized as auditing • After scope freeze, planning and execution of the work in controlled by engineer		7	
8. Ocean ways for large module transportation		3	
9. International market players much more experienced with the execution and management of lump sum	15	5	20
10. Opportunity to make more money with lump sum, than cost reimbursable, internationally		2	
11. Easier to find bidders willing/able to accept lump sum contracts	6		
12. Easier to obtain external funding for international projects since costs are perceived to be capped through the use of lump sum	3		
13. The international market desires lump sum bidding and contracts on all jobs from a single part to a large project execution			8
14. More open to negotiation on price internationally, particularly in the Middle East, than locally. (Different cultural underpinnings.)			8

Two construction respondents believed international to be riskier than Alberta due to the political instability of many countries participating in the oil and gas industry.

4.3.2 Company Interest in Lump Sum (Q12)

Participants were asked to quantitatively state what they perceive to be their company's interest in using lump sum contracting strategies. They were then asked to explain the perceived advantages or disadvantages of lump sum contracting.



Q12 'Company Interested in Lump Sum'		
Response	**Frequency (N)**	**Percent**
Yes	90	73.8
No	31	25.4
Total	121	99.2

Figure 4-13 - Frequency Table for Perceived Company Interest in Lump Sum

One respondent chose not to answer this question. Of the participants that answered most believed their company was interested in using lump sum, by a large majority (74.4%).

Qualitative Responses

Respondents gave the following perceived advantages and disadvantages of lump sum use in the Alberta oil and gas market.

Table 4-4 – Advantages of Lump Sum Contracting

Advantages	**Operator**	**Engineer**	**Constructor**
Cost certainty for owners	32	6	2
Lump sum has higher profit margin through effective project management and control of risks Greater contractor incentive to control risks		11	15
All parties are focused on the same target of delivering project on cost and schedule • Lump sum contracts foster a higher level of team work and diligence due to the allocation of risk		3	2
The project scope is forced to be more clearly defined and agreed upon • Engineering design is complete before construction	2	6	3
• Interested if risk sharing with client or another contractor		3	2
Better cost certainty and control for contractor Mitigates the risk of cost overrun			3
• Transfer of risk to contractor	6		
Decrease of project cost	4		
Minimizes site supervision and fewer management resources required by operator during construction	2		3
Hedges against inflation	2		
Contractor has more control over planning and execution of work a. More effective utilization of field personnel b. Less interference from client c. Can receive more competitive pricing on equipment and materials		6	8
Fewer reporting requirements			3

As indicated by the responses listed above, Operators were very aligned in their perception of the advantages to using lump sum contracting. The majority believed that lump sum would ensure project cost certainty. More Engineers and Constructors chose the potential for increased profit margins for their interest in lump sum.

Table 4-5 – Disadvantages of Lump Sum Contracting

Disadvantages	**Operator**	**Engineer**	**Constructor**
Too many unknown risks • As contract complexity and scope size gets larger, the number of risks increase and a larger risk premium must be applied, which increases investment cost High level of risk rests on contractors shoulders		3	6
Too risky because of Alberta labour market challenges • Site labour responsibility a major deterrent		3	
• Cannot fast track (overlap phases) of project		1	
Too much operator interference Owner must relinquish control of project planning and execution to contractor at contract award		5	3
Insufficient scope definition • Engineering contracts do not typically have sufficiently clear definition of detailed scope to enable contractor to accurately predict the schedule and resources requirements		5	
• As contract size grows, the number of contractors able to handle the work decreases		1	
Lump Sum more appropriate for small packages of work • EPCM • Not materials/equipment/construction • Module fabrication • Not TurnKey • Piping	2	3	
• Cost of creating a lump sum proposal is a deterrent if not a high likelihood of winning the bid		2	
Potential for many scope changes	1		

A comment worth noting, made by the Constructor respondents was that they would prefer a process where the risks are identified and shared with the client or other contracting parties, based on which party can most easily control that risk. Based on this comment and the subject of risk identified in the preliminary interviews and Primary Survey, a question was asked on the Secondary Survey concerning what this risk sharing should look like in Alberta oil and gas.

4.3.3 Application of Lump Sum: Financial Ranges and Types of Scope Companies are willing to Lump Sum (Q24 and Q25)

Respondents were asked whether they believed their companies would be interested in applying lump sum contracting in the future. They were asked to speculate on the maximum financial range and scopes of work their companies might be interested in employing lump sum. The scope of work was an open-ended question that was then categorized by the researcher.

12.3% of respondents believed their companies would be unwilling to engage in lump sum contracts over any financial range. The largest area of interest, by a small margin, for employing lump sum, was in the $100MM - $1B financial range. Only a small number (11.5%) of respondents felt their companies were interested in lump sum projects greater than $1B.

Q24 'Financial Ranges Companies Willing to Lump Sum'			
Financial Range	**Frequency (N)**	**Percent**	**Valid Percent**
<$5MM	28	23.0	26.2
<$100MM	30	24.6	28.0
<$1B	35	28.7	32.7
>$1B	14	11.5	13.1
Total	107	87.7	100.0

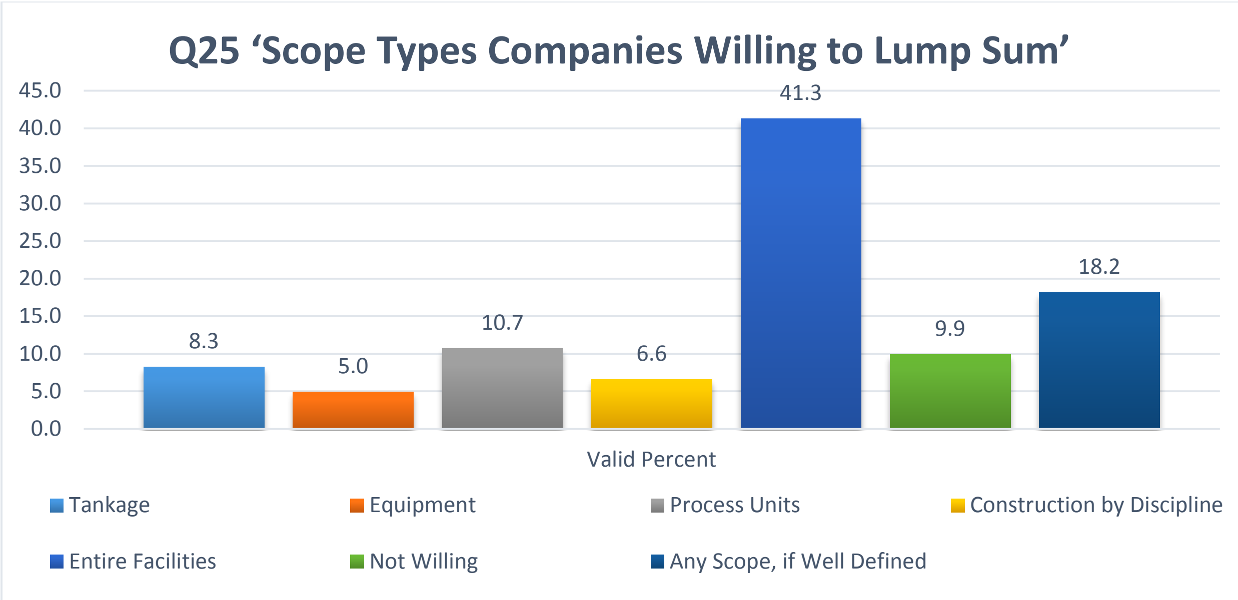
Figure 4-14 - Frequency Table for the Maximum Financial Range a Company is willing to Lump Sum

Qualitative Responses

The maximum scope of work was categorized into the following categories:

1. Tankage
2. Equipment
3. Individual Process Units
4. Construction by Discipline (electrical, mechanical, I&C, etc.)
5. Complete Facilities
6. Any Scope, if well defined
7. Not willing to use Lump Sum.

One participant declined to provide a response.



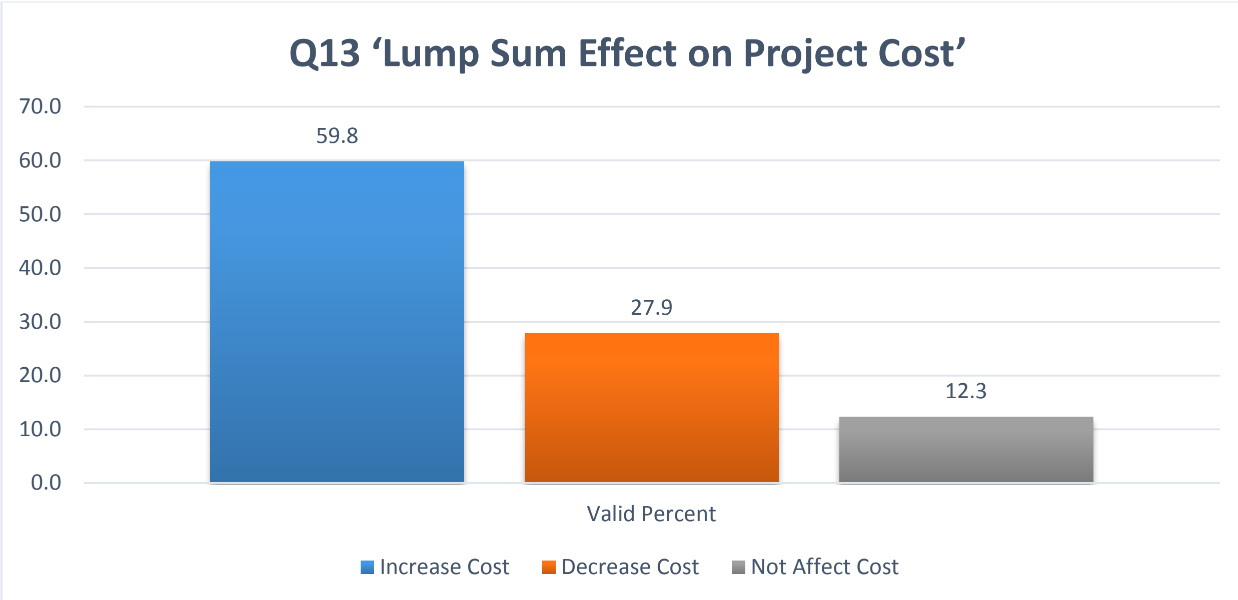
Q25 'Scope Types Companies Willing to Lump Sum'			
Scope Types	**Frequency (N)**	**Percent**	**Valid Percent**
Tankage	10	8.2	8.3
Equipment	6	4.9	5.0
Process Units	13	10.7	10.7
Construction by Discipline	8	6.6	6.6
Entire Facilities	50	41.0	41.3
Not Willing	12	9.8	9.9
Any Scope, if Well Defined	22	18.0	18.2
Total	121	99.2	100.0

Figure 4-15 - Frequency Table for the Largest Scope of Work a Company is willing to Lump Sum

Additional clarifying information was provided by reviewing the answers to this question, regarding what scope of work a company is willing to lump sum. Many constructors were willing to perform the full scope of complete facility construction. However, having a well-defined scope was mentioned often as a pre-requisite. When using lump sum for direct field construction, labour was mentioned as a concern, while shop labour was mentioned as not a concern for lump sum. Many engineers were willing to perform the full scope of a complete facility under lump sum contracting, but mentioned the issues of having a complete scope and owner companies relinquishing control over project execution to the contractor, as pre-requisites for doing this. A clarification made by one engineering respondent, who was willing to lump sum complete facilities, was that their company was only willing to do so using their own internal construction division. They did not trust the abilities and efficiency of external contractor firms. By their comments, operating companies seemed less confident about using lump sum for entire facilities. They expressed concern over the ability to define the scope sufficiently to effectively use lump sum. One respondent was willing to lump sum any scope, up to entire facilities, excluding brown field work, for example, plant upgrades. They felt brown field would present too much of a challenge for scope definition and up front risk identification, to effectively use lump sum.

4.3.4 Lump Sum Effect on Project Cost (Q13)

Participants were asked to indicate their perception of the effect on project cost of using lump sum contracting. They were also asked to quality the reason(s) for their response. The majority of respondents believed that costs would increase (59.8%). The second most popular category was that costs would decrease (27.9%).



Q13 'Lump Sum Effect on Project Cost'		
Cost	**Frequency (N)**	**Valid Percent**
Increase Cost	73	59.8
Decrease Cost	34	27.9
Not Affect Cost	15	12.3
Total	122	100.0

Figure 4-16 - Perceived Effect of Lump Sum on Project Cost

Qualitative Responses

Company participants gave the following reasons, summarized in Table 4-6 and Table 4-7, below, for the perceived project cost increase and project cost decrease due to lump sum implementation.

Table 4-6 – Reasons for Perceived Cost Increase due to Lump Sum Use

Reasons for Cost Increase with Lump Sum Use	Operator	Engineer	Constructor
1. Large risk factor/premium would be employed to account for: • labour risks • owner interference • scope changes • external market factors o Dependent on geographic area deficiencies in the contract scope clarity	11	33	14
2. Change impacts during execution due to: (50% of respondents) a. incomplete scope b. scope changes • Potential for claims	4		8
c. Contractors would quote high lump sum prices because they are in high demand due to economic growth of the Alberta oil and gas industry	3		
3. Change impacts due to incomplete scope definition entering execution	2		
4. Lump sum use on projects for which it is an inappropriate contracting strategy	1		
5. Constructors are not interest in partnering on lump sum because they will not take the risk on labour productivity		3	

Table 4-7 – Reasons for Perceived Cost Decrease due to Lump Sum Use

Reasons for Cost Decrease with Lump Sum Use	**Operator**	**Engineer**	**Constructor**
Scope would be well managed, resulting in fewer changes	6		
1. Fixed cost would result in contractor more effectively managing risks	2		
2. Competitive bidding will drive cost lower 3. Useful tool in down markets	1		
4. Lump sum structures will change current inefficient behaviour patterns and control against cost increases. • Stakeholders responsible for the effectiveness and efficiency of their scope of work		5	
5. More efficient project delivery o More efficient planning, execution, and management of project o Projects are less efficient under cost-reimbursable o Increased productivity • Better cost control	4		10
6. Equipment and material suppliers respond with more competitive pricing			6

Operator respondents, who answered that project cost would not be affected by implementing lump sum contracting, felt that cost would not change, rather costs would just be essentially reallocated. Using lump sum would result in contractors supplying more experienced and higher performing teams so the projects would be executed more efficiently and to a high quality standard. Lump sum establishes a project cost ceiling that does not exist in cost reimbursable. Though often perceived as a less expensive option, the lack of efficiency in cost reimbursable delivery causes costs to climb to about the same amount as the risk premium built into lump sum contracts.

Constructors, who felt there would be no change in cost, gave the following reasons:

1. No relation between payment structure selected and project TIC (Total Installed Cost)
2. Cost is based on historical productivity, and current labour and equipment costs. HOOH (Home Office Overhead) and profit are assigned based on the market and risks
3. Payment structure type just reallocates when/where the costs are spent. Does not change final cost.

It is to be noted that in all scenarios, increase, decrease and no effect, respondents are observing that economic growth would affect the lump sum price. Low economic growth would result in more contractor competitive bidding and thus lower prices; and higher economic growth would result in more owner projects in competition for contractors and thus higher prices.

An interesting observation is that the reasons given for increase and decrease of cost are essentially the same, but in inverse. Those who said cost would increase seem to believe that current project behaviors will not change as a result of a lump sum contracting strategy versus a cost reimbursable strategy. Through their answers, they are predicting the results of these behaviors in a lump sum environment. Those looking from the cost decrease point of view are assuming that the new payment structure will force behavioral changes, and thus promote the project behavior required in a lump sum environment.

4.3.5 Interest in Lump Sum structures by Project Phase (b_Q1 through b_Q4)

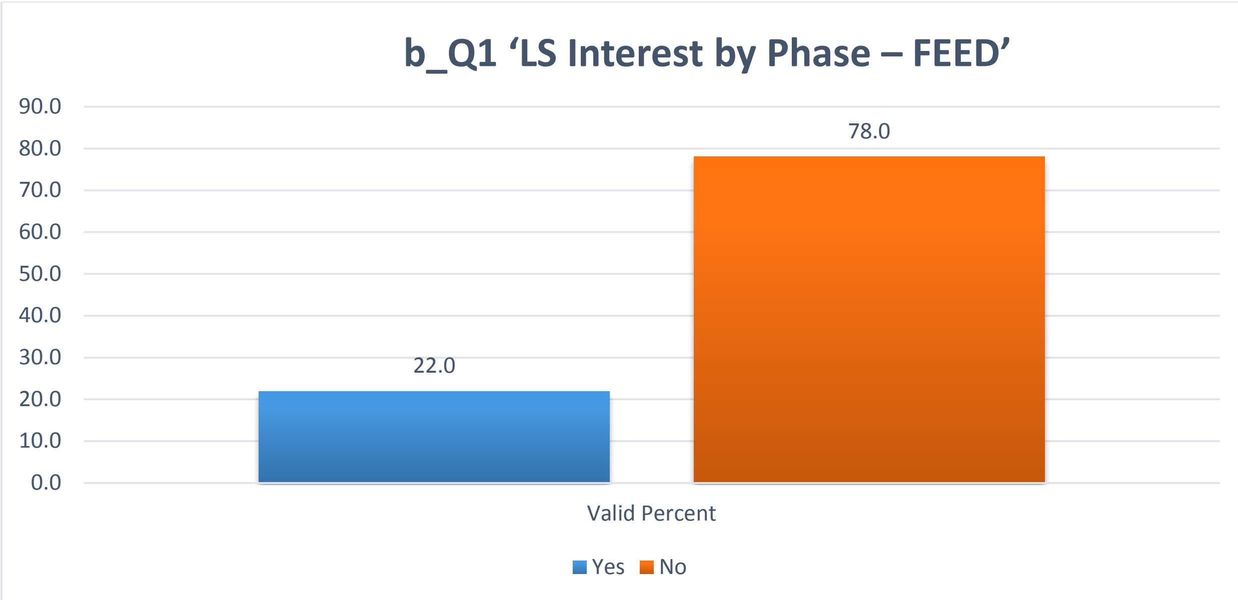
Engineer participants were asked about their interest in employing lump sum payment structures for specific phases of a project:

1. FEED Phase
2. Detailed Engineering Phase
3. Construction Phase
4. Full EPC Contract.

Respondents were also asked to offer the reasons for their lack of interest, if lump sum did not appeal to them at a particular project that stage.

4.3.5.1 Interest in Lump Sum for FEED Phase (b_Q1)

From the responses provided, it is clear that the majority of engineering contactors were not interested in employing lump sum for FEED Phase (78.0%).



b_Q1 'LS Interest by Phase – FEED'		
Response	**Frequency (N)**	**Percent**
Yes	9	22.0
No	32	78.0
Total	41	100.0

Figure 4-17 - Frequency Table for Lump Sum Interest by Phase: FEED (b_Q1)

Qualitative Responses

The two main reasons for not preferring lump sum for FEED Phase were:

Table 4-8 – Reasons for Lack of Engineer Interest in Lump Sum for FEED Phase

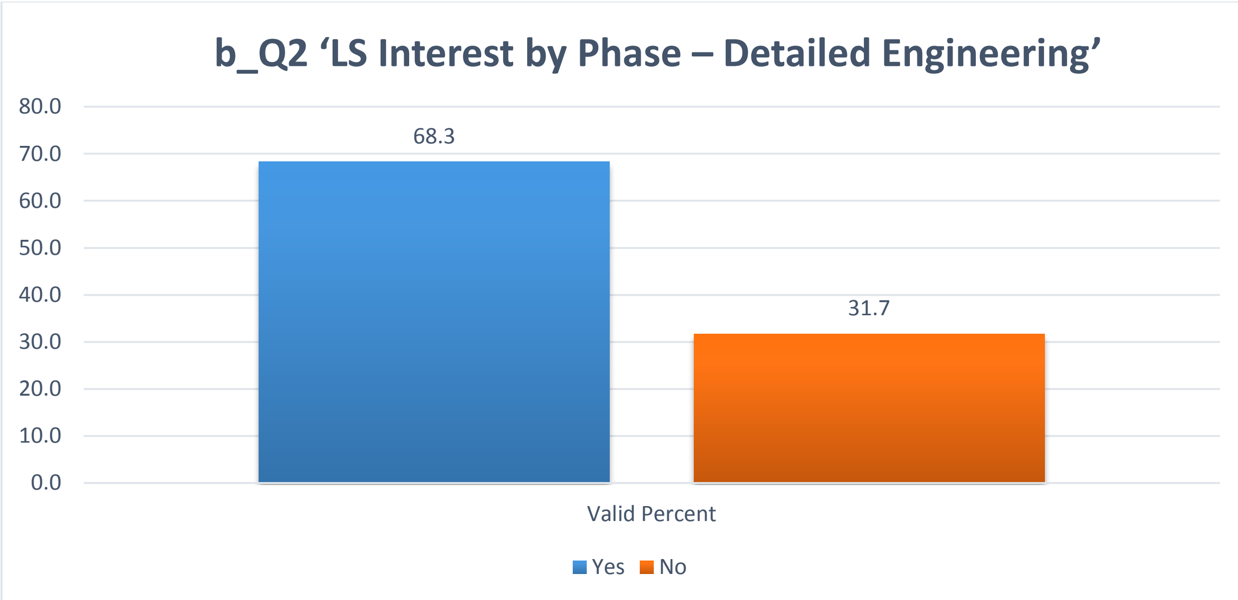
Reasons for Lack of Interest in Lump Sum for FEED Phase	**Engineer**
1. Incomplete scope: o Too much risk as owners have not finalized their scope and concept o Very difficult for an owner to specify the scope of services included and consequently the hour estimate is not reliable o Lump Sum for FEED is not the best approach for the client, as it is more cost effective to define the scope of the project and overall project execution on a cost reimbursable basis o Owner involvement in the FEED phase is often substantial, and there are many approval levels on plans and drawings that are beyond the control of the engineer Too early in development for adequate scope definition	15
2. Reduction in creativity of design: o FEED stage is the time to consider the best options for the project while LS contracting drives opposite behaviours. Conceptual and FEED stages are time for divergent thinking which is not compatible with LS o Lump sum in FEED reduces creativity o The FEED phase of the facility design is the time to study all the different solutions available to achieve an end result o By nature, FEED work is much more undefined and typically requires major studies and an evaluation of options; this could significantly impact man-hours	10

4.3.5.2 Interest in Lump Sum for Detailed Engineering (b_Q2)

Engineers showed considerably more interest in using lump sum for Detailed Engineering phase (68.3%) rather than for FEED phase. Respondents who were interested in using lump sum for Detailed Engineering phase stated that the reason was because:

- The contractor can control the work because the scope should be clearly defined from the FEED stage.

Respondents who were not interested in using lump sum for Detailed Engineering phase stated that it was because lack of scope definition still existed entering the Detailed Engineering Phase and that owner companies were still highly involved in execution. One respondent commented that they would be interested after the 90% model review during Detailed Engineering.

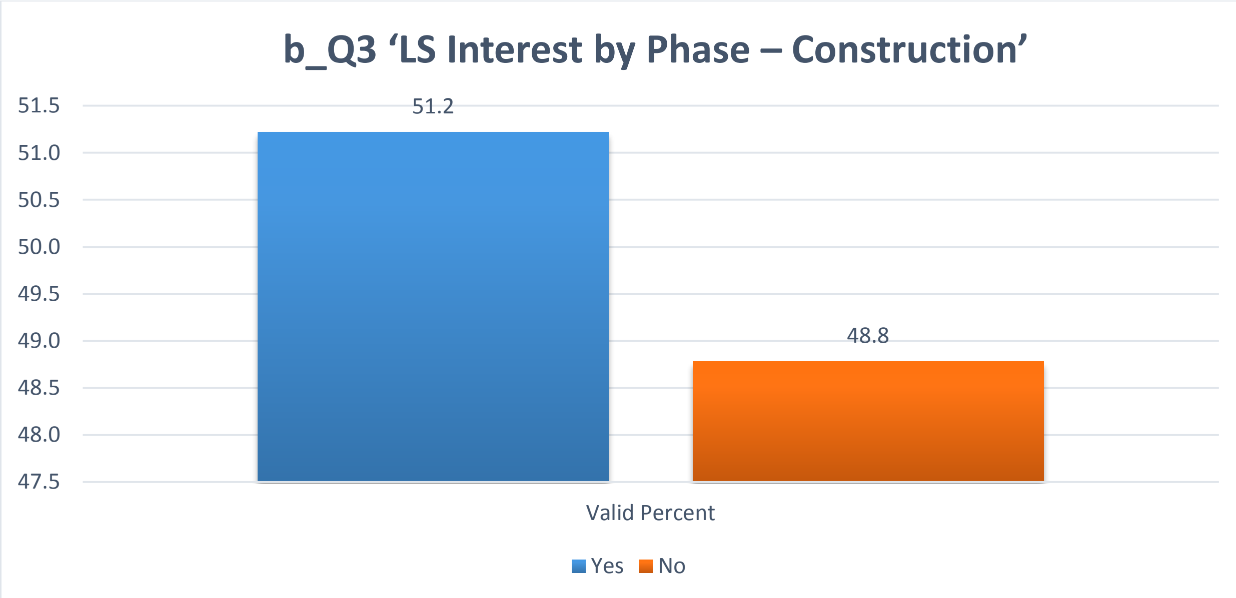


b_Q2 'LS Interest by Phase – Detailed Engineering'		
Response	**Frequency (N)**	**Valid Percent**
Yes	28	68.3
No	13	31.7
Total	41	100.0

Figure 4-18 - Lump Sum Interest by Phase: Detailed in using lump sum for Detailed Engineering phase Engineering (b_Q2)

4.3.5.3 Interest in Lump Sum for Construction (b_Q3)

Engineers were slightly less interested in using lump sum for the Construction phase (51.2%) than they were in using lump sum for Detailed Engineering phase.



b_Q3 'LS Interest by Phase – Construction'		
Response	**Frequency (N)**	**Valid Percent**
Yes	21	51.2
No	20	48.8
Total	41	100.0

Figure 4-19 - Lump Sum Interest by Phase: Construction (b_Q3)

Qualitative Responses

Respondents who said "Yes" to using lump sum for the Construction phase qualified their response with the statements listed below. Respondents would only agree to a lump sum contractual arrangement if:

1. Constructors willing to commit to lump sum contracts were available
2. An arrangement could be reached with the operator where, if construction productivity goes down for a reason out of the control of the engineer/constructor, the contractor will be compensated
3. The contract was for small pieces of work only.

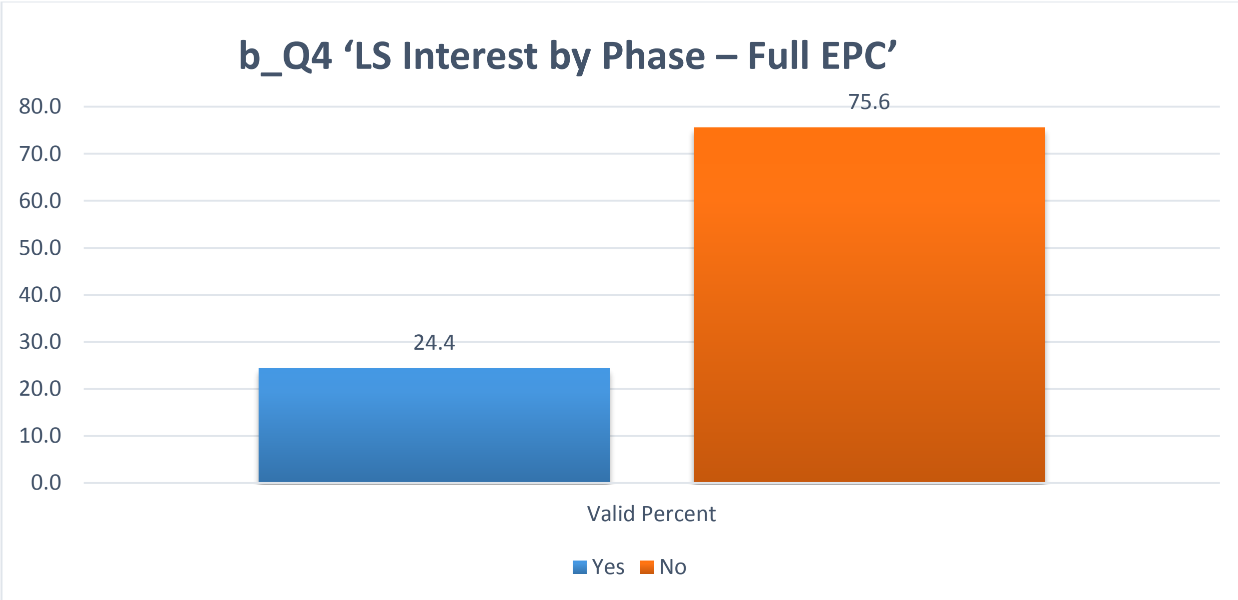
Respondents, who said "No" to using lump sum for the Construction phase, identified the main reasons why, as listed in Table 4-9, below:

Table 4-9 – Reasons for Lack of Engineer Interest in Lump Sum for Construction

Reasons for Lack of Interest in Lump Sum for Construction	Engineer
1. Direct field labour cost is too risky because it is outside the control of the engineer: • Lack of skilled resources • Lack of skilled construction supervision • Poor labor productivity • Rigid work organizations (unions)	15
• Constructors unwilling to share the risk of lump sum; they prefer cost reimbursable	3
2. Prepared to take the risk on growth of quantities, but not on labour productivity	7
3. The risk premium built into the contract, associated with anticipated productivity fluctuations, will make the lump sum price more expensive to the owner than cost reimbursable	4
4. In the current state of the construction environment, it is difficult to define the appropriate amount of construction supervision the owner companies should have	1
5. Because of the industry lack of experience with lump sum, owners may want to supervise and oversee the contractor more than the contractor has built into the price	1

4.3.5.4 Interest in Lump Sum for Full EPC (b_Q4)

Engineers were about as interested in using lump sum for full EPC (24.4%) as they were in using lump sum for FEED (22.0%). The reasons for this were the same as the reasons provided for each different phase.

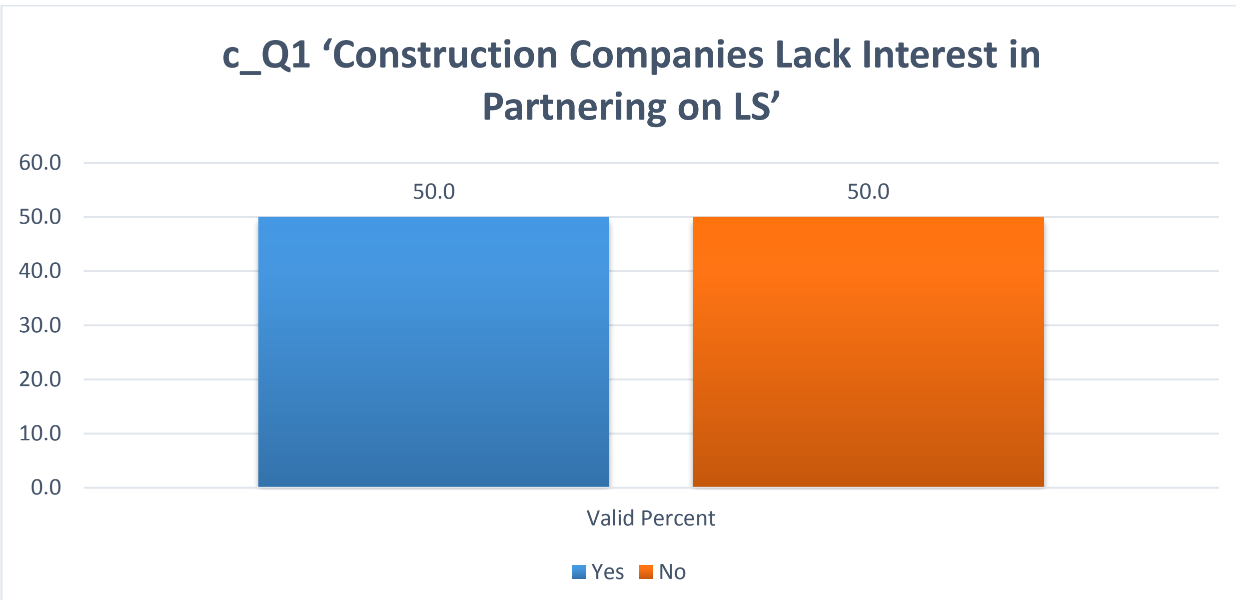


b_Q4 'LS Interest by Phase – Full EPC'		
Response	**Frequency (N)**	**Valid Percent**
Yes	10	24.4
No	31	75.6
Total	41	100.0

Figure 4-20 - Lump Sum Interest by Phase: Full EPC (b_Q4)

4.3.6 Construction Company Interest in Partnering on Lump Sum (c_Q1)

Feedback from the pre-interviews with engineer representatives contends that one of the main reasons for the lack of interest in lump sum projects by engineering companies is the lack of interest in lump sum by the constructors that they must partner with to perform the full scope of work, through construction. Construction survey participants were asked if they believed this assumption to be true and to explain the reason(s) for the lack of interest, if they felt it existed.



c_Q1 'Construction Companies Lack Interest in Partnering on LS'			
Response	**Frequency (N)**	**Percent**	**Valid Percent**
Yes	20	48.8	50.0
No	20	48.8	50.0
Total	40	97.6	100.0
Missing	1	2.4	0.0

Figure 4-21 - Construction Companies Lack Interest in Partnering on Lump Sum (c_Q1)

From analyzing the data, it was found that 50% of Constructors believed the assumption, there is a lack of interest on the part of construction companies in partnering on lump sum projects, to be a correct assumption and 50% of Constructors believed it to be an incorrect assumption. However, upon review, participants' long answer responses often appeared to disagree with their quantitative responses. The survey question may have been phrased vaguely, and will be left out of correlation analysis because of the unreliability of the quantitative data.

Qualitative Responses

From the long answer explanations, the majority of Constructors appear to be not interested in partnering on lump sum projects with Engineers, even if Constructors are interested in performing lump sum contracts in general.

Respondents not interested in partnering on lump sum projects, offered the following reasons why this was the case:

Table 4-10 – Reasons for Lack of Constructor Interest in Partnering on Lump Sum

Reasons for Lack of Interest in Partnering on Lump Sum	**Constructor**
1. Alberta has a risk avoidance culture • Engineering and owner organizations are conditioned to do cost reimbursable engineering	1
2. Perception that Engineering Companies do not have a good track record of producing complete, quality drawings in a defined time period • Many engineering companies are currently understaffed and unable to provide accurate drawings on time. Therefore the risks are now transferred to the contractors, even in a partnership • Constructors willing to execute lump sum projects, however, EPCs do not put out complete packages to get the lump sum cost estimation from • Scope of work poorly defined	4
3. General lack of knowledge in the industry as it relates to lump sum contracting and the associated management of the process • Lack of interest in lump sum is due to lack of lump sum execution experience. Results in disagreements on inclusions/exclusions and claims, resulting in deterioration of relationships	2
4. There is the perception that engineers want the construction partner to assume a disproportionate amount of risk • No interest because greater risk is placed on the contractor in lump sum than cost reimbursable • Construction phase is the project's largest cost and biggest risk project phase Constructors believe there is a disproportionately unfair division of risk versus reward in lump sum partnership situations	4
5. The market is too busy to bother accepting lump sum contracts that pose more risk • Cost reimbursable works in the Constructors favour. There is no reason to accept more risk	2
6. Lump Sum leads to a drain on the labour pool as companies involved must	1

Reasons for Lack of Interest in Partnering on Lump Sum	Constructor
submit low bids to obtain the work	
7. Often perform lump sum for owner organizations. However, partnering with an engineering company adds layers of bureaucracy that are prohibitive to achieving a lump sum arrangement	1
8. Constructors have found that most engineering companies are not interested in lump sum partnerships	1
9. Perception that Engineering firms spend too much of the budget early and then try to make up money by cutting corners during execution	1
10. Perception that Engineering companies under bid the project to get the work and then create change requests and extras to make up the losses during execution, affecting the construction company execution	1
11. Engineering companies that must partner with construction companies have difficulty selecting a commercial model **12.** Poor contract structure	2

Respondents who were interested in partnering on lump sum projects offered the following reasons why this was the case:

Table 4-11 – Reasons for Constructor Interest in Partnering on Lump Sum

Reasons for Interest in Partnering on Lump Sum	Constructor
1. Willing to perform construction using lump sum, either in a JV or separately	6
2. Would be interested if the potential reward is much greater than other payment structures • There must be an opportunity to make money on risk premium and make a higher profit margin	8
3. Would be interested with a reasonable risk sharing strategy	3

The common areas of concern appear to be around the division of risk, complete engineering packages prior to Construction phase (scope definition), availability of labour, and the lack of industry knowledge around lump sum contacting and management.

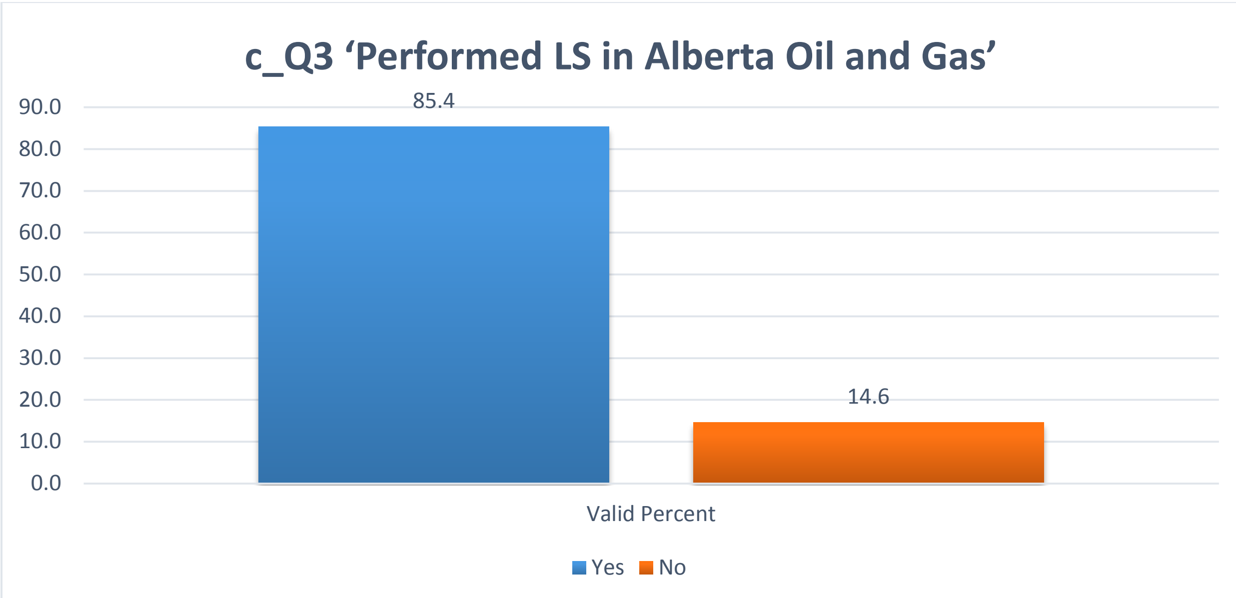
4.3.7 Construction Company Interest in Employing Lump Sum (c_Q2)

C_Q2 purposely omitted as it is a repeat of Q12.

4.3.8 Lump Sum Construction Use (c_Q3 & c_Q4)

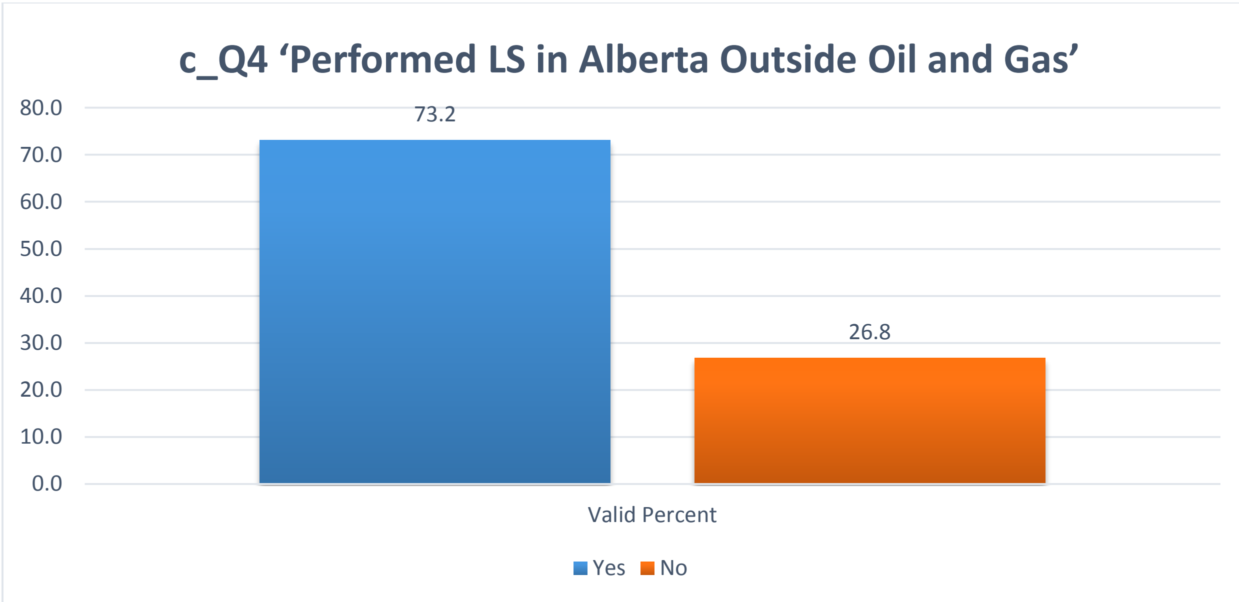
From the pre-interviews, it was noted that construction companies already perform lump sum contracts in Alberta outside of the oil and gas industry. Government projects, such as civil contracts, are mandatory lump sum contracts. Construction respondents were asked if they had performed lump sum within and outside oil and gas.

More survey participants have performed lump sum payment structures within oil and gas (85.4%) than in industries outside oil and gas (73.2%).



c_Q3 'Performed LS in Alberta Oil and Gas'		
Response	**Frequency (N)**	**Valid Percent**
Yes	35	85.4
No	6	14.6
Total	41	100.0

Figure 4-22 - Frequency Table for Lump Sum Construction within Oil and Gas



c_Q4 'Performed LS in Alberta Outside Oil and Gas'		
Response	**Frequency (N)**	**Valid Percent**
Yes	30	73.2
No	11	26.8
Total	41	100.0

Figure 4-23 - Frequency Table for Lump Sum Construction Outside Oil and Gas

4.4 Risk Management

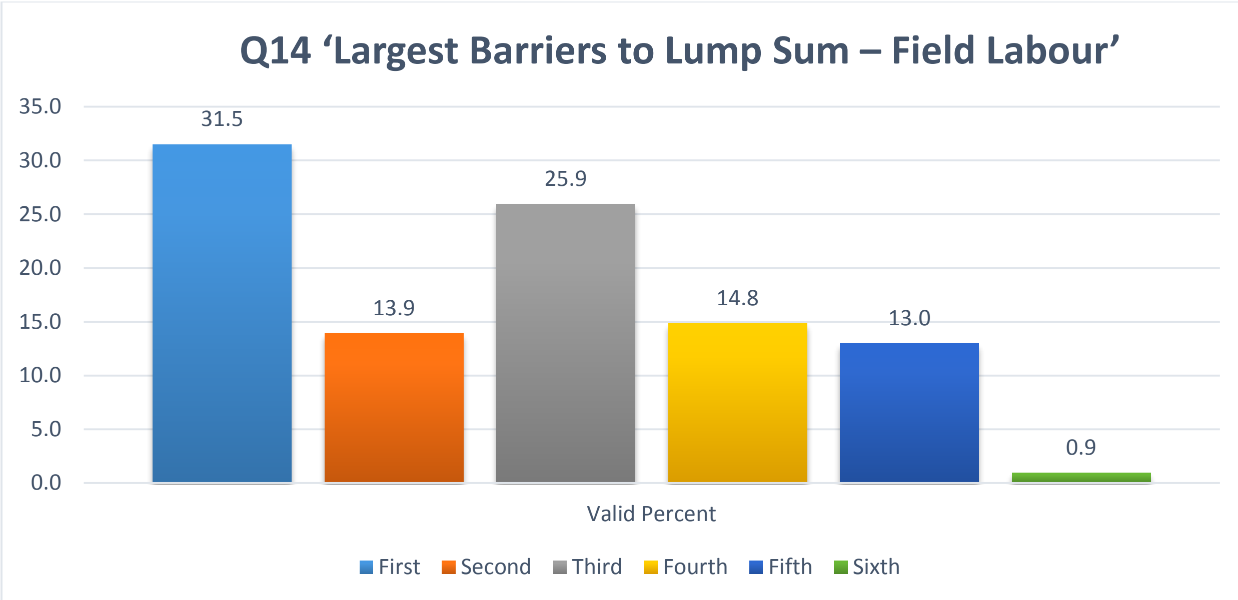
Risk management, in this research, deals with the respondents' perceived risks of shifting to lump sum contracting.

4.4.1 Barriers to Lump Sum Contracting in Alberta Oil and Gas (Q14-Q19)

A list of barriers to lump sum in Alberta oil and gas was developed from the pre-interviews. The barriers suggested by the interviewees are listed below:

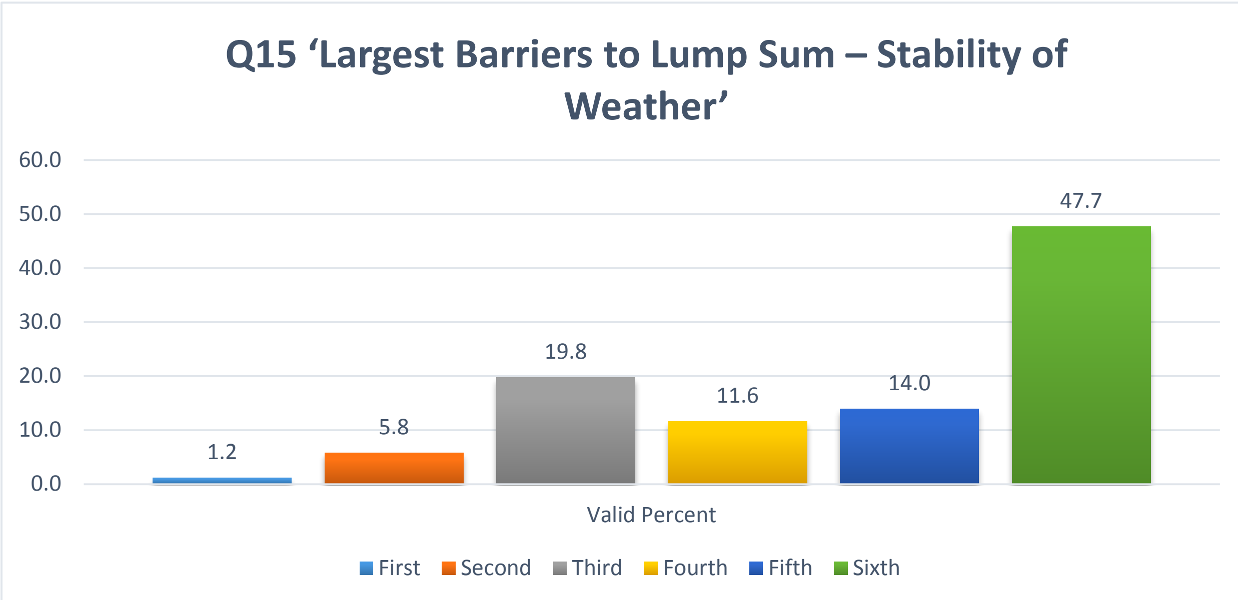
1. Field labor cost and predictability/constrictive labour environment
2. Stability of weather difficult to predict, thereby making productivity difficult to predict
3. Local construction culture favors cost reimbursable
    - Engineering companies that choose to take on Lump Sum have little ability to control construction risk
4. Module size constraints due to limitations with existing transportation infrastructure and no access to major waterways for shipping
5. Client late changes
6. Lack of scope definition (incomplete RFP/RFQ).

Survey participants were asked to rank each barrier in order of importance, with one representing the most important barrier and six representing the least important barrier. They were also asked to identify any barriers on the list that they felt were not important or would not impact the viability of using lump sum structures in Alberta oil and gas. They were to identify the barriers with no impact by leaving them out of the ranking. In addition, respondents were asked to suggest any barriers left out of the initial list that they felt would have a direct impact on lump sum feasibility. Figures 4-15 to 4-20 show the frequency of ranking for each barrier.



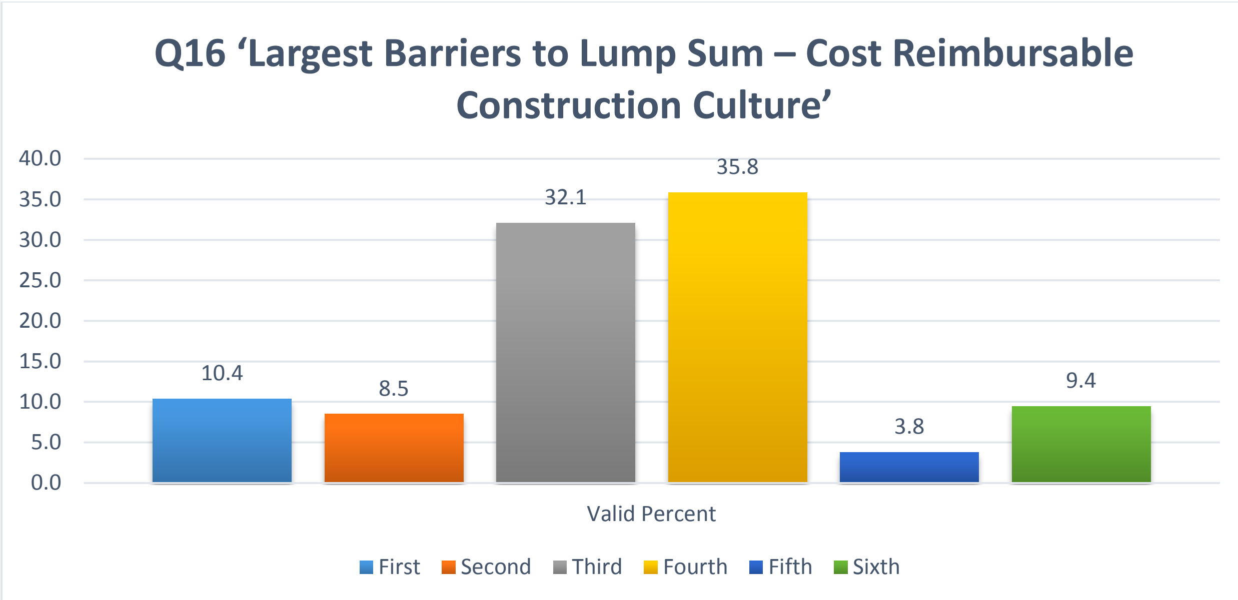
Q14 'Largest Barriers to Lump Sum – Field Labour'			
Ranking	**Frequency (N)**	**Percent**	**Valid Percent**
First	34	27.9	31.5
Second	15	12.3	13.9
Third	28	23.0	25.9
Fourth	16	13.1	14.8
Fifth	14	11.5	13.0
Sixth	1	0.8	0.9
Total	108	88.5	100.0

Figure 4-24 - Frequency of Largest Barriers to Lump Sum: Field Labour



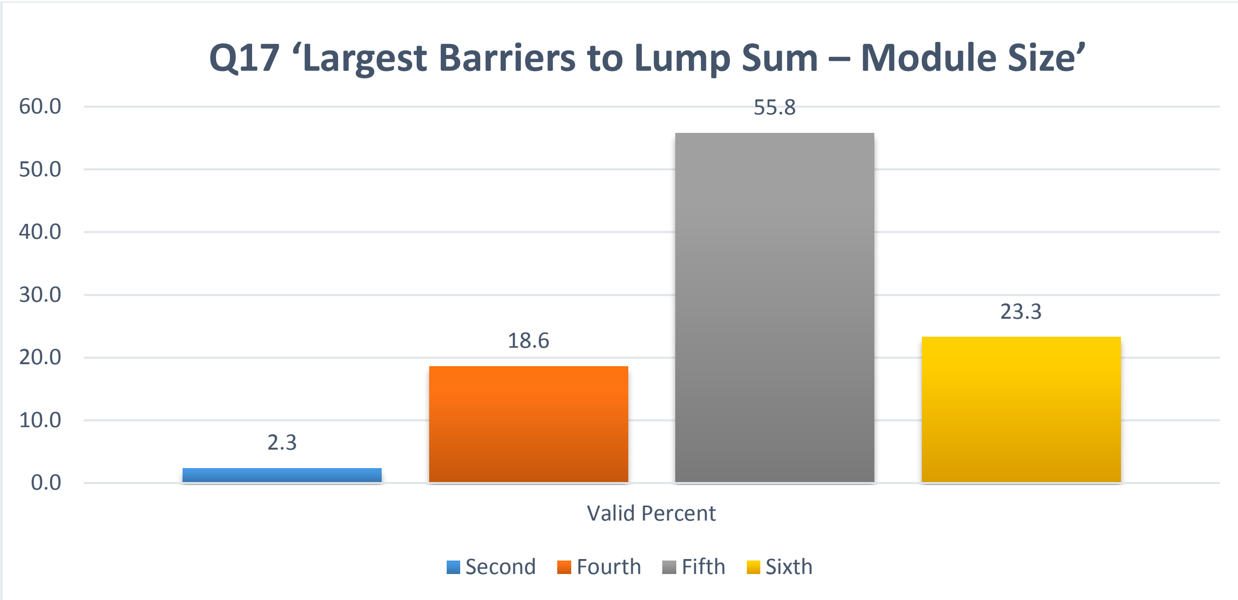
Q15 'Largest Barriers to Lump Sum – Stability of Weather'			
Ranking	**Frequency (N)**	**Percent**	**Valid Percent**
First	1	0.8	1.2
Second	5	4.1	5.8
Third	17	13.9	19.8
Fourth	10	8.2	11.6
Fifth	12	9.8	14.0
Sixth	41	33.6	47.7
Total	86	70.5	100.0

Figure 4-25 - Frequency of Largest Barriers to Lump Sum: Stability of Weather



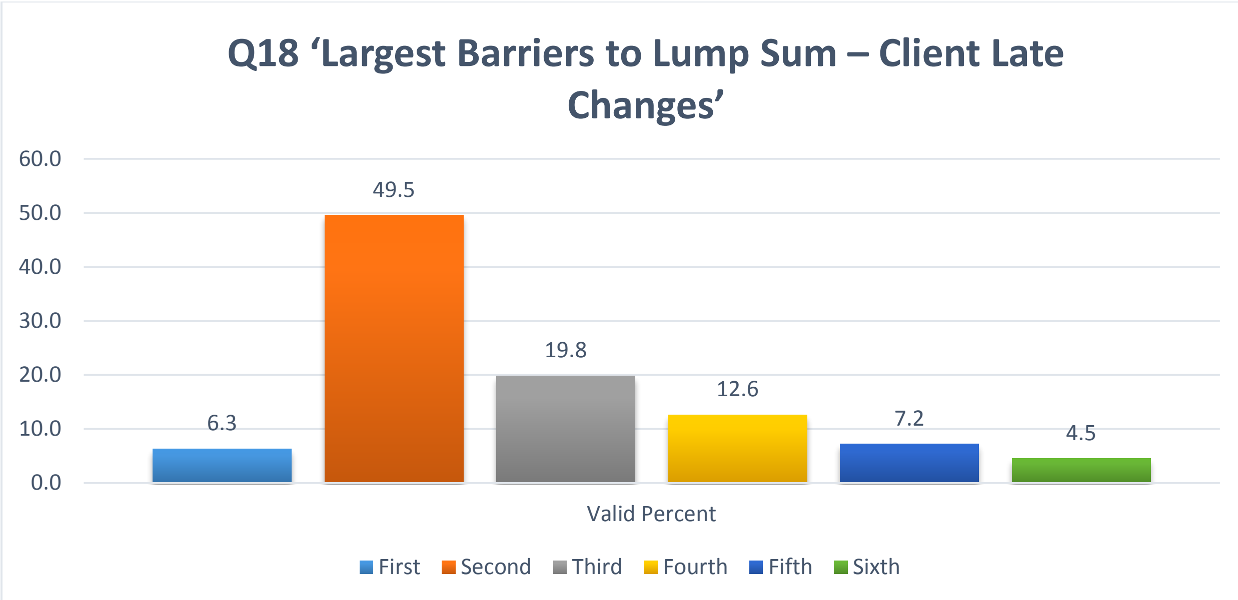
Q16 'Largest Barriers to Lump Sum – Cost Reimbursable Construction Culture'			
Ranking	**Frequency (N)**	**Percent**	**Valid Percent**
First	11	9.0	10.4
Second	9	7.4	8.5
Third	34	27.9	32.1
Fourth	38	31.1	35.8
Fifth	4	3.3	3.8
Sixth	10	8.2	9.4
Total	106	86.9	100.0

Figure 4-26 - Frequency of Largest Barriers to Lump Sum: Cost Reimbursable Construction Culture



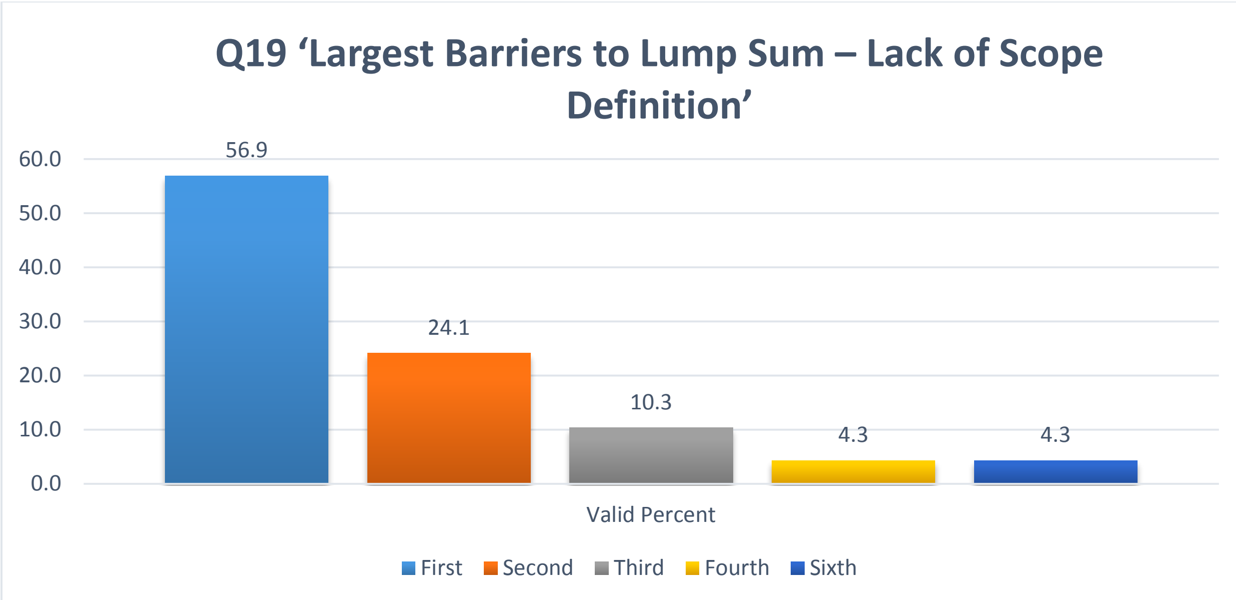
Q17 'Largest Barriers to Lump Sum – Module Size'			
Ranking	**Frequency (N)**	**Percent**	**Valid Percent**
Second	2	1.6	2.3
Fourth	16	13.1	18.6
Fifth	48	39.3	55.8
Sixth	20	16.4	23.3
Total	86	70.5	100.0

Figure 4-27 - Frequency of Largest Barriers to Lump Sum: Module Size Restrictions



Q18 'Largest Barriers to Lump Sum – Client Late Changes'			
Ranking	**Frequency (N)**	**Percent**	**Valid Percent**
First	7	5.7	6.3
Second	55	45.1	49.5
Third	22	18.0	19.8
Fourth	14	11.5	12.6
Fifth	8	6.6	7.2
Sixth	5	4.1	4.5
Total	111	91.0	100.0

Figure 4-28 - Frequency of Largest Barriers to Lump Sum: Client Late Changes



Q19 'Largest Barriers to Lump Sum – Lack of Scope Definition'			
Ranking	**Frequency (N)**	**Percent**	**Valid Percent**
First	66	54.1	56.9
Second	28	23.0	24.1
Third	12	9.8	10.3
Fourth	5	4.1	4.3
Sixth	5	4.1	4.3
Total	116	95.1	100.0
Missing	6	4.9	0.0

Figure 4-29 - Frequency of Largest Barriers to Lump Sum: Scope Definition

The ranked order of barriers was determined by first selecting the barrier ranked as first by percentage. To determine the barrier ranked second, the first and second ranking percentages of the remaining barriers were added together. The barrier with the highest percentage of first and second rankings was determined to be the second most important barrier. This process was repeated to rank all remaining barriers.

Table 4-12 - Ranking of Largest Barriers to Lump Sum Structures in Alberta Oil and Gas

Ranking	Field Labour %	Stability of Weather %	Cost Reimbursable Construction Culture %	Module Size Limitations %	Client late Changes %	Lack of Scope Definition %
First	27.9	0.8	9.0	0	5.7	54.1
Second	12.3	4.1	7.4	1.6	45.1	23
Third	23.0	13.9	27.9	0	18	9.8
Fourth	13.1	8.2	31.1	13.1	11.5	4.1
Fifth	11.5	9.8	3.3	39.3	6.6	0
Sixth	0.8	33.6	8.2	16.4	4.1	4.1
Not important	11.5	29.5	13.1	29.5	9.0	4.9

The major barriers were seen as:

1. Lack of scope definition (incomplete RFP/RFQ)
2. Client late changes
3. Field labour cost and predictability/constrictive labour environment
4. Cost reimbursable local construction culture.

The following barriers, weather stability and module size constraint, were viewed as unimportant to the feasibility of using lump sum. The question regarding barriers to using lump sum in the Alberta oil and gas industry was further analyzed for correlation to determine if any significant disconnects existed between target groups. This would help to identify if different risks were of greater concern to different parties.

Qualitative Responses

Table 4-13 – Additional Barriers to Lump Sum Contracting in Alberta

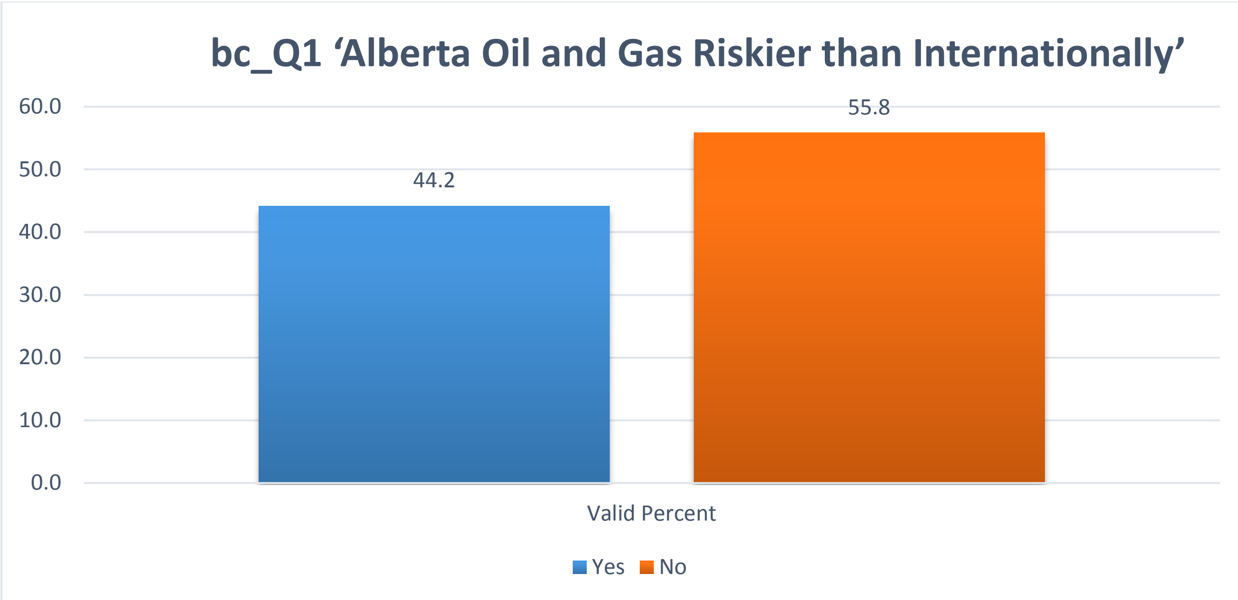
Additional Barriers to Lump Sum	Operator	Engineer	Constructor
1. Lack of lump sum management and execution experience • Lack of experience of local companies with handling the risks associated with lump sum	10	8	14
2. Excessively high construction indirect costs		2	
3. Limited availability of skilled workforce and supervision:	6	8	9

Additional Barriers to Lump Sum	Operator	Engineer	Constructor
4. Turnover rate has diluted the talent pool in the province. The need for more bodies has added many marginal people at all levels of industry • Lack of availability of key experienced senior resources due to high demand and diluted talent pool			
5. High cost of field labour versus shop labour		2	
6. High demand for shops on module infrastructure corridors is increasing prices		4	
7. Labour is 10X more expensive locally than internationally		2	
8. Poor Front End planning	4		
9. Poor Management of Change	2		
10. Productivity varies significantly with geographical area, and the productivity factor is often underestimated	2		
11. Fast Tracking • Companies are eager to fast track projects, but do not allow for projects to properly follow the stage gated process, leaving a significant number of uncertainties. This leads to project price climbing	6		
12. Lack of effective competition amongst the contractors and engineering companies	3		
13. Conflicting objectives are created when different payment structures are employed on the same project			2
14. Risk adverse and adversarial business culture • There is a more adversarial environment locally instead of a collaborative one, as compared to the industry internationally • Companies are accustomed to cost reimbursable behaviour patterns • Contractors do not want to accept the risks associated with lump sum contracting	5	8	5
15. Inadequate time for lump sum bid preparation 16. Lengthy bid process	2		3
17. Operating company interference. Owners desire the same amount of involvement as in cost reimbursable in the planning and execution of work	2	4	2
18. Cost reimbursable is more effective in maintaining target price mark-ups			1

Common themes repeated in answers to the additional barriers to lump sum question include lack of experience with lump sum management, talent pool dilution, adversarial Canadian business culture, high owner desire for involvement in project execution, desire for fast tracking, and poor front-end planning. Desire for fast tracking and lack of experience were the most frequently mentioned barriers to lump sum.

4.4.2 Opinion of Risk Level in Alberta Oil and Gas Compared to International Oil and Gas (bc_Q1)

Based on answers provided during pre-interviews, engineers seemed to view the contracting risk as higher in Alberta oil and gas, as compared to internationally, from a lump sum perspective. Given that they are both on the contractor side of the industry, engineering and construction survey participants were asked this question. Five participants chose not to answer the question. Of those who responded, 44.2% viewed Alberta as riskier, while 55.8% did not. Further analysis was performed to determine if there was a statistically significant difference between the engineering and construction opinion.



bc_Q1 'Alberta Oil and Gas Riskier than Internationally'			
Response	**Frequency (N)**	**Percent**	**Valid Percent**
Yes	34	41.5	44.2
No	43	52.4	55.8
Total	77	93.9	100.0
Missing	5	6.1	0.0

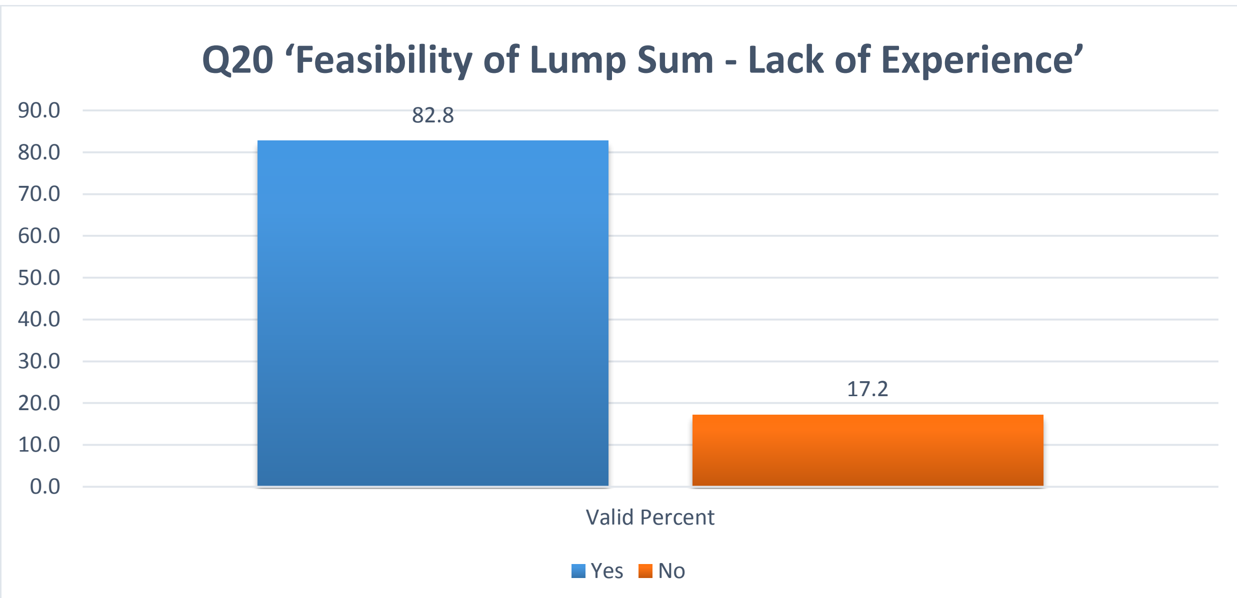
Figure 4-30 - Frequency Table for Perception of Alberta Oil and Gas Industry as Riskier than International Oil and Gas

4.5 Project Management Experience

Project management experience, in this research, deals with the perceived project management experience and competence, in Alberta oil and gas, with the management of lump sum projects.

4.5.1 Lump Sum Project Management Experience (Q20)

A common topic arising from the pre-interviews and the responses to previous survey questions was the lack of lump sum management and execution experience. Respondents were asked if they believed there to be a lack of lump sum execution and management experience on all sides of the industry (engineer, constructor, and operator) in Alberta oil and gas, which prevents lump sum contracting from being a feasible option. The majority of respondents (82.8%) felt this lack of experience was a barrier to lump sum feasibility.

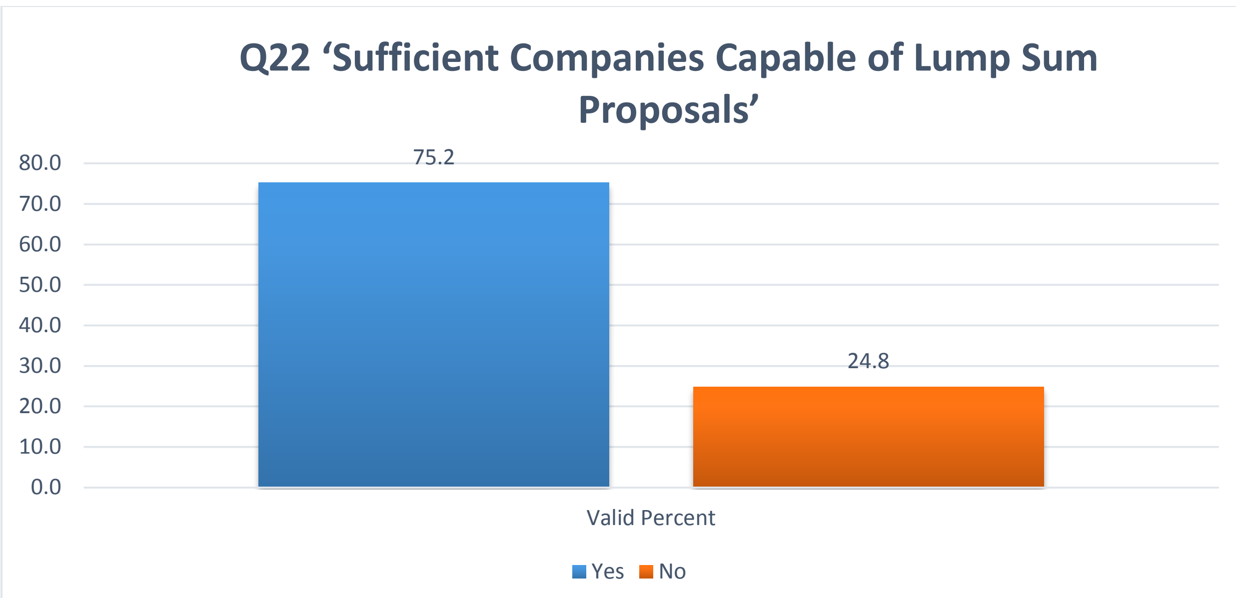


Q20 'Feasibility of Lump Sum - Lack of Experience'		
Response	**Frequency (N)**	**Valid Percent**
Yes	101	82.8
No	21	17.2
Total	122	100.0

Figure 4-31 - Frequency Table for Lack of Lump Sum Management and Execution Experience

4.5.2 Sufficient Contractor Companies with Lump Sum Bidding Experience (Q22)

Developing a lump sum bid proposal is highly resource intensive when compared to the preparation of cost reimbursable proposals. Pre-interviewees stated a concern around the number of contracting companies' familiar enough with preparing lump sum bid proposals, so as to create enough competitive bidding to enable owner companies to judge the validity of the lump sum proposals. Survey participants were asked if they believed there were sufficient companies conducting work in Alberta capable of developing lump sum bid proposals. The majority of respondents (74.6%) felt that there were sufficient companies capable of putting together lump sum bid proposals.

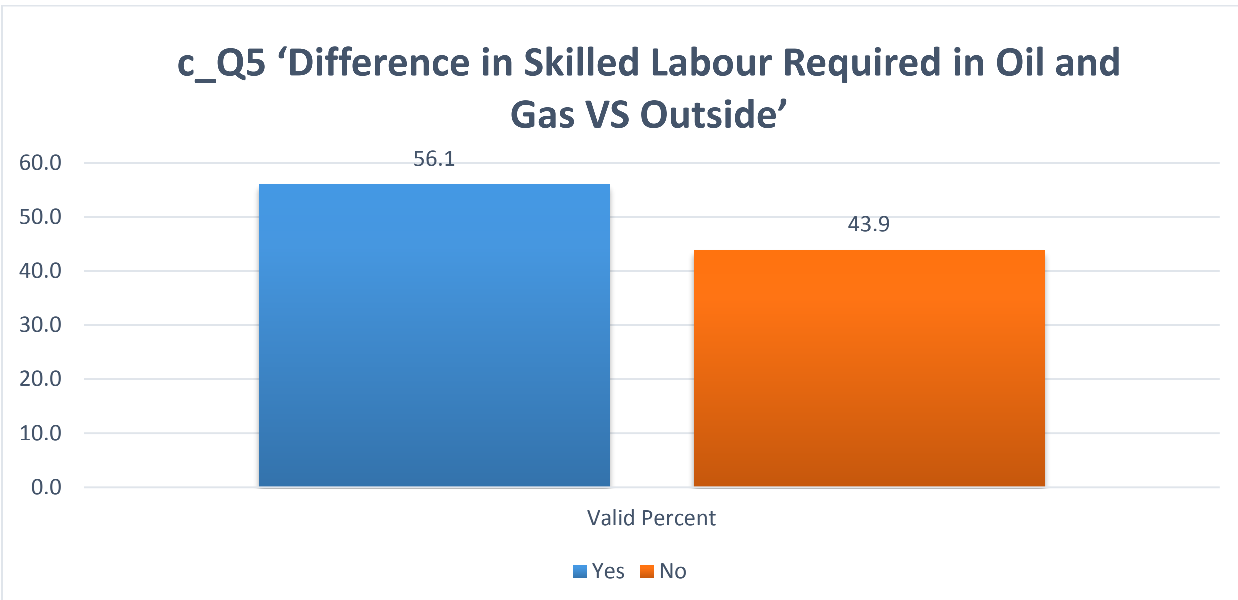


Q22 'Sufficient Companies Capable of Lump Sum Proposals'			
Response	**Frequency (N)**	**Percent**	**Valid Percent**
Yes	91	74.6	75.2
No	30	24.6	24.8
Total	121	99.2	100.0

Figure 4-32 - Frequency Table for Sufficient Companies Capable of Lump Sum Bidding

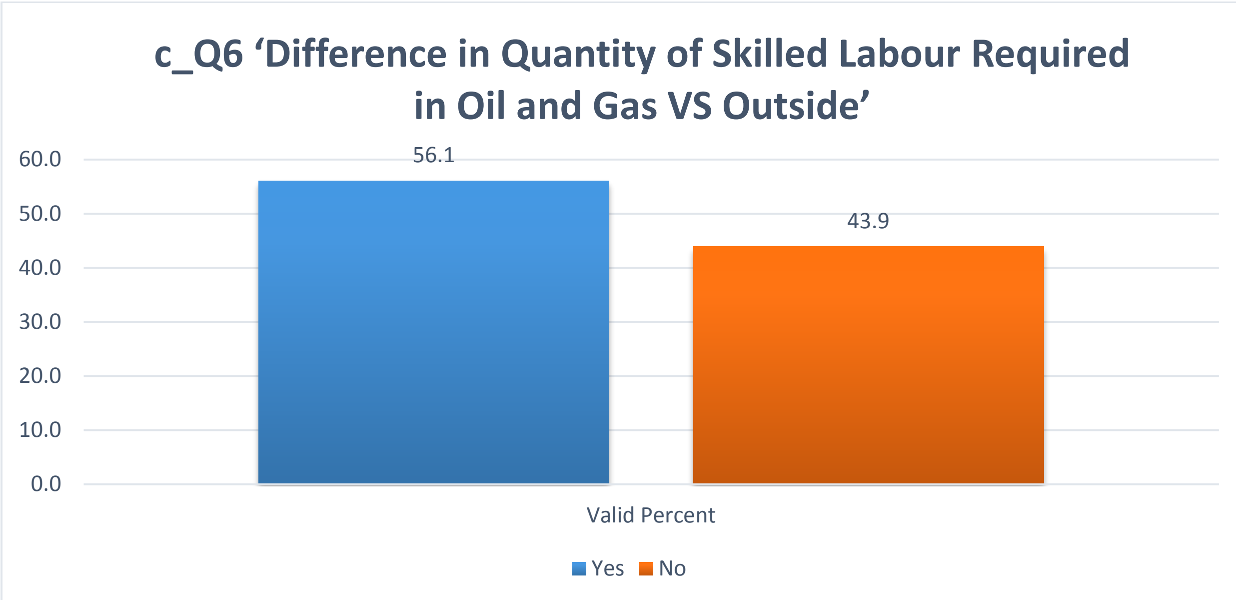
4.5.3 Differences in Skilled Labour between Alberta Oil and Gas and other Alberta Construction Industries (c_Q5 &c_Q6)

Preliminary interview responses speculated that one of the reasons construction companies are hesitant to perform lump sum within oil and gas is that different types and quantities of skilled labour are required within oil and gas. Engineering and Construction interviewees claimed that higher numbers of more qualified skilled labour are required in oil and gas. The same percentage of respondents (56.1%) felt there were differences in the types of labour required and quantity of labour required within oil and gas compared to other Alberta Industries.



c_Q5 'Difference in Skilled or Unskilled Labour Required in Oil and Gas VS Outside'		
Response	**Frequency (N)**	**Valid Percent**
Yes	23	56.1
No	18	43.9
Total	41	100.0

Figure 4-33 - Frequency Table for Differences in Types of Skilled Labour Required between Alberta Oil and Gas and other Alberta Industries (c_Q5)



c_Q6 'Difference in Quantity of Skilled Labour Required in Oil and Gas VS Outside'		
Response	**Frequency (N)**	**Valid Percent**
Yes	23	56.1
No	18	43.9
Total	41	100.0

Figure 4-34 - Frequency Table for Differences in Quantities of Skilled and Unskilled Labour Required between Alberta Oil and Gas and other Alberta Industries (c_Q6)

Qualitative Responses

Respondents were very aligned in the reasons for their opinion regarding labour requirements. The reasons given by respondents for differences in labour requirements between the different industries are listed in Table 4-16, below.

Table 4-14 – Difference in Yes of Labour Required Within and Outside Oil and Gas

Differences in Types of Labour Required within and outside Oil and Gas	Constructor
Oil and gas requires more stringent quality and safety codes and specifications, therefore a higher skill level is required within oil and gas, with more safety training	7
More journeymen are required as well as there are more specialized labour areas required to construct equipment for severe service, like high pressure welding and boilermakers	9

Of the respondents who answered “No” to the difference in labour requirements question, some respondents had the same qualifying statements as the respondents who answered “Yes”. The quality programs in place in oil and gas are more stringent due to the higher risk involved in plant operation. Some respondents commented that they have found that government projects have better engineering and scope definition.

For the question pertaining to difference in quantity of labour requirements between oil and gas versus other industries, respondents who felt there were differences gave the following four reasons why they believed to be the case:

Table 4-15 – Differences in Quantity of Labour Required within and Outside Oil and Gas

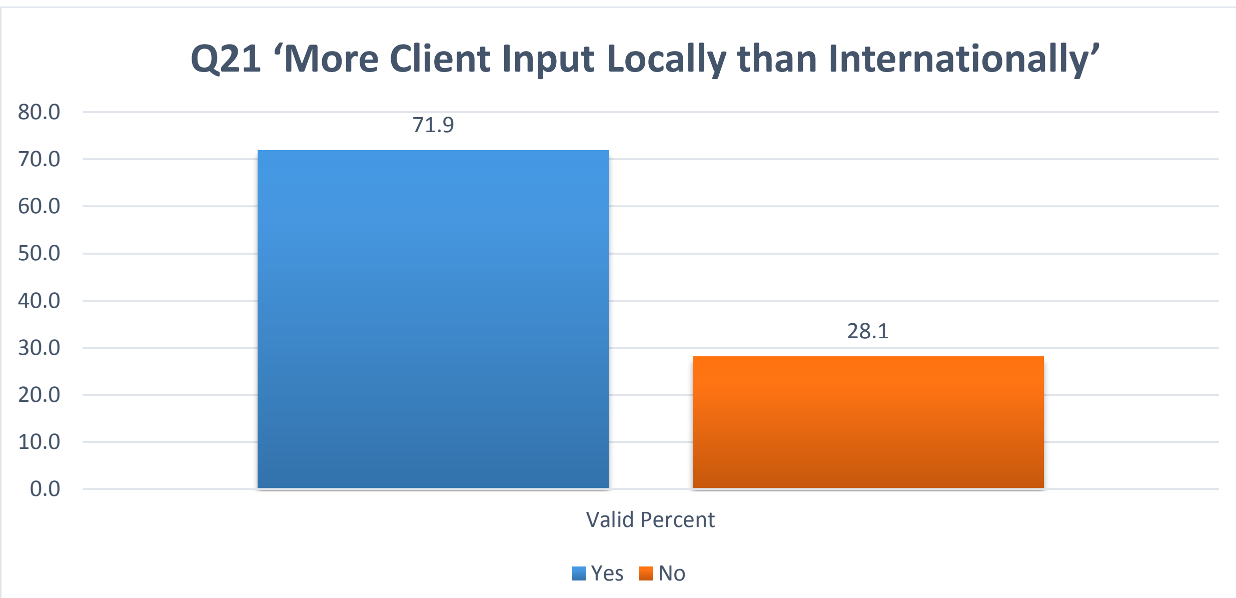
Differences in Quantity of Labour Required within and outside Oil and Gas	Constructor
Oil and gas projects typically have significantly larger scopes of work than other industrial projects	6
Oil and gas projects have very compressed schedules (fast tracked projects) so larger crews are required	5
Larger numbers of skilled workers in more discipline areas are required in oil and gas	2
Oil and gas is more highly regulated from a quality and safety perspective and the industry ensures that the labour crews meet the required Journeyman threshold, while other industries are not as strict with following the regulation	4

4.6 Stakeholder Challenges

Stakeholder challenges, in this research, deals with the perceived negative influence various stakeholders can have on a lump sum project in Alberta. In particular, the perceived major sources of interference to operating and contractor companies.

4.6.1 Operator Interference and Desired Level of Input Compared to International Oil and Gas Clients (Q21)

Engineering and constructors interviewed during the first phase of research, believe lump sum contracting works well internationally because international owners are willing to be hands-off after the initial scoping of the project (after RFP). Based on these responses, survey participants were asked if they believe Alberta owner companies desire higher levels of input and interfere more with project execution than do international clients. The majority of respondents (71.9%) felt that higher levels of local client input were an issue.



Q21 'More Client Input Locally than Internationally'			
Response	**Frequency (N)**	**Percent**	**Valid Percent**
Yes	87	71.3	71.9
No	34	27.9	28.1
Total	121	99.2	100.0

Figure 4-35 - Frequency Table for Higher Local Client Interference Compared to International Clients

Qualitative Responses

Operator respondents who felt local operating companies interfered more than international companies, were additionally asked what they believed were the reasons behind this difference in behaviour pattern. Three major themes were observable in the responses:

- Poor initial project scoping resulting in late changes
- Improperly distributed project decision-making authority within the operating companies
    - Individuals with little project execution experience and understanding of the requirement for scope freeze and the impact of late changes are maintaining influence over the project throughout all phases
- Highly skilled engineering workforce at operating companies in Alberta.

The following sections provide more detail about the themes arising from the operator responses.

a. Poor Initial Project Scoping

Lack of proper initial scoping and development of project standards require the owner to make changes later in the development process than would be ideal. In a lump sum contracting situation, this has a larger impact than in a cost reimbursable environment. Poor scope definition is often due to:

- Late key stakeholders engagement/involvement:
    - Stakeholders engage too late in the project development process (field operations, maintenance, regulatory, etc.) resulting in changes that are necessary, but should have been identified earlier
- Project Fast-Tracking
    - Owner companies try to fast track projects without freezing functional requirements properly as the design evolves

    - Facility design is often forced to move forward (fast-tracking) before the subsurface information is verified or the economics of the project calculated
- Business Unit budgets are released late in the year
    - Does not leave enough time to do upfront detailed planning. There is no steady development of projects. Once budgets are released, projects are forced to accelerate quickly, bypassing the front end planning stage. It's "0MPH or 150MPH"
- Differences in government requirements locally versus internationally
    - Often internationally, development plans are required to be submitted to and vetted by the local government before the project is allowed to proceed.
    - This forces owners to define projects early. This is not done in Alberta and often projects are allowed to move forward before all the required information is defined or acquired.

b. Improperly Distributed Project Decision-Making Authority

Decision-making authority is not always properly distributed within the owner company, resulting in the people with little project management and execution experience interfering with the project process.

- Project Managers feel that Business Units and Operational Departments within the organization continue to have influence over the project after turnover to the execution team and that they often lack project execution experience. As a result, Business Units and Operational Departments do not understand the need for a frozen scope and the impact of late changes
- Business Units and Operational Groups feel that Project Managers do not properly communicate the project impacts of potential changes

- The flow of money from operational groups to the project team for project execution is the main root cause for not having sufficient and proper delegation of authority with the owner companies. Business Units are held accountable for the money spent on projects, but often feel they have little control over the project outcome, so try to influence the project after turnover to the execution team. The execution team often feel held back from efficiently executing the project by the oversight of Business Unit personnel with no project execution knowledge.

c. Skilled Engineering Workforce at Operating Companies in Alberta

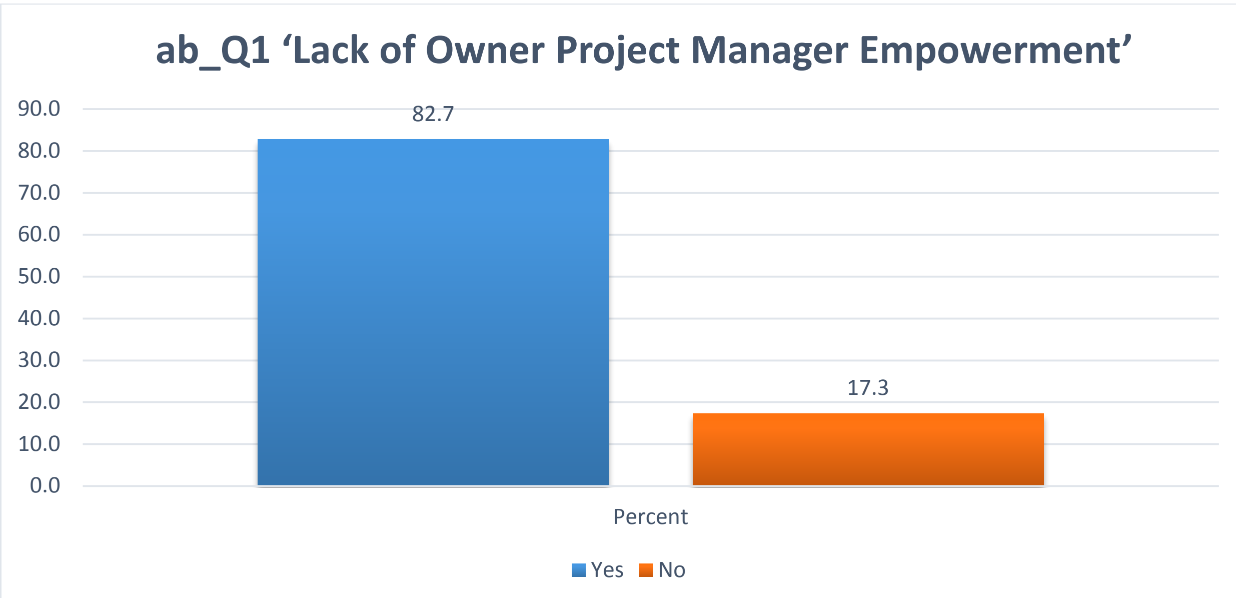
Local clients employ a highly skilled engineering workforce and thus look to have more input in the project design, than happens internationally.

- Owner company engineers perceive there to be a lack of skilled management at the engineering companies. This has resulted in owner company engineers taking greater control over the execution of projects and developing the habit of directing contractor work. This behaviour pattern can potentially lead to claims in a lump sum environment.
- Many large oil and gas projects in Alberta involve new technologies or new implementations of existing technologies, because of the decline in conventional recovery and the increase in oil sands and enhanced recovery strategies. Operating companies' feel they need to be directly involved with the development of the design at all stages as they consider the engineering companies to have little or no direct knowledge and experience with the new applications.

4.6.2 Project Manager Empowerment within Operating Companies (ab_Q1)

In the pre-interview phase, potential lack of project manager empowerment at the owner companies was a repeated theme cited by contractor interviewees. Respondents expressed doubts that operator project managers were given adequate authority to control their projects and to decline late changes which have cost and schedule impacts, that are suggested by other stakeholders within the organization. Contracting company interviewees felt this contributed greatly to project risk when operating in a lump sum environment.

Operating and Engineering respondents were asked if project manager empowerment at the owner organization was an issue and to provide some context as to why they felt this way. The majority of respondents (82.7%) consider lack of empowerment and authority as an issue.



ab_Q1 'Lack of Owner Project Manager Empowerment'		
Response	**Frequency (N)**	**Percent**
Yes	67	82.7
No	14	17.3
Total	81	100.0

Figure 4-36 - Frequency Table for Opinion on Project Manager Empowerment with Operating Companies (ab_Q1)

Qualitative Responses

The engineer respondents made statements explaining the context of their answers. A common theme among the engineering responses was that owner company operational departments have too much authority to make, what they perceive to be, functional, unnecessary changes to the project scope on which the contracting companies bid and the AFE were based. The engineering responses listed below indicate the common themes.

- Owners' project managers are not empowered enough to execute the project that the AFE was based on. Other owner company stakeholders are free to make changes/additions to the original scope of work as the project progresses, resulting in delays and cost overruns
- The project should be defined, estimated, and delivered as originally conceived at the completion of FEED. "Improving" the project through the EPC stage leads to delays, cost overruns, and results in quality issues
- The project managers are not empowered enough to say 'no' to inconsequential late changes from the Business Unit
- Operational departments at client companies are given too much power to be involved in the project process even though they lack the understanding of project management principles.

Common themes among operator participants were:

- A lack of project management methods experience and knowledge within the Business Units and senior management
- A lack of trust between the Business Units and the Project Management departments around the actual cost of projects and impact of changes
- Inadequate involvement of stakeholders during early phases of the project.

It was noted that the Business Unit leaders often felt the project managers were misleading them about the actual cost of the facility and not properly communicating the impact of requested changes. It was mentioned that this lack of trust could have stemmed from past miscommunications and project overruns without proper documentation to explain the overruns. Operational respondent comments are below:

1. Lack of Business Unit (BU) project management experience and understanding of project delivery methods and stage gated process
2. Miscommunication from Project Managers (PM) to operational groups on past projects, resulting in a misunderstanding of the impact of late changes
3. It is more difficult for operational groups to get the projects approved by upper management with the real price, so they create a lower unverified budget price and blame PMs when the project does not come in at the budgeted amount
4. Not enough involvement of BU personnel and other stakeholders upfront
5. Lack of support from management for Project Managers
6. Lack of understanding of project delivery by Business Units
7. At the corporate level, there is no experience with project management at the corporate level, thus why would they trust the project managers
8. Miscommunication and overruns on past projects without proper documentation, inspire a lack of confidence by the operational groups
9. BU creates lower, unverified project budget from their experience because they have a harder time getting the budget approved with the real number
10. I believe they feel that most changes are "small" and "irrelevant". The operational/BU side of the business lacks the knowledge of the project management side of the business and, honestly, most seem like they could care less to learn it
11. It is not always an issue of saying no to late changes. It is more about explaining to the BU and Operations what the impact is of the proposed change. If this information was provided, the BU/OPs can then decide if the change is beneficial
12. Poor understanding of project management principles by senior management
13. Business Units are not following the gated process in order to FEL the projects, and dissipate technical uncertainties before execution; i.e. complete the subsurface models (Static and Dynamic models) and exploitation program before sanction. Do not fast track, again. FEL is the key
14. Not enough involvement by the owner/business unit personnel upfront in the project to build in confidence. PM's tend to build something more than fit for purpose designs.

- Insufficient information in cost estimate due to fast tracking
- Final number dictated by BU-Top Mgmt for project sanction
- Not allowing to use known-unknown contingency numbers at project discretion
- No provisions for event driven risks (Unknown-Unknowns) on project cost estimate
- Inappropriate risk mitigation plans

15. Constant change and lack of proper FEED
16. Very little value is placed on project management principles. That does seem to be changing though with some of the massive overruns on mega projects in Alberta
17. Owners' desire to maintain its flexibility by not making decisions early and understanding what the scope is and the impact of late changes to the project
18. Business Units and OPs demand late changes, don't understand the effect and then are unhappy with the final costs. Lump sum will present them with a much more immediate impact of late changes
19. This is a very important problem. PMs are overloaded and get no support from their department managers. A little pressure from the BU and your dept. manager is in your office to pressure you more.

Based on the operator responses, proper change impact documentation processes either do not exist, are not effective in communicating the required information to the appropriate stakeholders, or are not being implemented properly. Organizations may not be effectively managing the stakeholder identification and engagement process. Also, perhaps more project management training should be cultivated within operating groups, within the operator organization.

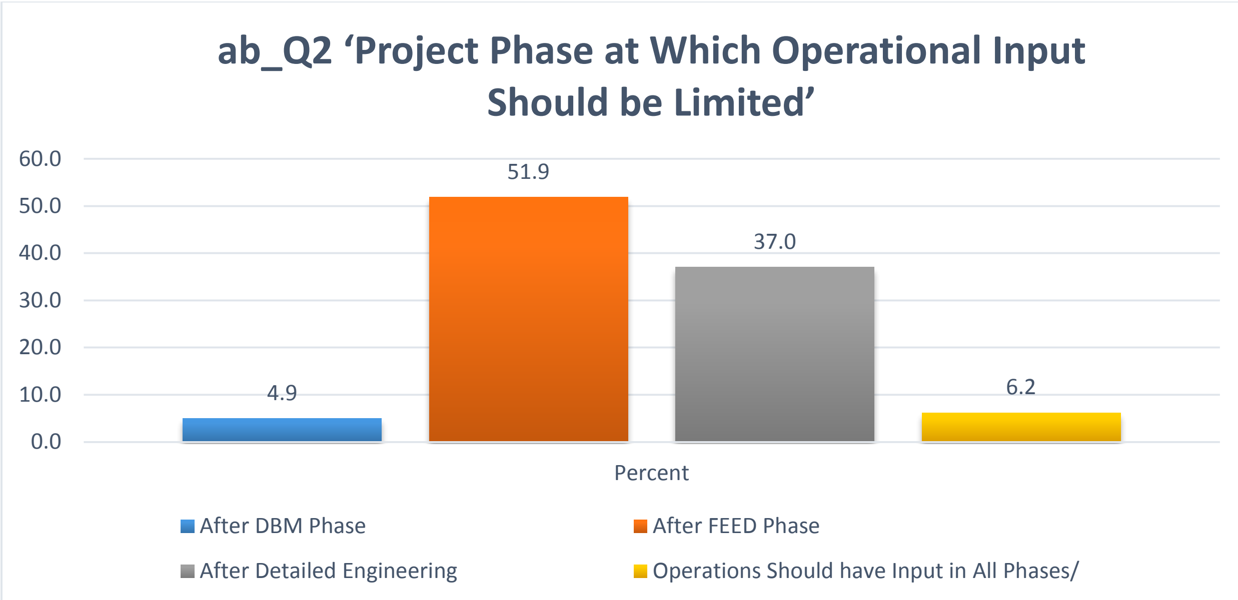
In hindsight, this question should have been asked of the construction company respondents, as well. As an area for future study, it would be interesting to gauge the effect construction companies perceive lack of project management empowerment has on the project execution phase.

4.6.3 Project Phase at Which Operational/Stakeholder Input Should be Limited (ab_Q2)

In pre-interviews, one of the reasons for the difficulty in achieving a frozen design and scope that is required for lump sum projects was identified as owner company operational group input extending too late into the design process. Opinions were expressed that operational input needed to be restricted at some phase in the project to only changes required for safety and basic functionality. To determine the appropriate project phase for stakeholder engagement/operational input, to ensure smooth lump sum project execution, respondents were asked at what stages operational input should be limited. The choices given were:

- After Conceptual Design Phase
- After DBM Phase
- After FEED Phase
- After Detailed Design Phase
- Operations should have Unlimited Input in All Phases

Respondents were also asked to qualify their answer with additional comments explaining their choice. From the responses, the most frequently selected choice was 'After FEED Phase' with 51.9% of respondents wanting input restricted to design changes for safety and basic functionality. The second most popular choice was 'After Detailed Design Phase' with 37.0%.



ab_Q2 'Project Phase at Which Operational Input Should be Limited'		
Response	**Frequency (N)**	**Percent**
After DBM Phase	4	4.9
After FEED Phase	42	51.9
After Detailed Engineering	30	37.0
Operations Should have Input in All Phases/	5	6.2
Total	81	100.0

Figure 4-37 - Project Phase at Which Operational Input should be Limited (ab_Q2)

Qualitative Responses

Engineer and operator comments included themes such as involving experienced operational personnel upfront, proper-upfront scoping, accountability for the impact of changes, and restricting late changes to only functionally required changes. The comments are categorized in Table 4-10, below:

Table 4-16 – Opinions on Which Phase Operational Input Should be Limited

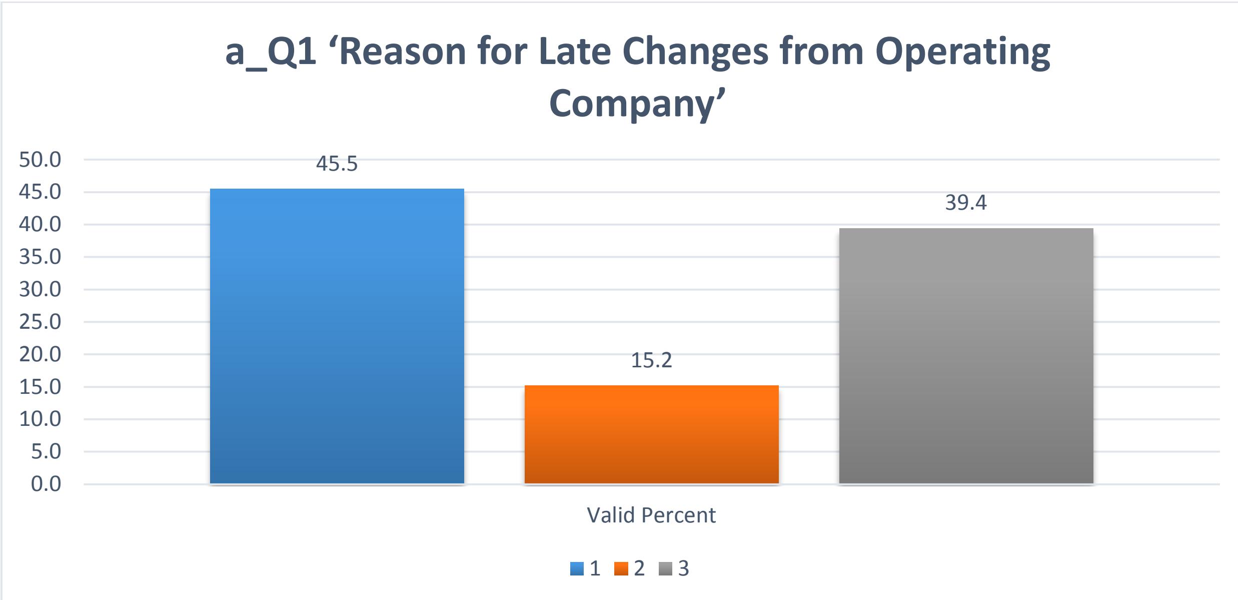
Phase at which to limit Stakeholder/Operational Input	**Operator**	**Engineer**
Operational team providing input should be lead by someone with significant experience in project execution		8
Dedicated and experienced operations representative should be involved in the design as the single point of contact for operations	16	
Input level depends on the impact of the change In a lump sum situation the changes would be submitted by change order therefore it is in the owners best interest to limit them		8
Stakeholders should be held accountable for the impact/ cost of the changes. • Operations should be involved in all stages of the project, but they must be held accountable for their involvement (cost, schedule, scope and commercial impacts)	10	10
• Operations should have input at all stages but the ability of operations to make major changes in later phases should be severely restricted to only key revisions necessary for proper design functionality and safety	10	18

4.6.4 Reasons for Late Changes within Operating Companies (a_Q1)

During pre-interviews, late changes to project scope emerged as one of the themes that may cause lump sum contracting issues within the Alberta oil and gas industry. Three main reasons for these late changes were provided during the pre-interviews:

1. Changes in understanding of the internal business needs, within the client organization
2. External market changes
3. Technical aspects of the project were originally not fully understood (many projects involve new technologies in an immature market).

The operator respondents were asked to select what they felt was the main reason for late change requests being sent to engineering. They were also asked to add any reasons they felt were missing. Seven respondents chose not to answer this question. The majority of respondents chose changes in internal business needs (45.5%) or technical aspects not fully understood (39.4%).



a_Q1 'Reason for Late Changes from Operating Company'			
Reason	**Frequency (N)**	**Percent**	**Valid Percent**
Changes in Internal Business Needs	15	37.5	45.5
External Market Changes	5	12.5	15.2
Technical Aspects not Fully Understood	13	32.5	39.4
Total	33	82.5	100.0
Missing	7	17.5	0.0

Figure 4-38 - Frequency Table for Reasons for Operator Late Changes (a_Q1)

Qualitative Responses

Missing reasons for operator late changes and additional comments provided by respondents are included in Table 4-11, below:

Table 4-17 – Missing Reasons for Operator Late Changes

Missing Reasons for Operator Late Changes	**Operator**
Often no definition of project success	3
3. Little understanding of business requirements and project objective prior to kicking off execution	4
4. Very little understanding in operating companies of how cost/schedule/scope are intertwined	6
5. Inadequate early involvement of all required stakeholders/subject matter experts	5
6. Lack of adequate definition of and understanding of risks	4
7. Fast Tracking due to schedule pressures; not allowing sufficient time for engineering	3
8. Lack of constructability reviews during engineering phase	2
9. Inadequate coordination efforts among various disciplines of engineering	1

5 Secondary Survey Results

The Survey Results sections are organized first by survey and by the order of questions within that survey. This ordering made the data easier to analyze.

The following naming convention is used in the summary of survey results:

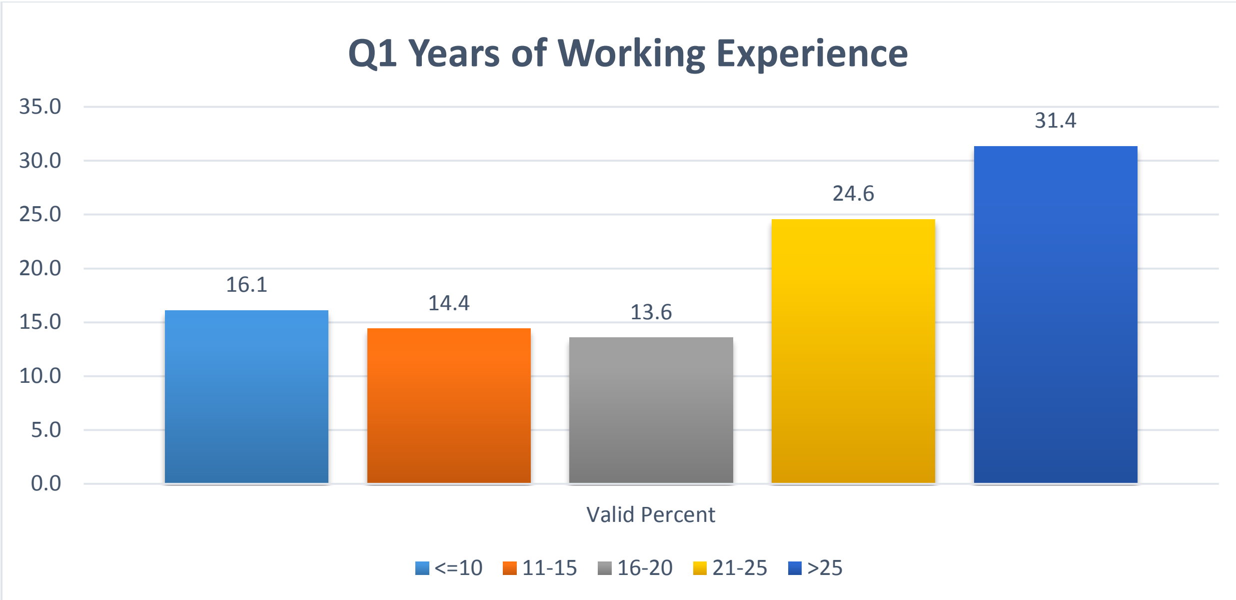
- Oil and Gas Operating Companies are referred to as 'Operators'
- Engineering Companies are referred to as 'Engineers'
- Construction Companies are referred to as 'Constructors'.

5.1 Demographic Information

The survey was administered to industry professionals in Alberta oil and gas. Survey participants were asked several demographic identifying questions, including type of organization, years' of work experience, and role in organization.

5.1.1 Years of Working Experience (Q1)

55.9% of respondents had greater than 20 years' working experience, so the sample was considered to contain senior, knowledgeable respondents.



Q1 Years of Working Experience		
Years	**Frequency**	**Valid Percent**
<=10	19	16.1
11-15	17	14.4
16-20	16	13.6
21-25	29	24.6
>25	37	31.4
Total	118	100.0

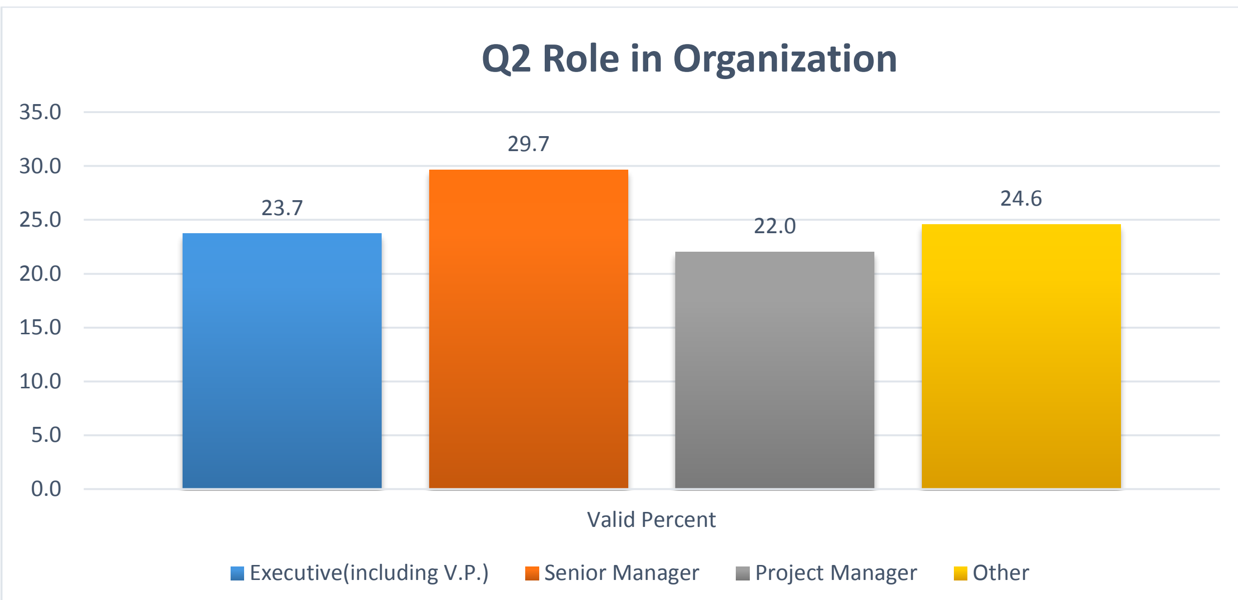
Figure 5-1 - Frequency Table for Years Working Experience (Q1)

5.1.2 Role in Organization (Q2)

A respondent's role in their organization was categorized into:

- Executive and Vice Presidents
- Senior Manager
- Project Manager/Construction Manager
- Other

Senior Managers included engineering managers and asset managers. Project Managers included program managers, project managers, and construction managers. The 'Other' category included controllers, contract managers, and discipline engineers.



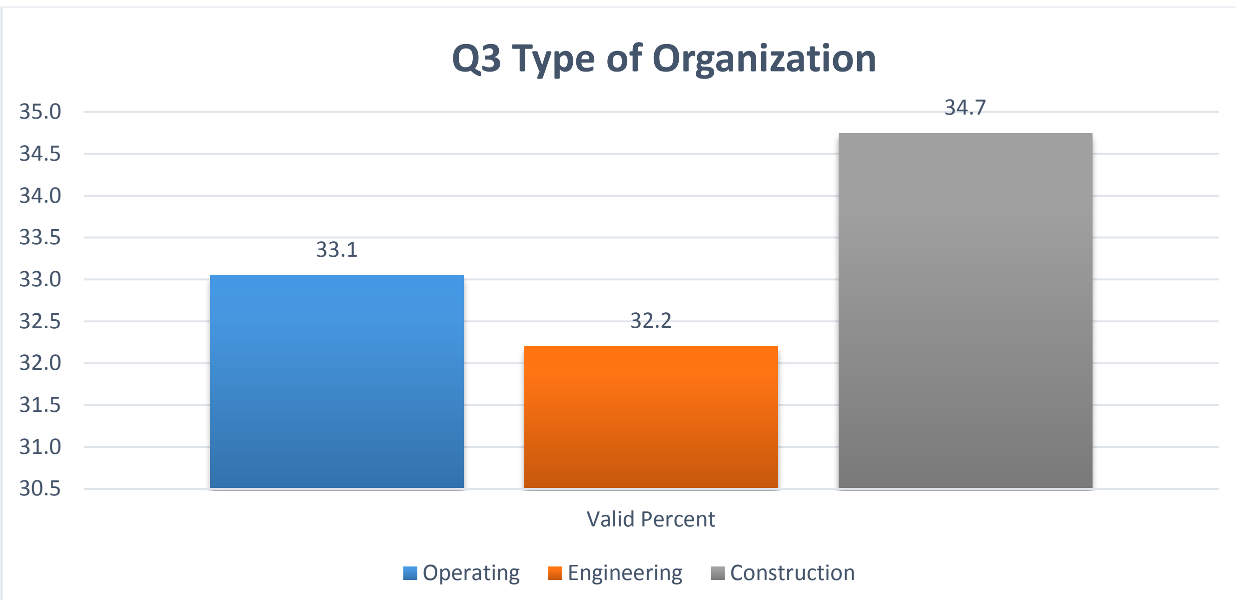
Q2 Role in Organization		
Role	**Frequency**	**Valid Percent**
Executive(including V.P.)	28	23.7
Senior Manager	35	29.7
Project Manager	26	22.0
Other	29	24.6
Total	118	100.0

Figure 5-2 - Frequency Table for Role in Organization (Q2)

The percentage of respondents in each group was fairly consistent, with the largest percentage being Senior Management (29.7%). There was a higher percentage of participants than desirable that fell into the 'Other' category. However, given that respondents from the 'Other' category still have very important roles in their organizations that do influence project outcomes, their insights are considered valuable to the overall study.

5.1.3 Type of Organization (Q3)

There were fairly consistent numbers of participants from each of operating (33.1%), engineering (32.2%), and construction companies (34.7%), with a total of 118 respondents.



Q3 Type of Organization		
Type	**Frequency**	**Valid Percent**
Operating	39	33.1
Engineering	38	32.2
Construction	41	34.7
Total	118	100.0

Figure 5-3 - Frequency Table for Type of Organization (Q3)

5.2 Current Contract Trends

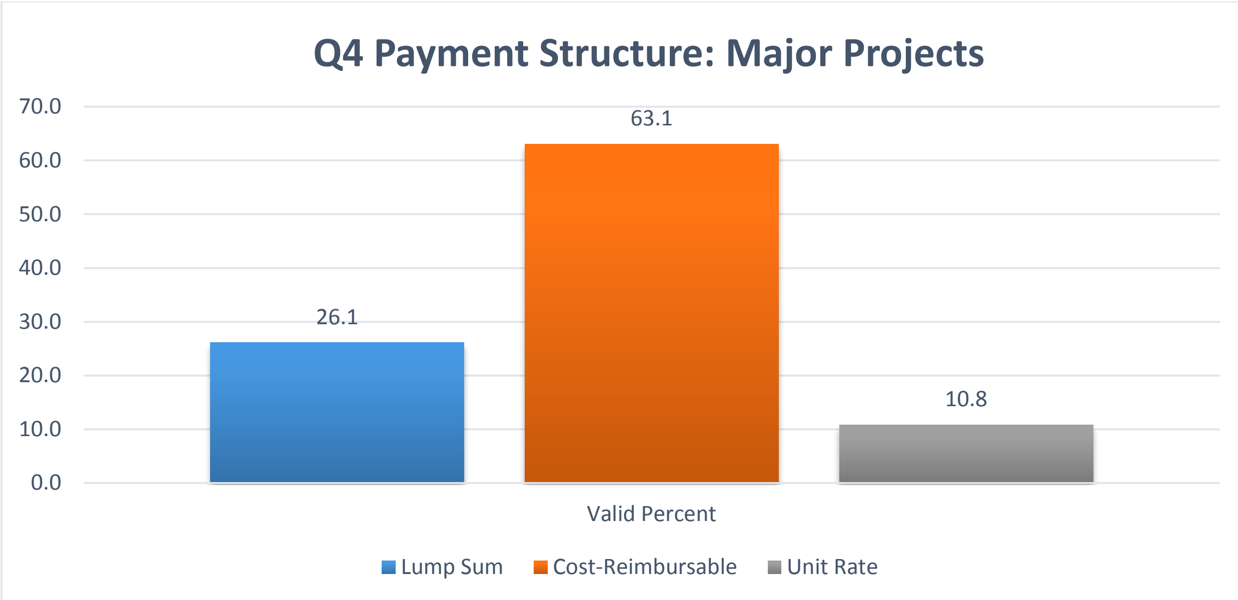
Survey participants were asked information about their current companies, to be used as additional independent variables for data analysis. Company-specific contract practice information is shown in Figures 5-4 to 5-10.

5.2.1 Payment Structure by Project Scope (Q4-Q9)

Participants were asked to identify the payment structures their companies currently use on the following types of projects:

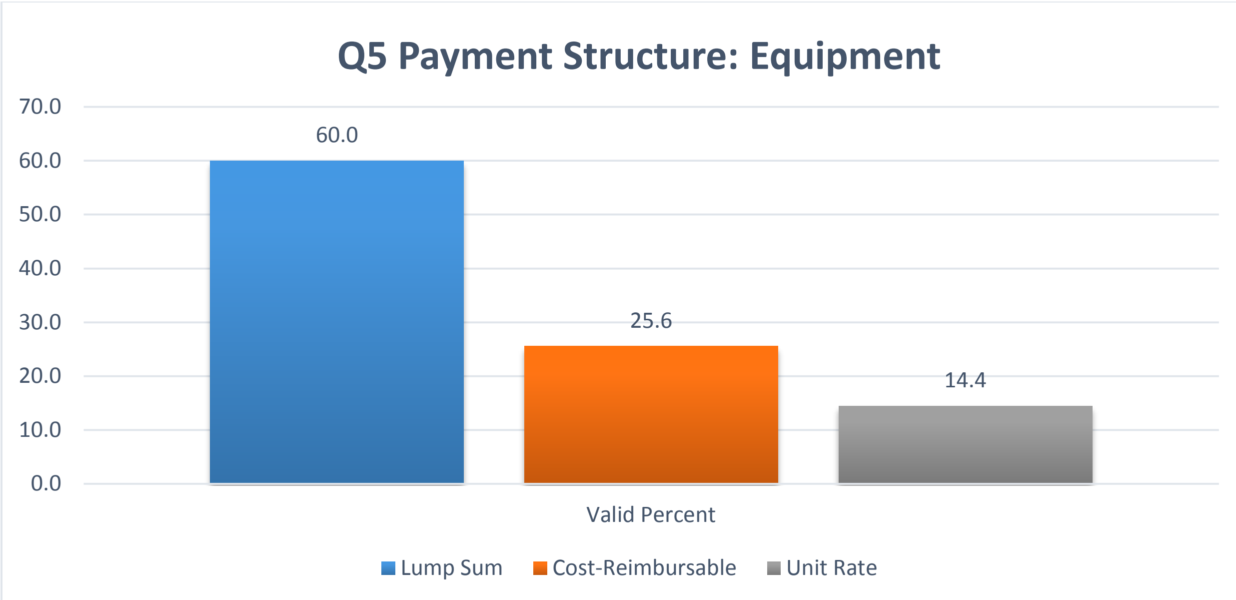
1. Major Projects (Q4)
2. Equipment (Q5)
3. Buildings (Q6)
4. Tankage (Q7)
5. International Projects (Q8)
6. Local Projects (Q9)

The response options were Lump Sum, Cost Reimbursable, or Unit Rate. For the purposes of this survey, major projects were defined as projects exceeding $500MM. For Major Projects, the most frequently used payment structure is cost reimbursable (63.1%). This was the anticipated result, given that the responses from pre-interviews and the previous survey indicated that lump sum did not have wide-spread use on major projects in Alberta, in recent years. The most frequently used payment structure for Equipment, Buildings, and Tankage was lump sum: 60.0%, 67.0%, and 65.7%, respectively. This was also expected based on the previous survey, as respondents indicated that lump sum was used locally most often for these types of purchases.



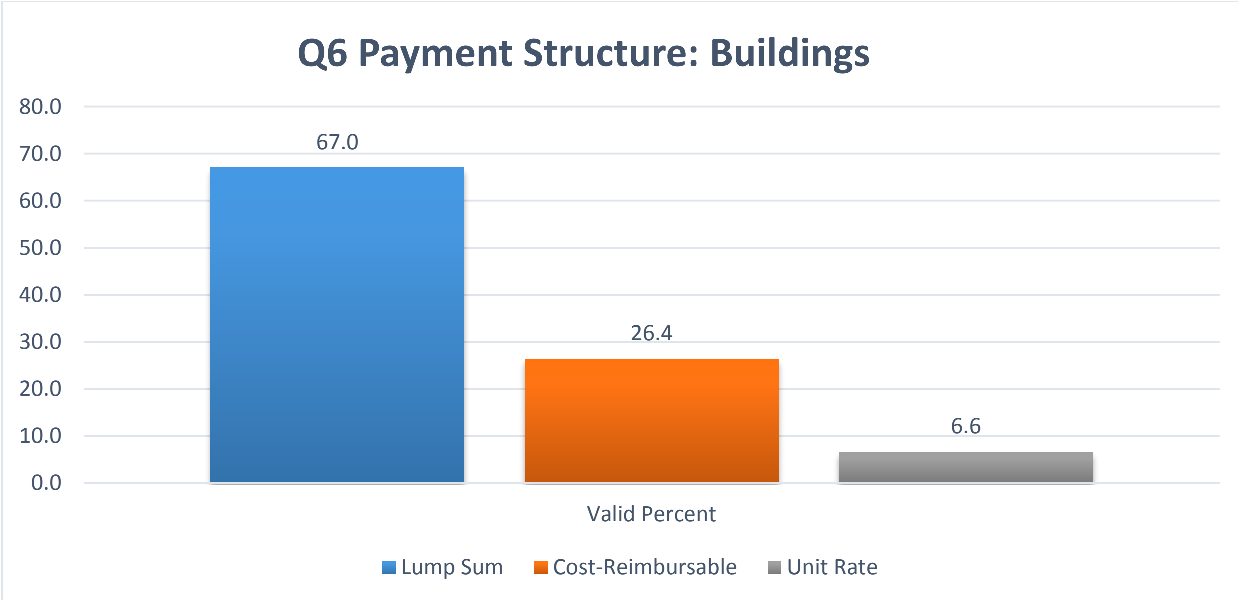
Q4 Payment Structure: Major Projects			
Payment Structure	**Frequency**	**Percent**	**Valid Percent**
Lump Sum	29	24.6	26.1
Cost Reimbursable	70	59.3	63.1
Unit Rate	12	10.2	10.8
Total	111	94.1	100.0

Figure 5-4 - Frequency Table for Current Payment Structure Types: Major Projects (Q4)



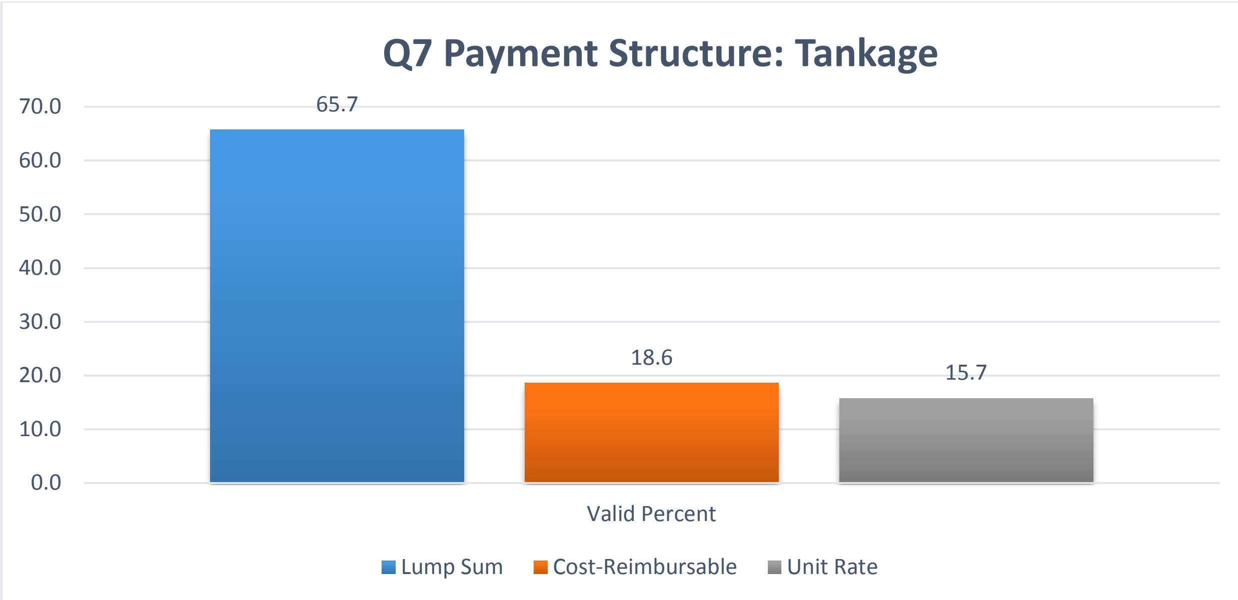
Q5 Payment Structure: Equipment			
Payment Structure	**Frequency**	**Percent**	**Valid Percent**
Lump Sum	54	45.8	60.0
Cost Reimbursable	23	19.5	25.6
Unit Rate	13	11.0	14.4
Total	90	76.3	100.0

Figure 5-5 - Frequency Table for Current Payment Structure Types: Equipment (Q5)



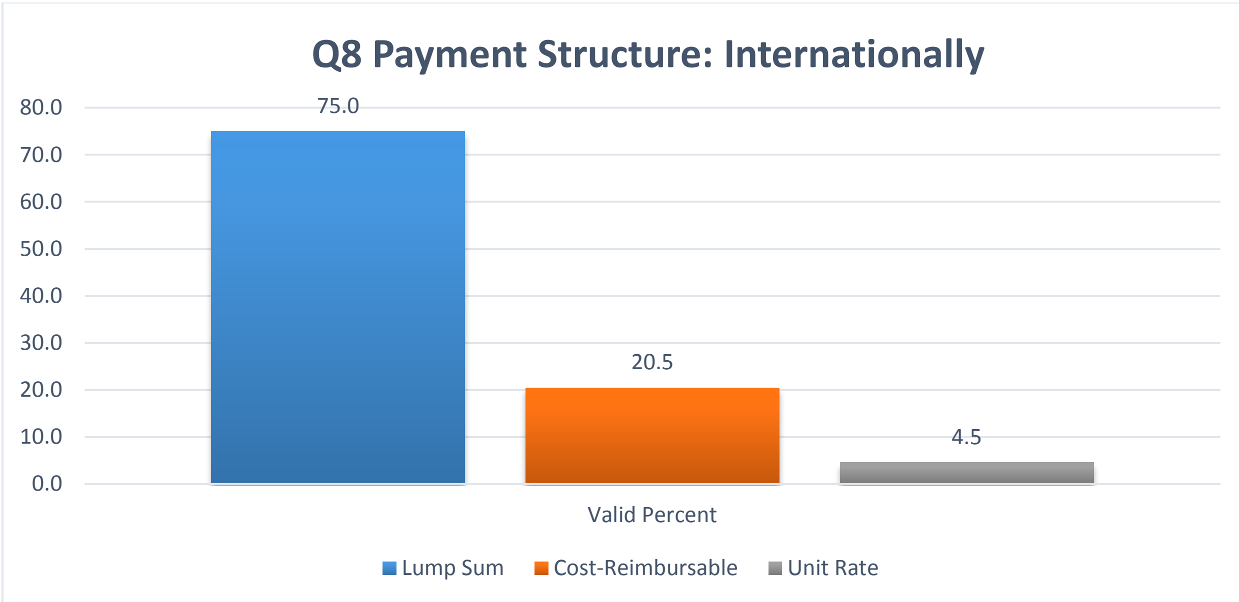
Q6 Payment Structure: Buildings			
Payment Structure	**Frequency**	**Percent**	**Valid Percent**
Lump Sum	61	51.7	67.0
Cost Reimbursable	24	20.3	26.4
Unit Rate	6	5.1	6.6
Total	91	77.1	100.0

Figure 5-6 - Frequency Table for Current Payment Structure Types: Buildings (Q6)



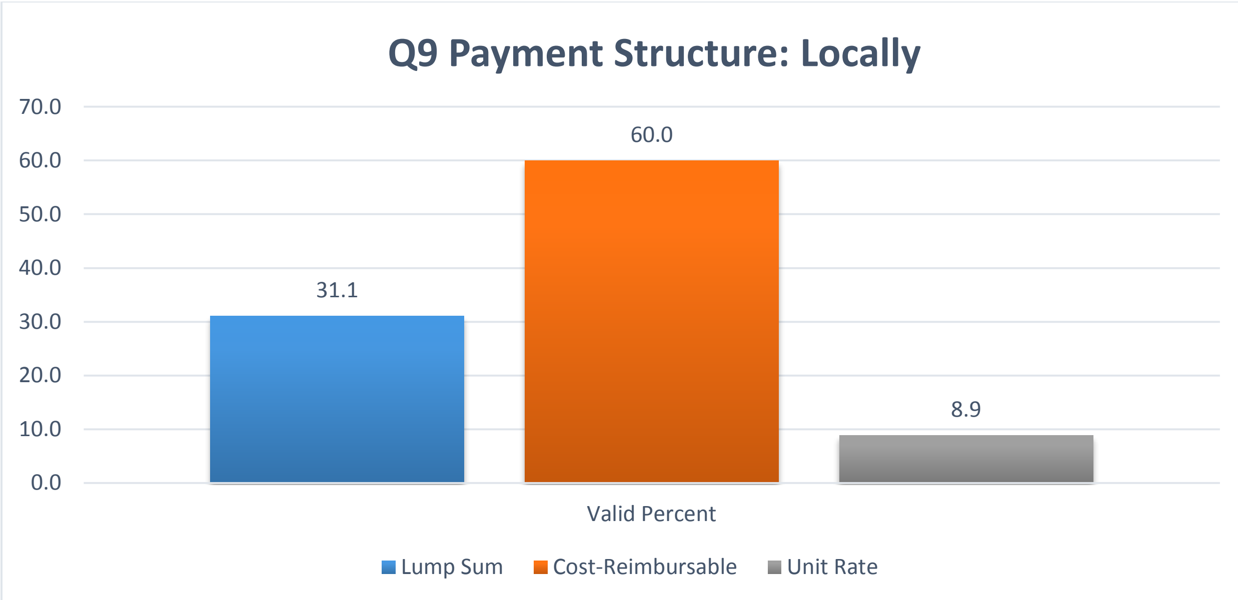
Q7 Payment Structure: Tankage			
Payment Structure	**Frequency**	**Percent**	**Valid Percent**
Lump Sum	46	39.0	65.7
Cost Reimbursable	13	11.0	18.6
Unit Rate	11	9.3	15.7
Total	70	59.3	100.0

Figure 5-7 - Frequency Table for Current Payment Structure Types: Tankage (Q7)



Q8 Payment Structure: Internationally			
Payment Structure	**Frequency**	**Percent**	**Valid Percent**
Lump Sum	33	28.0	75.0
Cost Reimbursable	9	7.6	20.5
Unit Rate	2	1.7	4.5
Total	44	37.3	100.0

Figure 5-8 - Frequency Table for Current Payment Structure Types: International Projects (Q8)



Q9 Payment Structure: Locally			
Payment Structure	**Frequency**	**Percent**	**Valid Percent**
Lump Sum	28	23.7	31.1
Cost Reimbursable	54	45.8	60.0
Unit Rate	8	6.8	8.9
Total	90	76.3	100.0

Figure 5-9 - Frequency Table for Current Payment Structure Types: Local Projects (Q9)

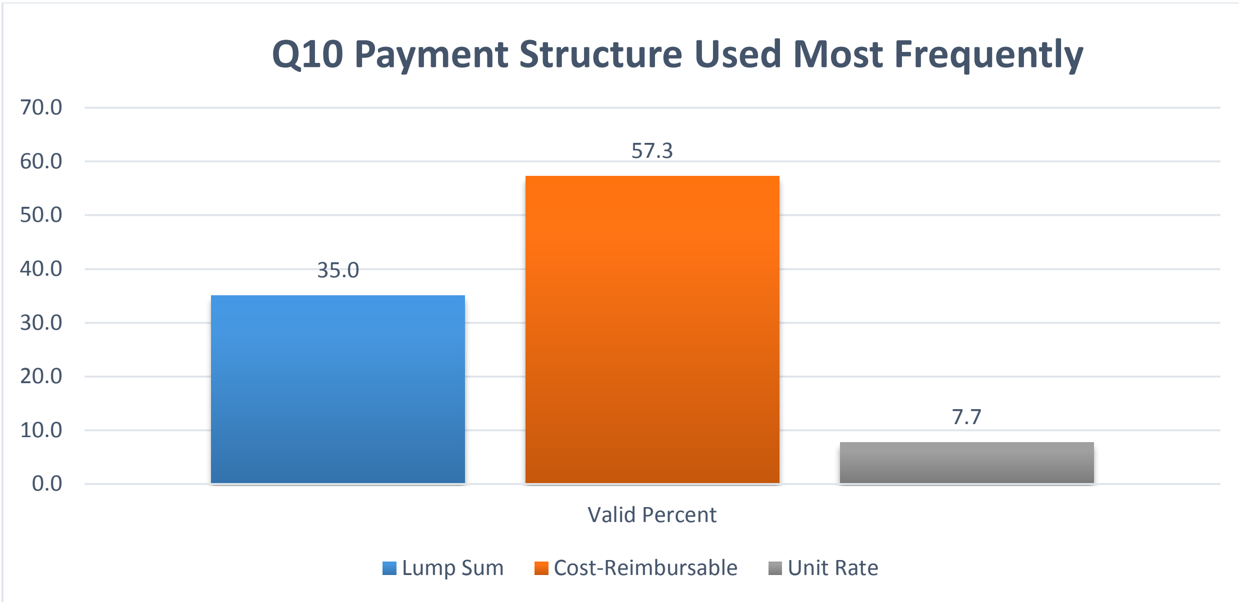
Question Q8 and Q9 dealt with payment structure types used on projects internationally and in Alberta. Internationally, the most commonly used payment structure type was lump sum (75%), with cost reimbursable being used by 20.5% of the sample. In Alberta, the most commonly used payment structure type was cost reimbursable (60%), with lump sum being used by 31.1% of the sample.

This data suggests that the preferred payment structure type being used in Alberta oil and gas industry is still cost reimbursable, with lump sum being used for vendor supplied packages. Approximately 30% more companies in Alberta oil and gas are using cost reimbursable as their main payment structure type, than companies using lump sum. The data also confirms that lump sum is the most commonly used payment structure on international oil and gas projects.

5.2.2 Frequency and Size of Lump Sum Projects in Alberta (Q10 & Q11)

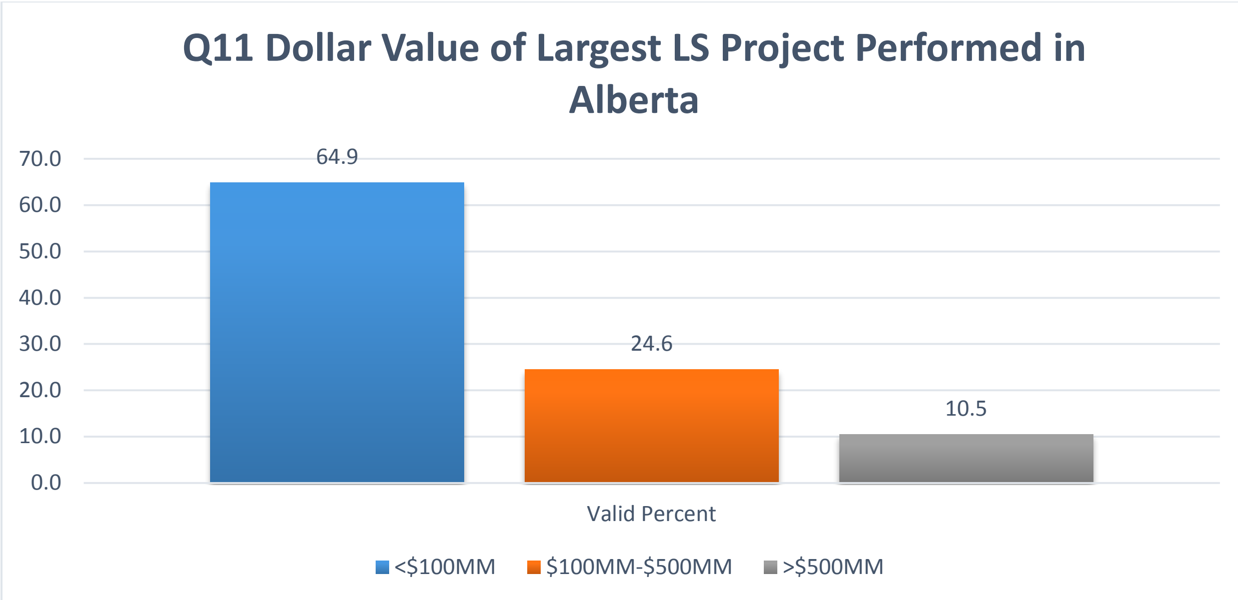
To further examine the use of lump sum, participants were asked what payment structure types they used most frequently at their companies and the largest project value they have executed on a lump sum basis. This question is similar, to questions asked in the first survey. Since some participants of the first survey opted out of the question as they were hesitant to provide dollar values, this question was asked again in an attempt to obtain a larger response sample.

One participant chose not to answer their company's most frequently used payment structure type and four participants declined to provide answers for project dollar values. The payment structure most frequently used was cost reimbursable (57.3%) with lump sum (35%) as the second most popular structure type. Of this sample, the most common maximum dollar project size executed on a lump sum basis was less than $100MM (64.9%). The next most common project dollar value was $100MM - $500MM category (24.6%). This data indicates that very few companies are using lump sum for major projects.



Q10 Payment Structure Used Most Frequently			
Payment Structure	**Frequency**	**Percent**	**Valid Percent**
Lump Sum	41	34.7	35.0
Cost Reimbursable	67	56.8	57.3
Unit Rate	9	7.6	7.7
Total	117	99.2	100.0

Figure 5-10 - Frequency Table for Payment Structure used Most Frequently (Q10)



Q11 Dollar Value of Largest LS Project Performed in Alberta			
Dollar Value	**Frequency**	**Percent**	**Valid Percent**
<$100MM	74	62.7	64.9
$100MM-$500MM	28	23.7	24.6
>$500MM	12	10.2	10.5
Total	114	96.6	100.0

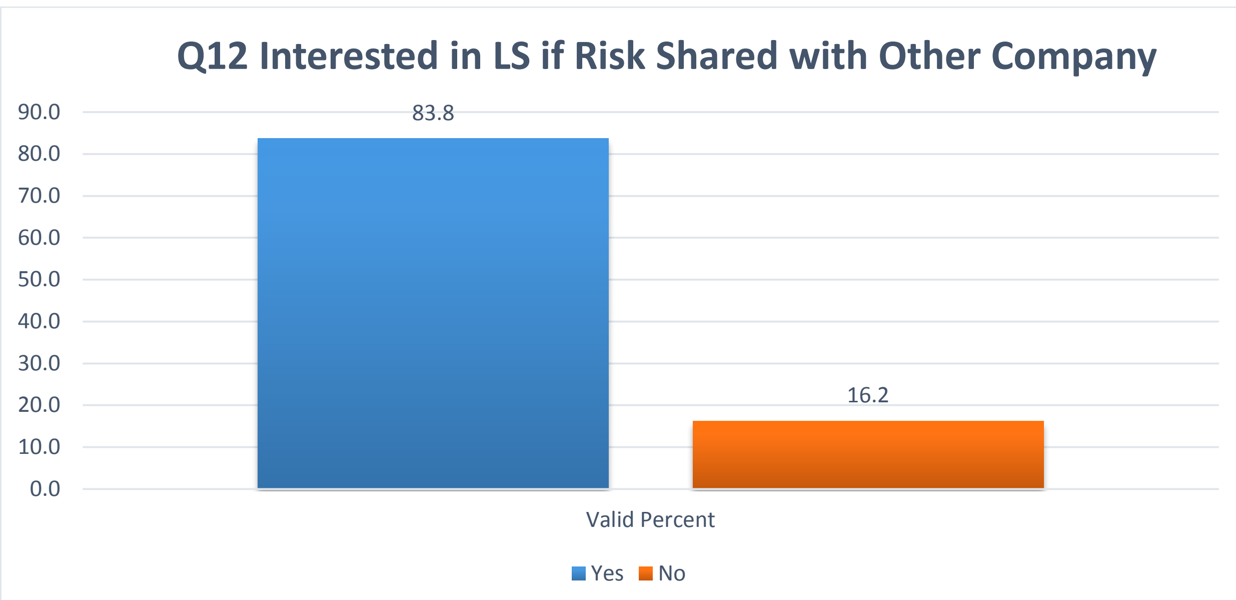
Figure 5-11 – Value of Largest Lump Sum Project Performed in Alberta (Q11)

5.3 Contract Strategy

Contract strategy, in this research, deals with the respondents' perceived effect of lump sum use on project performance.

5.3.1 Interest in Risk Sharing (Q12)

A main theme developed from pre-interviews and the first survey was concern surrounding the management of risk under a lump sum payment structure. In the first survey, many contractor respondents declared they would be interested in lump sum if their company could share the risk with another contractor or the client. One participant chose not to respond to this question. Of the respondents who did answer, 83.8% were interested in lump sum execution if some suitable risk sharing strategy could be developed and agreed upon.



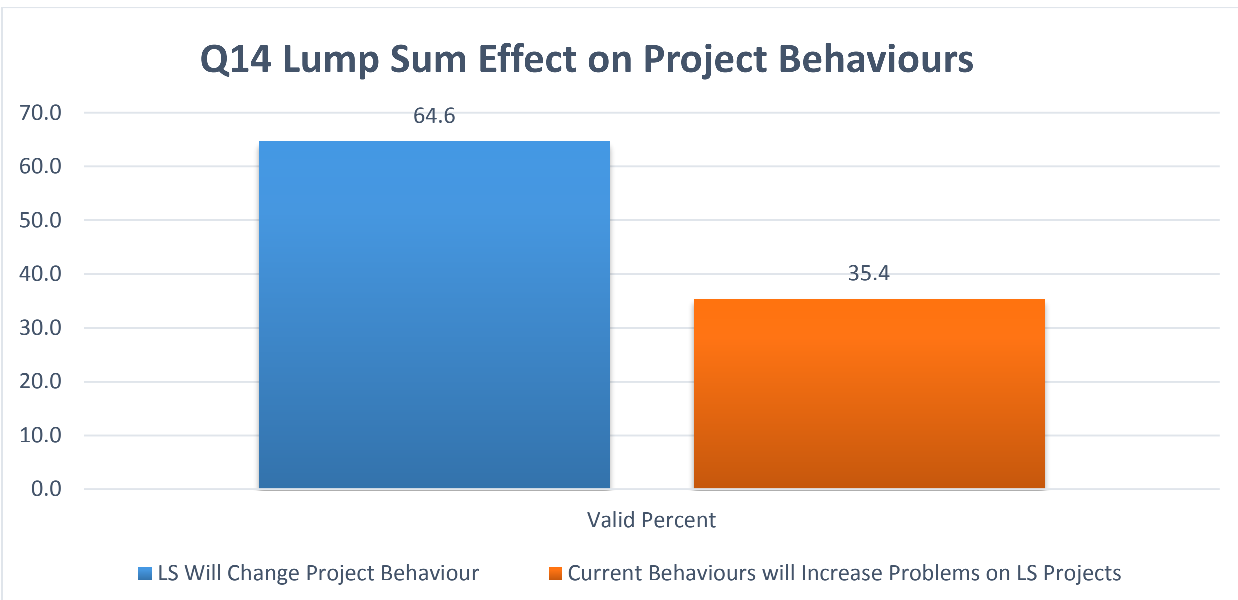
Q12 Interested in LS if Risk Shared with Other Company			
Response	**Frequency**	**Percent**	**Valid Percent**
Yes	98	83.1	83.8
No	19	16.1	16.2
Total	117	99.2	100.0

Figure 5-12 - Frequency Table for Interest in Lump Sum with Risk Sharing (Q12)

5.3.2 Lump Sum Effect on Project Behaviours (Q14)

The subject of project behaviours in cost reimbursable and lump sum environments had been introduced by respondents in the previous phase of the study. Some industry participants had expressed that inefficiency existed in project behaviours as a consequence of an existing cost reimbursable culture in the Alberta oil and gas environment. This theme appeared again in the responses analysis of Section 2.3.2.

Participants in the second survey were asked if using a lump sum payment structure would change current project behaviours that lead to inefficiencies, or if the current behaviours would lead to increased project problems upon switching to a lump sum payment structure. The majority of respondents felt that project behaviours would change with the introduction of lump sum (64.6%). Nineteen respondents chose not to participate in this question.



Q14 LS Effect on Project Behaviours			
Response	**Frequency**	**Percent**	**Valid Percent**
LS Will Change Project Behaviour	64	54.2	64.6
Current Behaviours will Increase Problems on LS Projects	35	29.7	35.4
Total	99	83.9	100.0

Figure 5-13 - Lump Sum Effect on Project Behaviors

Qualitative Responses

Participants were asked to qualify their responses to the question about the effect they believed lump sum would have on project behaviours, by indicating the reasons why they felt their choice would be the case. Table 5-5, below, summarizes the reasons given by organizational type. Repeated answers were combined. A common theme from the behaviour change answers were that efficiency would become a powerful business driver in lump sum and that upfront planning and scope definition would improve. Respondents who felt that problems would just increase when using lump sum had similar themes, but viewed them from the opposite side. They were concerned about the potential lack of lump sum management skills preventing an increase in efficiency, lack of skilled labour, insufficient upfront planning and lack of scope definition.

Table 5-1 – Reasons Lump Sum will Change Project Behaviour in Alberta Oil and Gas

Lump Sum will Change Project Behaviours	**Operator**	**Engineer**	**Constructor**
• Operator is less involved in execution and less likely to make project changes	5		
• If contractor is experienced, will execute the project effectively in lump sum	7		
• Efficiencies become a business driver for the contractor o Contractors will be more efficient in managing project scope and productivity o Encourage better upfront planning o Encourage better scope definition o Profit incentive for efficient execution o Opportunity to achieve higher profit margins by altering behaviour	16	8	6
• Behaviour change will be forced by competitive bidding from international companies moving into the local industry		3	
• Contractors will more effectively manage productivity			4
• Lump sum rewards contractors for ingenuity			2

Table 5-2 – Reasons Current Behaviours will lead to Additional Problems in a Lump Sum Environment

Current Behaviours will Lead to Additional Problems in a Lump Sum Environment	**Operator**	**Engineer**	**Constructor**
• Cost reimbursable behaviours will lead to late changes	2		
• Fast tracked projects will lack the scope definition required for effective lump sum		5	
• Lack of skilled labour			
• Lack of lump sum management experience o Owners will not relinquish the required level of control on execution, resulting in lost productivity o Lack of skilled construction management locally		7	5
• Lack of scope definition			2
• Lack of trust between contractor and operator			1
• Lump sum causes a more adversarial relationship between owner and contractor over changes and differences in contract interpretation			3

5.4 Risk Management

Risk management, in this research, deals with the respondents' perceived risks of shifting to lump sum contracting.

5.4.1 Models for Risk Sharing

Qualitative Responses

To delve further into the idea of risk sharing, participants were asked if risk sharing on lump sum would interest them and what would they envision this risk sharing to look like. The categorized comments on the respondents' visions of risk sharing are listed in Table 5-2, below.

Table 5-3 – Visions of Risk Sharing on Lump Sum Projects in Alberta

Vision of Risk Sharing on Lump Sum Projects	Operator	Engineer	Constructor
• The parties able to influence the risk should be responsible for the risk a) Risks within the sphere of influence/control of the contractor should be theirs b) Risks outside the control of the contractor should be the owners (weather, material cost, etc.) c) External Risks: Shared between contractor and owner Internal risks: Contractor	8	3	
d) Risk Share on items that drive a high risk premium	2		
• Prior to Contract Execution, risks should be evaluated and a distribution decided upon • Agreement on a price for the 'known unknowns' • Design development • Scope growth • Schedule extension • Material unavailability • Standby time	3	4	
• Use unit price within lump sum • Lump sum plus unit rates for extra work	2		
• Clearly define roles and responsibilities prior to contract execution • Split based on percentage with defined roles and responsibilities • 60% contractor; 40% owner	4	2	

Vision of Risk Sharing on Lump Sum Projects	Operator	Engineer	Constructor

• Incentives designed to create the right behaviours should be implemented
    • Incentives to achieve milestones
    • Risk and reward strategy, risk primarily assigned to schedule and productivity
	2	2	5

• Owner takes risk on:
    • Quantities
    • Camp accommodations
    • Escalation, if basis of escalation is defined at contract award
    • weather
    • Material cost
	6		

• Contractor takes risk on:
    • Productivity
    • Design risk, after FEED validation
    • Currency exchange
    • Transportation of workforce
	6		

• Contractor accepts bulk of the risk	1		
• Financing whereby one partner provides the funds necessary whilst the other partner assumes the construction risks	1		
• Review of contract on a periodic basis so changes and constraints can be re-aligned with the project. Changes to the contract may be required		2	
• Based on project return on investment for client • Percentage of the contract price paid based on future revenue of owners producing site		2	3
• Sharing the risks, including Liquidated Damages, with subcontractors and vendors		1	2
• A pre-defined maximum risk level above which the owner would assume the risk		1	

• Contractor Risks:
    • Productivity
    • Rework/scope change resulting from poor quality and workmanship
    • Accommodations
    • Finding labour
    • Training labour
• Management of safety
		7	

• Owner Risks:
    • Weather
    • Geotechnical
    • Scope changes
    • Force Majeur
		7	

Vision of Risk Sharing on Lump Sum Projects	Operator	Engineer	Constructor
• Build a relationship with the owner, develop the project team together			2
• Provided scope is defined, not much risk sharing required			4
• 50/50 equality and trust are imperative to project success			1
• Cost to target with variable margins			2
• Owner needs to bear the bulk of the risk			3

Several themes can be extracted from the responses:

1. Clear definition of roles and responsibilities with respect to risk prior to contract execution and periodic review of the contract to maintain alignment with current project circumstances.
    a. Predetermining which party is responsible for which risks
    b. Contractors being responsible for the risks within their sphere of control and owners taking the risk or sharing the risk on external risks

2. Incentives for assuming risk
    a. A percentage of the producing facility revenue
    b. Risk/reward for achieving milestones, schedule and productivity targets
3. All contracting parties (vendors and subcontractors) taking on a portion of the risk
4. Agreed upon risk premium based on identified factors
    a. Splitting the risk value by a predetermined percentage
    b. Basing premium on 'known unknowns'
    c. Ceiling on contractor risk, above which the operator would assume the risk cost impact
5. Have a mechanism in the contract for costing changes
    a. Unit rate for risk items that are outside the contractors control.

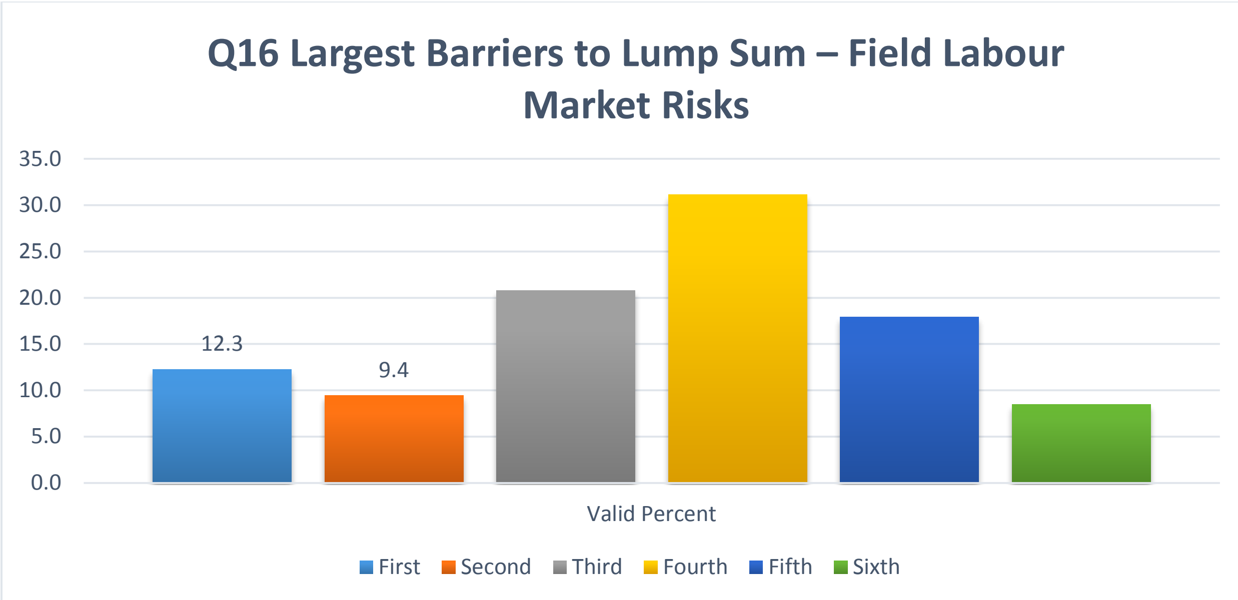
Only the operating companies and engineers specifically identified risks, and who should assume responsibility for those risks. Engineering and operating companies were fairly well aligned in their risk split. Combining their lists results in the following:

- Owner Risks:
    - Quantities
    - Camp accommodations (possibly)
    - Escalation
    - Weather
    - Material cost
    - Geotechnical
    - Scope changes
    - Force Majeur
- Contractor Risks:
    - Productivity
    - Rework as a result of quality or design/construction error
    - Currency exchange
    - Transportation of workforce
    - Camp accommodations (possibly)
    - Finding labour
    - Training labour
    - Management of site safety.

5.4.2 Barriers to Lump Sum Contracting in Alberta Oil and Gas (Q16-Q21)

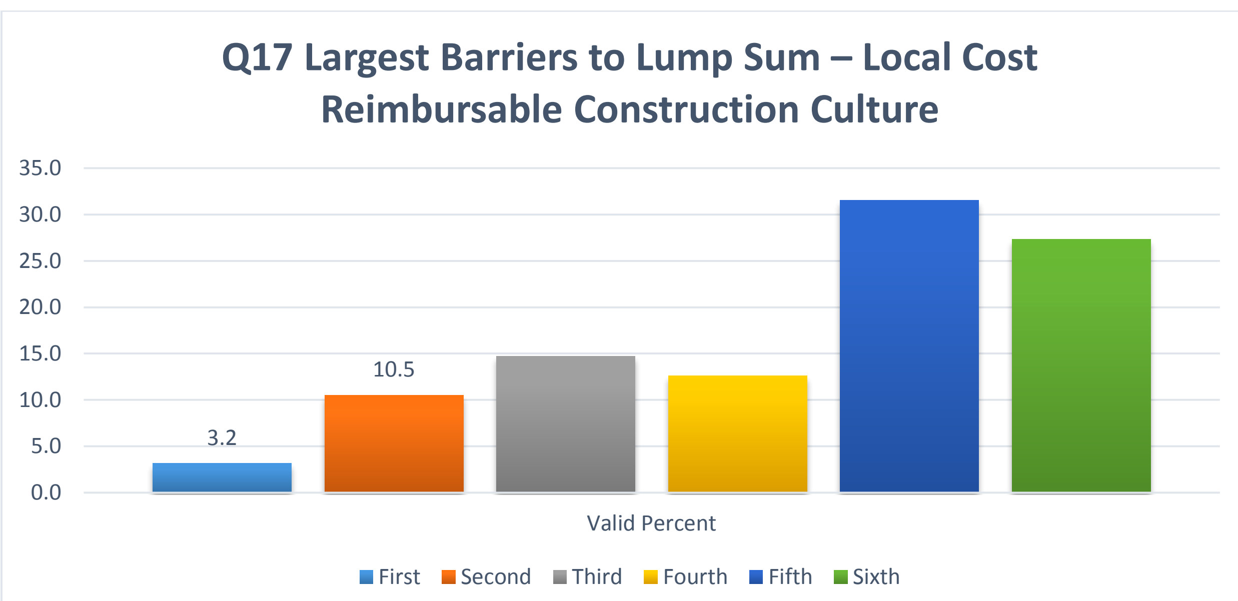
The list of barriers to effective lump sum contracting in the Alberta oil and gas environment was revised by applying feedback from the First Survey and using the rankings and most popular additional barriers provided. The following revised list of barriers was given to participants in this study to rank in order of importance.

1. Field labour market risks
2. Local construction companies favour cost-reimbursable contracts
3. Client late changes
4. Lack of scope definition
5. Client desire for fast tracking
6. Lack of experience in industry with LS contracts and their management roles



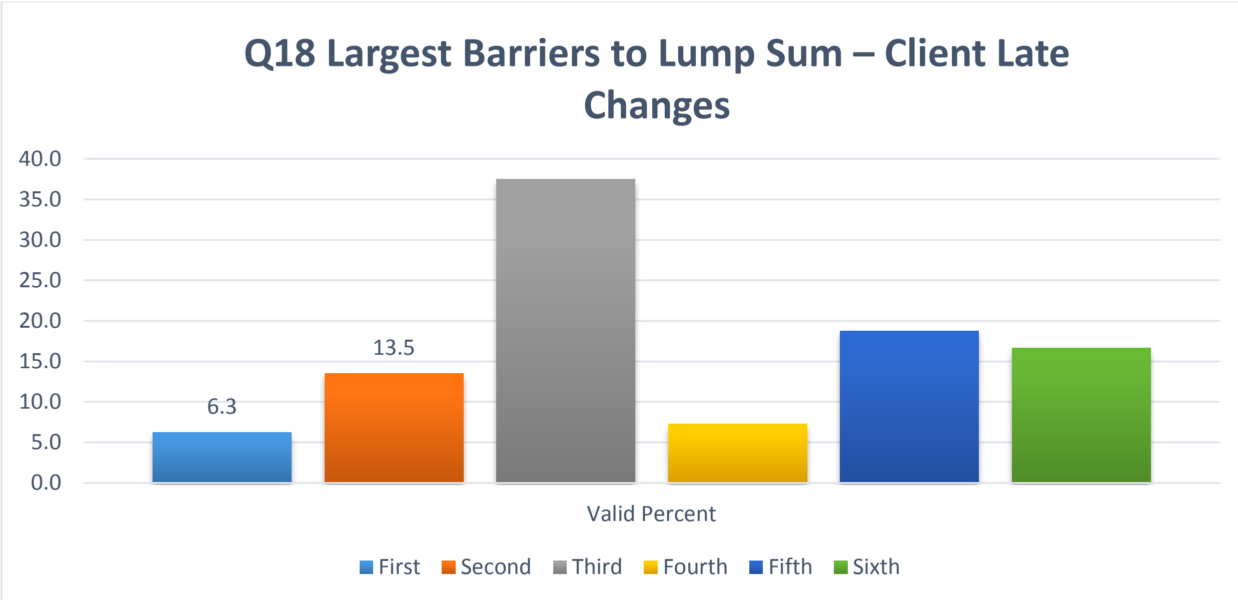
Q16 Largest Barriers to Lump Sum – Field Labour Market Risks			
Ranking	**Frequency**	**Percent**	**Valid Percent**
First	13	11.0	12.3
Second	10	8.5	9.4
Third	22	18.6	20.8
Fourth	33	28.0	31.1
Fifth	19	16.1	17.9
Sixth	9	7.6	8.5
Total	106	89.8	100.0

Figure 5-14 - Largest Barriers to Lump Sum – Field Labour Market Risks



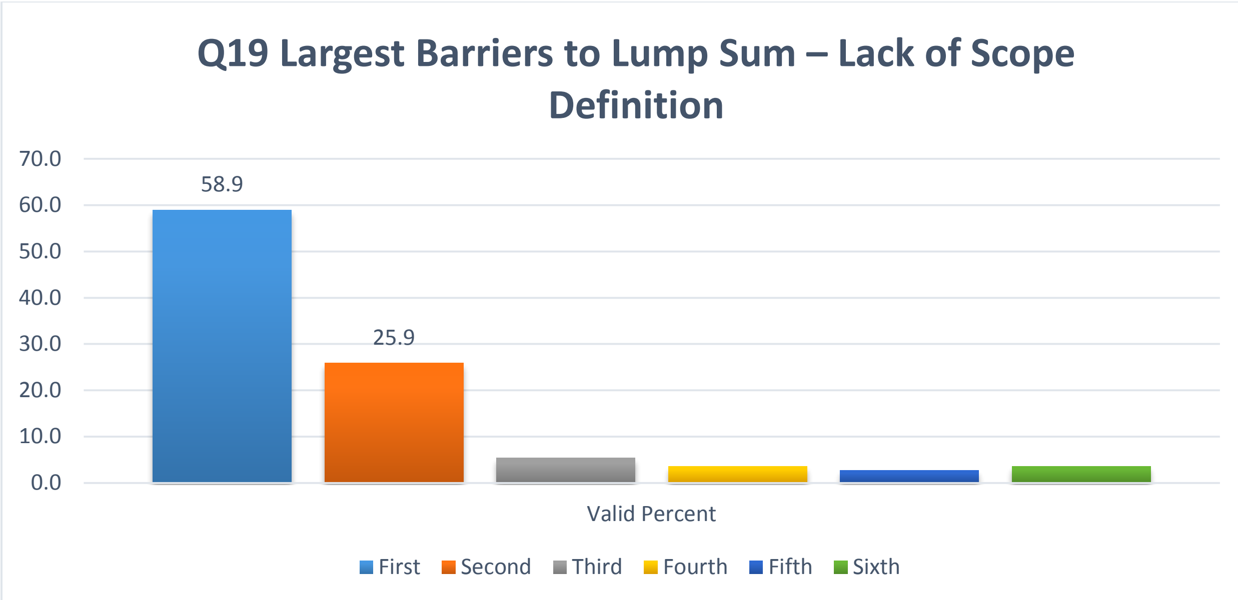
Q17 Largest Barriers to Lump Sum – Local Cost Reimbursable Construction Culture			
Ranking	**Frequency**	**Percent**	**Valid Percent**
First	3	2.5	3.2
Second	10	8.5	10.5
Third	14	11.9	14.7
Fourth	12	10.2	12.6
Fifth	30	25.4	31.6
Sixth	26	22.0	27.4
Total	95	80.5	100.0

Figure 5-15 - Largest Barriers to Lump Sum – Local Cost Reimbursable Construction Culture



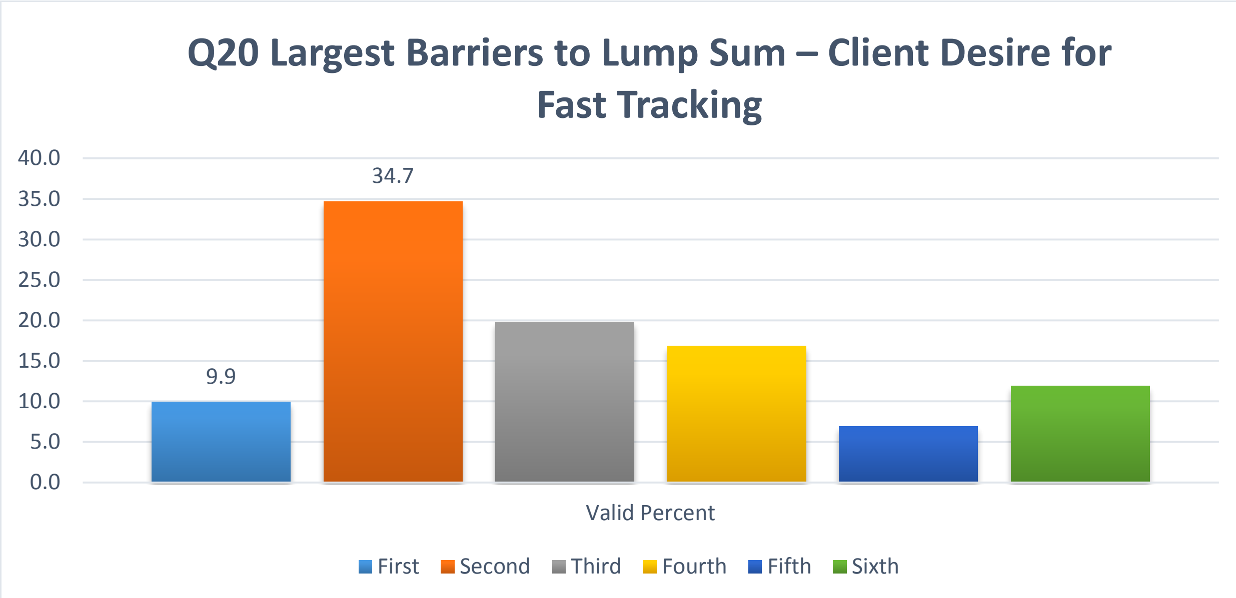
Q18 Largest Barriers to Lump Sum – Client Late Changes			
Ranking	**Frequency**	**Percent**	**Valid Percent**
First	6	5.1	6.3
Second	13	11.0	13.5
Third	36	30.5	37.5
Fourth	7	5.9	7.3
Fifth	18	15.3	18.8
Sixth	16	13.6	16.7
Total	96	81.4	100.0

Figure 5-16 - Largest Barriers to Lump Sum – Client Late Changes



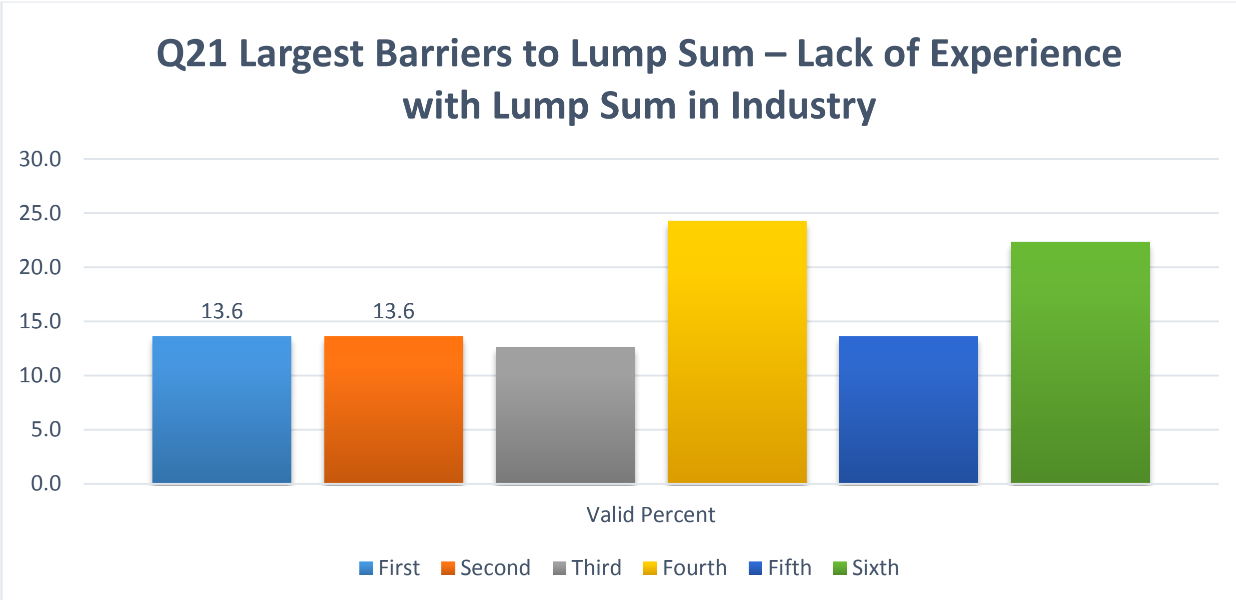
Q19 Largest Barriers to Lump Sum – Lack of Scope Definition			
Ranking	**Frequency**	**Percent**	**Valid Percent**
First	66	55.9	58.9
Second	29	24.6	25.9
Third	6	5.1	5.4
Fourth	4	3.4	3.6
Fifth	3	2.5	2.7
Sixth	4	3.4	3.6
Total	112	94.9	100.0

Figure 5-17 - Largest Barriers to Lump Sum – Lack of Scope Definition



Q20 Largest Barriers to Lump Sum – Client Desire for Fast Tracking			
Ranking	**Frequency**	**Percent**	**Valid Percent**
First	10	8.5	9.9
Second	35	29.7	34.7
Third	20	16.9	19.8
Fourth	17	14.4	16.8
Fifth	7	5.9	6.9
Sixth	12	10.2	11.9
Total	101	85.6	100.0

Figure 5-18 - Largest Barriers to Lump Sum – Client Desire for Fast Tracking



Q21 Largest Barriers to Lump Sum – Lack of Experience with Lump Sum in Industry			
Ranking	**Frequency**	**Percent**	**Valid Percent**
First	14	11.9	13.6
Second	14	11.9	13.6
Third	13	11.0	12.6
Fourth	25	21.2	24.3
Fifth	14	11.9	13.6
Sixth	23	19.5	22.3
Total	103	87.3	100.0

Figure 5-19 - Largest Barriers to Lump Sum – Lack of Experience with Lump Sum in Industry

The same strategy used in the first survey for determining the rankings for barriers to lump sum was employed for the second survey results. The barriers were ranked in order of importance.

1. Lack of scope definition
2. Client desire for fast tracking
3. Client late changes / Field labour market risks (evenly ranked)
4. Lack of experience in industry with LS contracts and their management roles
5. Local construction companies favour cost reimbursable contracts

Table 5-4 – Ranking of Major Barriers to Lump Sum in Alberta Oil and Gas

Ranking	Field Labour %(N)	Desire for Fast tracking %(N)	Cost Reimbursable Construction Culture %(N)	Lack of Experience %(N)	Client late Changes %(N)	Lack of Scope Definition %(N)
First	11.1	8.5	2.5	11.9	5.1	55.9
Second	8.5	29.7	8.5	11.9	11	24.6
Third	18.6	16.9	11.9	11	30.5	5.1
Fourth	28	14.4	10.2	21.2	5.9	3.4
Fifth	16.1	5.9	25.4	11.9	15.3	2.5
Sixth	7.6	10.2	22	19.5	13.6	3.4
Not Important	10.2	14.4	19.5	12.7	18.6	5.1

Participants were asked to suggest methods for treating/mitigating their top ranked risk barrier, other than building provision for it into a risk premium.

Qualitative Responses

To mitigate lack of scope definition and client late changes, participants suggested:

- Later conversion to lump sum/ hybrid contracting strategy
- Provide more time for engineering/project definition; longer FEED phase
- Engage contractor early on in the project to help develop scope: work as a team with a common purpose
- Base approvals on completeness of deliverables, rather than calendar date
- Implement and follow a Gate Review Process
- Base lump sum bids on firm data, or on data from a similar project
- Do not lump sum a schedule-driven project
- Use engineering firms to develop scope, but engage a constructor to utilize their experience in constructability
- Use Alliance contracting strategies and an open book policy
- Maintain a cradle to grave philosophy. Contract members of the Engineering, Procurement and Construction companies to maintain a presence throughout the entire project
- Implement a strong Change Management strategy in the contract terms and conditions.

To mitigate the risks associated with Fast Tracking:

- Perform enough up front engineering to achieve scope freeze and then empower the Project Managers to manage the changes
- Do not use lump sum for fast tracked projects
- Hybrid contract models.

To mitigate lack of experience with Lump Sum:

- Hire individuals with international experience where lump sum is used more frequently
- Train project team (contractor and owner) together on the skills required
- Division of risk prior to project execution. Risk would be identified, priced, and divided between owner and contractor.

To mitigate local cost reimbursable culture:

- Change will be forced upon the industry with increased request for lump sum from clients
- A switch toward lump sum will force behaviour changes and will reduce late changes, lack of scope definition, etc.
- Start project lessons learned databases within an individual's organization
- Recruit project advisors, project and construction managers with international oil and gas experience. In Europe, the Middle East, and Asia, where lump sum is the common contracting strategy
- Implement Hybrid Contracting – Cost reimbursable or Unit Rate with conversion to Lump Sum upon completion of an agreed upon percentage of detailed engineering.

To mitigate field labour risks:

- Enhanced training and education
- Improved knowledge of market sensitivity
- Develop robust labour acquisition plan and agree with the owner on the cost of risk premium for this element

- Divide field labour risks between owner and contractor
    - Contractor: productivity
    - Owner: availability.

Additional barriers to lump sum listed by industry participants included:

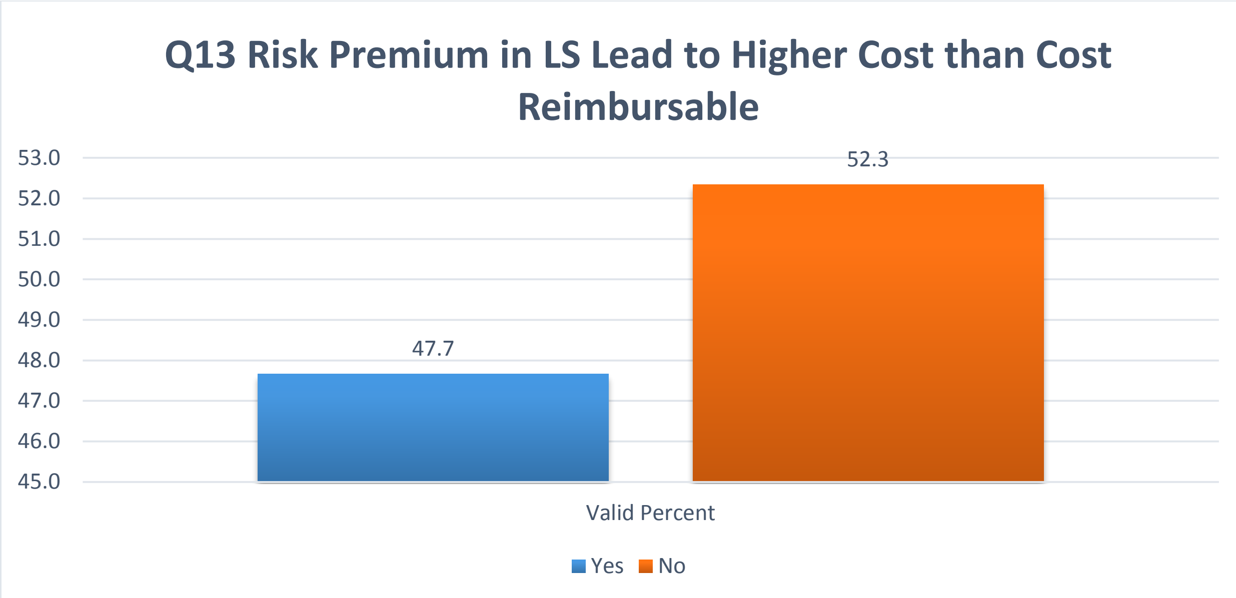
- Market instability
- Long duration of contracts make risks and fluctuations hard to anticipate
- Lack of knowledge by contractors of owner drivers and long term objectives, i.e. understanding of why an owner may need to fast track
- Huge project sizes are restrictive
- Lack of effective workface planning.

5.4.3 Effect on Final Project Cost of Risk Premium in Lump Sum (Q13)

The suggestion was made, by some Operator respondents in the first survey that cost reimbursable may appear to be the less expensive option at project outset when compared with lump sum and the risk premium applied. However, because of the inefficiency they feel is associated with cost reimbursable execution and the lack of a cost ceiling, costs would actually expand to be comparable with or higher than the costs for an equivalent project performed under lump sum.

Respondents in this survey were asked if they felt lump sum risk premiums would result in a higher project cost than cost reimbursable, despite the potential for inefficiency in cost reimbursable.

Eleven respondents declined to answer the question. The frequency results were not clear in identifying an industry wide opinion. More respondents felt that lump sum risk premiums would not result in a higher project cost than the project cost for cost reimbursable execution (52.3%), but only by a small margin.



Q13 Risk Premium in LS Lead to Higher Cost than Cost Reimbursable			
Response	**Frequency**	**Percent**	**Valid Percent**
Yes	51	43.2	47.7
No	56	47.5	52.3
Total	107	90.7	100.0

Figure 5-20 - Frequency Table for Effect on Project Cost of Lump Sum Risk Premium Compared to Cost Reimbursable (Q13)

Qualitative Responses

Participants were asked to explain their perceptions. There was agreement on both sides of the question that high levels of unpredictability existed for certain project elements, such as labour, materials, and scope definition. Also, that higher risk results in higher contingencies being built into a contract to cover the unknowns. Also, there was much discussion around the idea that contractors may assign a higher rate of profit to a lump sum job versus a cost reimbursable job, to obtain compensation for accepting the additional risk exposure.

It was noted that responses could essentially be grouped into two categories, regardless of whether a respondent felt lump sum would increase project costs or not increase them:

- Efficiency and planning

- Management of risk

Respondents who felt lump sum would not result in higher project costs believed lump sum would improve project execution efficiencies, force scope definition and project planning, and drive increased attention to management of risk. Respondents who felt lump sum would increase project cost higher than costs experienced under cost reimbursable felt the lack of industry proficiency for proper planning and the current trend toward inefficiency would result in higher prices in a lump sum situation. The same respondents also believed that the increased levels of risk exposure for lump sum would cause higher costs, as compensation would have to be for the added risk exposure. Essentially, those respondents who felt lump sum would not increase project cost felt that lump sum would drive new behaviours; while the respondents who felt lump sum would result in higher costs, felt old behaviours would remain the same, except they carried more negative impacts in a lump sum environment.

The responses separated by organizational type, response, and category are listed in the following two tables, below. Repeated answers are combined.

Table 5-5 – Reasons Risk Premium in Lump Sum will not Cause Higher Project Costs

Reasons Risk Premium in Lump Sum will not Cause Higher Project Cost	Operator	Engineer	Constructor
Efficiency and Planning			
• Lump sum forces better planning on both sides of industry, imposing better strategy around interfaces, constructability, contract strategies, and scheduling o Provided strong project execution plan, there will be increase o Will result in using industry best practices for projects development like FEL -Front End loading techniques, Process Definition Rated Index -PDRI, VE –Value Engineering, ODCL – Owner Check List, etc.	5	5	
• On smaller, less complex projects o Cost of inefficiencies is less than the costs associated with the risk premiums and upfront work related to lump sum structures • On larger, complex projects o Costs of inefficiencies can be significantly more than the risk premiums and costs for	1		

Reasons Risk Premium in Lump Sum will not Cause Higher Project Cost	Operator	Engineer	Constructor
doing the research and planning ahead. The quality of the front end engineering and design can also reduce the risk premium but the associated cost may not be justified for low risk activities or small budget projects			
• In Lump Sum, the contractor is responsible for managing the work o In cost-reimbursable, the owner has a much larger role. o Contractors manage the project more efficiently than operating companies are capable of doing in cost-reimbursable	3		
• Pressure for contractor efficiency to retain as much extra profit as possible out of risk premium o In cost-reimbursable, no incentive to manage the work effectively. o Lump sum provides motivation to complete work more efficiently as there are immediate bonuses for completing work under budget.	2	5	5
• Will result in well-defined scope and quality deliverables o Will force scope definition and completion of engineering drawings	3	4	4
Management of Risk			
• Risks should be appropriately divided between contractors and owners	5	5	3
• Contractor will include provision for all external risks in the risk premium, but will still result in lower cost	3		
• Should be restricted to small defined scopes of work to reduce risk	2		
• Include contractual provision for changes with pre-determined mark-up to reduce change related risk	4		
• Drives different behaviour and risk accountability model			2

Table 5-6 – Reasons Risk Premium in Lump Sum will Cause Higher Project Costs

Reasons Risk Premium in Lump Sum will Cause Higher Project Cost	Operator	Engineer	Constructor
Efficiency and Planning			
• Owner business drivers and contractor inexperience (lump sum management, technical skills, project location, environment), could result in higher costs	2		
• Scope will likely not be adequately defined, therefore must apply a large risk premium	1	5	4
• Should be a higher reward for accepting higher levels of risk		3	
• Do not believe cost reimbursable causes inefficiency			3
• The project management skills for lump sum do not exist in oil and gas locally, on both contractor and owner side			6
• Project delays will result in higher cost in lump sum			2
Management of Risk			
• On larger projects where unknowns and risk are greater • Depends on division of risk. Contractor taking on the risk for elements outside their control will result in a higher risk premium • External risks have significant levels of unpredictability (labour, materials, etc.)	2	5	8
• Contractor will add in higher profit margins to account for higher levels of risk o Lump Sum has higher profit margins for accepting the risk. Cost reimbursable margins are lower	3		4

5.4.4 Labour Market Risk (Q22)

A great deal of concern around labour market risk was found to exist in the Alberta oil and gas industry, based on the pre-interviews and the first survey. Three aspects of labour market risk were mentioned in previous phases of the research:

1. Productivity
2. Availability
3. Cost.

To determine which of the three risks was of most concern to the industry, participants were asked to select the top labour risk from the three choices. The top labour market risk was perceived to be 'Availability' (44.2%), with 'Productivity' (38.1%) a close second. From the frequency of responses, 'Cost' appeared to be of least concern to the oil and gas industry in Alberta.

Q22 Top Labour Market Risk			
Risk	**Frequency**	**Percent**	**Valid Percent**
Productivity	43	36.4	38.1
Availability	50	42.4	44.2
Cost	20	16.9	17.7
Total	113	95.8	100.0

Figure 5-21 - Top Labour Market Risk

Qualitative Responses

Respondents were asked to give their opinion about the root cause of the labour market risk they had selected as the top risk.

Table 5-7 – Root Cause of Productivity Risk for Lump Sum

Root Cause of Productivity Risk for Lump Sum	Operator	Engineer	Constructor
• Lack of viable Project Execution Plan or not properly following PEP	4	8	4
• Poor management of labour stemming from cost reimbursable environment	4	2	3
• Difficult to predict productivity factor for estimating purposes because of external risk factors (weather, material delays, accommodation availability, travel, etc.)	3		
• High project complexity on large projects		1	1
• Number of interfaces on large projects		2	1
• Lack of training for labour		1	2
• Skill level of supervision	5		2

It was also mentioned that productivity was the only factor under a company's control. Availability and cost would affect the industry equally.

Table 5-8 – Root Cause of Availability Risk for Lump Sum

Root Cause of Availability Risk for Lump Sum	Operator	Engineer	Constructor
• Investment in projects is outpacing the number of skilled individuals in the market	14	4	15
• Market has enough skilled labour to satisfy demand, but with high rates of compensation, workers may only work for part of the year, having made enough to support themselves through breaks	2		2
• Outsourcing labour globally may lead to a lack of development of the local workforce through apprenticeships			3
• Diluted labour pool	5	1	4

Table 5-9 – Root Cause of Cost Risk for Lump Sum

Root Cause of Cost Risk for Lump Sum	Operator	Engineer	Constructor
• Overheated labour market driving compensation rates up		14	2
• Estimating cost of labour is difficult due to quick market changes	2		2

5.5 Project Managmenent Experience

Project management experience, in this research, deals with the perceived project management experience and competence, in Alberta oil and gas, with the management of lump sum projects.

5.5.1 Areas of Industry Inexperience with Lump Sum

Qualitative Responses

From the first survey, 82.8% of respondents believed that lack of industry experience with lump sum contracting would impact the feasibility of moving to a lump sum contracting environment in Alberta oil and gas. Participants from the second survey were asked to identify what they felt were the specific areas of industry inexperience, if they agreed with the statement. Table 5-11, below, lists a summary of the areas of concern expressed by a number of respondents in each organizational type. Repeated answers have been combined.

Table 5-10 – Areas of Industry Inexperience with Lump Sum

Areas of Industry Inexperience with Lump Sum	Operator	Engineer	Constructor
1. Inexperience with properly estimating costs • Dilution of the Estimator skill set • Many estimators have learned their trade in the cost reimbursable environment. Those skills are not applicable to lump sum estimating	8	7	7
2. Lack of proper industry benchmarking tools • Lack of useable Lessons Learned tracking tools • Lack of formal processes for cost management and scheduling to ensure repeatability	5		5
3. Engineers have difficulty issuing complete IFC (Issued for Construction) package, essential to Lump Sum construction	1		
4. Lack of understanding of risks within a lump sum environment • Difficulty properly identifying risks • Difficulty dividing/fairly allocating risks between client and contractor • Difficulty deciding what should be included/excluded from the lump sum contract	9	8	
5. Lack of qualified Construction Supervision: • Superintendents	3		

Areas of Industry Inexperience with Lump Sum	Operator	Engineer	Constructor
• Foremen/General Foremen			
6. Lack of Project Management/ Construction Management lump sum skills	5	4	3
7. Lack of sufficient quality specifications on the owner's side to set quality expectations • Quality is the tool for owners to manage lump sum contracts	3		7
8. Lack of experience on the contractor side with properly constructing lump sum bids	2		
9. Lack of skilled Project Controls • Very little experience scheduling lump sum work		5	3
10. Lack of proper Change Management processes and procedures • Poor contract structure related to change management		3	
11. Little Mega Project Lump Sum experience, locally • Very little lump sum work completed over $100MM		4	1
12. Lack of Contract Management and Contract Administration specialists within the industry		5	4
13. Lack of focus on profitability through increased efficiency		2	
14. Lack of Quality (QA/QC) personnel on contractor and client side			6
15. Lack of Constructability Planning skill set • Lack of skill with engineering design for efficient constructability • Lack of supply chain management for constructability planning			3
16. EP&CM (Engineering, Procurement, and Construction Management) companies lack personnel with field experience			1

5.6 Stakeholder Challenges

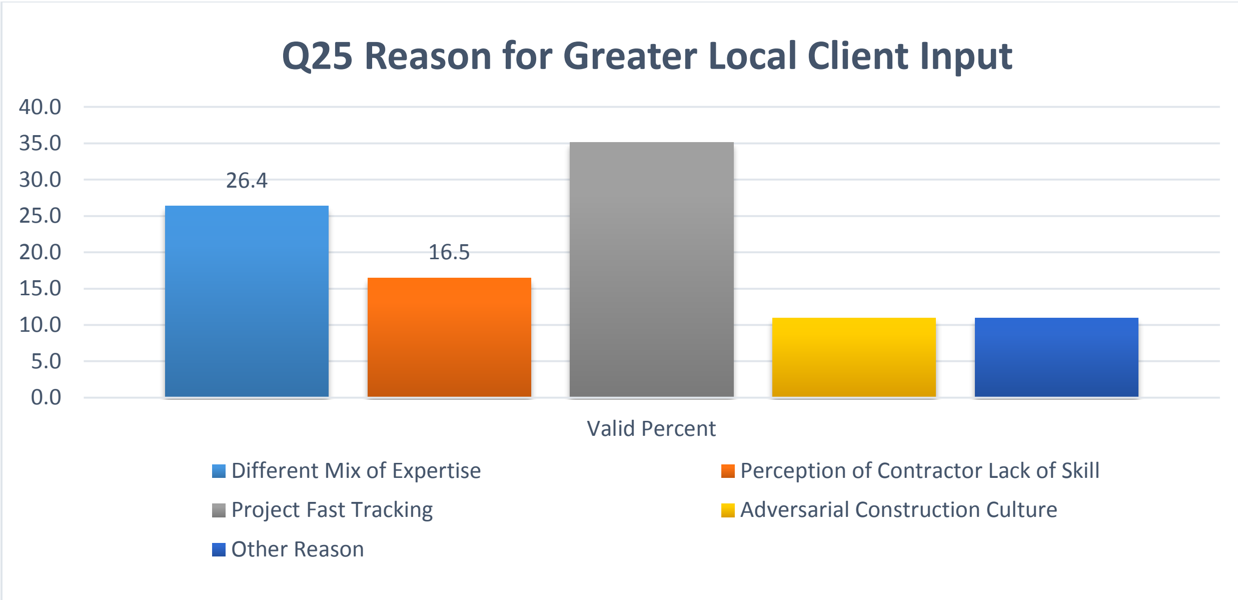
Stakeholder challenges, in this research, deals with the perceived negative influence various stakeholders can have on a lump sum project in Alberta. In particular, the perceived major sources of interference to operating and contractor companies.

5.6.1 Reasons for Greater Local Client Interference

Study participants from the first survey believed Alberta operators desired more input into projects and interfered with the management of projects more than international clients do. To determine the main reason why industry thought this was the case, the top reasons given by the Operators were combined with reasons provided by the contractors in answers to the first survey. The respondents to the second survey were asked which of the following reasons was considered the main reason for client interference:

1. More highly skilled workforce at local operators than international operators
2. Perception of lack of skill at contractor companies
3. Project Fast tracking
4. Local adversarial construction culture
5. Other Reason.

Twenty-seven respondents chose not to answer this question. The top two answers included the desire for project fast tracking (35.2%) and higher skill level workforce at local operators (26.4%). The ten participants who responded 'Other' were asked to supply the missing reason(s).



Q25 Reason for Greater Local Client Input			
Reason	**Frequency**	**Percent**	**Valid Percent**
Different Mix of Expertise	24	20.3	26.4
Perception of Contractor Lack of Skill	15	12.7	16.5
Project Fast Tracking	32	27.1	35.2
Adversarial Construction Culture	10	8.5	11.0
Other Reason	10	8.5	11.0
Total	91	77.1	100.0

Figure 5-22 - Reason for Greater Local Client Input

Qualitative Responses

The missing or additional reasons for owner interference, as offered by participants, are listed in Table 5-12, below:

Table 5-11 – Reasons for Increased Local Operator Project Interference

Reasons for Increased Local Operator Project Interference	Operator	Engineer	Constructor
Immaturity of SAGD/Bitumen Mining process • Operators unsure of technical requirements • Less defined scope, late changes, rework	1	2	
Profit margins are lower for operators, locally • Less tolerant of overruns than international clients	2	2	
Both contractor and operator sides are more risk adverse, locally	1	1	1

6 Data Analysis Results

The data collected from the Primary and Secondary Survey was analyzed for relationships. Due to the large volume of data, only those findings that were correlated are discussed. The following section is organized under the four factors found, from literature, to influence project outcome:

- Contract Strategy;
  - Primary Survey Results: Sections 6.1.1 to 6.1.10
  - Secondary Survey Results: Sections 6.1.11 to 6.1.16
- Risk Management;
  - Primary Survey Results: Sections 6.2.1 to 6.2.10
  - Secondary Survey Results: Sections 6.2.11 to 6.2.17
- Project Management Experience;
  - Primary Survey Results: Sections 6.3.1 to 6.3.4
  - Secondary Survey Results: No quantitative data
- Stakeholder Challenges.
  - Primary Survey Results: Sections 6.4.1 to 6.4.3
  - Secondary Survey Results: Section 6.4.4

The results of the statistical analysis of the variables identified under these four factors are discussed below, grouped as laid out in Figures 6-1 and 6-2. Tables summarizing the analysis results and a summary of the correlation meanings are given in Sections 6.1 to 6.5. For the detailed examination of each correlation, see Appendix 3. Degrees of Freedom (df) in the tables of Section 6 in the number of values in the statistical calculation that are free to vary (Glossary of Statistical Term, 2008).

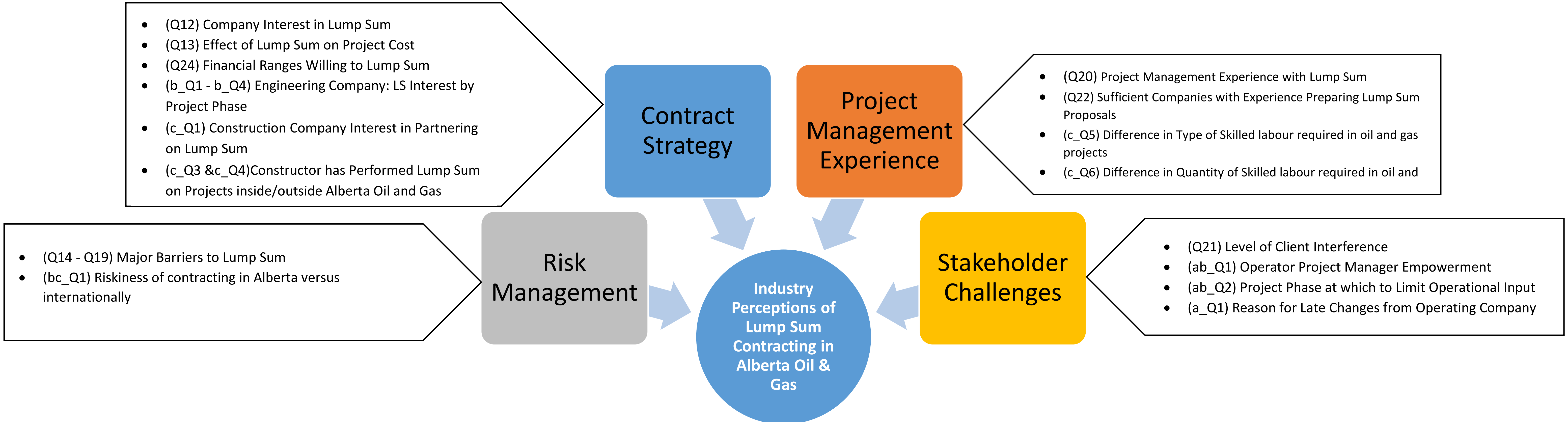


Figure 6-1 – Grouping of the Statistical Analysis Variables for the Primary Survey

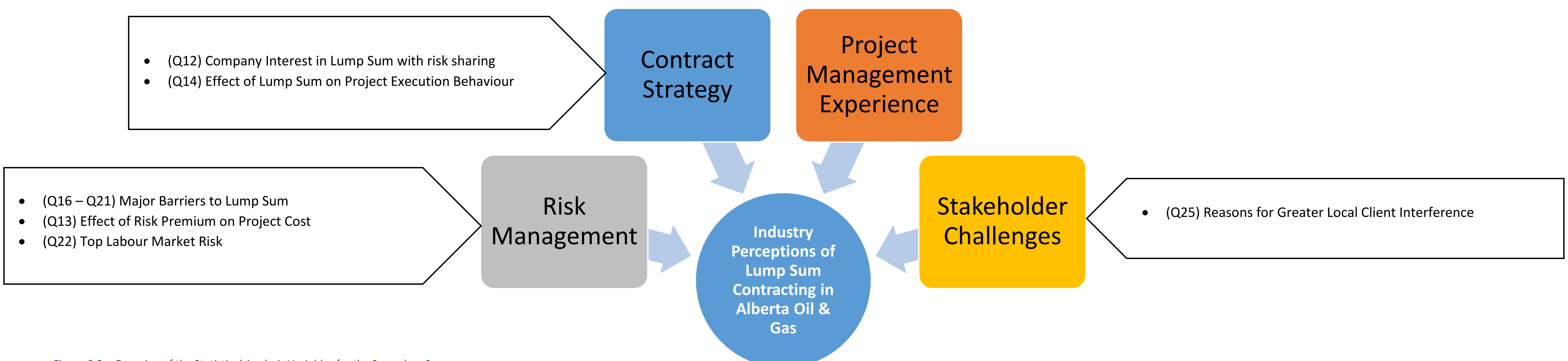


Figure 6-2 – Grouping of the Statistical Analysis Variables for the Secondary Survey

6.1 Contract Strategy

Contract strategy, in this research, deals with the respondents' perceived effect of lump sum use on project performance. This section uses Chi Square and Fisher Exact tests to find significant correlations between the survey questions on industry's willingness to use lump sum and the demographic and company specific practice factors that may influence these opinions.

Primary Survey

6.1.1 Company Interest in Lump Sum (Q12)

Table 6-1 - Examination of Hypotheses H1 – H14 For Company Interest In Lump Sum (Q12)

Independent Variable	Yes N (%)	No N (%)	χ^2	df	P	Value Reflects Fisher Exact Test
Q1: Employment Type						
Operating Company	36 (92.3%)	3 (7.7%)	18.921	2	<0.001	
Engineering Company	21 (51.2%)	20 (48.8%)				
Construction Company	33 (80.5%)	8 (19.5%)				
Q2: Role In Organization						
Executive + VP	19 (63.3%)	11 (36.7%)	3.422	3	0.331	
Senior Manager	26 (83.9%)	5 (16.1%)				
Project Manager	28 (75.7%)	9 (24.3%)				
Other	17 (73.9%)	6 (26.1%)				
Q3: Years Working Experience						
≤ 15 Years	13 (100.0%)	0 (0.0%)			<0.001	X
16-20 Years	15 (57.7%)	11 (42.3%)				
21-25 Years	6 (42.9%)	8 (57.1%)				
> 25 Years	56 (82.4%)	12 (17.6%)				
Q4: Company Operates Internationally						
Works Internationally	88 (79.3%)	23 (20.7%)			<0.001	X
Does Not Work Internationally	1 (11.1%)	8 (88.9%)				
Q5.1: Company Engages In Lump Sum Payment Structure						
Yes	55 (82.1%)	12 (17.9%)	4.970	1	0.026	
No	34 (64.2%)	19 (35.8%)				

Independent Variable	Yes N (%)	No N (%)	χ^2	df	P	Value Reflects Fisher Exact Test
Q5.2: Company Engages In Cost Reimbursable Payment Structure						
Yes	70 (74.5%)	24 (25.5%)	0.021	1	0.886	
No	19 (73.1%)	7 (26.9%)				
Q5.3: Company Engages In Unit Rate Payment Structure						
Yes	43 (65.2%)	23 (34.8%)	6.221	1	0.013	
No	46 (85.2%)	8 (14.8%)				
Q8: Company Used Lump Sum On Past Project – Alberta						
Yes	76 (79.2%)	20 (20.8%)	5.586	1	0.018	
No	14 (56.0%)	11 (44.0%)				
Q9: Project Dollar Value – Alberta						
< \$5 MM	14 (63.6%)	8 (36.4%)	4.804		0.101	X
< \$100 MM	19 (90.5%)	2 (9.5%)				
< \$1 B	38 (82.6%)	8 (17.4%)				
Q10: Company Used Lump Sum On Past Project – Internationally						
Yes	52 (70.3%)	22 (29.7%)	1.530	1	0.216	
No	37 (80.4%)	9 (19.6%)				
Q11: Project Dollar Value – Internationally						
< \$5 MM	8 (80.0%)	2 (20.0%)	2.572		0.491	X
< \$100 MM	13 (72.2%)	5 (27.8%)				
< \$1 B	12 (70.6%)	5 (29.4%)				
> \$1 B	7 (100.0%)	0 (0.0%)				
b_Q5: Company Has Internal Construction Division						
Yes	18 (50.0%)	18 (50.0%)			1.000	X
No	3 (60.0%)	2 (40.0%)				
c_Q3: Performed Lump Sum In Western Canadian Oil And						

Independent Variable	Yes N (%)	No N (%)	χ^2	df	P	Value Reflects Fisher Exact Test
Gas						
Yes	33 (94.3%)	2 (5.7%)			<0.001	X
No	0 (0.0%)	6 (100.0%)				
c_Q4: Performed Lump Sum In Alberta Outside Oil & Gas						
Yes	23 (76.7%)	7 (23.3%)			0.412	X
No	10 (90.9%)	1 (9.1%)				

Opinion on Company Interest in Lump Sum Contracting (Q12) versus

- (Q1) Organizational Type: all were interested with Operators most interested. Engineers least interested. (Highly correlated)
    - (χ^2 =18.92, *df*=2, P<0.001).
- (Q3) Years Working Experience: Above 25 years' experience showed most interest in lump sum than other years' experience groups. (Highly correlated)
    - (Fisher Exact Test: P<0.001).
- (Q4) Operates Internationally: 80% of those who operated internationally were interested, with little interest from those whose companies did not operate internationally (Highly correlated)
    - (Fisher Exact Test: P<0.001).
- (C_Q3): Constructors use of Lump Sum in Alberta Oil and Gas: All who used lump sum had interest in lump sum. Those who had not used lump sum in oil and gas had no interest in lump sum (Highly correlated)
    - (Fisher Exact Test: P<0.001).
- (Q5.1) Use lump sum: more respondents whose companies used lump sum were interested than those who did not use lump sum(Medium correlation)
    - (χ^2 =4.97, *df*=1, P=0.026).
- (Q5.3) Use unit rate: respondents whose companies used unit rate were less likely to be interested in lump sum (Medium correlation)
    - (χ^2 =6.22, *df*=1, P=0.013).

- (Q8) Used lump sum on past Alberta projects: Those who used lump sum before locally were more interested than those who had not (Medium correlation)
    - (χ^2 =5.59, *df*=1, P=0.018).

6.1.2 Lump Sum Effect on Project Cost (Q13)

Table 6-2 - Examination of Hypotheses H15 – H28 *For* Lump Sum Effect On Project Cost *(Q13)*

Independent Variable	Increase Cost N (%)	Decrease Cost N (%)	Not Affect Cost N (%)	χ^2	df	P	Value Reflects Fisher Exact Test
Q1: Employment Type							
Operating Company	21 (52.5%)	13 (32.5%)	6 (15.0%)	22.829	4	<0.001	
Engineering Company	36 (87.8%)	5 (12.2%)	0 (0%)				
Construction Company	16 (39.0%)	16 (39.0%)	9 (22.0%)				
Q2: Role in Organization							
Executive + VP	19 (63.3%)	11 (36.7%)	0 (0.0%)			0.043	X
Senior Manager	19 (61.3%)	8 (25.8%)	4 (12.9%)				
Project Manager	20 (52.6%)	8 (21.1%)	10 (26.3%)				
Other	15 (65.2%)	7 (30.4%)	1 (4.3%)				
Q3: Years Working Experience							
≤ 15 Years	11 (84.6%)	2 (15.4%)	0 (0.0%)			0.006	X
16-20 Years	9 (34.6%)	13 (50.0%)	4 (15.4%)				
21-25 Years	13 (92.9%)	1 (7.1%)	0 (0.0%)				
> 25 Years	40 (58.0%)	18 (26.1%)	11 (15.9%)				
Q4: Company Operates Internationally							
Works Internationally	70 (62.5%)	27 (24.1%)	15 (13.4%)			0.006	X
Does Not Work Internationally	2 (22.2%)	7 (77.8%)	0 (0.0%)				
Q5.1: Company Engages in Lump Sum Payment Structure							
Yes	36 (53.7%)	21 (31.3%)	10 (14.9%)	3.107	2	0.212	
No	37 (68.5%)	13 (24.1%)	4 (7.4%)				
Q5.2: Company Engages in Cost Reimbursable Payment Structure							
Yes	67 (70.5%)	17 (17.9%)	11 (11.6%)	24.002	2	<0.001	
No	6 (23.1%)	17 (65.4%)	3 (11.5%)				
Q5.3: Company Engages in Unit Rate Payment Structure							
Yes	35 (52.2%)	25 (37.3%)	7 (10.4%)	6.329	2	0.042	

Independent Variable	Increase Cost N (%)	Decrease Cost N (%)	Not Affect Cost N (%)	χ^2	df	P	Value Reflects Fisher Exact Test
No	38 (70.4%)	9 (16.7%)	7 (13.0%)				
Q8: Company Used Lump Sum on Past Project – Alberta							
Yes	55 (56.7%)	27 (27.8%)	15 (15.5%)	4.644	2	0.098	
No	18 (72.0%)	7 (28.0%)	0 (0.0%)				
Q9: Project Dollar Value – Alberta							
< $5 MM	7 (31.8%)	9 (40.9%)	6 (27.3%)			0.001	X
< $100 MM	19 (90.5%)	1 (4.8%)	1 (4.8%)				
< $1 B	22 (46.8%)	17 (36.2%)	8 (17.0%)				
Q10: Company Used Lump Sum on Past Project - Internationally							
Yes	51 (68.0%)	11 (14.7%)	13 (17.3%)	20.255	2	<0.001	
No	22 (47.8%)	23 (50.0%)	1 (2.2%)				
Q11: Project Dollar Value - Internationally							
< $5 MM	3 (30.0%)	1 (10.0%)	6 (60.0%)			<0.001	X
< $100 MM	18 (100.0%)	0 (0.0%)	0 (0.0%)				
< $1 B	11 (64.7%)	6 (35.3%)	0 (0.0%)				
> $1 B	5 (71.4%)	1 (14.3%)	1 (14.3%)				
b_Q5: Company Has Internal Construction Division							
Yes	31 (86.1%)	5 (13.9%)	Null			1.000	X
No	5 (100.0%)	0 (0.0%)	Null				
c_Q3: Performed Lump Sum In Western Canadian Oil And Gas							
Yes	16 (45.7%)	10 (28.6%)	9 (25.7%)			0.004	X
No	0 (0.0%)	6 (100.0%)	0 (0.0%)				
c_Q4: Performed Lump Sum In Alberta Outside Oil & Gas							
Yes	6 (20.0%)	15 (50.0%)	9 (30.0%)			<0.001	X
No	10 (90.0%)	1 (9.1%)	0 (0.0%)				

Lump Sum Effect on Project Cost (Q13) versus:

- (Q1) Organizational Type: Engineers more likely than Operator and Constructors to perceive lump sum increased project cost. Constructors aligned with operators rather than engineers. Higher percentage of operators and constructors than engineers felt lump sum would decrease cost (Highly correlated)

    - (χ^2 =22.83, *df*=4, P<0.001).

- (Q2) Role in Organization: As seniority of role increased, so did perception that lump sum would increase cost. Project Managers were least likely to believe lump sum increased cost. (Medium Correlation)
    - (Fisher Exact Test: P=0.043).
- (Q3) Years' Experience: As experience increased, so did the perception that lump sum would increase cost compared to cost reimbursable. About 60% of respondents above 25 years felt project cost would increase. (Highly Correlated
    - (Fisher Exact Test: P=0.006).
- (Q4) Operates Internationally: Those whose companies work internationally believe lump sum will increase cost. Those who only operate locally were more likely to believe lump sum will decrease cost. (Highly correlated)
    - (Fisher Exact Test: P=0.006).
- (Q5.2) Use Cost Reimbursable: Those who engaged in cost reimbursable were much more likely to think lump sum increased cost than those who did not, who were more likely to think it decreased cost. (Highly correlated)
    - (χ^2 =24.00, *df*=2, P<0.001).
- (Q5.3) Use Unit Rate: Those who used unit rate were less likely than those who used cost reimbursable to believe lump sum increased cost. (Medium correlation)
    - (χ^2 =6.33, *df*=2, P=.042).
- (Q9) Maximum Value of Local Lump Sum Project: Those who had performed smaller lump sum projects that were above $5MM were more likely to believe it increased cost. Below $5MM, respondents believed it would decrease cost (Highly correlated)
    - (Fisher Exact Test: P=0.001).
- (Q10): Used Lump Sum Internationally: Those who have performed lump sum projects internationally were more likely to think lump sum increases cost. Those who had not used it internationally believed it would decrease cost (Highly correlated)

- o (χ^2 =20.26, *df*=2, P<0.001).

- (Q11): Maximum Value of International Lump Sum Project: Those with higher dollar value lump sum international projects more likely to have a negative view of the effect of using lump sum on cost in Alberta environment. (Highly correlated)
  - o (Fisher Exact Test: P<0.001).

6.1.3 Financial Ranges Companies Willing to Lump sum (Q24)

Table 6-3 - Examination of Hypotheses H131 – H145 For Financial Ranges Companies Willing To Lump Sum (Q24)

Independent Variable	< \$5 MM N (%)	< \$100 MM N (%)	< \$1 B N (%)	> \$1 B N (%)	χ^2	df	P	Value Reflects Fisher Exact Test
Q1: Employment Type								
Operating Company	8 (21.6%)	10 (27.0%)	10 (27.0%)	9 (24.3%)	10.836	6	0.094	
Engineering Company	7 (23.3%)	8 (26.7%)	10 (33.3%)	5 (16.7%)				
Construction Company	13 (32.5%)	12 (30.0%)	15 (37.5%)	0 (0.0%)				
Q2: Role in Organization								
Executive + VP	0 (0.0%)	8 (38.1%)	9 (42.9%)	4 (19.0%)	29.675	9	<0.001	
Senior Manager	10 (32.3%)	6 (19.4%)	9 (29.0%)	6 (19.4%)				
Project Manager	9 (27.3%)	5 (15.2%)	17 (51.5%)	2 (6.1%)				
Other	9 (40.9%)	11 (50.0%)	0 (0.0%)	2 (9.1%)				
Q3: Years Working Experience								
≤ 15 Years	4 (33.3%)	6 (50.0%)	0 (0.0%)	2 (16.7%)			<0.001	X
16-20 Years	12 (54.5%)	8 (36.4%)	0 (0.0%)	2 (9.1%)				
21-25 Years	3 (25.0%)	2 (16.7%)	5 (41.7%)	2 (16.7%)				
> 25 Years	9 (14.8%)	14 (23.0%)	30 (49.2%)	8 (13.1%)				
Q4: Company Operates Internationally								
Works Internationally	22 (22.4%)	29 (29.6%)	34 (34.7%)	13 (13.3%)			0.025	X
Does Not Work Internationally	6 (75.0%)	1 (12.5%)	1 (12.5%)	0 (0.0%)				
Q5.1: Company Engages in Lump Sum Payment Structure								
Yes	7 (11.3%)	19 (30.6%)	25 (40.3%)	11 (17.7%)	19.292	3	<0.001	
No	21 (47.7%)	11 (25.0%)	10 (22.7%)	2 (4.5%)				
Q5.2: Company Engages in Cost Reimbursable Payment Structure								

Independent Variable	< $5 MM N (%)	< $100 MM N (%)	< $1 B N (%)	> $1 B N (%)	χ^2	df	P	Value Reflects Fisher Exact Test
Yes	15 (18.5%)	30 (37.0%)	25 (30.9%)	11 (13.6%)	18.335	3	<0.001	
No	13 (52.0%)	0 (0.0%)	10 (40.0%)	2 (8.0%)				
Q5.3: Company Engages in Unit Rate Payment Structure								
Yes	17 (27.9%)	19 (31.1%)	16 (26.2%)	9 (14.8%)	3.258	3	0.353	
No	11 (24.4%)	11 (24.4%)	19 (42.2%)	4 (8.9%)				
Q8: Company Used Lump Sum on Past Project – Alberta								
Yes	26 (29.9%)	20 (23.0%)	28 (32.2%)	13 (14.9%)	7.957	3	0.047	
No	2 (10.0%)	10 (50.0%)	7 (35.0%)	1 (5.0%)				
Q9: Project Dollar Value – Alberta								
< $5 MM	21 (100.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)			<0.001	X
< $100 MM	0 (0.0%)	12 (60.0%)	7 (35.0%)	1 (5.0%)				
< $1 B	5 (11.6%)	8 (18.6%)	21 (48.8%)	9 (20.9%)				
Q10: Company Used Lump Sum on Past Project - Internationally								
Yes	14 (22.2%)	26 (41.3%)	16 (25.4%)	7 (11.1%)	12.938	3	0.005	
No	14 (32.6%)	4 (9.3%)	18 (41.9%)	7 (16.3%)				
Q11: Project Dollar Value - Internationally								
< $5 MM	9 (100.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)			<0.001	X
< $100 MM	0 (0.0%)	14 (77.8%)	4 (22.2%)	0 (0.0%)				
< $1 B	2 (15.4%)	4 (30.8%)	5 (38.5%)	2 (15.4%)				
> $1 B	0 (0.0%)	1 (16.7%)	0 (0.0%)	5 (83.3%)				
b_Q5: Company Has Internal Construction Division								
Yes	3 (11.5%)	8 (30.8%)	10 (38.5%)	5 (19.2%)			0.001	X
No	4 (100.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)				
c_Q3: Performed Lump Sum In Western Canadian Oil And Gas								
Yes	7 (20.6%)	12 (35.3%)	15 (44.1%)	Null			0.001	X
No	6 (100.0%)	0 (0.0%)	0 (0.0%)	Null				
c_Q4: Performed Lump Sum In Alberta Outside								

Independent Variable	< $5 MM N (%)	< $100 MM N (%)	< $1 B N (%)	> $1 B N (%)	χ^2	df	P	Value Reflects Fisher Exact Test
Oil & Gas								
Yes	10 (33.3%)	6 (20.0%)	14 (46.7%)	Null			0.042	X
No	3 (30.0%)	6 (60.0%)	1 (10.0%)	Null				

Financial Ranges Willing to Lump sum (Q24) versus:

- (Q1) Organizational Type: Operators had highest desire to use lump sum for mega projects. Constructors had no interest in mega projects. Engineer and Constructors largest interest in $100MM-$1B range (Medium correlation)
    - (Fisher Exact Test: P=0.044).
- (Q2) Role in Organization: Executives and Senior Managers were most interested in higher dollar value projects, with greatest interest shown in >$1B and >$100MM projects. (Highly correlated)
    - (χ^2 =29.68, *df*=9, P<0.001).
- (Q3) Years' Experience: >20 years' experience preferred $100-$1B. (Highly correlated)
    - (Fisher Exact Test: P<0.001).
- (Q4) Operates Internationally: With international experience willing to execute large projects, preferring $100MM-$1B. Those without were interested in <$5mm. (Medium correlation)
    - (Fisher Exact Test: P=0.025).
- (Q5.1) Use Lump Sum: Those who had used lump sum before willing to perform projects >$100MM (Highly correlated)
    - (χ^2 =19.29, *df*=3, P<0.001).
- (Q5.2) Use Cost Reimbursable: Those who use cost reimbursable were most interested in $5mm-$100MM. Those who did not were most interested in <$5mm. (Highly correlated)
    - (χ^2 =18.34, *df*=3, P<0.001).

- (Q8) Used lump sum on past Alberta projects: Those using lump sum locally were more likely to perform mega projects than those who had not. They were also more likely to perform projects <$5MM. (Medium correlation)
    - (χ^2 =7.96, *df*=3, P=0.047).
- (Q9) Maximum Value of Local Lump Sum Project: As the dollar value performed before increased, the dollar value they would perform again increased, except for a small portion who had performed up to $1B were only comfortable with <$5mm in the future. (Highly correlated)
    - (Fisher Exact Test: P<0.001).
- (Q10) Used Lump Sum Internationally: Those who had not performed lump sum internationally were more interested than those who had in larger value projects. (Highly correlated)
    - (χ^2 =12.94, *df*=3, P=0.005).
- (Q11): Maximum Value of International Lump Sum Project: Value of project performed internationally was value interested in, in Alberta. (Highly correlated)
    - (Fisher Exact Test: P<0.001).
- (B_Q5) Internal Construction Division: The most popular size for those with internal construction division was $100MM-$1B, with a healthy interest in >$1B. Those without a construction division were only willing on projects < $5mm. (Highly correlated)
    - (Fisher Exact Test: P=0.001).
- (C_Q3) Constructors Executing Lump sum in Oil and Gas: Those who had, much more interested in higher dollar value ($100mm-$1B), with no interest > $1B. (Highly correlated)
    - (Fisher Exact Test: P=0.001).
- (C_Q4) Constructors Executing Lump sum outside Oil and Gas : Those who had preferred $5MM-$100MM. (Medium correlation)
    - (Fisher Exact Test: P=0.042).

6.1.4 Engineering Company Interest in Lump Sum by Phase: FEED (b_Q1)

Table 6-4 - Examination of Hypotheses H180 – H191 *For* Lump Sum Interest By Phase – FEED *(b_Q1)*

Independent Variable	**Yes N (%)**	**No N (%)**	χ^2	**df**	**P**	**Value Reflects Fisher Exact Test**
Q1: Employment Type						
Operating Company	Null	Null	Null	Null	Null	
Engineering Company	9 (22.0%)	32 (78.0%)				
Construction Company	Null	Null				
Q2: Role in Organization						
Executive + VP	1 (5.9%)	16 (94.1%)			0.113	X
Senior Manager	4 (33.3%)	8 (66.7%)				
Project Manager	4 (33.3%)	8 (66.7%)				
Other	Null	Null				
Q3: Years Working Experience						
≤ 15 Years	1 (100.0%)	0 (0.0%)			0.071	X
16-20 Years	0 (0.0%)	5 (100.0%)				
21-25 Years	0 (0.0%)	5 (100.0%)				
> 25 Years	8 (26.7%)	22 (73.3%)				
Q4: Company Operates Internationally						
Works Internationally	9 (22.0%)	32 (78.0%)	Null	Null	Null	
Does Not Work Internationally	Null	Null				
Q5.1: Company Engages in Lump Sum Payment Structure						
Yes	2 (11.1%)	16 (88.9%)			0.254	X
No	7 (30.4%)	16 (69.6)				
Q5.2: Company Engages in Cost Reimbursable Payment Structure						
Yes	8 (20.0%)	32 (80.0%)			0.220	X
No	1 (100.0%)	0 (0.0%)				
Q5.3: Company Engages in Unit Rate Payment Structure						
Yes	1 (5.9%)	16 (94.1%)			0.056	X
No	8 (33.3%)	16 (66.7%)				
Q8: Company Used Lump Sum on Past Project – Alberta						
Yes	5 (20.8%)	19 (79.2%)			1.000	X
No	4 (23.5%)	13 (76.5%)				
Q9: Project Dollar Value – Alberta						
< $5 MM	Null	Null			<0.001	X
< $100 MM	4 (100.0%)	0 (0.0%)				
< $1 B	0 (0.0%)	14 (100.0%)				
Q10: Company Used Lump Sum on						

Independent Variable	Yes N (%)	No N (%)	χ^2	df	P	Value Reflects Fisher Exact Test
Past Project - Internationally						
Yes	3 (9.4%)	29 (90.6%)			0.001	X
No	6 (66.7)	3 (33.3%)				
Q11: Project Dollar Value - Internationally						
< $5 MM	Null	Null			0.550	X
< $100 MM	0 (0.0%)	5 (100.0%)				
< $1 B	0 (0.0%)	9 (100.0%)				
> $1 B	1 (16.7%)	5 (83.3%)				
b_Q5: Company Has Internal Construction Division						
Yes	6 (16.7%)	30 (83.3%)			0.061	X
No	3 (60.0%)	2 (40.0%)				

Engineering Company Interest in Lump Sum by Phase: FEED (b_Q1) versus:

- (Q9) Maximum Value of Local Lump Sum Project: The higher the lump sum project previously performed, the less interest in early phase lump sum work (Highly correlated)
    - (Fisher Exact Test: $P<0.001$).
- (Q10) Used Lump Sum Internationally: Those who had use lump sum internationally were less interested in FEED phase than not. (Highly correlated)
    - (Fisher Exact Test: $P=0.001$).

6.1.5 Engineering Company Interest in Lump Sum by Phase: Detailed Engineering (b_Q2)

Table 6-5 - Examination of Hypotheses H192 – H203 For Lump Sum Interest By Phase - Detailed Engineering (b_Q2)

Independent Variable	Yes N (%)	No N (%)	χ^2	df	P	Value Reflects Fisher Exact Test
Q1: Employment Type						
Operating Company	Null	Null	Null	Null	Null	
Engineering Company	28 (68.3%)	13 (31.7%)				
Construction Company	Null	Null				
Q2: Role in Organization						
Executive + VP	12 (70.6%)	5 (29.4%)			0.761	X

Independent Variable	Yes N (%)	No N (%)	χ^2	df	P	Value Reflects Fisher Exact Test
Senior Manager	9 (75.0%)	3 (25.0%)				
Project Manager	7 (58.3%)	5 (41.7%)				
Other	Null	Null				
Q3: Years Working Experience						
≤ 15 Years	1 (100.0%)	0 (0.0%)			0.466	X
16-20 Years	3 (60.0%)	2 (40.0%)				
21-25 Years	2 (40.0%)	3 (60.0%)				
> 25 Years	22 (73.3%)	8 (26.7%)				
Q4: Company Operates Internationally						
Works Internationally	28 (68.3%)	13 (31.7%)	Null	Null	Null	
Does Not Work Internationally	Null	Null				
Q5.1: Company Engages in Lump Sum Payment Structure						
Yes	11 (61.1%)	7 (38.9%)	0.764	1	0.382	
No	17 (73.9%)	6 (26.1%)				
Q5.2: Company Engages in Cost Reimbursable Payment Structure						
Yes	27 (67.5%)	13 (32.5%)			1.000	X
No	1 (100.0%)	0 (0.0%)				
Q5.3: Company Engages in Unit Rate Payment Structure						
Yes	6 (35.3%)	11 (64.7%)	14.604	1	<0.001	
No	22 (91.7%)	2 (8.3%)				
Q8: Company Used Lump Sum on Past Project – Alberta						
Yes	16 (66.7%)	8 (33.3%)	0.071	1	0.790	
No	12 (70.6%)	5 (29.4%)				
Q9: Project Dollar Value – Alberta						
< $5 MM	Null	Null			0.092	X
< $100 MM	4 (100.0%)	0 (0.0%)				
< $1 B	6 (42.9%)	8 (57.1%)				
Q10: Company Used Lump Sum on Past Project - Internationally						
Yes	19 (59.4%)	13 (40.6%)			0.038	X
No	9 (100.0%)	0 (0.0%)				
Q11: Project Dollar Value - Internationally						
< $5 MM	Null	Null			0.002	X
< $100 MM	0 (0.0%)	5 (100.0%)				
< $1 B	4 (44.4%)	5 (55.6%)				

Independent Variable	Yes N (%)	No N (%)	χ^2	df	P	Value Reflects Fisher Exact Test
> $1 B	6 (100.0%)	0 (0.0%)				
b_Q5: Company Has Internal Construction Division						
Yes	25 (69.4%)	11 (30.6%)			0.645	X
No	3 (60.0%)	2 (40.0%)				

Engineering Company Interest in Lump Sum by Phase: Detailed Engineering (b_Q2) versus:

- (Q5.3) Use Unit Rate: Those who did not use unit rate were less interested in lump sum for detailed engineering than those who did. (Highly correlated)
  - (χ^2 =14.60, *df*=1, P<0.001).
- (Q10) Used Lump Sum Internationally: Both groups much more interested in lump sum for detailed than for FEED. International users less interested in lump sum for detailed engineering than those who had not internationally (Medium correlation)
  - (Fisher Exact Test: P=0.038).
- (Q11): Maximum Value of International Lump Sum Project: Higher the dollar value performed internationally, the more interest in lump sum for detailed engineering. (Highly correlated)
  - (Fisher Exact Test: P=0.002).

6.1.6 Engineering Company Interest in Lump Sum by Phase: Construction (b_Q3)

Table 6-6 - Examination of Hypotheses H204 – H215 For Lump Sum Interest By Phase – Construction (b_Q3)

Independent Variable	Yes N (%)	No N (%)	χ^2	df	P	Value Reflects Fisher Exact Test
Q1: Employment Type						
Operating Company	Null	Null	Null	Null	Null	
Engineering Company	21 (51.2%)	20 (48.8%)				
Construction Company	Null	Null				
Q2: Role in Organization						

Independent Variable	Yes N (%)	No N (%)	χ^2	df	P	Value Reflects Fisher Exact Test
Executive + VP	8 (47.1%)	9 (52.9%)			0.526	X
Senior Manager	5 (41.7%)	7 (58.3%)				
Project Manager	8 (66.7%)	4 (33.3%)				
Other	Null	Null				
Q3: Years Working Experience						
≤ 15 Years	1 (100.0%)	0 (0.0%)			0.055	X
16-20 Years	3 (60.0%)	2 (40.0%)				
21-25 Years	5 (100.0%)	0 (0.0%)				
> 25 Years	12 (40.0%)	18 (60.0%)				
Q4: Company Operates Internationally						
Works Internationally	21 (51.2%)	20 (48.8%)	Null	Null	Null	
Does Not Work Internationally	Null	Null				
Q5.1: Company Engages in Lump Sum Payment Structure						
Yes	11 (61.1%)	7 (38.9%)	1.257	1	0.262	
No	10 (43.5%)	13 (56.5%)				
Q5.2: Company Engages in Cost Reimbursable Payment Structure						
Yes	20 (50.0%)	20 (50.0%)			1.000	X
No	1 (100.0%)	0 (0.0%)				
Q5.3: Company Engages in Unit Rate Payment Structure						
Yes	13 (76.5%)	4 (23.5%)	7.411	1	0.006	
No	8 (33.3%)	16 (66.7%)				
Q8: Company Used Lump Sum on Past Project – Alberta						
Yes	8 (33.3%)	16 (66.7%)	7.411	1	0.006	
No	13 (76.5%)	4 (23.5%)				
Q9: Project Dollar Value – Alberta						
< $5 MM	Null	Null			0.278	X
< $100 MM	0 (0.0%)	4 (100.0%)				
< $1 B	5 (35.7%)	9 (64.3%)				
Q10: Company Used Lump Sum on Past Project - Internationally						
Yes	18 (56.3%)	14 (43.8%)			0.277	X
No	3 (33.3%)	6 (66.7%)				
Q11: Project Dollar Value - Internationally						
< $5 MM	Null	Null			0.007	X
< $100 MM	5 (100.0%)	0 (0.0%)				

Independent Variable	Yes N (%)	No N (%)	χ^2	df	P	Value Reflects Fisher Exact Test
< $1 B	3 (33.3%)	6 (66.7%)				
> $1 B	6 (100.0%)	0 (0.0%)				
b_Q5: Company Has Internal Construction Division						
Yes	21 (58.3%)	15 (41.7%)			0.021	X
No	0 (0.0%)	5 (100.0%)				

Engineering Company Interest in Lump Sum by Phase: Construction (b_Q3) versus:

- (Q5.3) Use Unit Rate: Those who used unit rate were highly interested in construction phase for future projects. Those who had not were not interested. (Highly correlated)
    - (χ^2 =7.41, *df*=1, P=0.006).
- (Q8) Used lump sum on past Alberta projects: Those who have used lump sum before were not interested in lump sum for construction. Those that had not, were. (Highly correlated)
    - (χ^2 =7.41 *df*=1, P=0.006).
- (Q11): Maximum Value of International Lump Sum Project: Highly correlated those who had performed large projects >$1B were all interested in lump sum for construction. $100MM-$1B not interested in construction.
    - (Fisher Exact Test: P=0.007).
- (B_Q5) Internal Construction Division: Those with an internal construction division were interested in lump sum for construction. Those without were not interested. (Medium correlation)
    - (Fisher Exact Test: P=0.021).

6.1.7 Engineering Company Interest in Lump Sum for Full EPC (b_Q4)

Table 6-7 - Examination of Hypotheses H216 – H227 For Lump Sum Interest By Phase – Full EPC (b_Q4)

Independent Variable	Yes N (%)	No N (%)	χ^2	df	P	Value Reflects Fisher Exact Test
Q1: Employment Type						
Operating Company	Null	Null	Null	Null	Null	
Engineering Company	10 (24.4%)	31 (75.6%)				
Construction Company	Null	Null				
Q2: Role in Organization						
Executive + VP	3 (17.6%)	14 (82.4%)			0.352	X
Senior Manager	5 (41.7%)	7 (58.3%)				
Project Manager	2 (16.7%)	10 (83.3%)				
Other	Null	Null				
Q3: Years Working Experience						
≤ 15 Years	1 (100.0%)	0 (0.0%)			0.173	X
16-20 Years	0 (0.0%)	5 (100.0%)				
21-25 Years	2 (40.0%)	3 (60.0%)				
> 25 Years	7 (23.3%)	23 (76.7%)				
Q4: Company Operates Internationally						
Works Internationally	10 (24.4%)	31 (75.6%)	Null	Null	Null	
Does Not Work Internationally	Null	Null				
Q5.1: Company Engages in Lump Sum Payment Structure						
Yes	6 (33.3%)	12 (66.7%)			0.289	X
No	4 (17.4%)	19 (82.6%)				
Q5.2: Company Engages in Cost Reimbursable Payment Structure						
Yes	9 (22.5%)	31 (77.5%)			0.244	X
No	1 (100.0%)	0 (0.0%)				
Q5.3: Company Engages in Unit Rate Payment Structure						
Yes	2 (11.8%)	15 (88.2%)			0.152	X
No	8 (33.3%)	16 (66.7%)				
Q8: Company Used Lump Sum on Past Project – Alberta						
Yes	5 (20.8%)	19 (79.2%)			0.714	X
No	5 (29.4%)	12 (70.6%)				
Q9: Project Dollar Value – Alberta						
< $5 MM	Null	Null			1.000	X
< $100 MM	0 (0.0%)	4 (100.0%)				
< $1 B	2 (14.3%)	12 (85.7%)				
Q10: Company Used Lump Sum on Past Project - Internationally						
Yes	7 (21.9%)	25 (78.1%)			0.662	X

Independent Variable	Yes N (%)	No N (%)	χ^2	df	P	Value Reflects Fisher Exact Test
No	3 (33.3%)	6 (66.7%)				
Q11: Project Dollar Value - Internationally						
< $5 MM	Null	Null			<0.001	X
< $100 MM	0 (0.0%)	5 (100.0%)				
< $1 B	0 (0.0%)	9 (100.0%)				
> $1 B	6 (100.0%)	0 (0.0%)				
b_Q5: Company Has Internal Construction Division						
Yes	10 (27.8%)	26 (72.2%)			0.310	X
No	0 (0.0%)	5 (100.0%)				

Engineering Company Interest in Lump Sum for Full EPC (b_Q4) versus:

- (Q11): Maximum Value of International Lump Sum Project: All that performed >$1B were interested in full EPC. All who had performed <$1B were not interested. (Highly correlated)
    - (Fisher Exact Test: P<0.001).

6.1.8 Construction Companies Lack Interest in Partnering on Lump Sum Projects (c_Q1)

The quantitative results were deemed invalid, thus this question was not analyzed.

6.1.9 Construction Company has Performed Lump Sum on Projects in Alberta Oil and Gas Industry (c_Q3)

Table 6-8 - Examination of Hypotheses H228 – H240 For Performed Lump Sum In Alberta Oil And Gas (c_Q3)

Independent Variable	Yes N (%)	No N (%)	χ^2	df	P	Value Reflects Fisher Exact Test
Q1: Employment Type						
Operating Company	Null	Null	Null	Null	Null	
Engineering Company	Null	Null				
Construction Company	35 (85.4%)	6 (14.6%)				
Q2: Role in Organization						
Executive + VP	10 (100.0%)	0 (0.0%)			0.044	X

Independent Variable	Yes N (%)	No N (%)	χ^2	df	P	Value Reflects Fisher Exact Test
Senior Manager	6 (100.0%)	0 (0.0%)				
Project Manager	7 (100.0%)	0 (0.0%)				
Other	12 (66.7%)	6 (33.3%)				
Q3: Years Working Experience						
≤ 15 Years	8 (100.0%)	0 (0.0%)			<0.001	X
16-20 Years	4 (40.0%)	6 (60.0%)				
21-25 Years	2 (100.0%)	0 (0.0%)				
> 25 Years	21 (100.0%)	0 (0.0%)				
Q4: Company Operates Internationally						
Works Internationally	32 (100.0%)	0 (0.0%)			<0.001	X
Does Not Work Internationally	3 (33.3%)	6 (66.7%)				
Q5.1: Company Engages in Lump Sum Payment Structure						
Yes	21 (100.0%)	0 (0.0%)			0.009	X
No	14 (70.0%)	6 (30.0%)				
Q5.2: Company Engages in Cost Reimbursable Payment Structure						
Yes	20 (100.0%)	0 (0.0%)			0.021	X
No	15 (71.4%)	6 (28.6%)				
Q5.3: Company Engages in Unit Rate Payment Structure						
Yes	23 (79.3%)	6 (20.7%)			0.156	X
No	12 (100.0%)	0 (0.0%)				
Q8: Company Used Lump Sum on Past Project – Alberta						
Yes	35 (85.4%)	6 (14.6%)	Null	Null	Null	
No	Null	Null				
Q9: Project Dollar Value – Alberta						
< $5 MM	7 (53.8%)	6 (46.2%)			0.001	X
< $100 MM	13 (100.0%)	0 (0.0%)				
< $1 B	15 (100.0%)	0 (0.0%)				
Q10: Company Used Lump Sum on Past Project - Internationally						
Yes	19 (100.0%)	0 (0.0%)			0.023	X
No	16 (72.7%)	6 (27.3%)				
Q11: Project Dollar Value - Internationally						
< $5 MM	4 (100.0%)	0 (0.0%)	Null	Null	Null	
< $100 MM	9 (100.0%)	0 (0.0%)				

Independent Variable	Yes N (%)	No N (%)	χ^2	df	P	Value Reflects Fisher Exact Test
< $1 B	Null	Null				
> $1 B	Null	Null				

The questions posed to construction companies on LS use within the oil and gas industry in Alberta and outside the oil and gas industry within Alberta were used to determine if there was less interest in LS for oil and gas than the other construction sectors. It was predicted that there would be differences in the prevalence and financial magnitude of use of LS in oil and gas and outside oil and gas.

Constructor Has Performed Lump Sum on Projects in Alberta Oil and Gas Industry (c_Q3) versus:

- (Q4) Operates Internationally: 100% who operate internationally used lump sum locally. Of those who did not work internationally, very few used lump sum in local oil and gas (Highly correlated)
    - (Fisher Exact Test: P<0.001).
- (Q9) Maximum Value of Local Lump Sum Project: > $5MM, all had used lump sum on oil and gas projects (Highly correlated)
    - (Fisher Exact Test: P=0.001).
- (Q10) Used Lump Sum Internationally: Lower percentage of those who had not performed lump sum internationally had performed lump sum locally than those with international experience. (Medium correlation)
    - (Fisher Exact Test: P=0.023).

6.1.10 Construction Company has Performed Lump Sum on Projects in Alberta Outside Oil and Gas (c_Q4)

Table 6-9 - Examination of Hypotheses H241 – H253 For Company Performed Lump Sum In Western Canada Outside Oil And Gas (c_Q4)

Independent Variable	Yes N (%)	No N (%)	χ^2	df	P	Value Reflects Fisher Exact Test
Q1: Employment Type						
Operating Company	Null	Null	Null	Null	Null	

Independent Variable	Yes N (%)	No N (%)	χ^2	df	P	Value Reflects Fisher Exact Test
Engineering Company	Null	Null				
Construction Company	30 (73.2%)	11 (26.8%)				
Q2: Role in Organization						
Executive + VP	9 (90.0%)	1 (10.0%)			0.379	X
Senior Manager	4 (66.7%)	2 (33.3%)				
Project Manager	6 (85.7%)	1 (14.3%)				
Other	11 (61.1%)	7 (38.9%)				
Q3: Years Working Experience						
≤ 15 Years	5 (62.5%)	3 (37.5%)			0.239	X
16-20 Years	6 (60.0%)	4 (40.0%)				
21-25 Years	1 (50.0%)	1 (50.0%)				
> 25 Years	18 (85.7%)	3 (14.3%)				
Q4: Company Operates Internationally						
Works Internationally	23 (71.9%)	9 (28.1%)			1.000	X
Does Not Work Internationally	7 (77.8%)	2 (22.2%)				
Q5.1: Company Engages in Lump Sum Payment Structure						
Yes	16 (76.2%)	5 (23.8%)	0.200	1	0.655	
No	14 (70.0%)	6 (30.0%)				
Q5.2: Company Engages in Cost Reimbursable Payment Structure						
Yes	12 (60.0%)	8 (40.0%)	3.450	1	0.063	
No	18 (85.7%)	3 (14.3%)				
Q5.3: Company Engages in Unit Rate Payment Structure						
Yes	18 (62.1%)	11 (37.9%)			0.018	X
No	12 (100.0%)	0 (0.0%)				
Q8: Company Used Lump Sum on Past Project – Western Canada						
Yes	30 (73.2%)	11 (26.8%)	Null	Null	Null	
No	Null	Null				
Q9: Project Dollar Value – Western Canada						
< $5 MM	10 (76.9%)	3 (23.1%)			0.027	X
< $100 MM	6 (46.2%)	7 (53.8%)				
< $1 B	14 (93.9%)	1 (6.7%)				
Q10: Company Used Lump Sum on Past Project - Internationally						
Yes	15 (78.9%)	4 (21.1%)	0.602	1	0.438	
No	15 (68.2%)	7 (31.8%)				
Q11: Project Dollar Value - Internationally						

Independent Variable	Yes N (%)	No N (%)	χ^2	df	P	Value Reflects Fisher Exact Test
< $5 MM	4 (100.0%)	0 (0.0%)			0.228	X
< $100 MM	5 (55.6%)	4 (44.4%)				
< $1 B	Null	Null				
> $1 B	Null	Null				

Constructor has Performed Lump Sum on Projects in Alberta Outside Oil and Gas Industry (c_Q4) versus:

- (Q9) Maximum Value of Local Lump Sum Project: Those performing larger projects are performing them on projects inside and outside oil and gas (Medium correlation)
    - (Fisher Exact Test: P=0.027)

Secondary Survey

6.1.11 Payment Structure Used Most Frequently: by Scope (Major Projects, Equipment, Buildings, Tankage) (Q4-Q7)

Table 6-10 – Examination of Hypotheses H1-H3 for Payment Structure Most Frequently Used: Major Projects (Q4)

Independent Variable	Lump Sum N (%)	Cost - Reimbursable N (%)	Unit Rate N (%)	χ^2	df	P	Value Reflects Fisher Exact Test
Q1: Years Working Experience							
≤ 10 Years	6 (35.3%)	7 (41.2%)	4 (23.5%)			0.011	X
11-15 Years	0 (0.0%)	14 (82.4%)	3 (17.6%)				
16-20 Years	7 (43.8%)	9 (56.3%)	0 (0.0%)				
21-25 Years	8 (27.6%)	17 (58.6%)	4 (13.8%)				
> 25 Years	8 (25.0%)	23 (71.9%)	1 (3.1%)				
Q2: Role in Organization							
Executive + VP	11 (44.0%)	10 (40.0%)	4 (16.0%)			0.046	X
Senior Manager	5 (15.2%)	26 (78.8%)	2 (6.1%)				
Project Manager	6 (23.1%)	19 (73.1%)	1 (3.8%)				
Other	7 (25.9%)	15 (55.6%)	5 (18.5%)				
9							
Q3: Type Of Organization							
Operating Company	4 (10.3%)	30 (76.9%)	5 (12.8%)			0.002	X
Engineering Company	13 (37.1%)	22 (62.9%)	0 (0.0%)				
Construction Company	12 (32.4%)	18 (48.6%)	7 (18.9%)				

Table 6-11 - Examination of Hypotheses H4-H6 for Payment Structure Most Frequently Used: Equipment (Q5)

Independent Variable	Lump Sum N (%)	Cost - Reimbursabl e N (%)	Unit Rate N (%)	χ^2	df	P	Value Reflects Fisher Exact Test
Q1: Years Working Experience							
≤ 10 Years	8 (72.7%)	2 (18.2%)	1 (9.1%)	20.996	8	0.007	
11-15 Years	8 (57.1%)	6 (42.9%)	0 (0.0%)				
16-20 Years	11 (78.6%)	3 (21.4%)	0 (0.0%)				
21-25 Years	6 (33.3%)	4 (22.2%)	8 (44.4%)				
> 25 Years	21 (63.6%)	8 (24.2%)	4 (12.1%)				
Q2: Role in Organization							
Executive + VP	8 (53.3%)	4 (26.7%)	3 (20.0%)	16.687	6	0.011	
Senior Manager	23 (69.7%)	7 (21.2%)	3 (9.1%)				
Project Manager	13 (59.1%)	2 (9.1%)	7 (31.8%)				
Other	10 (50.0%)	10 (50.0%)	0 (0.0%)				
Q3: Type Of Organization							
Operating Company	27 (75.0%)	4 (11.1%)	5 (13.9%)			0.089	X
Engineering Company	14 (53.8%)	8 (30.8%)	4 (15.4%)				
Construction Company	13 (46.4%)	11 (39.3%)	4 (14.3%)				

Table 6-12 - Examination of Hypotheses H7-H9 for Payment Structure Most Frequently Used: Buildings (Q6)

Independent Variable	Lump Sum N (%)	Cost - Reimbursable N (%)	Unit Rate N (%)	χ^2	df	P	Value Reflects Fisher Exact Test
Q1: Years Working Experience							
≤ 10 Years	10 (76.9%)	3 (23.1%)	0 (0.0%)	35.809	8	<0.001	
11-15 Years	6 (40.0%)	9 (60.0%)	0 (0.0%)				
16-20 Years	11 (91.7%)	1 (8.3%)	0 (0.0%)				
21-25 Years	11 (57.9%)	2 (10.5%)	6 (31.6%)				
> 25 Years	23 (71.9%)	9 (28.1%)	0 (0.0%)				
Q2: Role in Organization							
Executive + VP	11 (64.7%)	3 (17.6%)	3 (17.6%)	14.554	6	0.024	
Senior Manager	21 (61.8%)	10 (29.4%)	3 (8.8%)				
Project Manager	19 (90.5%)	2 (9.5%)	0 (0.0%)				
Other	10 (52.6%)	9 (47.4%)	0 (0.0%)				
Q3: Type Of Organization							
Operating Company	30 (76.9%)	8 (20.5%)	1 (2.6%)			0.273	X
Engineering Company	19 (65.5%)	8 (27.6%)	2 (6.9%)				
Construction Company	12 (52.2%)	8 (34.8%)	3 (13.0%)				

Table 6-13 - Examination of Hypotheses H10-H12 for Payment Structure Most Frequently Used: Tankage (Q7)

Independent Variable	Lump Sum N (%)	Cost - Reimbursable N (%)	Unit Rate N (%)	χ^2	df	P	Value Reflects Fisher Exact Test
Q1: Years Working Experience							
≤ 10 Years	5 (62.5%)	2 (25.0%)	1 (12.5%)	30.492	8	<0.001	
11-15 Years	0 (0.0%)	6 (60.0%)	4 (40.0%)				
16-20 Years	12 (100.0%)	0 (0.0%)	0 (0.0%)				
21-25 Years	8 (57.1%)	2 (14.3%)	4 (28.6%)				
> 25 Years	21 (80.8%)	3 (11.5%)	2 (7.7%)				
Q2: Role in Organization							
Executive + VP	7 (100.0%)	0 (0.0%)	0 (0.0%)	28.945	6	<0.001	
Senior Manager	22 (66.7%)	4 (12.1%)	7 (21.2%)				
Project Manager	14 (73.7%)	1 (5.3%)	4 (21.1%)				
Other	3 (27.3%)	8 (72.7%)	0 (0.0%)				
Q3: Type Of Organization							
Operating Company	25 (83.3%)	0 (0.0%)	5 (16.7%)			0.002	X
Engineering Company	10 (45.5%)	8 (36.4%)	4 (18.2%)				
Construction Company	11 (61.1%)	5 (27.8%)	2 (11.1%)				

*Payment Structure Used Most Frequently: (Major Projects, Equipment, Buildings, Tankage) Versus Organizational Type (Q4-Q7 * Q3)*

- (Q3 * Q4) Organizational Type * Payment Structure on major projects: All organizational types were more likely to be using cost reimbursable for major projects. Operators were most likely and Constructors least likely. More engineers and constructors using lump sum for major project than operators. (Highly correlated)
  - (Fisher Exact Test: P=0.002).
- (Q3 * Q7) Organizational Type * Payment Structure on Tankage: All organizational types used lump sum for tankage. (Highly correlated)
  - (Fisher Exact Test: P=0.002).

6.1.12 Payment Structure Used Most Frequently: Locally (Q9)

Table 6-14 - Examination of Hypotheses H16-H19 for Payment Structure Most Frequently Used: Locally (Q9)

Independent Variable	**Lump Sum N (%)**	**Cost - Reimbursable N (%)**	**Unit Rate N (%)**	χ^2	**df**	**P**	**Value Reflects Fisher Exact Test**
Q1: Years Working Experience							
≤ 10 Years	7 (63.6%)	4 (36.4%)	0 (0.0%)			<0.001	**X**
11-15 Years	4 (33.3%)	6 (50.0%)	2 (16.7%)				
16-20 Years	6 (50.0%)	6 (50.0%)	0 (0.0%)				
21-25 Years	7 (30.4%)	10 (43.5%)	6 (26.1%)				
> 25 Years	4 (12.5%)	28 (87.5%)	0 (0.0%)				
Q2: Role in Organization							
Executive + VP	8 (47.1%)	6 (35.3%)	3 (17.6%)			0.062	
Senior Manager	11 (32.4%)	22 (64.7%)	1 (2.9%)				
Project Manager	4 (19.0%)	13 (61.9%)	4 (19.0%)				
Other	5 (27.8%)	13 (72.2%)	0 (0.0%)				
Q3: Type Of Organization							
Operating Company	9 (30.0%)	20 (66.7%)	1 (3.3%)			0.248	
Engineering Company	7 (24.1%)	20 (69.0%)	2 (6.9%)				
Construction Company	12 (38.7%)	14 (45.2%)	5 (16.1%)				
Q8: Payment Structure: Internationally							
Lump Sum	4 (12.9%)	25 (80.6%)	2 (6.5%)			0.020	X
Cost - Reimbursable	0 (0.0%)	9 (100.0%)	0 (0.0%)				
Unit Rate	0 (0.0%)	0 (0.0%)	2 (100.0%)				

*Payment Structure Used Most Frequently: International versus Payment Structure Used Most Frequently: Locally (Q8 * Q9):*

- (Q8 * Q9) Payment Structure Most Frequently Used: Internationally Versus Locally: Those who used lump sum internationally used cost reimbursable locally, same as all other groups. The local market may be dictating cost reimbursable rather than being influenced by experience with lump sum execution. (Medium Correlation)
  - (Fisher Exact Test: P=0.02).

6.1.13 Payment Structure Used Most Frequently (Q10)

Table 6-15 - Examination of Hypotheses H20-H23 for Payment Structure Most Frequently Used (Q10)

Independent Variable	**Lump Sum N (%)**	**Cost - Reimbursable N (%)**	**Unit Rate N (%)**	χ^2	**df**	**P**	**Value Reflects Fisher Exact Test**
Q1: Years Working Experience							
≤ 10 Years	7 (38.9%)	11 (61.1%)	0 (0.0%)			<0.001	**X**
11-15 Years	0 (0.0%)	12 (70.6%)	5 (29.4%)				
16-20 Years	10 (62.5%)	6 (37.5%)	0 (0.0%)				
21-25 Years	9 (31.0%)	16 (55.2%)	4 (13.8%)				
> 25 Years	15 (40.5%)	22 (59.5%)	0 (0.0%)				
Q2: Role in Organization							
Executive + VP	14 (50.0%)	11 (39.3%)	3 (10.7%)			0.036	**X**
Senior Manager	10 (28.6%)	24 (68.6%)	1 (2.9%)				
Project Manager	4 (15.4%)	19 (73.1%)	3 (11.5%)				
Other	13 (46.4%)	13 (46.4%)	2 (7.1%)				
Q3: Type Of Organization							
Operating Company	9 (23.1%)	27 (69.2%)	3 (7.7%)			0.018	X
Engineering Company	14 (37.8%)	23 (62.2%)	0 (0.0%)				
Construction Company	18 (43.9%)	17 (41.5%)	6 (14.6%)				
Q11: Dollar Value of Largest LS Project Performed In Alberta							
< $100 MM	27 (36.5%)	40 (54.1%)	7 (9.5%)	1.597	4	0.809	
$100 MM - $500 MM	9 (32.1%)	17 (60.7%)	2 (7.1%)				
> $500 MM	5 (41.7%)	7 (58.3%)	0 (0.0%)				

*Payment Structure Used Most Frequently versus Organizational Type (Q10 * Q3):*

- (Q3) Organizational Type: Operators and Engineers use cost reimbursable most frequently, while Constructors used lump sum slightly more frequently than cost reimbursable (Medium Correlation)
    - (Fisher Exact Test: P=0.18)

6.1.14 Dollar Value of Largest Lump Sum Project Performed in Alberta (Q11)

Table 6-16 - Examination of Hypotheses H24-H26 for Dollar Value Of Largest Lump Sum Projects Performed In Alberta (Q11)

Independent Variable	< \$100 MM N (%)	\$100 MM - \$500 MM N (%)	> \$500 MM N (%)	χ^2	df	P	Value Reflects Fisher Exact Test
Q1: Years Working Experience							
≤ 10 Years	14 (77.8%)	4 (22.2%)	0 (0.0%)			<0.001	**X**
11-15 Years	8 (47.1%)	5 (29.4%)	4 (23.5%)				
16-20 Years	14 (87.5%)	2 (12.5%)	0 (0.0%)				
21-25 Years	26 (89.7%)	3 (10.3%)	0 (0.0%)				
> 25 Years	12 (35.3%)	14 (41.2%)	8 (23.5%)				
Q2: Role in Organization							
Executive + VP	21 (75.0%)	4 (14.3%)	3 (10.7%)			0.042	X
Senior Manager	23 (71.9%)	9 (28.1%)	0 (0.0%)				
Project Manager	13 (50.0%)	10 (38.5%)	3 (11.5%)				
Other	17 (60.7%)	5 (17.9%)	6 (21.4%)				
Q3: Type Of Organization							
Operating Company	19 (52.8%)	14 (38.9%)	3 (8.3%)			0.003	
Engineering Company	29 (78.4%)	8 (21.6%)	0 (0.0%)				
Construction Company	26 (63.4%)	6 (14.6%)	9 (22.0%)				

*Dollar Value of Largest Lump Sum Project Performed in Alberta versus Organizational Type (Q11 * Q3)*

- (Q3) Organizational Type: The majority of major of large dollar value projects (>\$100MM) are not being performed on a lump sum basis. (Highly correlated)
    - (Fisher Exact Test: P=0.003)

6.1.15 Interest in Lump Sum with Risk Sharing (Q12)

Table 6-17 - Examination of Hypotheses H27-H37 for Interested In Lump Sum If Risk Shared With Other Company (Q12)

Independent Variable	Yes N (%)	No N (%)	χ^2	df	P	Value Reflects Fisher Exact Test
Q1: Years Working Experience						
≤ 10 Years	16 (84.2%)	3 (15.8%)	3.053	4	0.549	
11-15 Years	12 (70.6%)	5 (29.4%)				
16-20 Years	14 (87.5%)	2 (12.5%)				
21-25 Years	24 (82.8%)	5 (17.2%)				
> 25 Years	32 (88.9%)	4 (11.1%)				
Q2: Role in Organization						

Independent Variable	Yes N (%)	No N (%)	χ^2	df	P	Value Reflects Fisher Exact Test
Executive + VP	26 (92.9%)	2 (7.1%)	4.764	3	0.190	
Senior Manager	25 (73.5%)	9 (26.5%)				
Project Manager	23 (88.5%)	3 (11.5%)				
Other	24 (82.8%)	5 (17.2%)				
Q3: Type Of Organization						
Operating Company	28 (73.7%)	10 (26.3%)	4.241	2	0.120	
Engineering Company	34 (89.5%)	4 (10.5%)				
Construction Company	36 (87.8%)	5 (12.2%)				
Q4: Payment Structure: Major Projects						
Lump Sum	29 (100.0%)	0 (0.0%)	8.677	2	0.013	
Cost - Reimbursable	52 (75.4%)	17 (24.6%)				
Unit Rate	10 (83.3%)	2 (16.7%)				
Q5: Payment Structure: Equipment						
Lump Sum	43 (81.1%)	10 (18.9%)	0.222	2	0.895	
Cost - Reimbursable	18 (78.3%)	5 (21.7%)				
Unit Rate	11 (84.6%)	2 (15.4%)				
Q6: Payment Structure: Buildings						
Lump Sum	53 (88.3%)	7 (11.7%)	2.643	2	0.267	
Cost - Reimbursable	19 (79.2%)	5 (20.8%)				
Unit Rate	4 (66.7%)	2 (33.3%)				
Q7: Payment Structure: Tankage						
Lump Sum	40 (88.9%)	5 (11.1%)	12.656	2	0.002	
Cost - Reimbursable	12 (92.3%)	1 (7.7%)				
Unit Rate	5 (45.5%)	6 (54.5%)				
Q8: Payment Structure: Internationally						
Lump Sum	26 (78.8%)	7 (21.2%)			0.517	X
Cost - Reimbursable	9 (100.0%)	0 (0.0%)				
Unit Rate	2 (100.0%)	0 (0.0%)				
Q9: Payment Structure: Locally						
Lump Sum	25 (89.3%)	3 (10.7%)			0.357	X
Cost - Reimbursable	42 (79.2%)	11 (20.8%)				
Unit Rate	8 (100.0%)	0 (0.0%)				
Q10: Payment Structure Used Most Frequently						
Lump Sum	39 (95.1%)	2 (4.9%)	6.126	2	0.047	
Cost - Reimbursable	51 (77.3%)	15 (22.7%)				
Unit Rate	7 (77.8%)	2 (22.2%)				
Q11: Dollar Value of Largest LS Project Performed In Alberta						
< $100 MM	63 (86.3%)	10 (13.7%)			0.371	X
$100 MM - $500 MM	21 (75.0%)	7 (25.0%)				

Independent Variable	Yes N (%)	No N (%)	χ^2	df	P	Value Reflects Fisher Exact Test
> $500 MM	10 (83.3%)	2 (16.7%)				

Interested in Lump Sum if Risk Sharing with another Organization (Q12) versus

- (Q4) Payment Structure Used on Major Projects: Those who have used lump sum on major projects were interested in risk sharing. Those who used cost reimbursable were least interested in risk sharing. (Medium correlation)
  - (χ^2 =8.68, *df*=2, P=0.013).
- (Q10) Payment Structure Used Most Frequently: Those who used lump sum were most interested in risk sharing for lump sum. (Medium correlation)
  - (χ^2 =6.13, *df*=2, P=0.047).

6.1.16 Lump Sum Payment Structure Effect on Project Behaviours (Q14)

Table 6-18 - Examination of Hypotheses H49-H59 for Lump Sum Effect On Project Behaviours (Q14)

Independent Variable	Lump Sum Will Change Project Behaviour N (%)	Current Behaviours Will Increase Problems On Lump Sum Projects N (%)	χ^2	df	P	Value Reflects Fisher Exact Test
Q1: Years Working Experience						
≤ 10 Years	11 (64.7%)	6 (35.3%)	3.127	4	0.537	
11-15 Years	8 (50.0%)	8 (50.0%)				
16-20 Years	8 (61.5%)	5 (38.5%)				
21-25 Years	13 (61.9%)	8 (38.1%)				
> 25 Years	24 (75.0%)	8 (25.0%)				
Q2: Role in Organization						
Executive + VP	13 (72.2%)	5 (27.8%)	7.694	3	0.053	
Senior Manager	20 (64.5%)	11 (35.5%)				
Project Manager	20 (80.0%)	5 (20.0%)				
Other	11 (44.0%)	14 (56.0%)				
Q3: Type Of Organization						
Operating Company	31 (86.1%)	5 (13.9%)	11.566	2	0.003	
Engineering Company	16 (50.0%)	16 (50.0%)				
Construction Company	17 (54.8%)	14 (45.2%)				
Q4: Payment Structure: Major Projects						
Lump Sum	14 (66.7%)	7 (33.3%)	7.084	2	0.029	
Cost - Reimbursable	44 (68.8%)	20 (31.3%)				
Unit Rate	3 (27.3%)	8 (72.7%)				

Independent Variable	Lump Sum Will Change Project Behaviour N (%)	Current Behaviours Will Increase Problems On Lump Sum Projects N (%)	χ^2	df	P	Value Reflects Fisher Exact Test
Q5: Payment Structure: Equipment						
Lump Sum	34 (70.8%)	14 (29.2%)	4.312	2	0.116	
Cost - Reimbursable	8 (44.4%)	10 (55.6%)				
Unit Rate	7 (53.8%)	6 (46.2%)				
Q6: Payment Structure: Buildings						
Lump Sum	33 (64.7%)	18 (35.3%)	1.548	2	0.461	
Cost - Reimbursable	10 (50.0%)	10 (50.0%)				
Unit Rate	3 (50.0%)	3 (50.0%)				
Q7: Payment Structure: Tankage						
Lump Sum	31 (72.1%)	12 (27.9%)	12.217	2	0.002	
Cost - Reimbursable	2 (16.7%)	10 (83.3%)				
Unit Rate	5 (50.0%)	5 (50.0%)				
Q8: Payment Structure: Internationally						
Lump Sum	12 (38.7%)	19 (61.3%)			0.165	X
Cost - Reimbursable	2 (22.2%)	7 (77.8%)				
Unit Rate	2 (100.0%)	0 (0.0%)				
Q9: Payment Structure: Locally						
Lump Sum	18 (85.7%)	3 (14.3%)	6.405	2	0.041	
Cost - Reimbursable	27 (54.0%)	23 (46.0%)				
Unit Rate	5 (62.5%)	3 (37.5%)				
Q10: Payment Structure Used Most Frequently						
Lump Sum	18 (62.1%)	11 (37.9%)	0.117	2	0.943	
Cost - Reimbursable	40 (65.6%)	21 (34.4%)				
Unit Rate	5 (62.5%)	3 (37.5%)				
Q11: Dollar Value of Largest LS Project Performed In Alberta						
< $100 MM	38 (61.3%)	24 (38.7%)	0.924	2	0.630	
$100 MM - $500 MM	17 (70.8%)	7 (29.2%)				
> $500 MM	5 (55.6%)	4 (44.4%)				

Lump Sum Effect on Project Behaviours (Q14) versus:

- (Q3) Organizational Type: Operators believed lump sum would correct project behaviours. Engineers and constructors were split on if behaviours would change or stay the same (Highly correlated)
    - (χ^2 =11.57, *df*=2, P=0.003).

- (Q4) Payment Structure Used on Major Projects: Those who used lump sum and cost reimbursable on major projects were more likely to believe lump sum would change project behaviours. Those who used unit rate were of the opposite opinion. (Medium correlation)
    - (χ^2 =7.08, *df*=2, P=0.029).
- (Q9) Payment Structure Most Frequently Used: Locally: Those who generally used lump sum believed lump sum would change project behaviours. Cost reimbursable users were much less likely to have that opinion. (Medium correlation)
    - (χ^2 =6.41, *df*=2, P=0.041).

6.2 Risk Management

Risk management, in this research, deals with the respondents' perceived risks of shifting to lump sum contracting. This section uses Chi Square, Fisher Exact Tests, T-Tests, and Oneway ANOVA to find significant relationships between the survey questions on industry's perceived risks to use lump sum and the demographic and company specific practice factors that may influence these opinions. The T-Tests and Oneway Anova analyses are being used to determine relationships between respondents' demographic and company specific practice information and opinion on the relative importance of identified barriers to lump sum. Barriers are listed below by survey:

Primary Survey:

1. Field labor market cost and predictability
2. Stability of weather difficult to predict, thereby making productivity difficult to predict
3. Local construction culture favors cost-reimbursable.
4. Module size constraints due to limitations with existing transportation infrastructure and no access to major waterways for shipping
5. Client late changes
6. Lack of scope definition (incomplete RFP/RFQ).

Secondary Survey:

1. Field labour market risks
2. Local construction companies favour cost-reimbursable contracts
3. Client late changes
4. Lack of scope definition
5. Client desire for fast tracking
6. Lack of experience in industry with LS contracts and their management roles

6.2.1 Organization Operates Internationally (Q4)

Table 6-19 – Examination of Hypotheses H41 – H46 for Company Operates Internationally (Q4)

Examination of Hypotheses H41 – H46 for Company Operates Internationally (Q4)						
Dependant Variable		**Independent Variable**		**T**	**(df)**	**P**
		Y	**N**			
Field Labour (Q14)	Mean	2.576	3.667	-2.225	106	0.028
	S.D.	1.436	1.000			
	N	99	9			
Stability of Weather (Q15)	Mean	4.922	3.222	3.598	84	0.001
	S.D.	1.345	1.302			
	N	77	9			
Cost-Reimbursable Construction Culture (Q16)	Mean	3.247	5.333	-5.122	104	0.000
	S.D.	1.155	1.323			
	N	97	9			
Module Size (Q17)	Mean	4.974	5.000	-0.092	84	0.927
	S.D.	0.827	0.500			
	N	77	9			
Client Late Changes (Q18)	Mean	2.824	2.333	1.139	109	0.257
	S.D.	1.246	1.118			
	N	102	9			
Lack of Scope Definition (Q19)	Mean	1.822	1.444	0.887	114	0.377
	S.D.	1.242	1.014			
	N	107	9			

- Q4 * Q14 had a medium correlation (t(106)= -2.23, P=0.028); ('Yes' M=2.58; 'No' M=3.67)
- Q4 * Q15 were highly correlated (t(84)= 3.60, P=0.001); ('Yes' M = 4.92; 'No' M = 3.22)
- Q4 * Q16 were highly correlated (t(104)= -5.12, P<0.001); ('Yes' M = 3.25; 'No' M = 5.33)

Two interesting observations that can be drawn are that companies who operate internationally were more concerned about risks stemming from field labour constraints and local cost reimbursable construction culture

There are two potential limitations with this T-Test analysis: the difference in size between the two groups of Q4 and that the 'No' group contains fewer than 20 data points. Comparing a large and small group together may give inaccurate results and there may reduce the ability to detect differences that are there.

6.2.2 Organization Engages in Lump Sum Payment Structures (Q5.1)

Table 6-20- Examination of Hypotheses H47 – H52 for Company Engages in Lump Sum Payment Structure (Q5.1)

Examination of Hypotheses H47 – H52 for Company Engages in Lump Sum Payment Structure (Q5.1)						
Dependant Variable		**Independent Variable**		**T**	**(df)**	**P**
		Y	**N**			
Field Labour (Q14)	Mean	2.724	2.600	0.447	106	0.656
	S.D.	1.542	1.309			
	N	58	50			
Stability of Weather (Q15)	Mean	5.283	4.125	4.066	84	0.000
	S.D.	1.259	1.381			
	N	46	40			
Cost-Reimbursable Construction Culture (Q16)	Mean	3.000	3.938	-3.903	103	0.000
	S.D.	1.239	1.210			
	N	57	48			
Module Size (Q17)	Mean	4.804	5.175	-2.200	84	0.031
	S.D.	0.885	0.636			
	N	46	40			
Client Late Changes* (Q18)	Mean	2.656	2.959	-1.231	83.554	0.222
	S.D.	1.031	1.457			
	N	61	49			
Lack of Scope Definition (Q19)	Mean	1.968	1.596	1.627	113	0.107
	S.D.	1.204	1.241			
	N	63	52			
* Asterisk denotes equal variance not assumed.						

- Q5.1 * Q15 was highly correlated (t(84)= 4.07, P<0.001); ('Yes' M=5.28; 'No' M=4.13)
- Q5.1 * Q16 was highly correlated (t(103)= -3.90, P<0.001); ('Yes' M=3.00; 'No' M=3.94)
- Q5.1 * Q17 has a medium correlation (t(84)= -2.20, P=0.031); ('Yes' M=4.80; 'No' M=5.18)

An interpretation of the results could be that companies who engage in lump sum believe local cost reimbursable construction culture and infrastructure constraints for large modules (lack of waterways) as larger barriers to lump sum execution than those who do not use lump sum.

6.2.3 Organization Engages in Cost Reimbursable Payment Structures (Q5.2)

Table 6-21 - Examination of Hypotheses H53 – H58 Company Engages in Cost Reimbursable Payment Structure (Q5.2)

Examination of Hypotheses H53 – H58 Company Engages in Cost Reimbursable Payment Structure (Q5.2)						
Dependant Variable		**Independent Variable**		**T**	**(df)**	**P**
		Y	**N**			
Field Labour* (Q14)	Mean	2.512	3.154	-2.336	55.620	0.023
	S.D.	1.493	1.120			
	N	82	26			
Stability of Weather* (Q15)	Mean	4.983	4.192	2.202	39.096	0.034
	S.D.	1.282	1.625			
	N	60	26			
Cost-Reimbursable Construction Culture (Q16)	Mean	3.190	4.154	-3.426	103	0.001
	S.D.	1.210	1.347			
	N	79	26			
Module Size* (Q17)	Mean	4.967	5.000	-0.216	75.933	0.830
	S.D.	0.894	0.500			
	N	61	25			
Client Late Changes* (Q18)	Mean	2.774	2.846	-0.258	108	0.797
	S.D.	1.206	1.377			
	N	84	26			
Lack of Scope Definition (Q19)	Mean	1.854	1.615	0.869	113	0.387
	S.D.	1.093	1.627			
	N	89	26			
* Asterisk denotes equal variance not assumed.						

- Q5.2 * Q14 has a medium correlation (t(55.62)= -2.34, P=0.023); (‘Yes’ M=2.51; ‘No’ M=3.15)
- Q5.2 * Q15 has a medium correlation (t(39.10)= 2.20, P=0.034); (‘Yes’ M=4.98; ‘No’ M=4.19)
- Q5.2 * Q16 was highly correlated (t(103)= -3.43, P=0.001); (‘Yes’ M=3.19; ‘No’ M=4.15)

The results show that those who engage in cost reimbursable feel labour market risks and cost reimbursable construction culture are larger risks to lump sum than those who do not use cost reimbursable.

6.2.4 Organization Engages in Unit Rate Payment Structures (Q5.3)

Table 6-22 - Examination of Hypotheses H59 – H64 Company Engages in Unit Rate Payment Structure (Q5.3)

Examination of Hypotheses H59 – H64 Company Engages in Unit Rate Payment Structure (Q5.3)						
Dependant Variable		**Independent Variable**		**T**	**(df)**	**P**
		Y	**N**			
Field Labour* (Q14)	Mean	2.421	2.941	-1.869	88.598	0.065
	S.D.	1.164	1.654			
	N	57	51			
Stability of Weather* (Q15)	Mean	4.500	4.977	-1.551	79.719	0.125
	S.D.	1.550	1.285			
	N	42	44			
Cost-Reimbursable Construction Culture (Q16)	Mean	3.772	3.021	3.048	103	0.003
	S.D.	1.282	1.229			
	N	57	48			
Module Size* (Q17)	Mean	5.140	4.814	1.925	67.707	0.058
	S.D.	0.560	0.958			
	N	43	43			
Client Late Changes* (Q18)	Mean	2.542	3.078	-2.301	108	0.023
	S.D.	1.134	1.309			
	N	59	51			
Lack of Scope Definition (Q19)	Mean	1.855	1.736	0.516	113	0.607
	S.D.	1.134	0.964			
	N	62	53			
* Asterisk denotes equal variance not assumed.						

- Q5.3 * Q15 was highly correlated (t(103)= 3.05, P=0.003); ('Yes' M=3.78; 'No' M=3.02)
- Q5.3 * Q17 has a medium correlation (t(108)= -2.30, P=0.023); ('Yes' M=2.52; 'No' M=3.08)

The results show that those who engage is unit rate are less concerned about the local cost reimbursable construction culture and more concerned about client late change than those who do not use unit rate

6.2.5 Company use of Lump Sum on Past Projects: International (Q10)

Table 6-23 - Examination of Hypotheses H77 – H82 Company Used Lump Sum on Past Project – Internationally (Q10)

Examination of Hypotheses H77–H82 Company Used Lump Sum on Past Project – Internationally (Q10)						
Dependant Variable		**Independent Variable**		**T**	**(df)**	**P**
		Y	**N**			
Field Labour* (Q14)	Mean	2.406	3.070	-2.472	99.677	0.015

Examination of Hypotheses H77–H82 Company Used Lump Sum on Past Project – Internationally (Q10)						
	S.D.	1.498	1.261			
	N	64	43			
Stability of Weather* (Q15)	Mean	5.170	4.231	3.139	74.998	0.002
	S.D.	1.257	1.477			
	N	47	39			
Cost-Reimbursable Construction Culture (Q16)	Mean	3.156	3.833	-2.697	104	0.008
	S.D.	1.198	1.360			
	N	64	42			
Module Size* (Q17)	Mean	4.878	5.108	-1.424	80.863	0.158
	S.D.	0.927	0.567			
	N	49	37			
Client Late Changes* (Q18)	Mean	2.742	2.841	-0.405	108	0.686
	S.D.	1.071	1.478			
	N	66	44			
Lack of Scope Definition (Q19)	Mean	1.971	1.533	1.885	113	0.062
	S.D.	1.239	1.179			
	N	70	45			
* Asterisk denotes equal variance not assumed.						

- Q10 * Q14 has a medium correlation (t(99.68)= -2.472, P=0.015); ('Yes' M=2.41; 'No' M=3.07)
- Q10 * Q15 was highly correlated (t(75)= 3.14, P=0.002); ('Yes' M=5.17; 'No' M=4.23)
- Q10* Q16 was highly correlated (t(104)= -2.70, P=0.008); ('Yes' M=3.16; 'No' M=3.83)

The results showed that participants whose companies had worked internationally were more concerned about labour market constraints and the local cost reimbursable construction culture than those who had not used lump sum internationally. They were also less concerned about weather stability than those who had not worked internationally.

6.2.6 Type of Organization (Q1)

Table 6-24 - Examination of Hypothesis H29-H34 for Type of Organization (Q1)

Examination of Hypothesis H29-H34 for Type of Organization(Q1) Largest Barriers to Lump Sum							
Dependant Variable		**Independent Variable**			**F**	**(df)**	**P**
		Operating	**Engineering**	**Construction**			
Field Labour(Q14)	Mean	2.552	2.263	3.122	3.860	(2, 105)	0.024

Examination of Hypothesis H29-H34 for Type of Organization(Q1) Largest Barriers to Lump Sum							
	S.D.	1.152	1.671	1.269			
	N	29	38	41			
Stability of Weather(Q15)	Mean	4.118	5.036	4.805	2.313	(2, 83)	0.105
	S.D.	1.453	1.170	1.537			
	N	17	28	41			
Cost-Reimbursable Construction Culture(Q16)	Mean	2.852	3.053	4.146	12.827	(2, 103)	0.000
	S.D.	1.657	0.899	1.014			
	N	27	38	41			
Module Size(Q17)	Mean	5.000	4.964	4.976	0.010	(2, 83)	0.990
	S.D.	0.500	1.071	0.689			
	N	17	28	41			
Client Late Changes(Q18)	Mean	2.813	3.289	2.293	7.107	(2, 108)	0.001
	S.D.	1.176	1.393	0.929			
	N	32	38	41			
Lack of Scope Definition(Q19)	Mean	1.853	1.878	1.878	0.381	(2, 113)	0.684
	S.D.	1.374	0.812	0.812			
	N	34	41	41			

- Q1 * Q14 has a medium correlation ($F(2, 105)= 3.86$, $P=0.024$); ('Operator' M=2.55; 'Engineer' M=2.26; 'Constructor' M=3.12)
- Q1 * Q16 is highly correlated ($F(2, 103)= 12.83$, $P<0.001$); ('Operator' M=2.85; 'Engineer' M=3.05; 'Constructor' M=4.15)
- Q1 * Q18 is highly correlated ($F(2, 108)= 7.11$, $P=0.001$); ('Operator' M=2.81; 'Engineer' M=3.29; 'Constructor' M=2.29)

An interpretation of the data may be that Engineers view field labour as a larger issue than Constructors. Constructors may feel they have more control over field labour than engineers. Engineers and Operators feel local cost reimbursable construction culture is a bigger issue than Constructors and Constructors see client late changes as a bigger issue than Engineers.

6.2.7 Role in Organization (Q2)

Table 6-25 - Examination of Hypothesis H35-H40 for Role in Organization (Q2)

Examination of Hypothesis H35 & H40 for Role in Organization(Q2) Largest Barriers to Lump Sum								
Dependant Variable		Independent Variable				F	(df)	P
		Executive VP	Senior Manager	Project Manager	Other			
Field Labour(Q14)	Mean	1.833	2.280	3.677	2.818	12.050	(3, 104)	0.000
	S.D.	0.950	1.339	1.447	1.220			
	N	30	25	31	22			
Stability of Weather(Q15)	Mean	5.538	3.294	5.381	4.318	16.108	(3, 82)	0.000
	S.D.	1.067	0.772	1.117	1.492			
	N	26	17	21	22			
Cost-Reimbursable Construction Culture(Q16)	Mean	3.567	3.536	2.536	4.300	9.360	(3, 102)	0.000
	S.D.	0.935	1.427	0.838	1.455			
	N	30	28	28	20			
Module Size(Q17)	Mean	5.000	5.158	4.579	5.136	2.310	(3, 82)	0.082
	S.D.	0.980	0.688	0.769	0.560			
	N	26	19	19	22			
Client Late Changes(Q18)	Mean	3.133	3.129	2.600	2.000	4.974	(3, 107)	0.003
	S.D.	1.008	1.668	1.102	0.000			
	N	30	31	30	20			
Lack of Scope Definition(Q19)	Mean	1.933	2.129	1.212	2.000	3.848	(3, 112)	0.012
	S.D.	0.944	1.565	0.415	1.574			
	N	30	31	33	22			

- Q2 * Q14 is highly correlated (F(3, 104)= 12.05, P<0.001); ('Executive' M=1.83; 'Senior Manager' M=2.28; 'Project Manager' M=3.68; 'Other' M=2.82)
- Q2 * Q15 is highly correlated (F(3, 82)= 16.11, P<0.001); ('Executive' M=5.54; 'Senior Manager' M=3.29; 'Project Manager' M=5.38; 'Other' M=4.32)
- Q2 * Q16 is highly correlated (F(3, 102)= 9.36, P<0.001); ('Executive' M=3.57; 'Senior Manager' M=3.54; 'Project Manager' M=2.54; 'Other' M=4.30)
- Q2 * Q18 is highly correlated (F(3, 107)= 4.97, P=0.003); ('Executive' M=3.13; 'Senior Manager' M=3.13; 'Project Manager' M=2.60; 'Other' M=2.00)
- Q2 * Q19 is highly correlated (F(3, 112)= 3.85, P=0.012); ('Executive' M=1.93; 'Senior Manager' M=2.13; 'Project Manager' M=1.21; 'Other' M=2.00)

An interpretation of the results could be that Executives and senior managers see labour market risks as a bigger issue than project managers. Senior managers see weather stability as a bigger concern than Executives and project managers. Project managers see local cost reimbursable construction culture and lack of scope definition as a bigger issue than executives and senior managers

6.2.8 Maximum Lump Sum Project Dollar Value: Alberta (Q9)

Table 6-26 - Examination of Hypothesis H71-H76 for Maximum Project Dollar Value: Alberta(Q9)

Maximum Project Dollar Value: Alberta(Q9) Largest Barriers to Lump Sum							
Dependant Variable		**Independent Variable (Project Dollar Value)**			**F**	**(df)**	**P**
		<5$MM	**<100$MM**	**<1$B**			
Field Labour(Q14)	Mean	2.684	2.143	3.081	3.668	(2, 74)	0.030
	S.D.	1.250	1.062	1.382			
	N	19	21	37			
Stability of Weather(Q15)	Mean	3.647	4.150	5.750	17.880	(2, 58)	0.000
	S.D.	1.367	1.387	0.847			
	N	17	20	24			
Cost-Reimbursable Construction Culture(Q16)	Mean	4.632	3.950	2.872	15.964	(2, 75)	0.000
	S.D.	1.461	0.887	1.128			
	N	19	20	39			
Module Size(Q17)	Mean	4.875	5.500	4.654	16.830	(2, 59)	0.000
	S.D.	0.500	0.513	0.485			
	N	16	20	26			
Client Late Changes(Q18)	Mean	2.857	3.476	2.214	7.482	(2, 81)	0.001
	S.D.	1.153	1.778	0.925			
	N	21	21	42			
Lack of Scope Definition(Q19)	Mean	1.810	1.714	1.833	0.056	(2, 81)	0.945
	S.D.	1.778	0.956	1.248			
	N	21	21	42			

- Q9 * Q14 has a medium correlation ($F(2,74)= 3.67$, $P=0.03$); ('<$5MM' M=2.68; '<$100MM' M=2.14; '<$1B' M=3.08)
- Q9 * Q15 is highly correlated ($F(2,58)= 17.88$, $P<0.001$); ('<$5MM' M=3.65; '<$100MM' M=4.15; '<$1B' M=5.75)

- Q9 * Q16 is highly correlated (F(2,75)= 15.96, P<0.001); (‘<$5MM’ M=4.63; ‘<$100MM’ M=3.95; ‘<$1B’ M=2.87)
- Q9 * Q17 is highly correlated (F(2,59)= 16.83, P<0.001); (‘<$5MM’ M=4.88; ‘<$100MM’ M=5.50; ‘<$1B’ M=4.65)
- Q9 * Q18 is highly correlated (F(2,81)= 7.48, P=0.001); (‘<$5MM’ M=2.86; ‘<$100MM’ M=3.47; ‘<$1B’ M=2.21)

An interpretation of the results could be that those who had performed projects of less than $100MM saw field labour market constraints as a bigger issue than those who had performed larger projects. Those who had performed projects greater than $100MM saw weather stability as a smaller issue than those who had performed smaller projects. Those who had performed project greater than $100MM also saw local cost reimbursable construction culture as a larger issue than those who had performed smaller projects. Those who performed medium size (>$5MM < $100MM) projects saw module transportation infrastructure as a less important issue than those who performed small or very large projects. Those who performed projects greater than $100MM saw client late changes as a larger issue than those who performed smaller projects.

6.2.9 Maximum Lump Sum Project Dollar Value: International (Q11)

Table 6-27 - Examination of Hypothesis H83 – H88 for Maximum Project Value(Q11)

Examination of Hypothesis H83 – H88 for Maximum Project Value(Q11) Largest Barriers to Lump Sum								
Dependant Variable		**Independent Variable (Project Dollar Value)**				**F**	**(df)**	**P**
		<5$MM	**<100$MM**	**<1$B**	**>1$B**			
Field Labour(Q14)	Mean	1.857	2.222	2.467	2.333	0.317	3, 42	0.813
	S.D.	1.069	1.309	1.407	1.862			
	N	7	18	15	6			
Stability of Weather(Q15)	Mean	3.000	5.444	6.000	4.500	24.596	3, 29	0.000
	S.D.	1.000	0.511	0.000	2.121			
	N	7	18	6	2			
Cost-Reimbursable Construction Culture(Q16)	Mean	4.571	3.556	2.714	2.000	6.543	3, 41	0.001
	S.D.	1.512	0.856	1.204	1.549			
	N	7	18	14	6			

Module Size(Q17)	Mean	4.714	5.556	4.750	5.000	6.172	3, 31	0.002
	S.D.	0.756	0.511	0.463	0.000			
	N	7	18	8	2			
Client Late Changes(Q18)	Mean	3.333	2.500	2.467	3.667	4.041	3, 44	0.013
	S.D.	1.323	0.514	1.125	0.516			
	N	9	18	15	6			
Lack of Scope Definition(Q19)	Mean	2.667	1.722	2.000	2.500	1.280	3, 44	0.293
	S.D.	2.500	0.826	0.926	0.548			
	N	9	18	15	6			

- Q11 * Q15 are highly correlated ($F(3, 29)= 24.60$, $P<0.001$); (‘<$5MM’ M=3.00; ‘<$100MM’ M=5.44; ‘<$1B’ M=6.00; ‘>$1B’ M =4.50)
- Q11 * Q16 are highly correlated ($F(3, 41)= 6.54$, $P=0.001$); (‘<$5MM’ M=4.57; ‘<$100MM’ M=3.56; ‘<$1B’ M=2.71; ‘>$1B’ M =2.00)
- Q11 * Q17 are highly correlated ($F(3, 31)= 6.17$, $P<=.002$); (‘<$5MM’ M=4.71; ‘<$100MM’ M=5.56; ‘<$1B’ M=4.75; ‘>$1B’ M =5.00)
- Q11 * Q18 are highly correlated ($F(3, 44)= 4.04$, $P=0.013$); (‘<$5MM’ M=3.33; ‘<$100MM’ M=2.50; ‘<$1B’ M=2.47; ‘>$1B’ M =3.67)

Interpreting the results it can be seen that those who execute small projects see stability of weather as a larger issue than those who performed larger projects. Those who executed projects >$100MM see local cost re construction culture as a larger issue than those who performed smaller projects. While none found infrastructure constraints on module size as very important, those who executed medium size projects saw it as more important than other groups. Those who executed medium size projects saw client late changes as a more significant issue than those who executed large projects.

6.2.10 Contracting in Albeta Oil and Gas Riskier than Contracting in Oil and Gas Internationally (bc_Q1)

Table 6-28 - Examination of Hypotheses H280 – H293 For Alberta Oil And Gas Riskier Than Internationally (bc_Q1)

Independent Variable	Yes N (%)	No N (%)	χ^2	df	P	Value Reflects Fisher Exact Test

Independent Variable	Yes N (%)	No N (%)	χ^2	df	P	Value Reflects Fisher Exact Test
Q1: Employment Type						
Operating Company	Null	Null	46.944	1	<0.001	
Engineering Company	33 (80.5%)	8 (19.5%)				
Construction Company	1 (2.8%)	35 (97.2%)				
Q2: Role in Organization						
Executive + VP	17 (63.0%)	10 (37.0%)	19.312	3	<0.001	
Senior Manager	9 (50.0%)	9 (50.0%)				
Project Manager	8 (57.1%)	6 (42.9%)				
Other	0 (0.0%)	18 (100.0%)				
Q3: Years Working Experience						
≤ 15 Years	0 (0.00%)	9 (100.0%)			0.001	X
16-20 Years	3 (20.0%)	12 (80.0%)				
21-25 Years	5 (71.4%)	2 (28.6%)				
> 25 Years	26 (56.5%)	20 (43.5%)				
Q4: Company Operates Internationally						
Works Internationally	33 (48.5%)	35 (51.5%)			0.069	X
Does Not Work Internationally	1 (11.1%)	8 (88.9%)				
Q5.1: Company Engages in Lump Sum Payment Structure						
Yes	16 (47.1%)	18 (52.9%)	0.208	1	0.648	
No	18 (41.9%)	25 (58.1%)				
Q5.2: Company Engages in Cost Reimbursable Payment Structure						
Yes	34 (61.8%)	21 (38.2%)	24.353	1	<0.001	
No	0 (0.0%)	22 (100.0%)				
Q5.3: Company Engages in Unit Rate Payment Structure						
Yes	18 (39.1%)	28 (60.9%)	1.170	1	0.279	
No	16 (51.6%)	15 (48.4%)				
Q8: Company Used Lump Sum on Past Project – Alberta						
Yes	23 (38.3%)	37 (61.7%)	3.736	1	0.053	
No	11 (64.7%)	6 (35.3%)				
Q9: Project Dollar Value – Alberta						
< $5 MM	0 (0.0%)	13 (100.0%)	12.197	2	0.002	
< $100 MM	4 (23.5%)	13 (76.5%)				
< $1 B	13 (54.2%)	11 (45.8%)				
Q10: Company Used Lump Sum on Past Project - Internationally						
Yes	29 (63.0%)	17 (37.0%)	16.530	1	<0.001	

Independent Variable	Yes N (%)	No N (%)	χ^2	df	P	Value Reflects Fisher Exact Test
No	5 (16.1%)	26 (83.9%)				
Q11: Project Dollar Value - Internationally						
< $5 MM	0 (0.0%)	4 (100.0%)			0.013	X
< $100 MM	5 (35.7%)	9 (64.3%)				
< $1 B	7 (77.8%)	2 (22.2%)				
> $1 B	5 (83.3%)	1 (16.7%)				

Riskiness of Contracting in Alberta Oil and Gas Compared to Internationally (bc_Q1) versus:

- (Q1) Organizational Type: Engineers saw a higher risk level locally. Constructors did not. (Highly correlated)
  - (χ^2 =46.94, *df*=1, P<0.001).
- (Q2) Role in Organization: Executives were most likely to see Alberta as riskier, with project managers as a close second. Senior managers were split on the issue. (Highly correlated)
  - (χ^2 =19.31, *df*=3, P<0.001).
- (Q3) Years' Experience: >20 years' experience were more likely to think Alberta riskier. <20 years, more likely to think it is not. (Highly correlated)
  - (Fisher Exact Test: P=0.001).
- (Q5.2) Use Cost Reimbursable: Those whose companies engage in cost reimbursable were more likely to view local as riskier than international. Those who did not use cost reimbursable did not view locally as riskier. (Highly correlated)
  - (χ^2 =24.35, *df*=1, P<0.001).
- (Q9) Maximum Value of Local Lump Sum Project: As dollar value increased, so did percentage of respondents that thought Alberta oil and gas was riskier. (Highly correlated)
  - (χ^2 =12.20, *df*=2, P=0.002).

- (Q10) Used Lump Sum Internationally: Those who used lump sum internationally were more likely to believe that local oil and gas is riskier than internationally. (Highly correlated)
    - (χ^2 =16.53, *df*=1, P<0.001).
- (Q11): Maximum Value of International Lump Sum Project: As maximum project value increased, so did the perception of risk level locally. (Medium correlation)
    - (Fisher Exact Test: P=0.013).

Secondary Survey

6.2.11 Effect of Risk Premiums in Lump Sum on Project Cost (Q13)

Table 6-29 - Examination of Hypotheses H38-H48 for Effect of Risk Premium In Lump Sum compared to Cost-Reimbursable Examination (Q13)

Independent Variable	**Yes N (%)**	**No N (%)**	**χ^2**	**df**	**P**	**Value Reflects Fisher Exact Test**
Q1: Years Working Experience						
≤ 10 Years	4 (23.5%)	13 (76.5%)	14.483	4	0.006	
11-15 Years	12 (85.7%)	2 (14.3%)				
16-20 Years	8 (50.0%)	8 (50.0%)				
21-25 Years	8 (33.3%)	16 (66.7%)				
> 25 Years	19 (52.8%)	17 (47.2%)				
Q2: Role in Organization						
Executive + VP	13 (56.5%)	10 (43.5%)	13.065	3	0.004	
Senior Manager	15 (48.4%)	16 (51.6%)				
Project Manager	5 (19.2%)	21 (80.8%)				
Other	18 (66.7%)	9 (33.3%)				
Q3: Type Of Organization						
Operating Company	10 (28.6%)	25 (71.4%)	12.750	2	0.002	
Engineering Company	14 (42.4%)	19 (57.6%)				
Construction Company	27 (69.2%)	12 (30.8%)				
Q4: Payment Structure: Major Projects						
Lump Sum	12 (52.2%)	11 (47.8%)	4.990	2	0.082	
Cost - Reimbursable	27 (40.9%)	39 (59.1%)				
Unit Rate	9 (75.0%)	3 (25.0%)				
Q5: Payment Structure: Equipment						
Lump Sum	22 (44.0%)	28 (56.0%)	7.764	2	0.021	
Cost - Reimbursable	18 (78.3%)	5 (21.7%)				

Independent Variable	Yes N (%)	No N (%)	χ^2	df	P	Value Reflects Fisher Exact Test
Unit Rate	6 (46.2%)	7 (53.8%)				
Q6: Payment Structure: Buildings						
Lump Sum	18 (33.3%)	36 (66.7%)	15.768	2	<0.001	
Cost - Reimbursable	15 (71.4%)	6 (28.6%)				
Unit Rate	6 (100.0%)	0 (0.0%)				
Q7: Payment Structure: Tankage						
Lump Sum	17 (37.8%)	28 (62.2%)	4.256	2	0.119	
Cost - Reimbursable	7 (53.8%)	6 (46.2%)				
Unit Rate	6 (75.0%)	2 (25.0%)				
Q8: Payment Structure: Internationally						
Lump Sum	23 (69.7%)	10 (30.3%)			0.065	X
Cost - Reimbursable	4 (44.4%)	5 (55.6%)				
Unit Rate	0 (0.0%)	2 (100.0%)				
Q9: Payment Structure: Locally						
Lump Sum	6 (33.3%)	12 (66.7%)			0.470	X
Cost - Reimbursable	27 (50.9%)	26 (49.1%)				
Unit Rate	4 (50.0%)	4 (50.0%)				
Q10: Payment Structure Used Most Frequently						
Lump Sum	18 (52.9%)	16 (47.1%)			0.094	X
Cost - Reimbursable	26 (41.3%)	37 (58.7%)				
Unit Rate	7 (77.8%)	2 (22.2%)				
Q11: Dollar Value of Largest LS Project Performed In Alberta						
< $100 MM	33 (48.5%)	35 (51.5%)	4.136	2	0.126	
$100 MM - $500 MM	9 (39.1%)	14 (60.9%)				
> $500 MM	9 (75.0%)	3 (25.0%)				

Effect of Risk Premiums in Lump Sum on Project Cost (Q13) versus:

- (Q1) Years' Experience: As industry experience increased, certainty on effect of using lump sum on project cost compared to the same project executed under cost reimbursable decreased. Opinions on outcome were very split above 16 years' experience (Highly correlated)
    - (χ^2 =14.48, *df*=4, P=0.006).

- (Q2) Role in Organization: As seniority of role increased, perception that risk premiums increased cost above cost reimbursable increased. (Highly correlated)
    - (χ^2 =13.07, *df*=3, P=0.004).
- (Q3) Organizational Type: Operators viewed lump sum favourably with most believing risk premiums would not drive project cost above cost reimbursable project cost. Constructors viewed lump sum negatively with most believing risk premiums would drive up project cost. (Highly correlated)
    - (χ^2 =12.75, *df*=2, P=0.002).

6.2.12 Top Labour Market Risk to Lump Sum Execution (Q22)

Table 6-30 - Examination of Hypotheses H60-H70 for Top Labour Market Risk (Q22)

Independent Variable	**Productivity N (%)**	**Availability N (%)**	**Cost N (%)**	χ^2	**df**	**P**	**Value Reflects Fisher Exact Test**
Q1: Years Working Experience							
≤ 10 Years	6 (31.6%)	10 (52.6%)	3 (15.8%)			<0.001	**X**
11-15 Years	12 (70.6%)	5 (29.4%)	0 (0.0%)				
16-20 Years	8 (50.0%)	7 (43.8%)	1 (6.3%)				
21-25 Years	1 (4.2%)	11 (45.8%)	12 (50.0%)				
> 25 Years	16 (43.2%)	17 (45.9%)	4 (10.8%)				
Q2: Role in Organization							
Executive + VP	5 (21.7%)	12 (52.2%)	6 (26.1%)			0.098	**X**
Senior Manager	12 (34.3%)	19 (54.3%)	4 (11.4%)				
Project Manager	14 (53.8%)	10 (38.5%)	2 (7.7%)				
Other	12 (41.4%)	9 (31.0%)	8 (27.6%)				
Q3: Type Of Organization							
Operating Company	16 (41.0%)	21 (53.8%)	2 (5.1%)			<0.001	X
Engineering Company	14 (42.4%)	5 (15.2%)	14 (42.4%)				
Construction Company	13 (31.7%)	24 (58.5%)	4 (9.8%)				
Q4: Payment Structure: Major Projects							
Lump Sum	12 (50.0%)	10 (41.7%)	2 (8.3%)			0.420	
Cost - Reimbursable	26 (37.1%)	27 (38.6%)	17 (24.3%)				
Unit Rate	5 (41.7%)	6 (50.0%)	1 (8.3%)				
Q5: Payment Structure: Equipment							
Lump Sum	26 (48.1%)	27 (50.0%)	1 (1.9%)	12.469	4	0.014	

Independent Variable	Productivity N (%)	Availability N (%)	Cost N (%)	χ^2	df	P	Value Reflects Fisher Exact Test
Cost - Reimbursable	9 (39.1%)	9 (39.1%)	5 (21.7%)				
Unit Rate	4 (30.8%)	5 (38.5%)	4 (30.8%)				
Q6: Payment Structure: Buildings							
Lump Sum	28 (50.0%)	25 (44.6%)	3 (5.4%)	11.690	4	0.020	
Cost - Reimbursable	8 (33.3%)	10 (41.7%)	6 (25.0%)				
Unit Rate	0 (0.0%)	4 (66.7%)	2 (33.3%)				
Q7: Payment Structure: Tankage							
Lump Sum	22 (47.8%)	21 (45.7%)	3 (6.5%)	10.492	4	0.033	
Cost - Reimbursable	6 (46.2%)	3 (23.1%)	4 (30.8%)				
Unit Rate	2 (18.2%)	5 (45.5%)	4 (36.4%)				
Q8: Payment Structure: Internationally							
Lump Sum	12 (36.4%)	11 (33.3%)	10 (30.3%)			0.078	X
Cost - Reimbursable	6 (66.7%)	3 (33.3%)	0 (0.0%)				
Unit Rate	0 (0.0%)	2 (100.0%)	0 (0.0%)				
Q9: Payment Structure: Locally							
Lump Sum	10 (43.5%)	11 (47.8%)	2 (8.7%)			0.107	X
Cost - Reimbursable	22 (40.7%)	22 (40.7%)	10 (18.5%)				
Unit Rate	0 (0.0%)	6 (75.0%)	2 (25.0%)				
Q10: Payment Structure Used Most Frequently							
Lump Sum	17 (47.2%)	15 (41.7%)	4 (11.1%)			0.219	X
Cost - Reimbursable	23 (34.3%)	28 (41.8%)	16 (23.9%)				
Unit Rate	3 (33.3%)	6 (66.7%)	0 (0.0%)				
Q11: Dollar Value of Largest LS Project Performed In Alberta							
< $100 MM	24 (34.8%)	29 (42.0%)	16 (23.2%)			0.224	X
$100 MM - $500 MM	12 (42.9%)	14 (50.0%)	2 (7.1%)				
> $500 MM	7 (58.3%)	3 (25.0%)	2 (16.7%)				

Top Labour Market Risk to Lump Sum Execution (Q22) versus:

- (Q1) Years' Experience: > 25 years' experience selected productivity and availability almost evenly. (Highly correlated)
    - (Fisher Exact Test: P<0.001).
- (Q3) Organizational Type: Engineers were concerned by productivity and cost. Constructors and Operators were concerned by productivity and availability. (Highly correlated)

- (Fisher Exact Test: P<0.001).

6.2.13 Role in Organization (Q2)

Table 6-31 - Examination of Hypothesis H93 – H98 for Role in Organization (Q2)

Examination of Hypothesis H93- H98 for Position(Q2) Largest Barriers to Lump Sum								
Dependant Variable		**Independent Variable (Position)**				**F**	**(df)**	**P**
		Executive & VP	**Senior Manager**	**Project Manager**	**Other**			
Field Labour Market Risks(Q16)	Mean	3.522	3.486	3.667	3.708	0.152	3, 102	0.928
	S.D.	1.648	1.483	1.129	1.488			
	N	23	35	24	24			
Cost-Reimbursable Construction Culture(Q17)	Mean	4.385	4.563	3.833	4.769	1.962	3, 91	0.125
	S.D.	1.710	1.216	1.551	1.423			
	N	13	32	24	26			
Client Late Changes(Q18)	Mean	3.800	4.031	3.682	3.222	1.470	3, 92	0.228
	S.D.	0.941	1.534	1.524	1.649			
	N	15	32	22	27			
Lack of Scope Definition(Q19)	Mean	2.087	1.771	1.360	1.828	1.431	3, 108	0.238
	S.D.	1.881	1.190	0.907	0.848			
	N	23	35	25	29			
Client Desire for Fast Tracking(Q20)	Mean	2.294	3.121	3.500	3.296	2.440	3, 97	0.069
	S.D.	1.160	1.596	1.504	1.463			
	N	17	33	24	27			
Lack of Industry Lump Sum Experience(Q21)	Mean	3.105	3.765	4.636	3.571	3.181	3, 99	0.027
	S.D.	1.150	1.793	1.560	1.814			
	N	19	34	22	28			

- Q2 * Q21 has a medium correlation (F(3, 99)= 3.18, P=0.027); ('Executive' M=3.11; 'Senior Manager' M=3.77; 'Project Manager' M=4.64; 'Other' M=3.57)

An interpretation of this data is that Executives saw lack of LS management experience within the industry as a larger issue than Project Managers.

6.2.14 Type of Organization (Q3)

Table 6-32 - Examination of Hypothesis H99 – H104 for Type of Organization (Q3)

Examination of Hypothesis H99- H104 for Type of Organization(Q3) Largest Barriers to Lump Sum						
Dependant Variable	**Independent Variable (Organization Type)**			**F**	**(df)**	**P**
	Operating	**Engineering**	**Construction**			

Examination of Hypothesis H99- H104 for Type of Organization(Q3) Largest Barriers to Lump Sum							
Field Labour Market Risks(Q16)	Mean	3.564	3.625	3.571	0.018	2, 103	0.982
	S.D.	1.021	1.476	1.787			
	N	39	32	35			
Cost-Reimbursable Construction Culture(Q17)	Mean	4.000	4.542	4.788	2.826	2, 92	0.064
	S.D.	1.356	1.587	1.386			
	N	38	24	33			
Client Late Changes(Q18)	Mean	4.079	3.167	3.618	2.875	2, 93	0.061
	S.D.	1.496	1.341	1.538			
	N	38	24	34			
Lack of Scope Definition(Q19)	Mean	1.436	2.031	1.854	2.240	2, 109	0.111
	S.D.	0.852	1.732	1.062			
	N	39	32	41			
Client Desire for Fast Tracking(Q20)	Mean	3.359	3.667	2.526	5.481	2, 98	0.006
	S.D.	1.693	1.633	0.951			
	N	39	24	38			
Lack of Industry Lump Sum Experience(Q21)	Mean	4.500	3.063	3.636	7.114	2, 100	0.001
	S.D.	1.797	1.435	1.537			
	N	38	32	33			

- Q3 * Q20 are highly correlated (F(2, 98)= 5.48, P=0.006); ('Operator' M=3.36; 'Engineer' M=3.67; 'Constructor' M=2.53)
- Q3 * Q21 is highly correlated (F(2, 100)= 7.11, P=0.001); ('Operator' M=4.50; 'Engineer' M=3.06; 'Constructor' M=3.64)

From this analysis it can be seen that Constructors felt that client desire for fast tracking was a larger issues than the other company types. Engineers felt that lack of industry experience with lump sum execution was a larger issue than Operators did.

6.2.15 Payment Structures Most Frequently Used: International (Q8)

Table 6-33 - Examination of Hypothesis H105 – H110 for Payment Structure for International Projects (Q8)

Examination of Hypothesis H105-H110 for Payment Structure for Int'l Projects(Q8) Largest Barriers to Lump Sum						
Dependant Variable	**Independent Variable (Organization Type)**			**F**	**(df)**	**P**
	Lump Sum	**Cost-Reimbursable**	**Unit Rate**			

Examination of Hypothesis H105-H110 for Payment Structure for Int'l Projects(Q8) Largest Barriers to Lump Sum							
Field Labour Market Risks(Q16)	Mean	3.267	3.000	2.000	0.584	2, 38	0.562
	S.D.	1.596	2.000	0.000			
	N	30	9	2			
Cost-Reimbursable Construction Culture(Q17)	Mean	4.464	5.444	3.000	3.791	2, 36	0.032
	S.D.	1.427	0.527	0.000			
	N	28	9	2			
Client Late Changes(Q18)	Mean	3.400	4.889	0.000	8.340	1, 37	0.006
	S.D.	1.354	1.364	0.000			
	N	30	9	0			
Lack of Scope Definition(Q19)	Mean	2.344	1.556	1.000	1.493	2, 40	0.237
	S.D.	1.715	0.527	0.000			
	N	32	9	2			
Client Desire for Fast Tracking(Q20)	Mean	3.750	2.667	4.000	1.929	2, 40	0.160
	S.D.	1.669	0.707	0.000			
	N	28	9	2			
Lack of Industry Lump Sum Experience(Q21)	Mean	3.281	3.444	0.000	0.070	1, 39	0.793
	S.D.	1.764	1.014	0.000			
	N	32	9	0			

- Q8 * Q17 have a medium correlation (F(2, 36)= 3.79, P=0.032); ('Lump Sum' M=4.46; 'Cost Reimbursable' M=5.44; 'Unit Rate' M=3.00)
- Q8 * Q18 are highly correlated (F(1, 37)= 8.34, P=0.006); ('Lump Sum' M=3.40; 'Cost Reimbursable' M=4.89; 'Unit Rate' M=0)

An interpretation of the results could be that those respondents who used unit rate internationally saw local cost reimbursable construction culture as a larger problem than those who used cost reimbursable internationally. Those who used lump sum internationally saw client late changes as a larger problem than those who used cost reimbursable.

6.2.16 Payment Structures Most Frequently Used: Locally (Q9)

Table 6-34 - Examination of Hypothesis H111- H116 for Payment Structure Used Locally (Q9) Largest Barriers to Lump Sum

Examination of Hypothesis H111 – H116 for Payment Structure Used Locally (Q9) Largest Barriers to Lump Sum

Examination of Hypothesis H111 – H116 for Payment Structure Used Locally (Q9) Largest Barriers to Lump Sum							
Dependant Variable		**Independent Variable (Organization Type)**			**F**	**(df)**	**P**
		Lump Sum	**Cost-Reimbursable**	**Unit Rate**			
Field Labour Market Risks(Q16)	Mean	3.474	3.327	3.500	0.096	2, 76	0.909
	S.D.	1.219	1.605	1.309			
	N	19	52	8			
Cost-Reimbursable Construction Culture(Q17)	Mean	4.294	4.157	4.625	0.349	2, 73	0.707
	S.D.	1.213	1.617	1.302			
	N	17	51	8			
Client Late Changes(Q18)	Mean	3.650	4.367	2.667	5.297	2, 72	0.007
	S.D.	1.424	1.395	0.516			
	N	20	49	6			
Lack of Scope Definition(Q19)	Mean	1.500	2.093	1.000	3.412	2, 83	0.038
	S.D.	0.913	1.508	0.000			
	N	22	54	8			
Client Desire for Fast Tracking(Q20)	Mean	3.150	3.423	3.250	0.241	2, 77	0.786
	S.D.	1.496	1.576	1.389			
	N	20	52	8			
Lack of Industry Lump Sum Experience(Q21)	Mean	4.053	3.340	5.167	3.895	2, 75	0.025
	S.D.	2.094	1.580	0.753			
	N	19	53	6			

- Q9 * Q18 are highly correlated (F(2, 72)= 5.30, P=0.007); ('Lump Sum' M=3.65; 'Cost Reimbursable' M=4.37; 'Unit Rate' M=2.67)
- Q9 * Q19 have a medium correlation (F(2, 83)= 3.41, P=0.038); ('Lump Sum' M=1.50; 'Cost Reimbursable' M=2.09; 'Unit Rate' M=1.00)
- Q9 * Q21 have a medium correlation (F(2, 75)= 3.90, P=0.025); ('Lump Sum' M=4.05; 'Cost Reimbursable' M=3.34; 'Unit Rate' M=5.17)

Those who used unit rate locally perceived client late changes as a much larger risk that those who use cost reimbursable locally. Those who used cost reimbursable locally saw client late changes as an issue of less concern than those who used unit rate. Lack of lump sum experience was of less concern to frequent users of unit rate.

6.2.17 Payment Structures used Most Frequently Overall (Q10)

Table 6-35 - Examination of Hypothesis H117- H122 for Payment Structure Used most Frequently (Q10)

Examination of Hypothesis H117- H122 for Most Frequent Payment Structure (Q10) Largest Barriers to Lump Sum							
Dependant Variable		**Independent Variable (Organization Type)**			**F**	**(df)**	**P**
		Lump Sum	**Cost-Reimbursable**	**Unit Rate**			
Field Labour Market Risks(Q16)	Mean	3.733	3.485	3.556	0.311	2, 102	0.733
	S.D.	1.721	1.304	1.236			
	N	30	66	9			
Cost-Reimbursable Construction Culture(Q17)	Mean	4.167	4.491	4.667	0.633	2, 91	0.533
	S.D.	1.599	1.426	1.225			
	N	30	55	9			
Client Late Changes(Q18)	Mean	3.290	4.035	2.714	4.324	2, 92	0.016
	S.D.	1.419	1.546	0.488			
	N	31	57	7			
Lack of Scope Definition(Q19)	Mean	2.314	1.582	1.000	6.342	2, 108	0.002
	S.D.	1.694	0.924	0.000			
	N	35	67	9			
Client Desire for Fast Tracking(Q20)	Mean	2.758	3.345	3.111	1.614	2, 97	0.204
	S.D.	1.275	1.628	1.364			
	N	33	58	9			
Lack of Industry Lump Sum Experience(Q21)	Mean	3.969	3.540	5.000	2.680	2, 99	0.074
	S.D.	1.713	1.730	0.816			
	N	32	63	7			

- Q8 * Q18 have a medium correlation (F(2, 92)= 4.32, P=0.016); (‘Lump Sum’ M=3.29; ‘Cost Reimbursable’ M=4.04; ‘Unit Rate’ M=2.71)
- Q8 * Q19 are highly correlated (F(2, 108)= 6.34, P=0.002); (‘Lump Sum’ M=2.31; ‘Cost Reimbursable’ M=1.58; ‘Unit Rate’ M=1.00)

A post hoc test, Tukey’s Test, was performed to determine where the significant differences were between the groups. For Q18, no significance difference in opinion was shown between the groups. Future work could be done in investigating for a potential error. One finding from the analysis is that frequent users of lump sum were less concerned by the lack of scope definition than users of the other payment structure types.

6.3 Project Management Experience

Project management experience, in this research, deals with the perceived project management experience and competence, in Alberta oil and gas, with the management of lump sum projects. This section uses Chi Square and Fisher Exact tests to find significant correlations between the survey questions on industry's ability to effectively execute lump sum projects and the demographic and company specific practice factors that may influence these opinions.

Primary Survey

6.3.1 Project Management Experience in Lump Sum Contracting (Q20)

Table 6-36 - Examination of Hypotheses H89 – H102 For Feasibility Of Lump Sum - Lack Of Experience (Q20)

Independent Variable	Yes N (%)	No N (%)	χ^2	df	P	Value Reflects Fisher Exact Test
Q1: Employment Type						
Operating Company	36 (90.0%)	4 (10.0%)	6.366	2	0.041	
Engineering Company	36 (87.8%)	5 (12.2%)				
Construction Company	29 (70.7%)	12 (29.3%)				
Q2: Role in Organization						
Executive + VP	26 (86.7%)	4 (13.3%)	32.161	3	<0.001	
Senior Manager	28 (90.3%)	3 (9.7%)				
Project Manager	37 (97.4%)	1 (2.6%)				
Other	10 (43.5%)	13 (56.5%)				
Q3: Years Working Experience						
≤ 15 Years	8 (61.5%)	5 (38.5%)			0.099	X
16-20 Years	20 (76.9%)	6 (23.1%)				
21-25 Years	13 (92.9%)	1 (7.1%)				
> 25 Years	60 (87.0%)	9 (13.0%)				
Q4: Company Operates Internationally						
Works Internationally	97 (86.6%)	15 (13.4%)			0.001	X
Does Not Work Internationally	3 (33.3%)	6 (66.7%)				
Q5.1: Company Engages in Lump Sum Payment Structure						
Yes	61 (91.0%)	6 (9.0%)	7.386	1	0.007	
No	39 (72.2%)	15 (27.8%)				
Q5.2: Company Engages in Cost Reimbursable Payment Structure						
Yes	85 (89.5%)	10 (10.5%)			0.001	X
No	15 (57.7%)	11 (42.3%)				

Independent Variable	Yes N (%)	No N (%)	χ^2	df	P	Value Reflects Fisher Exact Test
Q5.3: Company Engages in Unit Rate Payment Structure						
Yes	54 (80.6%)	13 (19.4%)	0.439	1	0.508	
No	46 (85.2%)	8 (14.8%)				
Q8: Company Used Lump Sum on Past Project – Alberta						
Yes	79 (81.4%)	18 (18.6%)			0.561	X
No	22 (88.0%)	3 (12.0%)				
Q9: Project Dollar Value – Alberta						
< $5 MM	12 (54.5%)	10 (45.5%)			0.005	X
< $100 MM	19 (90.5%)	2 (9.5%)				
< $1 B	41 (87.2%)	6 (12.8%)				
Q10: Company Used Lump Sum on Past Project – Internationally						
Yes	68 (90.7%)	7 (9.3%)	8.851	1	0.003	
No	32 (69.6%)	14 (30.4%)				
Q11: Project Dollar Value – Internationally						
< $5 MM	9 (90.0%)	1 (10.0%)			0.133	X
< $100 MM	18 (100.0%)	0 (0.0%)				
< $1 B	13 (76.5%)	4 (23.5%)				
> $1 B	6 (85.7%)	1 (14.3%)				
b_Q5: Company Has Internal Construction Division						
Yes	31 (86.1%)	5 (13.9%)			1.000	X
No	5 (100.0%)	0 (0.0%)				
c_Q3: Performed Lump Sum In Western Canadian Oil And Gas						
Yes	29 (82.9%)	6 (17.1%)			<0.001	X
No	0 (0.0%)	6 (100.0%)				
c_Q4: Performed Lump Sum In Alberta Outside Oil & Gas						
Yes	23 (76.7%)	7 (23.3%)			0.247	X
No	6 (54.5%)	5 (45.5%)				

Effect of Industry Project Management Experience on feasibility of Lump Sum (Q20) versus:

- (Q1) Organizational Type: All groups saw a deficiency. Engineers were the most negative about the lump sum experience level locally (Medium correlation)
  - (χ^2 = 6.37, *df*=2, P = 0.41).

- (Q2) Role in Organization: With Increasing level of role seniority, there is an increasing level of confidence in the industry lump sum experience. (Highly correlated)
    - (χ^2 =32.16, *df*=3, P<0.001).
- (Q4) Operates Internationally: If a company operated internationally, they were much more likely to believe Alberta lacked project management experience with Lump Sum (Highly Correlated)
    - (Fisher Exact Test: P=0.001)
- (Q5.1) Use Lump Sum: Those who used lump sum were more likely to believe Alberta lacked project management experience with Lump Sum (Highly correlated)
    - (χ^2 =7.39, *df*=1, P=0.007).
- (Q5.2) Use Cost Reimbursable: Those who used cost reimbursable were more likely than those who did not to see a lack of experience (Highly correlated)
    - (Fisher Exact Test: P=0.001)
- (Q9) Maximum Value of Local Lump Sum Project: Those who had performed lump sum above $5MM were more likely to see a lack of experience than <$5MM. (Highly correlated)
    - (Fisher Exact Test: P=0.005).
- (Q10) Used Lump Sum Internationally: Those who had used lump sum on international projects much more likely to see lack of experience (Highly correlated)
    - (Fisher Exact Test: P=0.006)

6.3.2 Sufficient Companies Capable of Preparing Lump Sum Proposals (Q22)

Table 6-37 Examination of Hypotheses H117– H175 For Sufficient Companies Capable Of Lump Sum Proposals (Q22)

Independent Variable	Yes N (%)	No N (%)	χ^2	df	P	Value Reflects Fisher Exact Test
Q1: Employment Type						
Operating Company	33 (84.6%)	6 (15.4%)	9.272	2	0.010	
Engineering Company	24 (58.5%)	17 (41.5%)				
Construction Company	34 (82.9%)	7 (17.1%)				
Q2: Role in Organization						
Executive + VP	15 (50.0%)	15 (50.0%)	15.371	3	0.002	

Independent Variable	Yes N (%)	No N (%)	χ^2	df	P	Value Reflects Fisher Exact Test
Senior Manager	26 (83.9%)	5 (16.1%)				
Project Manager	33 (89.2%)	4 (10.8%)				
Other	17 (73.9%)	6 (26.1%)				
Q3: Years Working Experience						
≤ 15 Years	8 (61.5%)	5 (38.5%)			0.001	X
16-20 Years	26 (100.0%)	0 (0.0%)				
21-25 Years	10 (76.9%)	3 (23.1%)				
> 25 Years	47 (68.1%)	22 (31.9%)				
Q4: Company Operates Internationally						
Works Internationally	82 (73.9%)	29 (26.1%)			0.447	X
Does Not Work Internationally	8 (88.9%)	1 (11.1%)				
Q5.1: Company Engages in Lump Sum Payment Structure						
Yes	49 (73.1%)	18 (26.9%)	0.282	1	0.596	
No	41 (77.4%)	12 (22.6%)				
Q5.2: Company Engages in Cost Reimbursable Payment Structure						
Yes	68 (71.6%)	27 (28.4%)	2.846	1	0.092	
No	22 (88.0%)	3 (12.0%)				
Q5.3: Company Engages in Unit Rate Payment Structure						
Yes	49 (74.2%)	17 (25.8%)	0.045	1	0.832	
No	41 (75.9%)	13 (24.1%)				
Q8: Company Used Lump Sum on Past Project – Alberta						
Yes	75 (77.3%)	22 (22.7%)	1.171	1	0.279	
No	16 (66.7%)	8 (33.3%)				
Q9: Project Dollar Value – Alberta						
< $5 MM	21 (95.5%)	1 (4.5%)			0.008	X
< $100 MM	13 (61.9%)	8 (38.1%)				
< $1 B	41 (87.2%)	6 (12.8%)				
Q10: Company Used Lump Sum on Past Project - Internationally						
Yes	49 (65.3%)	26 (34.7%)	9.967	1	0.002	
No	41 (91.1%)	4 (8.9%)				
Q11: Project Dollar Value - Internationally						
< $5 MM	9 (90.0%)	1 (10.0%)			<0.001	X
< $100 MM	8 (44.4%)	10 (55.6%)				

Independent Variable	Yes N (%)	No N (%)	χ^2	df	P	Value Reflects Fisher Exact Test
< $1 B	17 (100.0%)	0 (0.0%)				
> $1 B	3 (42.9%)	4 (57.1%)				
b_Q5: Company Has Internal Construction Division						
Yes	20 (55.6%)	16 (44.4%)			0.382	X
No	4 (80.0%)	1 (20.0%)				
c_Q3: Performed Lump Sum In Western Canadian Oil And Gas						
Yes	28 (80.0%)	7 (20.0%)			0.567	X
No	6 (100.0%)	0 (0.0%)				
c_Q4: Performed Lump Sum In Alberta Outside Oil & Gas						
Yes	24 (80.0%)	6 (20.0%)			0.651	X
No	10 (90.9%)	1 (9.1%)				

Sufficient Companies Capable of Lump Sum Proposals (Q22) versus:

- (Q1) Organizational Type: Operators and constructors very confident that there were sufficient companies. Engineers were much less confident. (Highly correlated)
  - (χ^2 =9.27, *df*=2, P=0.01).
- (Q2) Role in Organization: Executives less confident than Senior or Project managers in industry ability to prepare lump sum bids (Highly correlated)
  - (χ^2 =15.37, *df*=3, P=0.002).
- (Q3) Years' Experience: As experience level increased (>15), belief in industry capability decreased. Most >25 years believed there were insufficient capabilities. (Highly correlated)
  - (Fisher Exact Test: P=0.001).
- (Q9) Maximum Value of Local Lump Sum Project: Those who executed projects<$5MM were more confident that there sufficient companies (Highly correlated)
  - (Fisher Exact Test: P=0.008).
- (Q10) Used Lump Sum Internationally: Those who used lump sum internationally were less likely to believe the appropriate skills existed locally. (Highly correlated)

- o (χ^2 =9.97, *df*=1, P=0.002).
- (Q11): Maximum Value of International Lump Sum Project: Highly correlated but no clear conclusions.
  - o (Fisher Exact Test: P<0.001).

6.3.3 Difference in Types of Skilled Labour Required within the Oil and Gas Industry and Outside the Oil and Gas Industry (c_Q5)

Table 6-38 - Examination of Hypotheses H254 – H266 For Difference In Skilled Labour In Alberta Oil And Gas versus Outside Oil And Gas (c_Q5)

Independent Variable	Yes N (%)	No N (%)	χ^2	df	P	Value Reflects Fisher Exact Test
Q1: Employment Type						
Operating Company	Null	Null	Null	Null	Null	
Engineering Company	Null	Null				
Construction Company	23 (56.1%)	18 (43.9%)				
Q2: Role in Organization						
Executive + VP	9 (90.0%)	1 (10.0%)			<0.001	X
Senior Manager	1 (16.7%)	5 (83.3%)				
Project Manager	7 (100.0%)	0 (0.0%)				
Other	6 (33.3%)	12 (66.7%)				
Q3: Years Working Experience						
≤ 15 Years	0 (0.0%)	8 (100.0%)			0.001	X
16-20 Years	6 (60.0%)	4 (40.0%)				
21-25 Years	1 (50.0%)	1 (50.0%)				
> 25 Years	16 (76.2%)	5 (23.8%)				
Q4: Company Operates Internationally						
Works Internationally	15 (46.9%)	17 (53.1%)			0.054	X
Does Not Work Internationally	8 (88.9%)	1 (11.1%)				
Q5.1: Company Engages in Lump Sum Payment Structure						
Yes	16 (76.2%)	5 (23.8%)	7.057	1	0.008	
No	7 (35.0%)	13 (65.0%)				
Q5.2: Company Engages in Cost Reimbursable Payment Structure						
Yes	8 (40.0%)	12 (60.0%)			0.062	X
No	15 (71.4%)	6 (28.6%)				
Q5.3: Company Engages in Unit Rate Payment Structure						
Yes	16 (55.2%)	13 (44.8%)	0.034	1	0.853	

Independent Variable	Yes N (%)	No N (%)	χ^2	df	P	Value Reflects Fisher Exact Test
No	7 (58.3%)	5 (41.7%)				
Q8: Company Used Lump Sum on Past Project – Alberta						
Yes	23 (56.1%)	18 (43.9%)	Null	Null	Null	
No	Null	Null				
Q9: Project Dollar Value – Alberta						
< $5 MM	7 (53.8%)	6 (46.2%)	24.134	2	<0.001	
< $100 MM	1 (7.7%)	12 (92.3%)				
< $1 B	15 (100.0%)	0 (0.0%)				
Q10: Company Used Lump Sum on Past Project - Internationally						
Yes	7 (36.8%)	12 (63.2%)	5.331	1	0.021	
No	16 (72.7%)	6 (27.3%)				
Q11: Project Dollar Value - Internationally						
< $5 MM	1 (25.0%)	3 (75.0%)			0.308	X
< $100 MM	0 (0.0%)	9 (100.0%)				
< $1 B	Null	Null				
> $1 B	Null	Null				

Difference in Types of Labour required within the Oil and Gas Industry and Outside (c_Q5) versus:

- (Q2) Role in Organization: Executives and Project Managers believe there is a difference in skilled labour required. Senior managers do not think there is a difference. (Highly correlated))
  - (Fisher Exact Test: P<0.001)
- (Q3) Years' Experience: The majority of those >16 years felt there was a difference in skilled labour. Those with <15 years felt there was no difference. (Highly correlated)
  - (Fisher Exact Test: P=0.001)
- (Q5.1) Use Lump Sum: Those who used lump sum felt there was a difference in skills required. Those who did not use lump sum, did not see a difference. (Highly correlated)
  - (χ^2 =7.06, *df*=1, P=0.008).

- (Q9) Maximum Value of Local Lump Sum Project: Those who had performed projects >$100MM felt there was a difference. Those who had performed lower were more likely to think there was no difference (Highly correlated)
    - (χ^2 =24.13, *df*=2, P<0.001).
- (Q10) Used Lump Sum Internationally: Those who used lump sum internationally felt there was no difference in skilled labour required. Those who had not, felt there was a difference. (Medium correlation)
    - (χ^2 =5.33, *df*=1, P=0.021).

6.3.4 Difference in Quantity of Labour Required in Oil and Gas versus Outside (c_Q6)

Table 6-39 - Examination of Hypotheses H267 – H279 For Difference In Quantity Of Skilled Labour Required In Oil And Gas versus Outside Oil And Gas (c_Q6)

Independent Variable	Yes N (%)	No N (%)	χ^2	df	P	Value Reflects Fisher Exact Test
Q1: Employment Type						
Operating Company	Null	Null	Null	Null	Null	
Engineering Company	Null	Null				
Construction Company	23 (56.1%)	18 (43.9%)				
Q2: Role in Organization						
Executive + VP	9 (90.0%)	1 (10.0%)			<0.001	X
Senior Manager	1 (16.7%)	5 (83.3%)				
Project Manager	7 (100.0%)	0 (0.0%)				
Other	6 (33.3%)	12 (66.7%)				
Q3: Years Working Experience						
≤ 15 Years	0 (0.0%)	8 (100.0%)			0.001	X
16-20 Years	6 (60.0%)	4 (40.0%)				
21-25 Years	1 (50.0%)	1 (50.0%)				
> 25 Years	16 (76.2%)	5 (23.8%)				
Q4: Company Operates Internationally						
Works Internationally	15 (46.9%)	17 (53.1%)			0.054	X
Does Not Work Internationally	8 (88.9%)	1 (11.1%)				
Q5.1: Company Engages in Lump Sum Payment Structure						
Yes	16 (76.2%)	5 (23.8%)	7.057	1	0.008	
No	7 (35.0%)	13 (65.0%)				

Independent Variable	Yes N (%)	No N (%)	χ^2	df	P	Value Reflects Fisher Exact Test
Q5.2: Company Engages in Cost Reimbursable Payment Structure						
Yes	8 (40.0%)	12 (60.0%)			0.062	X
No	15 (71.4%)	6 (28.6%)				
Q5.3: Company Engages in Unit Rate Payment Structure						
Yes	16 (55.2%)	13 (44.8%)	0.034	1	0.853	
No	7 (58.3%)	5 (41.7%)				
Q8: Company Used Lump Sum on Past Project – Alberta						
Yes	23 (56.1%)	18 (43.9%)	Null	Null	Null	
No	Null	Null				
Q9: Project Dollar Value – Alberta						
< $5 MM	7 (53.8%)	6 (46.2%)	24.134	2	<0.001	
< $100 MM	1 (7.7%)	12 (92.3%)				
< $1 B	15 (100.0%)	0 (0.0%)				
Q10: Company Used Lump Sum on Past Project - Internationally						
Yes	7 (36.8%)	12 (63.2%)	5.331	1	0.021	
No	16 (72.7%)	6 (27.3%)				
Q11: Project Dollar Value - Internationally						
< $5 MM	1 (25.0%)	3 (75.0%)			0.308	X
< $100 MM	0 (0.0%)	9 (100.0%)				
< $1 B	Null	Null				
> $1 B	Null	Null				

Difference in Quantity of Labour Required in Oil and Gas and Outside (c_Q6) versus:

- (Q2) Role in Organization: Executives and Project Managers felt a difference in quantity existed. Senior managers did not. (Highly correlated)
  - (Fisher Exact Test: P=0.001)
- (Q3) Years' Experience: >15 years' experience believe there is a difference in quantity required. <15 years believe there is not a difference (Highly correlated)
  - (Fisher Exact Test: P=0.001)

- (Q5.1) Use Lump Sum: Those who use lump sum believe there is a difference in quantity of labour. Those who do not, believe there is not a difference (Highly correlated)
    - (χ^2 =7.06, *df*=1, P=0.008).
- (Q9) Maximum Value of Local Lump Sum Project: all who performed > $100MM saw a difference in quantity required. Those who had performed <$100MM were less likely to see a difference (Highly correlated)
    - (χ^2 =24.13, *df*=2, P<0.001).
- (Q10) Used Lump Sum Internationally: Those that had not used lump sum internationally felt there was a difference in quantity of labour required. Those who had used lump sum internationally felt there was not. (Medium correlation)
    - (χ^2 =5.33, *df*=1, P=0.021).

6.4 Stakeholder Challenges

Stakeholder challenges, in this research, deals with the perceived negative influence various stakeholders can have on a lump sum project in Alberta. In particular, the perceived major sources of interference to operating and contractor companies. This section uses Chi Square and Fisher Exact tests to find significant correlations between the survey questions on industry's perception of stakeholder risks and the demographic and company specific practice factors that may influence these opinions.

Primary Survey

6.4.1 Local Operating Company Interference Compared to International Operators (Q21)

Table 6-40 - Examination of Hypotheses H103 – H116 For More Client Input Locally Than Internationally (Q21)

Independent Variable	Yes N (%)	No N (%)	χ^2	df	P	Value Reflects Fisher Exact Test
Q1: Employment Type						
Operating Company	33 (84.6%)	6 (15.4%)	24.162	2	<0.001	
Engineering Company	36 (87.8%)	5 (12.2%)				
Construction Company	18 (43.9%)	23 (56.1%)				
Q2: Role in Organization						
Executive + VP	16 (53.3%)	14 (46.7%)	11.574	3	0.009	
Senior Manager	25 (80.6%)	6 (19.4%)				
Project Manager	32 (86.5%)	5 (13.5%)				
Other	14 (60.9%)	9 (39.1%)				
Q3: Years Working Experience						
≤ 15 Years	7 (53.8%)	6 (46.2%)			0.352	X
16-20 Years	20 (76.9%)	6 (23.1%)				
21-25 Years	11 (84.6%)	2 (15.4%)				
> 25 Years	49 (71.0%)	20 (29.0%)				
Q4: Company Operates Internationally						
Works Internationally	77 (69.4%)	34 (30.6%)			0.059	X
Does Not Work Internationally	9 (100.0%)	0 (0.0%)				
Q5.1: Company Engages in Lump Sum Payment Structure						
Yes	47 (70.1%)	20 (29.9%)	0.172	1	0.678	
No	39 (73.6%)	14 (26.4%)				

Independent Variable	Yes N (%)	No N (%)	χ^2	df	P	Value Reflects Fisher Exact Test
Q5.2: Company Engages in Cost Reimbursable Payment Structure						
Yes	76 (80.0%)	19 (20.0%)	15.595	1	<0.001	
No	10 (40.0%)	15 (60.0%)				
Q5.3: Company Engages in Unit Rate Payment Structure						
Yes	43 (65.2%)	23 (34.8%)	3.066	1	0.080	
No	43 (79.6%)	11 (20.4%)				
Q8: Company Used Lump Sum on Past Project – Alberta						
Yes	64 (66.0%)	33 (34.0%)	8.487	1	0.004	
No	23 (95.8%)	1 (4.2%)				
Q9: Project Dollar Value – Alberta						
< $5 MM	18 (81.8%)	4 (18.2%)	9.137	2	0.010	
< $100 MM	8 (38.1%)	13 (61.9%)				
< $1 B	31 (66.0%)	16 (34.0%)				
Q10: Company Used Lump Sum on Past Project – Internationally						
Yes	53 (70.7%)	22 (29.3%)	0.098	1	0.754	
No	33 (73.3%)	12 (26.7%)				
Q11: Project Dollar Value – Internationally						
< $5 MM	6 (60.0%)	4 (40.0%)			0.462	X
< $100 MM	9 (50.0%)	9 (50.0%)				
< $1 B	9 (52.9%)	8 (47.1%)				
> $1 B	6 (85.7%)	1 (14.3%)				
b_Q5: Company Has Internal Construction Division						
Yes	31 (86.1%)	5 (13.9%)			1.000	X
No	5 (100.0%)	0 (0.0%)				
c_Q3: Performed Lump Sum In Western Canadian Oil And Gas						
Yes	12 (34.3%)	23 (65.7%)			0.004	X
No	6 (100.0%)	0 (0.0%)				
c_Q4: Performed Lump Sum						

Independent Variable	Yes N (%)	No N (%)	χ^2	df	P	Value Reflects Fisher Exact Test
In Alberta Outside Oil & Gas						
Yes	13 (43.3%)	17 (56.7%)			1.000	X
No	5 (45.5%)	6 (54.5%)				

Local Operating Company Interference (Q21) versus:

- (Q1) Organizational Type: Operators and Engineers saw much greater local client input than international. Constructors were divided. (Highly correlated)
    - (χ^2 =24.16, *df*=2, P<0.001).
- (Q2) Role in Organization: As seniority level increased, there was a decrease in the perception that clients wanted higher levels of local input. (Highly correlated)
    - (χ^2 =11.57, *df*=3, P=0.009).
- (Q5.2) Use Cost Reimbursable: Those using cost reimbursable felt clients wanted more input. Those who did not, believed clients did not want more input locally (Highly correlated)
    - (Fisher Exact Test: P<0.001).
- (Q8) Used lump sum on past Alberta projects: Those who had used lump sum locally were less likely than those who had not to think clients wanted more input (Highly correlated)
    - (Fisher Exact Test: P=0.002)
- (Q9) Maximum Value of Local Lump Sum Project: Projects over $100MM and under $5MM believed clients wanted more input. (Highly correlated)
    - (χ^2 =9.14, *df*=2, P=0.01).

6.4.2 Project Phase at Which Operations Input Should be Limited (ab_Q2)

Table 6-41 - Examination of Hypotheses H157 – H168 For Project Phase At Which Operational Input Should Be Limited (ab_Q2)

Independent Variable	After DBM Phase N (%)	After FEED Phase N (%)	After Detailed Engineering N (%)	Operations Should Have Input In All Phases N (%)	χ^2	df	P	Value Reflects Fisher Exact Test
Q1: Employment Type								
Operating Company	4 (10.0%)	17 (42.5%)	17 (42.5%)	2 (5.0%)			0.106	X
Engineering Company	0 (0.0%)	25 (61.0%)	13 (31.7%)	3 (7.3%)				
Construction Company	Null	Null	Null	Null				
Q2: Role in Organization								
Executive + VP	0 (0.0%)	12 (60.0%)	8 (40.0%)	0 (0.0%)			0.036	X
Senior Manager	3 (12.0%)	11 (44.0%)	11 (44.0%)	0 (0.0%)				
Project Manager	0 (0.0%)	16 (51.6%)	11 (35.5%)	4 (12.9%)				
Other	1 (20.0%)	3 (60.0%)	0 (0.0%)	1 (20.0%)				
Q3: Years Working Experience								
≤ 15 Years	0 (0.0%)	3 (60.0%)	1 (20.0%)	1 (20.0%)			<0.001	X
16-20 Years	0 (0.0%)	4 (25.0%)	9 (56.3%)	3 (18.8%)				
21-25 Years	4 (33.3%)	7 (58.3%)	1 (8.3%)	0 (0.0%)				
> 25 Years	0 (0.0%)	28 (58.3%)	19 (39.6%)	1 (2.1%)				
Q4: Company Operates Internationally								
Works Internationally	4 (5.0%)	42 (52.5%)	30 (37.5)	4 (5.0%)	Null	Null	Null	
Does Not Work Internationally	Null	Null	Null	Null				
Q5.1: Company Engages in Lump Sum Payment Structure								
Yes	1 (2.2%)	29 (63.0%)	14 (30.4%)	2 (4.3%)			0.066	X
No	3 (8.8%)	12 (35.3%)	16 (47.1%)	3 (8.8%)				
Q5.2: Company Engages in Cost Reimbursable Payment Structure								
Yes	4 (5.3%)	37 (49.3%)	29 (38.7%)	5 (6.7%)			0.669	X
No	0 (0.0%)	4 (80.0%)	1 (20.0%)	0 (0.0%)				
Q5.3: Company Engages in Unit Rate Payment Structure								
Yes	0 (0.0%)	16 (42.1%)	17 (44.7%)	5 (13.2%)			0.006	X
No	4 (9.5%)	25 (59.5%)	13 (31.0%)	0 (0.0%)				
Q8: Company Used Lump Sum on Past Project – Alberta								
Yes	3 (5.4%)	23 (41.1%)	28 (50.0%)	2 (3.6%)			0.001	X
No	1 (4.0%)	19 (76.0%)	2 (8.0%)	3 (12.0%)				

Independent Variable	After DBM Phase N (%)	After FEED Phase N (%)	After Detailed Engineering N (%)	Operations Should Have Input In All Phases N (%)	χ^2	df	P	Value Reflects Fisher Exact Test
Q9: Project Dollar Value – Alberta								
< $5 MM	3 (33.3%)	1 (11.1%)	5 (55.6%)	0 (0.0%)			0.044	X
< $100 MM	0 (0.0%)	3 (37.5%)	5 (62.5%)	0 (0.0%)				
< $1 B	0 (0.0%)	14 (43.8%)	16 (50.0%)	2 (6.3%)				
Q10: Company Used Lump Sum on Past Project - Internationally								
Yes	4 (7.1%)	27 (48.2%)	21 (37.5%)	4 (7.1%)			0.585	X
No	0 (0.0%)	15 (62.5%)	8 (33.3%)	1 (4.2%)				
Q11: Project Dollar Value - Internationally								
< $5 MM	3 (50.0%)	0 (0.0%)	3 (50.0%)	0 (0.0%)			<0.001	X
< $100 MM	0 (0.0%)	9 (100.0%)	0 (0.0%)	0 (0.0%)				
< $1 B	0 (0.0%)	7 (41.2%)	10 (58.8%)	0 (0.0%)				
> $1 B	0 (0.0%)	4 (57.1%)	2 (28.6%)	1 (14.3%)				
b_Q5: Company Has Internal Construction Division								
Yes	Null	20 (55.6%)	13 (36.1%)	3 (8.3%)			0.213	X
No	Null	5 (100.0%)	0 (0.0%)	0 (0.0%)				

Project Phase at Which Operations Input Should be Limited (ab_Q2) versus:

- (Q3) Years' Experience: Those with more experience (>20 years) believe operational input should be limited earlier than those with less experience. (Highly correlated)
  - (Fisher Exact Test: P<0.001).
- (Q5.3) Use Unit Rate: Those who engage in unit rate are more comfortable with operational input in later stages than those who did not. (Highly correlated)
  - (Fisher Exact Test: P=0.006).
- (Q8) Used lump sum on past Alberta projects: Those who had not performed lump sum locally preferred limiting operational input earlier, after FEED Phase. Those who had wanted input limited after detailed engineering. (Highly correlated)
  - (Fisher Exact Test: P=0.001).

- (Q9) Maximum Value of Local Lump Sum Project: After detailed engineering was preferred by all who had responded. (Medium Correlation)
    - (Fisher Exact Test: P=0.044).
- (Q11): Maximum Value of International Lump Sum Project: >$5MM preferred either after FEED or after detailed engineering. (Highly correlated)
    - (Fisher Exact Test: P<0.001).

6.4.3 Reason for Late Changes from Operating Company (a_Q1)

Table 6-42 - Examination of Hypotheses H169 – H179 For Reasons For Late Changes From Operating Company (a_Q1)

Independent Variable	Changes in Understanding Internal Business Need N (%)	Changes in External Market Needs N (%)	Technical Aspects Originally Not Fully Understood N (%)	χ^2	df	P	Value Reflects Fisher Exact Test
Q1: Employment Type							
Operating Company	15 (45.5%)	5 (15.2%)	13 (39.4%)	Null	Null	Null	
Engineering Company	Null	Null	Null				
Construction Company	Null	Null	Null				
Q2: Role in Organization							
Executive + VP	2 (66.7%)	1 (33.3%)	0 (0.0%)			0.099	X
Senior Manager	8 (61.5%)	0 (0.0%)	5 (38.5%)				
Project Manager	5 (33.3%)	4 (26.7%)	6 (40.0%)				
Other	0 (0.0%)	0 (0.0%)	2 (100.0%)				
Q3: Years Working Experience							
≤ 15 Years	0 (0.0%)	0 (0.0%)	4 (100.0%)			0.002	X
16-20 Years	2 (28.6%)	0 (0.0%)	5 (71.4%)				
21-25 Years	4 (57.1%)	0 (0.0%)	3 (42.9%)				
> 25 Years	9 (60.0%)	5 (33.3%)	1 (6.7%)				
Q4: Company Operates Internationally							
Works Internationally	15 (46.9%)	5 (15.6%)	12 (37.5%)	Null	Null	Null	
Does Not Work Internationally	Null	Null	Null				
Q5.1: Company Engages in Lump Sum Payment Structure							
Yes	10 (47.6%)	5 (23.8%)	6 (28.6%)			0.146	X
No	5 (45.5%)	0 (0.0%)	6 (54.5%)				
Q5.2: Company Engages in Cost Reimbursable Payment Structure							
Yes	11 (39.3%)	5 (17.9%)	12 (42.9%)			0.138	X

Independent Variable	Changes in Understanding Internal Business Need N (%)	Changes in External Market Needs N (%)	Technical Aspects Originally Not Fully Understood N (%)	χ^2	df	P	Value Reflects Fisher Exact Test
No	4 (100.0%)	0 (0.0%)	0 (0.0%)				
Q5.3: Company Engages in Unit Rate Payment Structure							
Yes	8 (50.0%)	1 (6.3%)	7 (43.8%)			0.501	X
No	7 (43.8%)	4 (25.0%)	5 (31.3%)				
Q8: Company Used Lump Sum on Past Project – Alberta							
Yes	14 (56.0%)	1 (4.0%)	10 (40.0%)			0.006	X
No	1 (12.5%)	4 (50.0%)	3 (37.5%)				
Q9: Project Dollar Value – Alberta							
< $5 MM	2 (28.6%)	0 (0.0%)	5 (71.4%)			0.133	X
< $100 MM	4 (100.0%)	0 (0.0%)	0 (0.0%)				
< $1 B	7 (53.8%)	1 (7.7%)	5 (38.5%)				
Q10: Company Used Lump Sum on Past Project - Internationally							
Yes	8 (38.1%)	5 (23.8%)	8 (38.1%)			0.250	X
No	6 (54.5%)	0 (0.0%)	5 (45.5%)				
Q11: Project Dollar Value - Internationally							
< $5 MM	2 (33.3%)	0 (0.0%)	4 (66.7%)			0.002	X
< $100 MM	0 (0.0%)	4 (100.0%)	0 (0.0%)				
< $1 B	4 (66.7%)	0 (0.0%)	2 (33.3%)				
> $1 B	Null	Null	Null				

Reason for Late Changes from Operating Company (a_Q1) versus:

- (Q3) Years' Experience: <15 years were most concerned about technical aspects. Those with more experience were concerned about change internal business needs. Only those with >25 experience were concerned with external market needs. (Highly correlated)
  - (Fisher Exact Test: P=0.002).
- (Q8) Used lump sum on past Alberta projects: Those who used lump sum were most concerned about changing internal business needs. Those who had not, were most concerned about external market factors. (Highly correlated)

- (Fisher Exact Test: P=0.006).

Secondary Survey

6.4.4 Reason for Greater Local Client Input (Q25)

Table 6-43 - Examination of Hypotheses H82-H92 for Reason For Greater Local Client Input (Q25)

Independent Variable	Different Mix Of Expertise N (%)	Perception Of Contractor Lack Of Skill N (%)	Project Fast Tracking N (%)	Adversarial Construction Culture N (%)	Other Reason N (%)	χ^2	df	P	Value Reflects Fisher Exact Test
Q1: Years Working Experience									
≤ 10 Years	4 (26.7%)	0 (0.0%)	6 (40.0%)	2 (13.3%)	3 (20.0%)			<0.001	**X**
11-15 Years	0 (0.0%)	10 (83.3%)	0 (0.0%)	2 (16.7%)	0 (0.0%)				
16-20 Years	5 (38.5%)	1 (7.7%)	3 (23.1%)	3 (23.1%)	1 (7.7%)				
21-25 Years	1 (5.6%)	2 (11.1%)	10 (55.6%)	0 (0.0%)	5 (27.8%)				
> 25 Years	14 (42.4%)	2 (6.1%)	13 (39.4%)	3 (9.1%)	1 (3.0%)				
Q2: Role in Organization									
Executive + VP	0 (0.0%)	0 (0.0%)	12 (66.7%)	1 (5.6%)	5 (27.8%)			<0.001	**X**
Senior Manager	9 (30.0%)	3 (10.0%)	13 (43.3%)	4 (13.3%)	1 (3.3%)				
Project Manager	10 (43.5%)	3 (13.0%)	3 (13.0%)	3 (13.0%)	4 (17.4%)				
Other	5 (25.0%)	9 (45.0%)	4 (20.0%)	2 (10.0%)	0 (0.0%)				
Q3: Type Of Organization									
Operating Company	12 (38.7%)	4 (12.9%)	8 (25.8%)	3 (9.7%)	4 (12.9%)			0.159	X
Engineering Company	6 (24.0%)	3 (12.0%)	10 (40.0%)	1 (4.0%)	5 (20.0%)				
Construction Company	6 (17.1%)	8 (22.9%)	14 (40.0%)	6 (17.1%)	1 (2.9%)				
Q4: Payment Structure: Major Projects									
Lump Sum	1 (5.6%)	4 (22.2%)	10 (55.6%)	0 (0.0%)	3 (16.7%)			0.001	X
Cost - Reimbursable	22 (38.6%)	10 (17.5%)	10 (17.5%)	8 (14.0%)	7 (12.3%)				
Unit Rate	0 (0.0%)	1 (11.1%)	6 (66.7%)	2 (22.2%)	0 (0.0%)				
Q5: Payment Structure:									

Independent Variable	Different Mix Of Expertise N (%)	Perception Of Contractor Lack Of Skill N (%)	Project Fast Tracking N (%)	Adversarial Construction Culture N (%)	Other Reason N (%)	χ^2	df	P	Value Reflects Fisher Exact Test
Equipment									
Lump Sum	13 (28.9%)	6 (13.3%)	16 (35.6%)	5 (11.1%)	5 (11.1%)	19.741	8	0.011	
Cost - Reimbursable	4 (28.6%)	7 (50.0%)	2 (14.3%)	0 (0.0%)	1 (7.1%)				
Unit Rate	4 (33.3%)	0 (0.0%)	8 (66.7%)	0 (0.0%)	0 (0.0%)				
Q6: Payment Structure: Buildings									
Lump Sum	16 (32.0%)	6 (12.0%)	18 (36.0%)	5 (10.0%)	5 (10.0%)	17.293	8	0.027	
Cost - Reimbursable	5 (29.4%)	6 (35.3%)	6 (35.3%)	0 (0.0%)	0 (0.0%)				
Unit Rate	0 (0.0%)	0 (0.0%)	6 (100.0%)	0 (0.0%)	0 (0.0%)				
Q7: Payment Structure: Tankage									
Lump Sum	19 (44.2%)	2 (4.7%)	14 (32.6%)	4 (9.3%)	4 (9.3%)	26.042	8	0.001	
Cost - Reimbursable	1 (10.0%)	6 (60.0%)	3 (30.0%)	0 (0.0%)	0 (0.0%)				
Unit Rate	1 (14.3%)	1 (14.3%)	5 (71.4%)	0 (0.0%)	0 (0.0%)				
Q8: Payment Structure: Internationally									
Lump Sum	11 (42.3%)	6 (23.1%)	7 (26.9%)	1 (3.8%)	1 (3.8%)			0.064	X
Cost - Reimbursable	2 (22.2%)	4 (44.4%)	3 (33.3%)	0 (0.0%)	0 (0.0%)				
Unit Rate	0 (0.0%)	0 (0.0%)	0 (0.0%)	2 (100.0%)	0 (0.0%)				
Q9: Payment Structure: Locally									
Lump Sum	0 (0.0%)	3 (16.7%)	7 (38.9%)	5 (27.8%)	3 (16.7%)	22.762	8	0.004	
Cost - Reimbursable	20 (41.7%)	8 (16.7%)	14 (29.2%)	3 (6.3%)	3 (6.3%)				
Unit Rate	0 (0.0%)	0 (0.0%)	5 (71.4%)	2 (28.6%)	0 (0.0%)				
Q10: Payment Structure Used Most Frequently									
Lump Sum	3 (10.0%)	3 (10.0%)	18 (60.0%)	5 (16.7%)	1 (3.3%)			<0.001	X
Cost - Reimbursable	20 (37.7%)	11 (20.8%)	10 (18.9%)	3 (5.7%)	9 (17.0%)				
Unit Rate	0 (0.0%)	1 (14.3%)	4 (57.1%)	2 (28.6%)	0 (0.0%)				
Q11: Dollar Value of Largest LS Project Performed In Alberta									
< $100 MM	11 (20.8%)	9 (17.0%)	18	6 (11.3%)	9 (17.0%)			0.425	X

Independent Variable	Different Mix Of Expertise N (%)	Perception Of Contractor Lack Of Skill N (%)	Project Fast Tracking N (%)	Adversarial Construction Culture N (%)	Other Reason N (%)	χ^2	df	P	Value Reflects Fisher Exact Test
			(34.0%)						
$100 MM - $500 MM	6 (27.3%)	2 (9.1%)	11 (50.0%)	2 (9.1%)	1 (4.5%)				
> $500 MM	3 (25.0%)	4 (33.3%)	3 (25.0%)	2 (16.7%)	0 (0.0%)				

Reason for Greater Local Client Input (Q25) versus:

- (Q1) Years' Experience: >25 years' experience believe the mix of experience at local operators to be the reason for local client input. (Highly correlated)
    - (Fisher Exact Test: $P<0.001$).
- (Q2) Role in Organization: Executives and senior managers more likely to view desire for fast tracking as the reason for greater operator interference. (Highly correlated)
    - (Fisher Exact Test: $P<0.001$).
- (Q4) Payment Structure Used on Major Projects: Those that used lump sum on major projects saw project fast tracking as the issue. Those who used cost reimbursable were more likely to believe local operator expertise as the issue. (Highly correlated)
    - (χ^2 =23.77, df=8, P=0.003).
- (Q9) Payment Structure Most Frequently Used: Locally: Lump sum and unit rate users saw project fast tracking as the issue while cost reimbursable users saw greater operator expertise as the issue. (Highly correlated)
    - ($\chi2$ =22.76, df=8, P=0.004).
- (Q10) Payment Structure Used Most Frequently: Lump sum and unit rate users saw project fast tracking as the issue, while cost reimbursable users saw greater operator expertise as the issue. (Highly correlated)
    - (Fisher Exact Test: $P<0.001$).

6.5 Predicting interest in Lump Sum Contracting: Regressions Analysis

The following regressions, interest in lump sum and financial ranges of interest, were chosen for the following reasons:

- Operators are driving the lump sum market in Alberta
- A predicting model of interest level may help Operators evaluate contractor companies and whether it is justified to extend a Request for Proposal
- A predicting model for financial ranges of interest may help Operators evaluate what value of project for which a contractor is most willing and suited.

6.5.1 Multiple Logistic Regression – Company Interest in Lump Sum (Q12)

A logistic regression was performed to predict the outcome of Q12 (company interest in LS), a dichotomous dependent variable, using multiple categorical predictor variables with which Q12 was found to be highly correlated, specifically:

- Q1: Organizational Type
- Q3: Years working experience
- Q4: Company Operates Internationally

In analyzing the null hypothesis, there was found to be a 74.2% ability to predict a respondents company's interest in LS, without using any predictor variables. The Omnibus Tests of Model Coefficients, having included all the predictor variables, compares the model against the null hypothesis. The significance levels of this comparison are all <0.001, meaning the model will be a good predictor of Q12. The next result examined was the Nagelkerke R Square which explains how much of the variance is the outcome of Q12 is explained by the predictor variables. In this case, 59.4% of the variance in the outcome is predicted by the independent variables.

The Hosmer and Lemeshow Test was also reviewed for goodness of fit of the model, showing a significance of 0.64. Since this result is higher than 0.05 it shows to be a good model. From the Contingency Table for the Hosmer and Lemeshow Test, out of 11 subjects observed to be interested in LS, the model predicted 10.7. Finally, examining the Classification Table, the model was able to successfully predict 85% of the actual outcomes, approximately 10% better than without the model. The model in shown in Appendix 4.

To confirm that none of the independent variables displayed multicollinearity, Pearson Chi Squared correlations were run. Q1 and Q4 were found to be highly correlated (χ^2 =18.97, *df*=2, P<0.001). The logistic regression was re-run for Q1 and Q3 as the predictor variables and Q4 and Q3 as the predictor variables. The model including Q1 and Q3 was found to most successfully predict the actual outcomes, predicting 82.6% of the actual outcomes, compared with 80% success rate using Q4 and Q3. The final model is shown in Appendix 4. From the model Q1 was found to be the most significant factor in predicting whether a company was interested in LS. Q3 showed significantly less influence over the outcome. Operators were the reference category of Q1. From the model, the likelihood of being open to LS decreases from operators to constructors to engineers.

6.5.2 Ordinal Regression – Financial Ranges a Company is Willing to Lump Sum (Q24)

An ordinal regression was performed to predict the outcome of Q24 (financial ranges a company is willing to lump sum). The response variable, Q24 was treated as ordinal because the levels of Q24 have a natural low to high ordering, but the difference between values is arbitrary. The model uses multiple categorical predictor variables, with which Q24 was found to be highly correlated, specifically:

- Q2: Role in Organization
- Q3: Years working experience
- Q5.1: Company uses LS payment structures
- Q5.2: Company uses cost reimbursable payment structures
- Q10: Company has used LS Internationally

Q2 and Q3 are categorical variables with Q5.1, Q5.2 and Q10 being dichotomous. Originally, Q9 (maximum dollar value of local LS projects) and Q11 (maximum dollar value of international LS projects) were to be included in the model, given that they were highly correlated with the responses variable Q24. However, very few respondents answered these questions due to confidentiality, leaving only 34 valid cases in the ordinal logistic regression. The model would be over-fitted, causing a very misleading result.

The Model fitting information, a comparison of the 'Intercept Only' model against the model including the predictor variables, showed that the final model significantly improved the fit to the data. The chi-square significance of $P<0.001$ indicates that the model gives better predictions for the outcome categories. The Goodness of Fit table compares whether the observed data are consistent with the fitted model. The null hypothesis is that the model is good and if the chi square significance is greater than $P=0.05$, then the null hypothesis is not rejected and the fit is good. The analysis of the Q24 model shows a significance of <0.001. Unfortunately, this indicates that the model does not fit very well. Chi-square is sensitive to missing cells, and in this model there are 17 missing cells to 105 valid entries. Looking at the pseudo R-square is a better indicatory of goodness of fit. The Pseudo R-square Negelkerke statistic indicates whether the model is a good predictor of the outcome. The lower the R-square, the worse the model is. In this model the Negelkerke statistic is 0.413, indicating that the model can explain 41.3% of the variation between outcomes.

The Parameter Estimate Table shows the model, the relationship between the predictor variables and the outcome of Q24. What can be seen from the model is that only use of LS (Q5.1), use of cost-reimbursable (Q5.2), past use of LS internationally (Q10) and years' experience 16-20 years (Q3) are statistically significant predictors of Q24. Respondents whose companies use LS (Q5.1) are more likely to select higher levels of Q24. As well, respondents whose companies use cost-reimbursable are more likely to choose higher levels of Q24. Those who have performed LS internationally (Q10) are less likely to be willing to LS larger projects.

The Test of Parallel lines examines the proportional odds assumption. The null hypothesis assumes the slope of the coefficients in the model are the same across response categories. Failing to reject the null hypothesis ($P>0.05$) concludes that the assumption holds. For this model, $P=0.059$ so the assumption holds. The model for the ordinal regression in shown in Appendix 4.

7 Research Conclusions

7.1 Summary

Investments in Mega Projects in Alberta's oil and gas industry represent a significant proportion of the Alberta construction sector and economy. Massive cost overruns of up to 100% have been occurring on many of Alberta oil and gas projects. Previous studies on Alberta have indicated that the cost reimbursable construction culture that exists in the Alberta oil and gas environment may be a major cause of project cost overruns. These earlier studies have identified a demand for implementing lump sum contracting strategies as a method for reducing project cost overruns.

The intent of this study was to identify the perceptions of Operators, Engineers, and Constructors in the Alberta oil and gas industry regarding the use of lump sum contracts to mitigate cost overruns on Alberta projects. The following areas of interest were investigated:

- The current payment structure types being used
- Past use of lump sum contracting
- Perceived effect of lump sum on project performance
- The major risks to lump sum contracting and risk mitigations
- Perceived level of lump sum management and execution experience.

The thesis introduction detailed the background of cost overruns in the Alberta oil and gas industry, the need for and the goals of the study. The literature review presented an examination of four major areas of interest around contracting strategy that were found to influence project performance: contracting strategies, risk management, project management experience, and stakeholder challenges on mega projects. Various gaps in the research provided a justification for this study.

For the purposes of this study, interviews and surveys were designed to study variables based on the four areas of interest identified in the literature. For the first phase of the study, semi-structured, qualitative preliminary interviews were conducted with senior managers and executives from Alberta oil and gas Operating, Engineering Contracting, and Construction Contracting firms. These interviews verified the appropriateness of variables derived from literature. Common themes and information gathered from the preliminary interviews were used to create a confidential mixed-method primary survey that was distributed to experienced industry representatives from Operators, Engineers, and Constructors. Primary Survey questions that required further clarification and key themes arising from the Primary Survey formed the basis for a secondary survey. The Secondary Survey was a confidential survey administered during two seminars to members of Operating, Engineering and Construction companies. There were 122 and 118 respondents for the Primary and Secondary surveys, respectively. Tables 7-1 and 7-2 summarise the findings from both surveys.

Table 7-1 – Summary of findings from the Primary Survey

Categories	Factor	Response	%	Notes
Participant Demographics:	Role in Organization	Executives or Senior Managers	50	Even distribution of respondents from: Operators, Engineers, Constructors: 122 participants
	Years' Experience	>25	57	
Current Contract Strategy	Contract Type Use	Lump Sum	50	Lump sum used primarily internationally and for portions of local projects and fabrication. Engineers use LS almost exclusively on international projects
		Cost Reimbursable	80	
		Unit Rate	50	
	Lump Sum Use on Projects	Locally	80	• Engineers: LS used more internationally than locally • Operators/Constructors :LS used more locally than internationally • Engineers were only group performing LS contracts >$1B
		Internationally	62	
	Lump Sum Project Value	Locally: $100MM-$1B	40	
		Internationally: $5MM-$100MM	60	
	Why International Projects are More Conducive to Lump Sum	*Operators:* International market more experienced with LS	38	
		Constructors: International market more experienced with LS	50	
		Engineers: Owner involvement internationally is auditing; scope frozen, execution controlled by Engineers	17	
Industry Perceived Effect of Lump Sum	Company Interest in Lump Sum	Interested in Lump Sum	75	
	Advantages to Lump Sum	*Operators*: Cost certainty	80	
		Engineers: Higher profit margin/ greater incentive to control risks	27	

Categories	Factor	Response	%	Notes
		Constructors: Higher profit margin/greater risk control incentive	37	
	Disadvantages to Lump Sum	Operators: More appropriate for small work packages	5	
		Engineers: Too much owner interference	12	
		Constructors: High levels of risk result in larger risk premium	15	
	Financial Ranges Willing to Lump Sum	>$1B	12	
		$100MM-$1B	33	
	Scopes Willing To lump Sum	Entire Facilities	41	Require scope definition, only for green field, and reduced owner interference
	Effect of Lump Sum on Project Cost	Cost Increase	60	
	Reason for Cost Increase	Premium for risks contractors feel they cannot control (labour, interference, scope change, Etc.)	48	
	Reason for Cost Decrease	*Operators:* Force better scope management	15	
		Engineers: Change current inefficient project behaviours	12	
		Constructors: More efficient project delivery	24	
	Engineering Company: LS Interest by Project Phase	*FEED*	20	• Incomplete Scope • Reduces creativity of design
		Detailed Engineering	70	Can control work because scope is defined from FEED
		Construction	50	• If Constructors will commit to LS • Proper risk allocation
		Full EPC	25	Same as those for each phase
	Constructor Interest in Partnering on Lump Sum Projects	Disinterested: majority appeared disinterested from the long answers		• Perception that Engineers have history of producing incomplete IFC packages • Perception that Constructors being asked to absorb disproportionate amount of risk
Risks to Lump Sum	Major Barriers to Lump Sum	Lack of Scope Definition	1	Missing Reasons: • Fast Tracking • Lack of Lump Sum Experience *Number represents rank not percentage for this question
		Client Late Changes	2	
		Field Labour	3	
		Cost Reimbursable Construction Culture	4	
	Alberta Oil and Gas Riskier than Internationally	Contractors: Alberta is Riskier	44	

Categories	Factor	Response	%	Notes
Stakeholder Management Challenges for Lump Sum	Level of Client Interference	Identified as an Issue	72	• Poor Initial Scoping • Operator Company authority rests with Business Units • Perceived lack of skill at Engineering Company • Projects involve new technology or new implementations of existing technology
	Operator Project Manager Empowerment	Project Managers Lack Empowerment	84	• Business Units and operational departments within Operator have too much power (POO) • Lack of PM experience within Business Units and Senior Management • Improper Change Management • Inadequate early stakeholder involvement
	Project Phase at which to Limit Operational Input	Operational Input Limited after FEED	50	
	Proposed Solutions for Late Operational Input	*Operators:* Experienced operations rep. involved in design as single point of contact	40	
		Engineers: Operations have input at all stages, but restricted to functionality and safety	44	
	Reason for Late Changes from Operating Company	Changes in internal business needs	46	• Very little understanding in operating companies of how cost/schedule/scope are intertwined. • Inadequate early involvement of all required stakeholders/subject matter experts
		Technical aspects originally not fully understood	39	
Perceived Level of Experience with Lump Sum	Project Management Experience with Lump Sum	Lack proper skills	83	
	Companies with Experience Preparing Lump Sum Proposals	Sufficient companies	75	
	Different Type and Quantity of Skilled labour required in oil and gas projects	There is a difference in both, compared with projects outside oil and gas	56	
	Reasons	More journeymen in more specialized labour areas	22	
		More stringent safety codes and more	17	
		Fast tracked/compressed schedules	12	

Table 7-2 – Summary of findings from the Secondary Survey

Categories	Factor	Response	%	Notes
Participant Demographics:	Role in Organization	Executives or Senior Managers	53	Even distribution of respondents from: Operators, Engineers, Constructors: 118 participants
	Years' Experience	>20	56	
Current Contract Strategy	Contract Type Use	Major Projects: Cost Reimbursable	63	• Preferred local method for projects is still confirmed to be cost reimbursable. • Lump sum is the most common structure for international projects. • Lump sum local is mostly vendor packages.
		Equipment: Lump Sum	60	
		Buildings: Lump Sum	67	
		Tankage: Lump Sum	66	
		International Projects: Lump Sum	75	
		Local Projects: Cost Reimbursable	60	
Industry Perceived Effect of Lump Sum on Project Performance	Interest in Lump Sum with Risk Sharing	Interested in Lump Sum	84	
	Effect of Lump Sum on Project Execution Behaviours	Lump Sum will Change Project Behaviour	65	
	Reasons Behaviour will Change	Efficiencies become business driver for contactor	25	Efficiency is profit incentive for productivity
	Reasons Behaviour will not Change	Lack of industry project management experience with LS and Operator interference will result in loss of productivity	15	
Risks to Lump Sum	Major Barriers to Lump Sum and Mitigation Strategies	Lack of Scope Definition	1	• Adopt hybrid contracting • Implement a strong Change Management in contract • Do not LS Fast Tracked project • Maintain presence from engineering, procurement, and construction for project duration
		Client Desire for Fast Tracking	2	• Do not implement lump sum on schedule driven projects • Use hybrid contracts • Empower project managers to control unnecessary changes after scope freeze

Categories	Factor	Response	%	Notes
		Field Labour	3	• Improve knowledge of market sensitivity • Develop labour acquisition plans and agree with all parties the cost of labour risk premium • Divide field labour risk between Operator (Availability) and Contractor (Productivity) • Invest in required skilled labour training
		Client Late Changes	4	• Same as Lack of Scope definition
		Lack of LS Industry Experience	5	• Hire individuals with international experience • Train project team on skills required together (contractor and operator) • Allocate risk prior to project execution
		Cost Reimbursable Construction Culture	6	• Behaviour change will be forced with increased desire for lump sum from clients • Recruit project advisors and project/ construction managers with international oil and gas experience. • Implement hybrid contracting
	Risk Sharing Models	*Operator Risks: External Risks* • Quantities • Camp accommodations • Escalation • Weather • Material cost • Geotechnical • Scope changes • Force Majeure		• Clear Roles and Responsibilities regarding risk prior to contract execution and periodic review • Incentive for assuming risks: % of producing facility revenue; risk/reward for achieving milestones (schedule and productivity targets) • Agreed upon risk premium based on identified factors • Mechanism in contract for cost changes: unit rate for risk items that are outside contractor control
		Contractor Risks: Internal Risks • Productivity • Rework as a result of quality or design/construction error • Currency exchange • Transportation of workforce • Camp accommodations • Finding labour • Training labour Management of site safety		
	Effect or Risk Premium on Final Project Cost	Lump Sum Will not Result in Higher Project Cost	50	

Categories	Factor	Response	%	Notes
	Reasons Would Not Increase Cost	Forces better planning, better management of interfaces, constructability, contract strategies, and scheduling	13	
		Provides incentive for contractor efficiency to retain extra profit from risk premium	10	
		Will result in well-defined scope and quality deliverables	9	
	Reasons Would Increase Cost	Contractor adds higher profit margin to account for higher levels of risk from lump sum	9	
		Contractor responsible for risk elements outside their control; Will add risk premium	13	
		The project management skills for lump sum do not exist in oil and gas locally.	10	
	Top Labour Market Risks	Productivity	38	
	Root Cause: Productivity Risk	Operators: lack of skilled supervisions	13	
		Engineers & Constructors: lack of viable project execution plans	15	
	Top Labour Market Risks	Availability	44	
	Root Cause: Availability Risk	Investment in projects outpacing number of skilled individuals in the market and driving up compensation rates	28	
Stakeholder Management Challenges for Lump Sum	Reasons for Greater Local Client Interference	Desire for project fast tracking	35	Missing Reason: Profit margin lower for local client than international ones, so less tolerant of cost overruns
Perceived Level of Experience with Lump Sum	Areas of Inexperience with Project Management for Lump Sum	Inexperience with properly estimating costs and dilution estimator skill set	19	
		Operators and Engineers: Lack of understanding of how to identify, and fairly allocate risks in a lump sum environment	22	
		Constructors: Lack of sufficient quality specifications on the owners side to set quality expectations	17	

Statistical analyses were conducted using four test types (Chi Square, Fisher Exact Test, T-Test, One-Way ANOVA). 293 hypotheses from the Primary Survey and 122 hypotheses from the Secondary Survey were identified and tested. Figures 7-1 and 7-2 and Tables 7-3 and 7-4 that are presented below, summarize the statistically significant correlations.

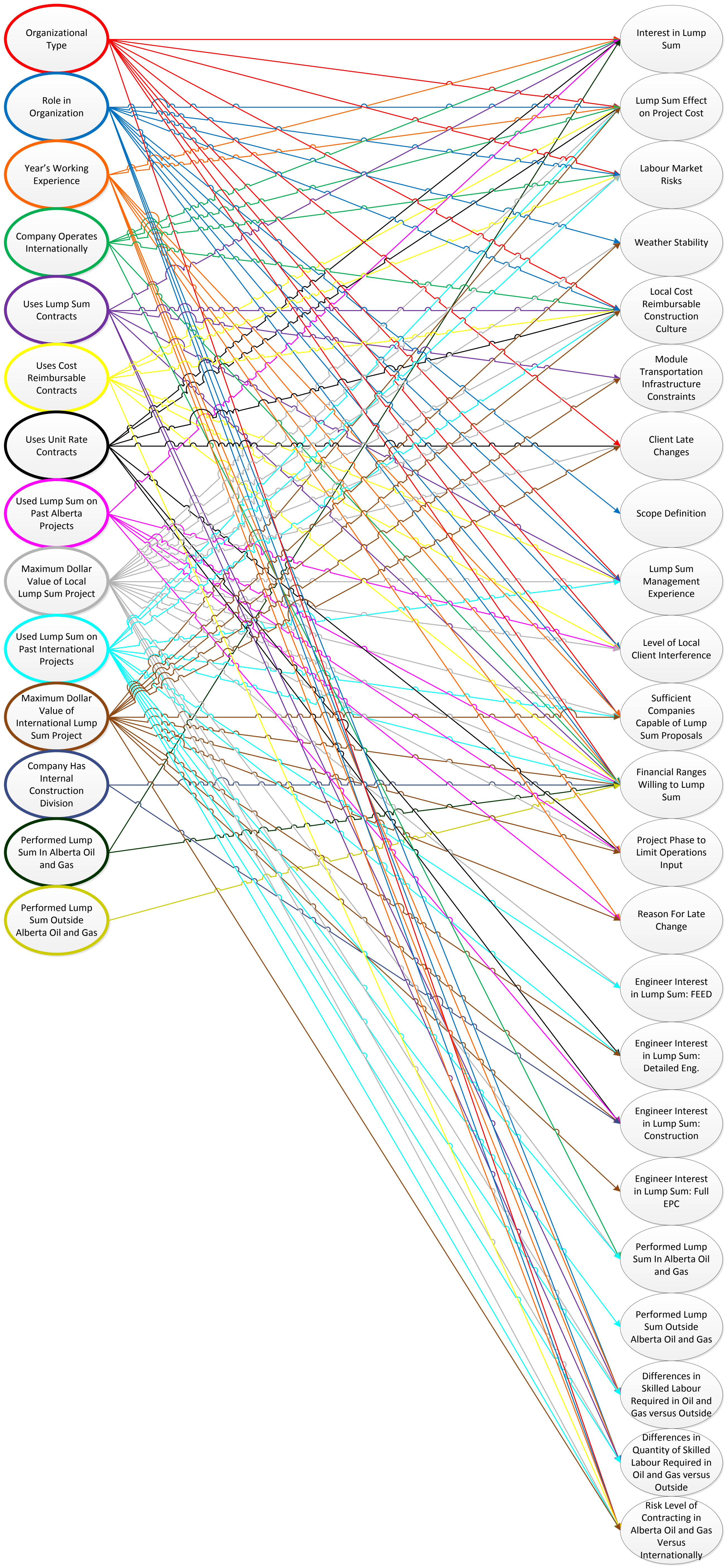


Figure 7-1 – Model of correlations from Primary Survey

Table 7-3 – Matrix of statistically significant correlations for the Primary Survey

Influencing Factors			Q12 Risk Sharing	Q13 Effect on Final Project Cost of Risk Premium in Lump Sum	Q14 Lump Sum effect of Project Behaviours	Q15 Largest Barriers to Lump Sum – Stability of Weather	Q16 Largest Barriers to Lump Sum – Cost-Reimbursable Construction Culture	Q17 Largest Barriers to Lump Sum – Module Size	Q18 Largest Barriers to Lump Sum – Client Late Changes	Q19 Largest Barriers to Lump Sum – Lack of Scope Definition'	Q20 Feasibility of Lump Sum - Lack of Experience	Q21 More Client Input Locally than Internationally	Q22 Sufficient Companies Capable of Lump Sum Proposals	Q24 Financial Ranges Companies Willing to Lump Sum
			DV	DV	DV	DV	DV	DV	DV	DV	DV	DV	DV	DV
Type of Organization	Q1	IV	<0.001	<0.001	0.024		<0.001		0.001		0.041	<0.001	0.01	
Role in Organization	Q2	IV		0.043	<0.001	<0.001	<0.001		0.003	0.012	<0.001	0.009	0.002	<0.001
Years Working Experience	Q3	IV	<0.001	0.006									0.001	<0.001
Company Operates Internationally	Q4	IV	<0.001	0.006	0.028	0.001	<0.001				0.001			0.025
Company Engages in Lump Sum Contracts	Q5.1	IV	0.026			<0.001	<0.001	0.031			0.007			<0.001
Company Engages in Cost-Reimbursable Contracts'	Q5.2	IV		<0.001	0.023	0.034	0.001				0.001	<0.001		<0.001
Company Engages in Unit Rate Contracts	Q5.3	IV	0.013	0.042			0.003		0.023					
Company Used Lump Sum on Past Project – Alberta	Q8	IV	0.018									0.004		0.047
Project Dollar Value – Alberta	Q9	IV		0.001	0.03	<0.001	<0.001	<0.001	0.001		0.005	0.01	0.008	<0.001
Company Used Lump Sum on Past Project – Internationally	Q10	IV		<0.001	0.015	0.002	0.008				0.003		0.002	0.005
Project Dollar Value – Internationally	Q11	IV		<0.001		<0.001	0.001	0.002	0.013				<0.001	<0.001
Lump Sum Effect on Project Cost	Q13	DV												
Largest Barriers to Lump Sum – Field Labour	Q14	DV												
Largest Barriers to Lump Sum – Stability of Weather'	Q15	DV												
Largest Barriers to Lump Sum – Cost-Reimbursable Construction Culture	Q16	DV												
Largest Barriers to Lump Sum – Module Size	Q17	DV												
Largest Barriers to Lump Sum – Client Late Changes	Q18	DV												
Largest Barriers to Lump Sum – Lack of Scope Definition	Q19	DV												
Company has Internal Construction Division	b_Q5	IV												0.001
Performed LS in Albertan Oil and Gas	c_Q3	IV	<0.001	0.004							<0.001	0.004		0.001
Performed LS in Alberta Outside Oil and Gas	c_Q4	IV		<0.001										0.042

			Factors Influenced											
			Project Manager Empowerment within Operating Companies	Project Phase at Which Operational/Stakeholder Input Should be Limited	Reasons for Late Changes within Operating Companies	Interest in Lump Sum for FEED Phase	Interest in Lump Sum for Detailed Engineering	Interest in Lump Sum for Construction	Interest in Lump Sum for Full EPC	Performed Lump Sum in Albertan Oil and Gas	Performed Lump Sum in Alberta Outside Oil and Gas	Difference in skilled or unskilled labour required in Oil and Gas VS Outside	Difference in Quantity of Skilled Labour Required in Oil and Gas VS Outside	Opinion of Risk Level in Alberta Oil and Gas Compared to International Oil and Gas
			ab_Q1	ab_Q2	a_Q1	b_Q1	b_Q2	b_Q3	b_Q4	c_Q3	c_Q4	c_Q5	c_Q6	bc_Q1
			DV	DV	DV	DV	DV	DV	DV	IV	IV	DV	DV	DV
Type of Organization	Q1	IV												<0.001
Role in Organization	Q2	IV		0.036						0.044		<0.001	<0.001	<0.001
Years Working Experience	Q3	IV		<0.001	0.002					<0.001		0.001	0.001	0.001
Company Operates Internationally	Q4	IV								<0.001				
Company Engages in Lump Sum Contracts	Q5.1	IV								0.009		0.008	0.008	
Company Engages in Cost-Reimbursable Contracts'	Q5.2	IV								0.021				<0.001
Company Engages in Unit Rate Contracts	Q5.3	IV		0.006			<0.001	0.006			0.018			
Company Used Lump Sum on Past Project – Alberta	Q8	IV		0.001	0.006			0.006						
Project Dollar Value – Alberta	Q9	IV		0.044		<0.001				0.001	0.027	<0.001	<0.001	0.002
Company Used Lump Sum on Past Project – Internationally	Q10	IV				0.001	0.038			0.023		0.021	0.021	<0.001
Project Dollar Value – Internationally	Q11	IV		<0.001	0.002		0.002	0.007	<0.001					0.013
Lump Sum Effect on Project Cost	Q13	DV												
Largest Barriers to Lump Sum – Field Labour	Q14	DV												
Largest Barriers to Lump Sum – Stability of Weather'	Q15	DV												
Largest Barriers to Lump Sum – Cost-Reimbursable Construction Culture	Q16	DV												
Largest Barriers to Lump Sum – Module Size	Q17	DV												
Largest Barriers to Lump Sum – Client Late Changes	Q18	DV												
Largest Barriers to Lump Sum – Lack of Scope Definition	Q19	DV												
Company has Internal Construction Division	b_Q5	IV						0.021						
Performed LS in Albertan Oil and Gas	c_Q3	IV												
Performed LS in Alberta Outside Oil and Gas	c_Q4	IV												

Legend

Chi Square	white
Fisher Exact	green
Oneway Anova	grey
T-test	blue
Highly Correlated	**Bold**
Medium Correlation	Not Bold

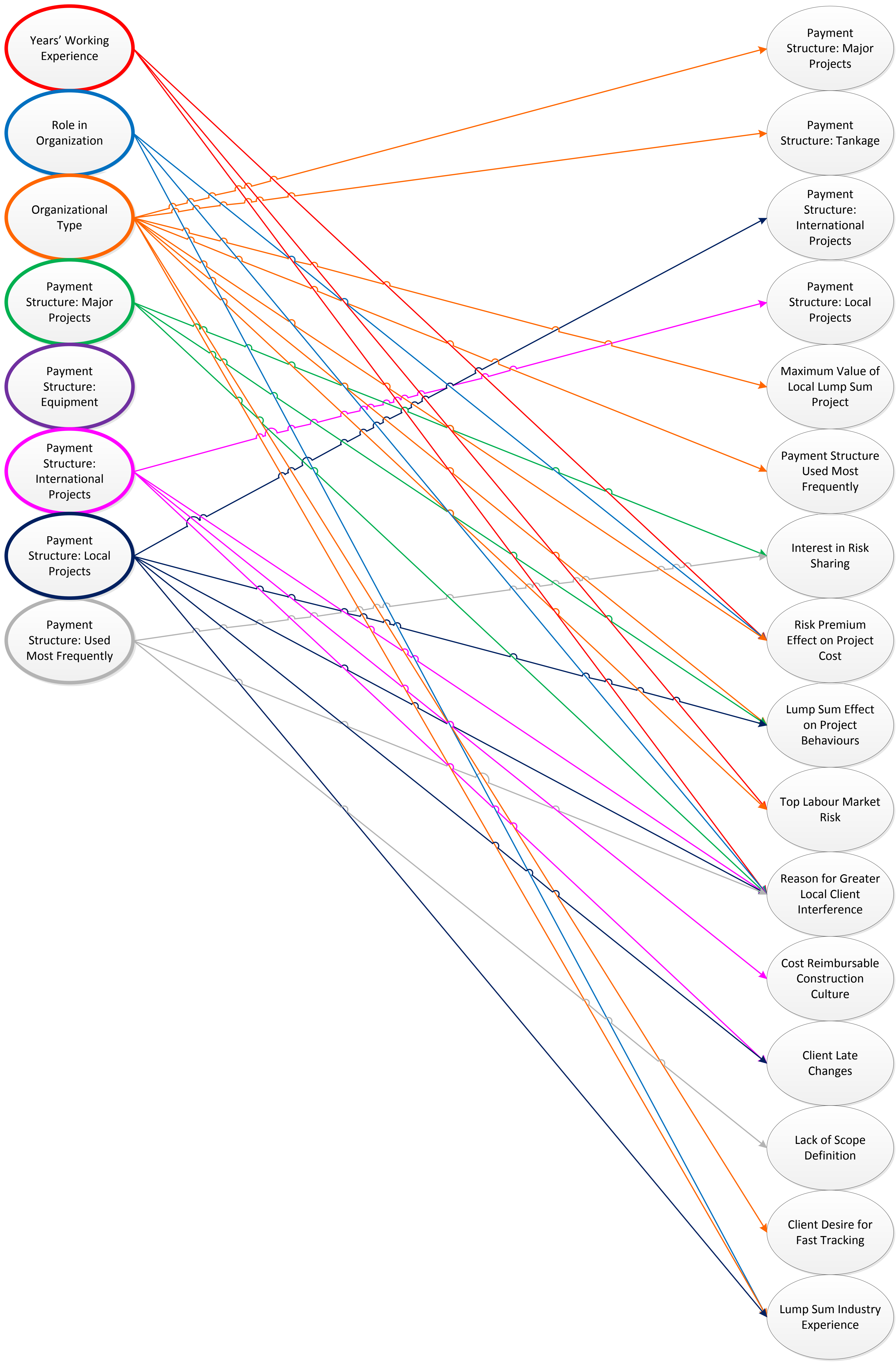


Figure 7-2 – Model of correlations from Secondary Survey

Table 7-4 - Matrix of statistically significant correlations for the Secondary Survey

			Factors Influenced																	
			Payment Structure: Equipment	Payment Structure: Buildings	Payment Structure: Tankage	Payment Structure: International Projects	Payment Structure: Local Projects	Payment Structure Used Most Frequently	Dollar Value of Largest LS Project Performed in Alberta	Interested in Lump Sum if Risk Shared with Other Company	Effect on Final Project Cost of Risk Premium in Lump Sum	Lump Sum Effect on Project Behaviours	Largest Barriers to Lump Sum – Field Labour Market Risks	Largest Barriers to Lump Sum – Local Cost Reimbursable Construction Culture	Largest Barriers to Lump Sum – Client Late Changes	Largest Barriers to Lump Sum – Lack of Scope Definition	Largest Barriers to Lump Sum – Client Desire for Fast Tracking	Largest Barriers to Lump Sum – Lack of Experience with Lump Sum in Industry	Top Labour Market Risk	Reason for Greater Local Client Input
			Q5	**Q6**	**Q7**	**Q8**	**Q9**	**Q10**	**Q11**	**Q12**	**Q13**	**Q14**	**Q16**	**Q17**	**Q18**	**Q19**	**Q20**	**Q21**	**Q22**	**Q25**
Influencing Factors			**DV**	**DV**	**DV**	**DV**	**DV**	**DV**	**DV**	**DV**	**DV**	**DV**	**DV**	**DV**	**DV**	**DV**	**DV**	**DV**	**DV**	**DV**
Years of Working Experience	**Q1**	**IV**	**0.007**	**<0.001**	**<0.001**		**<0.001**	**<0.001**	**<0.001**		**0.006**								**<0.001**	**<0.001**
Role in Organization	**Q2**	**IV**	0.011	0.024	**<0.001**						**0.004**							0.027		**<0.001**
Type of Organization	**Q3**	**IV**			**0.01**			0.027	**0.003**		0.002	**0.003**					**0.006**	**0.001**	**<0.001**	
Payment Structure: Major Projects	**Q4**	**IV**								0.013		0.029								**0.003**
Payment Structure: Equipment	**Q5**	**IV**									0.021								0.014	0.011
Payment Structure: Buildings	**Q6**	**IV**									**<0.001**								0.02	0.027
Payment Structure: Tankage	**Q7**	**IV**								**0.002**		**0.002**							0.033	**0.001**
Payment Structure: International Projects	**Q8**	**IV**					**<0.001**							0.032	**0.006**					**0.001**
Payment Structure: Local Projects	**Q9**	**IV**										0.041			**0.007**	0.038		0.025		**0.004**
Payment Structure Used Most Frequently	**Q10**	**IV**								0.047					0.016	**0.002**		0.074		**0.001**
Dollar Value of Largest LS Project Performed in Alberta	**Q11**	**IV**																		

Legend

Chi Square	white
Fisher Exact	green
Oneway Anova	grey
T-test	blue
Highly Correlated	**Bold**
Medium Correlation	Not Bold

7.2 Discussion and Concluding Remarks

The findings discussion in the following sections has been organized based on the five factors identified from the literature review.

7.2.1 Current Contract Trends

Through this study, the preferred contract strategy for projects in the Alberta oil and gas industry was found to be cost reimbursable. Many respondents (60%) were using cost reimbursable most frequently on Alberta oil and gas projects. Cost reimbursable was also found to be the dominant contract type on major projects greater than $500MM. This result is consistent with what was expected based on other studies on Alberta oil and gas (COAA, 2009; Jergeas, 2008). Locally, Lump sum contracting is being used primarily for pre-fabricated vendor packages such as equipment (60%), buildings (67%), and tankage (66%). Although not the primary contract type for larger projects, lump sum had been used by 52% of the participants on local projects between $100MM- $1B, in their company history.

Lump sum was found to be the main contract type used on international projects (75%). This result is consistent with other research studies on oil and gas projects in Asia, the Middle East, the United Kingdom, and Norway (Ganiyu & Shash, 2011; Johnson, 1987; Osmundsen at al., 2008; Palmer & Mukherjee, 2006). The study results showed that engineering companies were the most frequent users of lump sum internationally (83%) and were the only group to have used lump sum on projects greater than $1B. An interesting finding is that the majority of companies, that performed lump sum projects internationally, were still using cost reimbursable, locally. This may suggest that the market, rather than lack of lump sum experience, is the primary factor dictating the local contracting strategy.

Several themes aligning with quantitative survey responses were extracted from the unverified open-ended responses. Some respondents felt international projects are more conducive to the use of lump sum contracts because international market industry players are more experienced with the execution and management of lump sum projects. Some Engineers and Constructors viewed Operator interference as a relevant factor to the success of a lump sum project. They felt international Operators freeze the project scope before contract award. After scope freeze, planning and execution is the contractor responsibility. Several contractors in this study characterized international operator involvement as ‘auditing’ only. The theme of greater operating company interference in the local Alberta environment was mentioned throughout the contractor responses. This finding builds on previous research showing external stakeholders as being a major source of project tension for contractor companies (Bengtsson & Eriksson, 2002). The results of this survey indicate that contractors in Alberta may feel that local operating companies create more lump sum contract risk than Operators elsewhere. This result aligns with quantitative answer to the Primary Survey question about client interference.

7.2.2 Contract Strategy

In literature, lump sum contracts have been suggested as a possible tool for mitigating cost overruns on Alberta Oil and Gas mega projects. To implement lump sum as a mitigation strategy, there must be a market for lump sum projects from oil and gas operating companies and an interest in participating in these contracts from engineering and construction contractors. This study confirms there is an emerging awareness of lump sum projects in Alberta, as most respondent companies expressed interest in using lump sum contracts (75%). This result expands on the findings of previous research (Jergeas, 2009) by determining the interest level, by company type.

Through multiple logistic regression, organizational type was found to be the most significant predictor of interest in lump sum. Operators (92.3%) were the most interested and Engineers (51.2%) the least interested in lump sum. This result could perhaps be anticipated as Operators (principal) and contractors (agents) are two groups with very divergent interests. One group desires utility maximization (principal) and the other desires profit maximization (agents). Operators may feel more favourable toward lump sum contracts because lump sum may be perceived to offer better cost certainty and control, and transfer of risk to the agent companies. Engineers might have less interest in lump sum because of the increased risk absorbed by the contractor, due to operating company interference and ineffective risk identification and allocation.

Surprisingly, Constructors were more aligned, in lump sum interest (80.5%), with the Operators than with the Engineers. This may be explained by the open-ended survey questions. Engineers appeared to see more sources of risk than other organizational types. Engineer respondents were concerned about labour risk, risk of fast tracking, interference from local clients, and poor scope definition. Constructors listed far more advantages to lump sum contracts than Engineers:

- Higher profits margins, compared to cost reimbursable
- More control over planning and execution of work
- More effective utilization of field personnel
- Less interference from clients
- Will received more competitive pricing on equipment and materials.

The higher interest level from Constructors perhaps indicates that they feel, for their particular groups, the advantages of using lump sum, outweigh the risks.

Unexpectedly, Operators and Constructors were aligned on several questions throughout the survey. This alignment of Operators and Constructors was not anticipated because the two groups are on opposite sides of the industry. Rather, Engineers and Constructors were anticipated to be more aligned. Perhaps the source of alignment is that both Operators and Constructors rely on work executed by skilled labour in remote, field locations (operating facilities and construction sites) as the main source of revenue. Engineers may operate more in office settings rather than field locations.

The theme of concern with using lump sum for large complex work packages was identified in the open-ended survey answers. Some Operators felt that lump sum was more appropriate for small work packages and some contractors were disinterested in lump sum because large risk premiums would have to be applied as project scope size and complexity increased. Although the qualitative responses are not validated and cannot be generalized to the population of study, they appear to be consistent with the quantitative responses. The most respondents were willing to execute lump sum projects with financial ranges less than $100MM (60%). Thirty three percent were interested in projects in the $100MM-$1B range (33%).

The study results indicated there was only a small interest (12%) in performing mega projects using lump sum contracting. This result is significant because one of the reasons for suggesting the use of lump sum was to correct the large cost overruns on Alberta Mega Projects. With only 12% of the industry expressing an interest in executing mega projects with lump sum, this may indicate that the majority of respondents are not comfortable accepting the risks associated with large lump sum projects. The statistical analysis showed a statistically significant correlation between interest in lump sum by financial range and organizational type. The interest level was fairly consistent at ranges below $1B, with Constructors being slightly more interested in project under $100MM than the other groups. However, projects greater than $1B indicated than Operators had the highest desire for lump sum mega projects, while Constructors showed no interest in lump sum mega projects. Constructor lack of interest in using lump sum for mega projects may be a significant barrier to using lump sum as a mitigation for mega project cost overruns. These findings indicate that, although there is a market for lump sum, the interest level is imbalanced between Operators and contractors. There may be insufficient contactor resources to satisfy the client desire for lump sum payment strategies.

A potential solution for lump sum on mega projects, since $100MM-$1B was the most popular financial range (33%), may be to divide the scope between different contracts within that range. This may be more feasible, rather than to execute one large contract greater than $1B. The potential disadvantage is that larger numbers of contracts add complexity to the project through increased number of interfaces. This may reduce the efficiency of planning and execution that was given by respondents as an advantage to lump sum contracts.

Form the statistical analysis, study participants with greater than 25 years' working experience (82.4%) showed the most interest in lump sum of participants with greater than 16 years' experience. This indicates that amount and breadth of experience is related to willingness to shift contracting strategy away from cost reimbursable.

Another interesting finding was that respondents who had used lump sum on Alberta projects in the past, had a wider range of variability in the maximum financial ranges they were willing to lump sum on future projects, than respondents without local lump sum experience. Those with lump sum experience had more individuals willing undertake lump sum projects in the extreme ranges (30%, <$5MM; 15%, >$1B). Most respondents inexperienced with lump sum locally were clustered in the middle ranges (85%, >$5MM-<$1B). No definitive conclusions can be drawn from these results, but these results may be because different sizes of companies are participating in the survey or perhaps companies have had varying degrees of success with lump sum locally. Those willing to lump sum mega projects may have executed large projects successfully in the past, while those only willing to undertake projects less than $5MM may have encountered difficulties executing projects larger than that in the past.

The variation in scale of project respondents were willing to undertake may also indicate that companies with different risk attitudes were participating in the study. In literature, risk attitudes were described as risk adverse, risk neutral, or risk taking. If a given project situation was approached with different risk attitudes, these attitudes would lead to different behaviours and different outcomes (Hillson & Murray-Webster, 2007). Being a risk taker was discussed as being a positive trait, leading to potential financial benefits from effective management of risk rather than avoiding or transferring risk (Thevandran & Mawdesley, 2004; Wang & Yuan, 2011; Zou et al., 2007). Those respondents only willing to lump sum projects of a maximum of $5MM, may be risk adverse organizations and those who are willing to lump sum >$1B may be risk taking organizations. An area for future study may be to identify the typical risk attitude profile for local Operating and contractor companies. Profiling this risk attitude may help to identify if all groups are attempting to transfer risk rather than finding methods to effectively manage it.

Executives and Senior Managers also had a higher interest in lump sum mega projects than Project Managers. This finding is of interest because, Executives and Senior Management are more concerned with high level strategy and have a higher level of company responsibility than Project Managers. However, Project Managers are responsible for the day to day project execution and have more direct participation in project activities. It is possible that the leadership teams of respondent companies see the strategic benefit of lump sum but project managers are concerned about the large challenges associated with the day to day execution of lump sum mega projects in the local environment.

Participants whose companies had operated internationally showed the most interest in lump sum, while study participants whose companies had not operated internationally showed very little interest in lump sum. The companies that operated internationally were also willing to lump sum larger projects, while companies that had not operated internationally were interested in lump sum projects of <$5MM. These results suggest that operating internationally does seem to influence the willingness to execute projects in a lump sum environment. Many contractors with international experience mentioned the opportunity for higher profits in lump sum contracts in their open-ended answers. Those respondents who had not operated internationally may not have enough experience with lump sum to understand the potential advantages, which may reduce their willingness to execute higher financial ranges of project.

Another area of investigation in the study was engineering company interest in lump sum contracts by project phase. The interest by phase is presented below:

- FEED: 20%. Disinterest likely due to:
    - Incomplete project scope from the Operator
    - Lump sum reducing creativity on design
- Detailed Engineering: 70%. Interest likely due to:
    - Ability to control work
    - Scope defined from FEED phase
- Construction: 50%. Divided interest likely due to:
    - Concern for proper risk allocation
    - Potential Constructor disinterest in partnering on lump sum for Construction Phase

An area of interest, from the open-ended questions was the concern for potential Constructor disinterest in lump sum for Construction Phase. Many engineers in the study seemed to perceive a Constructor unwillingness to accept lump sum contracts. To further investigate this potential perception, Constructors were asked about their willingness to partner on lump sum construction projects in Alberta Oil and Gas. From analyzing the data, it was found that 50% of Constructors believed there is a lack of interest on the part of construction companies in partnering on lump sum projects However, upon review, participants' open-ended responses often appeared to disagree with their quantitative responses. As a result, no definitive conclusions could be drawn from the answers and the survey was left out of the statistical analysis.

From open-ended answers, the majority of Constructors appear to be not interested in partnering on lump sum projects with Engineers, even if Constructors are interested in performing lump sum contracts in general. The most frequent reason given for this perception was that Engineers do not have a history of producing complete IFC drawings and want to push what contractors feel is a disproportionate amount of risk onto the Constructors. Although this is not a validated finding, it represents a critical misalignment between two vital parties in the Alberta oil and gas environment. The author believes that the reluctance of Constructors to partner on the Construction phase of a lump sum project with Engineers and their reasons for this reluctance, may indicate systemic issues with the way the engineering phases on a project are being executed. It may also indicate issues with the proposed contracts between Engineers and Constructors. The potential misalignment between Constructors and Engineers has been identified as a valuable area of future study.

To further clarify the industry perceived effect of lump sum on project performance, the study investigated the perceived effect of lump sum on project cost and project behaviour. The majority (60%) of respondents felt that project cost would increase, while 28% felt project cost would decrease. From the unverified open-ended answers, organizational types gave the following reasons for their opinion:

- Major reasons for cost increase:
    - (48%) Large risk premium would be employed to account for risks contractors felt they could not control:
        - Labour

    - Owner interference
    - Scope change
    - External market factors like geographical area
    - Lack of scope clarity
- Major reasons cost decrease:
  - Operator: (15%) Force scope to be better managed
  - Engineer: (12%) Change and control current inefficient behaviour patterns
  - Constructor: (24%) More efficient planning, execution, and management of the project

The findings of this study indicate there is a statistically significant disagreement in respondent groups' perceptions regarding a number of important issues around effect of lump sum on project cost. Engineers (88%) were more likely than Operators (53%) and Constructors (39%) to perceive that lump sum would increase project cost; Operators (33%) and Constructors (39%) were more likely than the Engineers (12%) to believe lump sum would decrease project cost. As discussed previously, Operators and contractors have divergent interests of utility maximization and profit maximization. Operators might have been expected to have a more positive perception of lump sum given, from their open-ended answers, that lump sum may force better scope definition. However, the Constructor opinion was expected to be more aligned with the Engineer opinion. This was another example of Constructors being more aligned with the Operators than Engineers. Engineers may have the most negative perception of the lump sum effect on cost, because they are the first contractor group to see the amount of deficiency in scope clarity from the Operator. Because of this, perhaps Engineers are most likely to feel that the risk premium that must be built in to account for this lack of clarity will increase project cost.

Several other significant findings were that as seniority of role increased and years' working experience increased, so did the perception that lump sum project costs would increase. As well, having international operations and having lump sum use internationally was correlated with believing lump sum would increase cost, while having no international operations or lump sum use was correlated with believing lump sum would decrease cost. This may indicate that companies that are inexperienced internationally may not have an accurate understanding of the risks associated with lump sum execution. This may prevent them from being able to accurately assess the effect of those risks in the local market.

From the open-ended answers to the question on project cost, some survey respondents seemed to feel that a shift to lump sum may increase project efficiency and productivity by changing behaviour of the project team. Some literature has shown that contract type shapes behaviour on projects (Von Branconi and Loch, 2004). Many respondents (65%) felt that lump sum would lead to project behavioural changes because efficiency and productivity would become a profit incentive for the contractor.

A statistically significant difference existed between Operators and the Engineers and Constructors. A large percentage of Operators (86.1%) believed project behaviour would change under lump sum contracts. Engineers and Constructors were less optimistic, with 50% and 55% respectively believing project behaviours would stay the same. From the qualitative answers, respondents felt problems would occur on the project through a lack of industry lump sum management experience and operator interference. Although previous studies have indicated that in the long run, contract type does shape project behaviour (Branconi & Loch, 2004), Operators may be optimistic in the short term. Studies reviewed previously have indicated a period of “growing pains” where behaviours retained from executing on a cost reimbursable basis did not change immediately, thereby delaying the benefits associated with shifting to a lump sum payment strategy (Palmer & Mukherjee, 2006; Ward, 2008).

Operator optimism may also be shown by their belief (71%) that risk premiums in lump sum contracts would not increase the overall cost of a project compared with the same project under a cost reimbursable strategy. Engineers (58%) and Constructors (31%) seemed to be less optimistic with fewer believing risk premiums would not increase project cost. This may indicate that Operators have misestimated how high contractors feel the risk exposure for contractors is when using lump sum in the local environment.

7.2.3 Risk Management

Risk was identified in literature as a major factor influencing project success. To examine risk in the context of lump sum contracting in Alberta oil and gas, contractor study participants were asked if they perceived using lump sum in Alberta Oil and Gas to be riskier than lump sum on projects internationally. Contractors appeared to be divided in opinion, with 44% viewing Alberta oil and gas as riskier than contracting in other areas of the world. Some noteworthy statistically significant differences existed between respondent groups. Engineers (81%) were of the opinion that Alberta was riskier, while Constructors felt the opposite, with 97% perceiving no increased risk from contracting in Alberta. Engineers and Constructors have been misaligned in several areas throughout the study. The reason for the difference in perception should be investigated as an area of future study.

Highly experienced respondents (>20 years) were more likely to view Alberta oil and gas as riskier (58%), while those with fewer than 20 years' experience were more likely to not perceive an increase in risk (88%). It is possible that highly experienced individuals have had the opportunity to experience a broader range of projects, both locally and internationally, as a basis of comparison. Another result was that as the size of lump sum project a respondent's company had executed, both locally and internationally, the likelihood that risk was perceived to be higher increased. A conclusion that may be drawn is that as project dollar value increases, the perception of risk exposure locally increases as well. This result is consistent with expectations from literature. Large project success can be greatly affected by external risks (Bing et al., 2005). Contractor perception of controllability of risk is influenced by project size and complexity (Thevandran & Mawdesley, 2004; Wang & Yuan, 2011; Zou et al., 2007).

Perception of the controllability of risk has a large impact on project outcome (Zaghloul & Hartman, 2003). The results of this study seem to indicate a low perception of the controllability of risks is associated with project execution in Alberta. This low perception of risk controllability can be speculated upon based on respondent qualitative comments around the desire to add risk premiums and by the fact that 50% of respondents feel risk premiums associated with lump sum contracting will drive project costs up. As discussed previously, Operators and Constructors were not aligned in their opinion of the effect of risk premiums.

A main area deficiency area, identified in literature, of project management experience was risk identification and fair allocation of risk (Halari, 2010; Hartman & Snelgrove, 1996; Loots & Henchie, 2007). A main area of lump sum management experience listed qualitatively by Operators and Engineers was risk identification and fair allocation of risk. Participants were asked if an agreed upon risk sharing between clients and contactors would make them more likely to have interest in lump sum contracts. Interest in lump sum contracting increased to 84% when the concept of risk sharing was introduced. From the statistical analysis, most groups were interested in lump sum with risk sharing. There were limited statistically significant differences.

Qualitatively, participants offered many suggestions concerning the sharing and fair allocation of risk, including the following model for allocating project risk factors:

- Operator Risks:
  - Quantities
  - Camp accommodations (possibly)
  - Escalation
  - Weather
  - Material cost
  - Geotechnical
  - Scope changes
  - Force Majeur
- Contractor Risks:
  - Productivity
  - Rework as a result of quality or design/construction error
  - Currency exchange
  - Transportation of workforce
  - Camp accommodations (possibly)
  - Finding labour
  - Training labour
  - Management of site safety.

Most respondents qualitatively requested clear definition of roles and responsibilities with respect to risk, prior to contract execution, and a periodic review of the contract to maintain alignment with current project circumstances. The preoccupation with risk, risk premiums, and risk allocation on both the operator and contractor side may indicate that the Alberta oil and gas industry as a whole is risk adverse, with both sides trying to transfer as much risk as possible to the other. In literature, being risk adverse has been discussed as a potentially negative factor because of the potential for loss of income to contractors from avoiding risk rather than effectively managing it (Wang & Yuan, 2011; Zou et al., 2007) and the added project cost for owners from attempting to transfer all risk to contractors (Espinoza, 2011). A low level of trust between contracting parties in Alberta oil and gas could also explain the preoccupation with risk. When trust is low, risk is perceived as being high, and risk premiums tend to be correspondingly high (Das & Teng, 2004; Kardes et al. 2013). This fits with the result that some Constructors in this study viewed risk premiums to combat the major risks to lump sum in Alberta as the reason for cost increase on projects executed under a lump sum strategy. The risk allocation on Alberta lump sum oil and gas contracts may be an area for future study.

From the study, the major risks to implementing lump sum were identified in order, as:

1. Lack of scope definition;
2. Client desire for fast tracking;
3. Client late changes;
4. Field labour market risks;
5. Lack of experience in industry with lump sum contracts
6. Local construction companies favour cost reimbursable contracts.

There were several statistically significant differences around the subject of risk in this study. Participants whose companies operate internationally or perform lump sum internationally were more concerned about labour constraints and the local construction culture than participants whose companies did not operate internationally or perform international lump sum projects. In particular, local construction culture was ranked two full ranks higher by those respondents who operate internationally (mean Rank=3) than respondents who do not operate internationally (mean Rank=5). The difference in opinion could indicate that operating internationally and locally, gave those respondents a basis of comparison for evaluating project execution practices in the two areas. The results could indicate that labour constraints and construction culture are a larger issue than companies who only operate locally perceived it to be.

Another interesting finding was that Operators and Engineers ranked the cost reimbursable construction culture (mean Rank=3) as more important than Constructors (mean Rank=4). This misalignment of opinion, combined with the qualitative responses from Engineers indicating their concern around Constructor willingness to participate in lump sum contracts is potentially concerning. The results may indicate that Construction company contract strategy practice is viewed by the rest of the industry as a larger barrier to lump sum than, construction companies view it to be. As indicated previously, the misalignment of Constructors and Engineers on the Construction phase is worth investigating further.

Misalignment occurred in other areas as well. Engineers viewed field labour as a larger issue than Constructors. Constructors may be less concerned as they may feel they have more control over field labour than Engineers. Executives saw lack of lump sum management experience within the industry as a much larger issue than Project Managers. Constructors felt that client desire for fast tracking was a much larger issues than Operators. It is interesting to note that in many cases, the group introducing the risk, often ranked that risk lower than the other groups did, for example: Project Managers and lack of project management experience, or Operators and client desire for fast tracking. This could potential indicate an undervaluing of risk with respect to the risks that respondents themselves introduce to a project. The undervaluing of risk is a project manager phenomenon identified in literature (Durand, 2003; Simon et al, 2000; Titus, Covin & Slevin, 2011).

Respondents were asked to qualitatively suggest mitigations for the top six barriers identified. To mitigate these challenges a hybrid contracting strategy (cost reimbursable converting to lump sum during detailed engineering) and not using lump sum on a schedule driven project may mitigate scope definition and late change issues, and fast tracking requirements. Employing resources with international lump sum experience may mitigate the risk from a lack of lump sum experience, and a local cost reimbursable construction culture. To mitigate field labour risks, the industry must improve its knowledge of market sensitivities and develop robust labour acquisition plans, dividing the risk between client and contractor, possibly as part of a risk premium. These findings are exploratory and could be used to identify area for potential future study to confirm the validity of the suggestions.

The top labour market risks were found to be Availability (44%) and Productivity (38%). From the statistical analysis, respondents were split on the major labour market risks by organizational type. Operators and Constructors were concerned about productivity and availability, while Engineers were concerned about productivity and cost. This result shows that there are different sources of concern and that the labour market solution does not have a one-type-fits-all solution. The difference between Engineers and Operators and Constructors may be because of the nature and location of required resources. Operators and constructors require large quantities of skilled labour resources to operate and construct facilities in field locations, while Engineers require comparatively fewer numbers of engineering resources, located mostly in main centres. Thus engineers would be more concerned about the rising cost of attracting highly skilled engineers, rather than being concerned with the availability of larger numbers of labour resources. In lump sum, Engineers would require very skilled engineering talent to efficiently use allocated engineering hours, while Constructors and Operators would be more concerned with the availability of sufficient numbers of resources to complete the intensive construction phase of a project. The qualitative reasons given for productivity issues were lack of skilled labour supervision (Operators: 13%) and lack of viable Project Execution Plans (Engineers and Constructors: 15%). The main reason for availability issues was investment in projects is outpacing the labour market availability.

7.2.4 Project Management Experience

The perceived level of lump sum project management experience and competence was low. Of all respondents, 83% perceived a lack of experience and competence with managing lump sum projects in the Alberta oil and gas industry. From literature, skill with using the appropriate project management strategy for the selected contract type has a significant impact on mega project outcomes (Eweje et al, 2012). From the statistical analysis, Engineers and Operators, those executing lump sum projects internationally, and Project Managers all saw experience as a larger issue than other groups. Those with experience executing lump sum clearly see a lack of experience locally, which is not unanticipated. However, it is interesting to note that respondents who sell project management services (example: Engineering companies and Project Managers) perceive lack of experience as a more serious barrier to lump sum project success, than other respondent groups. A possible reason for this opinion may be that they have more first-hand knowledge of the project consequences of lack of experience and competence with project management.

The major areas of inexperience within lump sum project management identified by respondents included fair allocation of risk (Engineer/Operator: 22%), the estimator skillset (19%), and lack of sufficient quality specifications at Operator companies (Constructors: 17%). Investigating the robustness and completeness of the Operators quality specifications is an important are of future study. Quality specifications are the tool for Operators to control the project in a lump sum environment.

Although respondents observed there were companies capable of preparing lump sum bid proposals (75%), there were some significant differences between groups. The industry capability to develop accurate lump sum bids was questioned by Executives, Engineers, those individuals having greater than 25 years' working experience, and participants whose companies had used lump sum, internationally. The respondent groups listed above were all approximately 30% less confident in the industries capabilities with lump sum bidding than other groups. It is interesting to note that most groups included in the list above are quite senior or experienced with lump sum. They may have more experience either preparing proposals or reviewing than the other groups. It is possible that their assessment is more accurate of the industry capability. Unexpectedly, Project Managers, a group who felt the industry was inexperienced with lump sum management, did not appear to be concerned about the level of industry bid proposal skill. 89% of Project Managers felt there was adequate bid proposal skill in the industry. This result seems incongruent with their opinion of the industry lump sum experience and may warrant further investigation.

7.2.5 Stakeholder Challenges

The theme of stakeholder challenges was heavily emphasized in the study responses, both quantitatively and qualitatively. Many respondents (72%) felt that client (Operator) interference was an obstacle to effective lump sum use in Alberta oil and gas projects. This finding expands on existing research, which has found external stakeholder interference to be a major concern to contractors (Bengtsson & Eriksson, 2002).

The statistical analysis showed more concern around Operating company interference from the Operators (85%) and Engineers (88%) than the Constructors (44%). This result is surprising, but could indicate that Engineers are experiencing the brunt of client interference. Constructors may be sheltered from the client interference. Project managers (87%) were also more concerned than Executives (53%) around the issue of interference. The author believes this difference in level of concern is worthy of further investigation. Executives may be less concerned by interference because they do not experience the day-to-day project interactions that Project Managers must navigate. It is concerning to speculate that substantial misalignment exists between these two groups. Research has demonstrated the importance of frequent communication between the project manager and sponsoring senior leaders. Successful projects have had senior leadership that actively communicated with the project manager throughout the project whereas unsuccessful projects had senior leadership that had less involvement (Turner et al., 2009). It is possible that misalignments between senior leadership and the project execution teams exists in Alberta oil and gas and is worth investigating further.

The qualitative speculation around the issue of client interference also generated an interesting area for future study. One area of interest was tied to the lack of project management empowerment at Operating companies. A concept introduced qualitatively by some respondents was the perception of improperly distributed decision-making authority within the operating companies. Some felt that operational departments within the Operating organization continue to have influence over a project after turnover to the execution team, despite the lack project execution experience with the operational department. As a result, Business Units and Operational Departments do not understand the need for a frozen scope and the impact of late changes.

Some respondents felt the root cause of this continued operational influence, was the financial control operational groups exert on the project team for project execution. It was suggested that as revenue generating groups, budget and authority tends to rest with operational groups rather than project teams. Respondents felt this situation lead to improper delegation of project authority within the Operator. This speculation is consistent with discussions of Project Oriented Organizations from literature (Arvidsson, 2009). The local Operators appear to be organized in a manner consistent with the definition of POOs found in the literature and are having the same organizational structure driven problems with project execution as a result. Since the power is resting with the Business Units, the Project Managers and project teams are not empowered to properly control the projects they manage, with a mismatch between high accountability and low authority, such as is reported in previous project management research (Jonas, 2010). The prevalence of speculation around problems stemming from organizational structure indicates this to be an area that should be investigated.

Quantitatively, the two most selected reasons for client interference was project fast tracking (35%) and the mix of expertise (26%) of the operating company employees. From the statistical analysis, Executives (67%) and Senior Managers (43%) viewed project fast tracking as the primary reason. Project managers (44%) viewed the mix of expertise at client organizations as the primary reason for client interference. Those who executed lump sum locally saw project fast tracking as the major issue (56%)

Another area of stakeholder challenge was the lack of Operating company project manager empowerment. A large percentage of respondents (83%) felt lack of project manager empowerment was a significant issue for implementing lump sum in Alberta Oil and Gas. Respondents were asked to provide some qualitative context to this perception. From these unverified results, four themes emerged from the categorized responses:

- Operating company operational departments have too much authority over project execution
- Lack of project management methods experience and knowledge within the Operational departments and senior management of Operating Companies
- A lack of trust between the Operational departments and the Project Management departments around the actual cost of projects and impact of changes
- Inadequate involvement of stakeholders during early phases of the project.

These issues align with the issues experience at Project Oriented Organizations and should be investigated further in future studies. Based on the themes above and detailed respondent answers, it may be speculated that proper change management processes either do not exist at some Operators, are not effective for communicating the required impact of change to the appropriate stakeholders, or are not being implemented properly. Organizations may not be effectively managing the stakeholder identification and engagement process. Also, perhaps more project management training should be cultivated within operating groups, within the operator organization.

7.3 Major Research Contributions

This study investigated, for the first time, and performed an extensive analysis of the perceptions of operating, engineering, and construction companies in the Alberta oil and gas industry regarding the possibility and implications of shifting to a lump sum contracting environment. The study contributed to the body of knowledge through the following:

- Identified current contracting strategy trends within Alberta oil and gas industry (operating, engineering, and construction companies) with respect to frequency of use, scope of work, and financial range
- Created a knowledge base of industry views on the major risks to lump sum contracts and potential mitigations, and identified a potential risk sharing model for lump sum contracts in Alberta
- Determined perceptions of industry practitioners around the existence of project management experience and competence with lump sum projects in Alberta

- Identified major disconnects in viewpoints on lump sum contracting between operating, engineering, and construction companies
- Identified a power imbalance in the organizational structure of Alberta oil and gas operating companies that is perceived to be a cause of cost overruns in mega oil and gas projects in Alberta.

7.4 Limitations and Barriers of this Study

Limitations in undertaking this research include the following:

- The results were collected in Alberta from Operator, Engineering, and Construction companies who participate in the oil and gas industry. It may not be possible to generalise the results to other countries and industries because of market conditions, construction culture, organizational structure, etc.
- Other stakeholders in the industry, such as regulatory and environmental bodies, vendors, and small subcontractors, were not included in the study
- The size of respondents‘ organizations was not requested in the survey. Because of this, there is no basis for determining if size of organization was a statistically significant factor in respondents’ opinions
- Respondents’ qualitative answers to the open-ended questions were interpreted and categorized by the author. It is possible that the intent of a respondent’s answer could have been misunderstood and categorized improperly. Since the results have not been verified or validated, the results cannot be generalized and may not be representative of the whole population being studied.
- The participant groups for the Primary and Seconrday surveys were independently collected and share slightly different demographic profiles. Engineers compose 33% of the Primary Survey sample, compared to 32% of the Secondary Survey sample. Constructors compose 33% of the Primary Survey sample, compared to 35% of the Seconrday survey sample. As well, there was a difference of 26% in the number of respondents with greater than 25 years experience between the Primary and Secondary Survey. These differences could have resulted in some skewing of the data collected, as two slightly different demogrpaphic groups were being compared.

Barriers encountered during the undertaking of this research include the following:

- Some participants declined to answer some of the survey questions, particularly questions to do with the size of projects being executed, due to organizationally imposed restrictions on disclosing financial information about their company's projects. This restriction affected the sample size on questions related to dollar value of previously executed projects locally and internationally
- Obtaining a suitable sample size for statistical analysis was difficult and had the potential to disrupt the research study. The demographic of interest to the study was already replete with time commitments and it took a substantially longer than expected period of time and effort to collect a significant sample size.

7.5 Recommendations for Future Study

1. One area for future research, highlighted by this study, is the power imbalance between the Business Units and the Project Execution teams at Operator organizations. Previous research has shown that when project teams are provided more influence, autonomy, and support from senior management, the project performance is substantially better. This study has shown the local industry feels the lack of project management empowerment is having a detrimental effect on project performance and the potential feasibility of lump sum. Further research in the following areas would assist in streamlining lump sum use in the Alberta oil and gas industry:
    - Autonomy and empowerment of Operator project teams in Alberta oil and gas
    - Their access to required resources
    - The patterns of interaction between the project team and other line/business unit resources
    - The frequency and type of communications between the Project Manager and sponsoring upper managers.
2. Another area for future study is the disconnect that exists between Engineers and Constructors regarding partnering on the Construction Phase of lump sum projects. The

Constructors main reasons for not accepting lump sum contracts was the incompleteness of engineering entering the construction phase and the risk level placed on them. The management of the engineering phases of a project may be a systemic issue that is being masked by cost reimbursable use on projects. Further research into the reasons behind the incompleteness would be beneficial. As well, researching the types of contracts being drafted between partnering Engineers and Constructors may also shed some light on the risk transfer concerns.

3. Quality specifications are a major tool for the Operator to control a lump sum project. This study noted that Constructors found Operator Quality Control specifications to be lacking as a major source of lump sum inexperience that could jeopardize the feasibility of using lump sum. Investigation into the areas that may be lacking or deficiencies in local Operator quality specifications may prove helpful in the effort to effectively implement lump sum contracting.
4. The use of Factor Analysis on the quantitive data was investigated but not implemented due to time constraints. It is recommended as an area for future study.

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Appendix 1: Primary Survey Instrument

Section 1: Participant Demographic Information

Q1 - What type of organization do you work for?

1) Operating
2) Engineering
3) Construction

Q2 – What is your role within your organization?

Q3 - How many years working experience do you have?

Section 2: Organization Specific Information

Q4 – Does your company operate internationally?

1) Yes
2) No

Q5 – What contract type(s) or payment structure(s) does your company typically engage in? Feedback from pre-interviews with industry participants, identified three payment structure types – Lump Sum, Cost Reimbursable, and Unit Rate .

Q5.1 – Does your company engage in a Lump Sum payment structure?

1) Yes
2) No

Q5.2 – Does your company engage in a Cost Reimbursable payment structure?

3) Yes
4) No

Q5.3 – Does your company engage in a Unit Rate payment structure?

5) Yes
6) No

Please explain what portion of work your company is using for each payment structure.

b_Q5 – If your company is an engineering company, does your company have an internal construction division?

1) Yes
2) No

Q6 – Omitted from survey

Q7 – Omitted from survey

Q8 – Has your company used Lump Sum on projects in the Alberta oil and gas industry?

1) Yes
2) No

Q9 – If your company has used Lump Sum on projects in the Alberta oil and gas industry, what is the maximum lump sum contract dollar value?

Q10 – Has your company used Lump Sum on International oil and gas industry projects?

1) Yes
2) No

Q11 – If your company has used Lump Sum on International oil and gas industry projects, what is the maximum lump sum contract dollar value?

Section 3: Participant Opinion Questions

Q11 Part B– In your opinion, when comparing International projects to Alberta projects, are there any factors that make International projects more conducive to the effective use of Lump Sum contracting?

Q12 - Do you believe that your company is interested in engaging in Lump Sum contracting?

1) Yes
2) No

What do you perceive to be the advantages of using Lump Sum contracting strategies?

What do you perceive to be the disadvantages of using Lump Sum contracting strategies?

Q13 – What do you perceive to be the effect on project costs, when using Lump Sum contracting ? Please provide the reason(s) for the option(s) you selected.

1) Increase Costs
2) Decrease Costs
3) Will Not Affect Costs

Q14 - 19 – Feedback from pre-interviews with industry participants, proposed the following list of potential barriers to using Lump Sum contracting strategies in the Alberta oil and gas industry:

7. Field labor cost and predictability/constrictive labour environment
8. Stability of weather difficult to predict, thereby making productivity difficult to predict
9. Local construction culture favors cost-reimbursable
    i. Engineering companies that choose to take on Lump Sum have little ability to control construction risk
10. Module size constraints due to limitations with existing transportation infrastructure and no access to major waterways for shipping
11. Client late changes
12. Lack of scope definition (incomplete RFP/RFQ)

Rank each barrier to Lump Sum contracting in order of importance, with number 1 representing the most important barrier and number 6 representing the least important barrier.

Omit any barriers on the list that you believe are not important to or would not impact the viability of using Lump Sum structures in the Alberta oil and gas industry.

Include any additional barriers that you believe would have an impact on Lump Sum feasibility.

Q20 – Do you believe there is a lack of Lump Sum management and execution experience on all sides of industry (engineer, constructor, and operator) in the Alberta oil and gas industry, which prevents lump sum contracting from being a feasible option?

1) Yes
2) No

Q21 – Do you believe that Alberta owner companies want a higher degree of client input on projects, and interfere more with project execution than International clients do?

1) Yes
2) No

If your company is an Operator and you have selected the *Yes* option, please state what you think is the reason(s) behind these behaviour patterns.

Q22 – Do you believe there are a sufficient number of companies working in Alberta that are capable of developing Lump Sum bid proposals, so as to create enough competitive bidding to enable owner companies to judge the validity of Lump Sum proposals?

1) Yes
2) No

Q23 – Omitted from survey

Q24 – In your opinion, within what financial ranges do you think your company would be willing to use Lump Sum contracting?

Q25 – In your opinion, for what scope of work do you think your company would be willing to use Lump Sum contracting? (e.g. complete facilities, tankage, equipment, etc.)

Section 4: Participant Questions – Target Groups

Operating Companies and Engineering Companies

ab_Q1 – Do you believe that *Project Manager* empowerment within owner organizations is an issue? Please explain why you feel the way you do?

ab_Q2 – In your opinion, at what project phase should client operational input be limited?

- After Conceptual Design Phase

- After DBM Phase
- After FEED Phase
- After Detailed Design Phase
- Operations should have Unlimited Input in All Phases

Please qualify your selection with additional comments.

Operating Companies

a_Q1 – In your opinion, what is the main reason for *late change requests* being sent to engineering?

4. Changes in understanding of the internal business needs, within the client organization
5. External market changes
6. Technical aspects of the project were originally not fully understood (many projects involve new technologies in an immature market)

Include any additional reasons and qualifying comments.

Engineering Companies

b_Q1 – Do you believe your company is interested in employing Lump Sum payment structures for the *FEED Phase* of a project?

1) Yes
2) No

Please qualify your selection with additional comments.

If you selected the *No* option, why do you think your company is not interested in using Lump Sum for this phase?

b_Q2 – Do you believe your company is interested in employing Lump Sum payment structures for the *Detailed Engineering Phase* of a project?

1) Yes
2) No

Please qualify your selection with additional comments.

If you selected the *No* option, why do you think your company is not interested in using Lump Sum for this phase?

b_Q3 – Do you believe your company is interested in employing Lump Sum payment structures for the *Construction Phase* of a project?

1) Yes
2) No

Please qualify your selection with additional comments.

If you selected the *No* option, why do you think your company is not interested in using Lump Sum for this phase?

b_Q4 – Do you believe your company is interested in employing Lump Sum payment structures for a full *EPC* contract?

1) Yes
2) No

Please qualify your selection with additional comments.

If you selected the *No* option, why do you think your company is not interested in using Lump Sum for a full *EPC* contract?

Construction Companies

c_Q1 – Feedback from pre-interviews with engineering company representatives contends:

One of the main reasons for the lack of interest in Lump Sum projects by engineering companies is that the constructors they must partner with to execute the full scope of work have a lack of interest in using Lump Sum contracting

Do you believe this is a correct assumption?

1) Yes
2) No

If you believe constructors have a lack of interest in using Lump Sum contracting, what do you think is the reason(s) for the lack of interest?

c_Q2 – Omitted from survey

c_Q3 – Has your company used Lump Sum contracts for projects in the Alberta oil and gas industry?

1) Yes
2) No

c_Q4 – Has your company used Lump Sum contracts for projects in Alberta that are outside the oil and gas industry (e.g. government civil projects)?

1) Yes
2) No

If your company does not use Lump Sum contracts for oil and gas projects but does use Lump Sum contracts for projects external to the oil and gas sector, why do you think your company is doing this?

c_Q5 – In your opinion, is there a difference in the *types* of skilled/unskilled labour required for projects outside the Oil and Gas sector compared to the *types* of skilled/unskilled labour required for projects within the oil and gas industry?

1) Yes

2) No

Please qualify your selection with additional comments.

If you selected the *Yes* option, what do you think is the difference?

c_Q6 – In your opinion, is there a difference in the *numbers* of skilled/unskilled labour required for projects outside the oil and gas industry compared to the *numbers* of skilled/unskilled labour required for projects within the oil and gas industry?

1) Yes
2) No

Please qualify your selection with additional comments.

If you selected the *Yes* option, what do you think is the difference?

Engineering Companies and Construction Companies

bc_Q1 – From a Lump Sum contracting perspective, do you perceive the Alberta oil and gas industry to be riskier than the International oil and gas industry?

1) Yes
2) No

Appendix 2: Secondary Survey Instrument

Lump Sum Contracting in Alberta's Energy Sector

Secondary Survey

Demographic Information

Years of Working Experience:

Role in your Organization:

Type of Organization:

Engineering Company: ☐

Operating Company: ☐

Construction Company: ☐

Other:

Questionnaire Details

Please complete the form prior to the beginning of the seminar and return it to the presenters

1. What are your company's current payment structures, for the type of projects listed below?

1. **Major projects** **Lump Sum** ☐ **Cost Reimbursable** ☐ **Unit Price** ☐
2. **Equipment** **Lump Sum** ☐ **Cost Reimbursable** ☐ **Unit Price** ☐
3. **Buildings** **Lump Sum** ☐ **Cost Reimbursable** ☐ **Unit Price** ☐
4. **Tankage** **Lump Sum** ☐ **Cost Reimbursable** ☐ **Unit Price** ☐
5. **Internationally** **Lump Sum** ☐ **Cost Reimbursable** ☐ **Unit Price** ☐
6. **Locally** **Lump Sum** ☐ **Cost Reimbursable** ☐ **Unit Price** ☐

2. What payment structure does your company use most frequently?

1. **Lump Sum** ☐
2. **Cost Reimbursable** ☐
3. **Unit Price** ☐

3. In the Alberta oil and gas industry, what is the largest financial value of Lump Sum project your company has performed?

1. Below $100MM ☐
2. $100MM to $500MM ☐
3. >$500MM ☐

4. Do you believe your company would be interested in Lump Sum contracting if your company could share the risk with another contractor or client?

Yes ☐
No ☐

5. What do you envision risk sharing/risk allocation to look like?

6. Do you believe the risk premium that is applied to Lump Sum contracts will result in higher project costs than executing the same project under a Cost Reimbursable contract?

Yes ☐
No ☐

Why?

7. Results from a previous survey indicates that, for Cost Reimbursable projects, respondents believe there is a potential for inefficiencies associated with having no upper limit to costs.
In your opinion:

Will using a Lump Sum payment structure cause a positive change in the current project behaviours that lead to inefficiencies, thereby resulting in reduced inefficiencies? ☐

OR

Will using a Lump Sum payment structure effect no change in the current project behaviours that lead to inefficiencies, thereby resulting in increased problems for Lump Sum projects? ☐

Why?

8. Rank each barrier to using Lump Sum contracting in order of importance, with number 1 representing the most important barrier and number 6 representing the least important barrier:

1. **Field labour market risks**
2. **Local construction companies favour cost reimbursable contracts**
3. **Client late changes**
4. **Lack of scope definition**
5. **Client desire for fast tracking**
6. **Lack of experience in industry with LS contracts and their management roles**

9. How would you suggest treating / mitigating the risk for the top ranked barrier you previously selected?
(Other than building in a risk premium)

10. In your opinion, what is the top labour market risk for Lump Sum projects:

Productivity ☐
Availability ☐
Cost ☐

Why do you feel this is the case?

11. Survey target groups stated that ***industry inexperience with the management and execution of Lump Sum contracts*** **is a barrier to Lump Sum contract feasibility.**

If you agree with this statement, what do you believe are the main areas of industry inexperience?

12 In your opinion, are there sufficient companies capable of putting together Lump Sum bids?

- **Engineering Companies:**
  - **Yes** ☐
  - **No** ☐

What is the basis for this perception? (answer in the box below)

- **Owner Companies:**
  - **Yes** ☐
  - **No** ☐

What is the basis for this perception?

13. At what project stage should operational input be limited?

- **After Phase 1: Conceptual Design** ☐
- **After Phase 2: DBM** ☐
- **After Phase 3: FEED** ☐
- **After Phase 4: Detailed Engineering** ☐
- **After Construction** ☐
- **Operations should have unlimited input at all stages** ☐

14. Survey participants believe that local clients want more project input than international clients. Pick the reason you feel is most relevantas to *why* this would be the case:

- **The mix of expertise at Canadian companies compared to international companies** ☐
- **There is a perception that contractor companies lack certain skills** ☐
- **Projects are fast tracked - not enough front end work is done** ☐
- **Adversarial construction culture exists** ☐

- **If the reason you consider to be the most relevant is missing from the list, please add it below**

Appendix 3: Detailed Statistical Analysis

Appendix 4: Regression Models

Table A 1 Regression Model for Predicting Interest in Using Lump Sum Contracting

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	Q1			17.273	2	.000			
	Q1(1)	-4.364	1.057	17.031	1	.000	.013	.002	.101
	Q1(2)	-2.210	.905	5.969	1	.015	.110	.019	.646
	Q3			16.552	3	.001			
	Q3(1)	-5.382	3.513	2.347	1	.126	.005	.000	4.500
	Q3(2)	-6.342	3.591	3.119	1	.077	.002	.000	2.007
	Q3(3)	-2.520	3.491	.521	1	.470	.080	.000	75.310
	Constant	7.482	3.571	4.391	1	.036	1776.349		

Table A 2 Regression Model for Predicting Financial Ranges a Company is Willing to Lump Sum

Parameter Estimates

		Estimate	Std. Error	Wald	df	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Threshold	[Q24 = 1.0]	6.457	27.784	.054	1	.816	-47.999	60.913
	[Q24 = 2.0]	15.781	28.385	.309	1	.578	-39.852	71.415
	[Q24 = 3.0]	23.479	29.032	.654	1	.419	-33.422	80.381
Location	Q5.1	-15.748	27.873	.319	1	.572	-70.378	38.882
	Q5.2	26.971	53.254	.257	1	.613	-77.405	131.348
	Q10	0[a]			0			
	[Q2=1.0]	53.717	57.871	.862	1	.353	-59.709	167.142
	[Q2=2.0]	44.514	56.717	.616	1	.433	-66.650	155.678
	[Q2=3.0]	55.719	83.006	.451	1	.502	-106.970	218.409
	[Q2=4.0]	0[a]			0			
	[Q3=3.0]	-40.058	56.096	.510	1	.475	-150.005	69.888
	[Q3=4.0]	-24.310	28.442	.731	1	.393	-80.055	31.435
	[Q3=5.0]	-26.971	54.457	.245	1	.620	-133.704	79.762
	[Q3=6.0]	0[a]			0			
	[Q9=1.0]	-43.316	34.306	1.594	1	.207	-110.554	23.922
	[Q9=2.0]	24.310	29.608	.674	1	.412	-33.721	82.341
	[Q9=3.0]	0[a]			0			
	[Q11=1.0]	0[a]			0			
	[Q11=2.0]	0[a]			0			
	[Q11=3.0]	-36.174	55.473	.425	1	.514	-144.900	72.552
	[Q11=4.0]	0[a]			0			