International Journal of Construction Engineering and Management 2015, 4(6): 248-262
DOI: 10.5923/j.ijcem.20150406.04

A Theoretical Framework to Enhance the Conversion Process in Convertible Contracts

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Abstract In convertible contracts, different contract price arrangements such as costs reimbursable, unit rate, and lump sum are used at different levels of project definition and through the project life cycle to allocate cost and performance risks more appropriately between contracting parties. Deciding conversion points through the conversion process is a challenging exercise in managing convertible contracts in oil and gas projects. This paper, through a grounded theory study, introduces a theoretical framework to enhance the conversion process in convertible contracts. The main focus of the study has been on engineering, procurement, and construction (EPC) fast-track projects in the oil and gas industry. The theoretical framework introduces important factors that influence deciding the conversion points, provides practical recommendations to enhance the conversion process, and presents some of conversion strategies in applying convertible contracts.

Keywords Oil and gas projects, Fast-Tracking, Cost reimbursable, Lump sum, Convertible contracts, Conversion points

1. Introduction

In recent years, convertible contracts have been used in some oil and gas projects. In this hybrid contracting strategy, different contract price arrangements such as costs reimbursable, unit rate, and lump sum are used at different levels of project definition and through the project life cycle to allocate cost and performance risks more appropriately between contracting parties.

Since convertible contracts are new in the oil and gas industry, important aspects of this contracting strategy have not yet been addressed in academic publications, and few industrial papers present convertible contracts. In particular, deciding conversion points through the conversion process is a challenging exercise. Currently there is no systematic approach to determine the point of conversion in convertible contracts.

Through a grounded theory study, the objective of this paper is to present a theoretical framework to enhance the conversion process in convertible contracts. The main focus of the study has been on engineering, procurement, and construction (EPC) fast-track projects in the oil and gas industry. To provide a strong background on the research area, design development and execution phases of oil and gas projects as well as the contractual risk allocation process have been illustrated at the beginning of the paper. Following the explanation of research design and methodology, the process of developing the theoretical framework for the conversion process has been explained in detail. As the main result of this study, the proposed theoretical framework introduces important factors that influence deciding the conversion points, provides practical recommendations to enhance the conversion process, and presents some of possible conversion strategies in applying convertible contracts.

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Published online at http://journal.sapub.org/ijcem

2. Background

Understanding design development and execution phases of oil and gas projects is essential for discussing the concept of phased contract price arrangement and conversion process through the project life cycle. Moreover, fast tracking as a common execution strategy in oil and gas projects should be discussed and considered in constructing the theoretical framework for the conversion process.

The unpredictable and frequently fast-track nature of oil and gas projects requires a flexible contractual framework to balance the high level of risk and uncertainties shared between contracting parties and to minimize potential claims, disputes, and litigation costs during the execution of the project. Project risks are allocated to contracting parties through the project delivery methods and contract price arrangements. These two main pillars of contractual risk allocation are explained in this section. Lastly, the main characteristics of convertible contracts have been described based on the small amount of information in the literature.

2.1. Development Phases of Oil and Gas Projects

A clear vision of the phases of defining and executing oil and gas projects provides a better understanding of varying contract price arrangements at different stages of the project. Figure 1 illustrates the typical phases and decision gates in design development and execution of oil and gas projects.

The first three phases before the project execution, also called front end loading phases, are feasibility study, conceptual design, and basic design or front end engineering design (FEED). The feasibility phase validates technical and economic viability of the identified options to execute the project. Once the feasibility study is completed, conceptual design and expected values of preferred alternatives are developed to select the best option. Engineering activities during this phase are mainly process and systems engineering, with a few non-engineering activities. The main deliverables of this phase are the design basis memorandum (DBM) package including the cost estimate (±30%), execution plan, project organization plan, and contracting strategy of the selected project [1].

The last phase before starting the execution of the project is basic design or the FEED phase. The intent of FEED is to develop the definition of project scope and to provide all detailed plans required for the execution of the project. Engineering design specifications (EDS) and project cost estimate are major deliverables of this phase. The EDS define all elements of the project scope, and this is the control document for commencement of detailed engineering and procurement activities. Based on the cost estimate classification system developed by the Association for Advancement of Cost Engineering (AACE) International, the low and high ranges of estimate accuracy at the end of FEED are L = –10% to –20% and H = +10% to +30%.

A decision gate (DG) exists after each pre-execution phase of the project. There are two main purposes for each decision gate: to check if the previous phase is significantly completed and to decide if the project owner still wants to continue with the project. Therefore, decision gate 3 (DG 3) at the end of the FEED phase is the basis for approval for expenditure (AFE) or final investment decision (FID), meaning official budgeting approval for the execution of the project.

The execution phases, including detailed EPC activities, are usually performed by an EPC contractor. The FEED or basic design package is the basis of bidding for EPC contracts in oil and gas projects. The EPC contractor may be directly responsible for performing all the required work or may subcontract parts. In either case, the EPC contractor is in charge of the project performance and obliged to deliver the entire facility to the owner. The last phase of the project is handing over the commissioned plant to the operator and starting the operation of the facility.

In response to the vast fluctuations in the oil and gas market and with respect to the importance of the early return of investment, most oil and gas projects are performed in a fast-track mode to accelerate the project schedule and start early operation. Fast tracking is generally defined as the compression of the design and/or construction schedule through overlapping of activities or reduction in activity durations [2]. By overlapping project phases and activities, fast tracking reduces the project duration [3]. However, starting project phases or activities without complete information and scope definition will result in high levels of risk and uncertainties [4]. As a result of a study on oil sands projects, Jergeas found that the incomplete scope definition and inadequate front end loading are mainly due to fast-tracking and among the main reasons for cost and schedule overruns [5]. Design errors and omissions, change orders, construction rework, and overlooked work are the most common risks in fast-track projects [6].

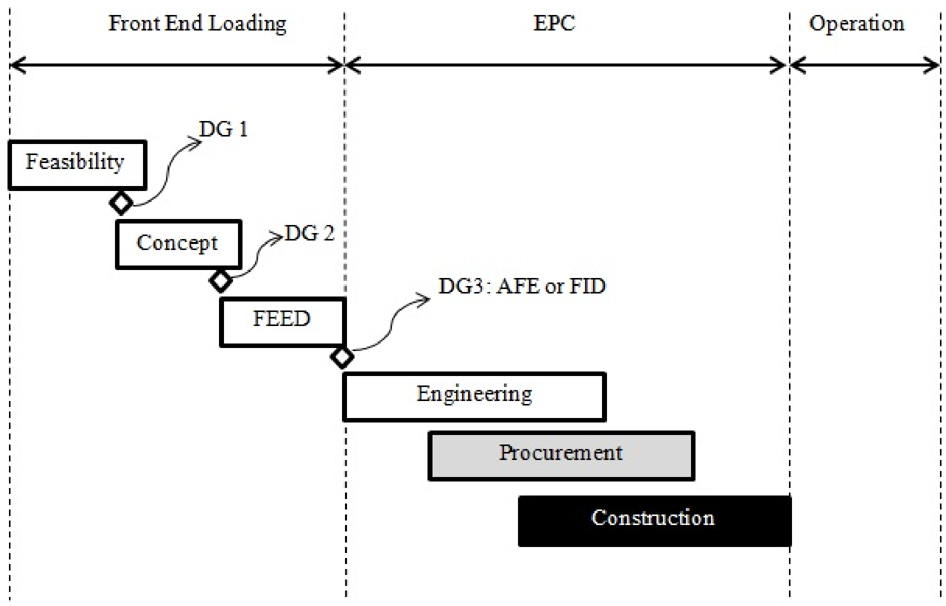

Figure 1. Typical life cycle of oil and gas projects

2.2. Contractual Risk Allocation

Project risks are allocated to the contracting parties through the project delivery methods and contract price arrangements. These two main components of contractual risk allocation are explained in following sections.

2.2.1. Project Delivery Methods

The project delivery method designates the contract scope, roles, and responsibility of contracting parties. The most common project delivery methods in execution of projects are as follows:

- Design–Bid–Build

In the design–bid–build project delivery method the owner enters into a contract with an engineering firm that provides design services based on the requirements provided by the owner [7]. The engineering firm provides engineering documents, including equipment specifications and drawings required for building the project. These engineering deliverables will be used by the owner as the basis to make a separate contract with a construction contractor, which is usually called a general or prime contractor.

In design–bid–build, engineering and construction activities are performed by two different entities through two separate contracts. There is no direct contractual relationship between engineering and construction contractors. If any problem arises during the construction phase due to design errors, the contractor proceeds with change orders, and the lack of communication between the engineering firm and the construction contractor may result in negative impacts on project performance [8]. However, this approach provides the opportunity to start construction activities with a complete engineering package, which results in less rework in the construction phase.

- Design–Build or EPC

In a design–build strategy, one single organization executes engineering, procurement, and construction phases of the project. In the oil and gas industry, EPC contract is an alternate term for design–build delivery method. If the scope of the EPC contract covers commissioning and start-up in addition to the engineering, procurement, and construction activities of the project, the contract usually is called EPC turnkey. In this approach, there is one single contract between the owner and a design–build or EPC contractor.

Using the same organization to perform engineering and construction activities decreases potential claims and disputes in the project life cycle. However, the design–build delivery method gives more power to the contractor and lessens the owner's control in project management and supervision. The EPC or design–build approach provides the opportunity for fast tracking to reduce the overall project duration.

- Construction management (CM)

Construction management (CM) is another form of project delivery in which the contractor performs management activities on behalf of the project owner. The construction manager can act as general contractor (CM as constructor) or as a liaison between the owner and the general contractor (CM as agent).

- Relational contracting strategies

Relational contracting defines relationships among the parties in which they do not always follow the legal mechanism offered by formal contracts and appreciate the mutual benefits and "win-win" scenarios through a more collaborative attitude [9]. The most common forms of relational contracting are: partnering, alliancing, and integrated project delivery (IPD).

2.2.2. Contract Price Arrangements

Contracts are mainly distinguished by the contract price arrangement and generally fall into one of the three main categories: fixed price, cost reimbursable, and guaranteed maximum price contracts [10].

- Fixed price contracts

Lump sum and unit price as two major variations of fixed price contracts are explained as follows.

Lump sum or stipulated price: Under a lump sum contract, the contractor is obliged to perform all the project work on a stipulated price basis and assumes most of the project risks and liabilities. The main advantage of this approach is knowing the ultimate time and cost required to complete the project. A lump sum contract requires a well-defined scope of work that completely provides project performance requirements.

Unit price: In the unit price arrangement, the contractor performs each unit of work for a fixed rate. In this contract type, the rate of performing each unit of work is fixed, but the quantities are subject to change.

- Cost reimbursable contracts

Under a cost reimbursable contract, the contractor will be reimbursed for all of its costs plus an agreed upon fee. Cost reimbursable contracts are more flexible to changes and unpredictable situations. However, in this contractual framework the owner does not have a clear vision of its financial commitment, and the contractor is not motivated to minimize the project costs [11]. Under this contracting strategy, project risks are mostly transferred to the owner. Selecting a contractor in a cost reimbursable contract is usually a subjective, easy, and fast process, while it is formal, difficult, and slow in lump sum contracts. Several variations are commonly used in the cost reimbursable contracts, including cost plus percentage of cost, cost plus fixed fee, and cost plus incentive fee.

- Guaranteed maximum price (GMP) contracts

Guaranteed maximum price (GMP) is an alternate contractual approach that comprises features of both cost reimbursable and lump sum contracts. While in GMP the contractor will be reimbursed for the actual costs in addition to an agreed fee, the total cost of project will be guaranteed to a maximum fixed amount.

2.3. Two-Stage Tendering Contracts

Two-stage tendering has been used in construction projects to achieve the early engagement of a contractor under a pre-construction service agreement (PCSA). The intention of the parties is to work together on a cost reimbursable or unit rate basis during the PCSA to develop the design and enter into a lump-sum construction contract in the second stage [12]. The main advantage of two-stage tendering approach is the participation of potential contractors in design development phase and project scope definition. Involvement of the contractor in the pre-execution phase provides early communication between the owner and the contractor to develop the design package that reflects the contractor's views regarding constructability, work sequencing, and selecting subcontractors [13].

However, there is no contractual obligation for both parties to proceed to the second stage and enter to the construction contract after the completion of PCSA.

Lawrence noted that the conversion from a PCSA to a lump sum construction contract will typically occur when the contractor has successfully tendered 70-80 percent by value of the subcontract packages for the project [13].

2.4. Convertible Contracts in Oil and Gas Projects

As illustrated in section 2.2.1, the EPC or design–build project delivery method provides the opportunity for fast tracking. However, design–build standard contract documents do not quite fit for fast tracking. Saltz supports the argument, "It is not unusual for design-build contracts to be used in fast-track situation but the forms do not really contemplate fast-track construction and must be modified to accommodate that situation" [14]. Lack of adapted contract clauses for fast-track projects in standard forms of contracts results in using exculpatory clauses. Exculpatory clauses are contractual clauses that transfer potential risks from one party to another [15]. Project owners typically use exculpatory clauses in traditional form of contracts to transfer project risks to contractors. The usual consequence of this inequitable risk assignment is consideration of more contingencies by contractors in their bid price, which will end with greater overall project cost [16].

Convertible contracts, as hybrid contracting strategies, have been used recently in fast-track oil and gas projects to optimize the risk balance between project owners and contractors [17]. In this contractual model, different contract price arrangements such as cost reimbursable, unit rate, and lump sum are used at different stages of the project life cycle to allocate cost and performance risks between contracting parties more appropriately.

The two-stage tendering can be considered as a form of convertible contracts for construction projects. However, the complexity and duration of mega projects in the oil and gas industry require a more dynamic conversion strategy to address different levels of risk and uncertainties through the project life cycle. Compare to the two-stage tendering contracts, convertible contracts in oil and gas projects provide more flexibility of using different contract price arrangements for different work packages during the project phases.

Convertible contracts bring several benefits to the project. Use of the cost reimbursable contract at the start of a project with an incomplete scope of work accommodates the needs of fast tracking without absorbing a high level of risk from inadequate scope definition. In other words, this approach reduces the high costs of risk premiums and contingencies that are commonly included in a lump sum price contract. Further, converting the contract when the contractor has more accurate information to bid a realistic fixed price provides a clear vision of the project's overall cost. Ultimately, convertible contracts combine the initial flexibility of the cost reimbursable methodology with the cost certainty of lump sum contracts [17].

3. Problem Statement and Objective

Very few industrial papers have discussed general characteristics of the convertible contracts and there is a significant gap in academic studies addressing the most challenging issues in managing convertible contracts. In particular, no systematic approach exists to determine the timing of conversion as a critical element to be decided by project authorities.

The main objective of this study is to develop a theoretical framework to enhance the conversion process in convertible contracts. The focus of this study is on oil and gas fast-track projects.

4. Research Design and Methodology

Because of the investigative nature of the study, a qualitative approach was chosen to accomplish its main objective. As stated by Creswell, grounded theory is a helpful qualitative research design when current theories about a phenomenon are either inadequate or nonexistent and is a way of discovering and developing theories rather than verification of pre-existing theories [18]. Since the main objective of this study is to develop a theoretical framework, grounded theory study was chosen as the main research design.

5. Developing the Theoretical Framework

The process of identifying, developing, and connecting relevant concepts to produce the grounded theory of this study were conducted through the following data collection and analysis activities.

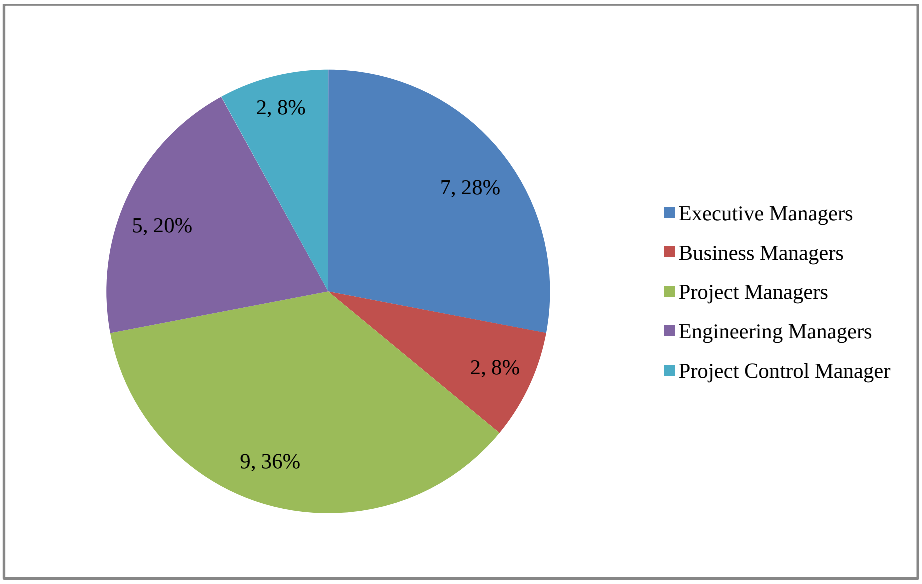

Figure 2. Breakdown of participants by their position

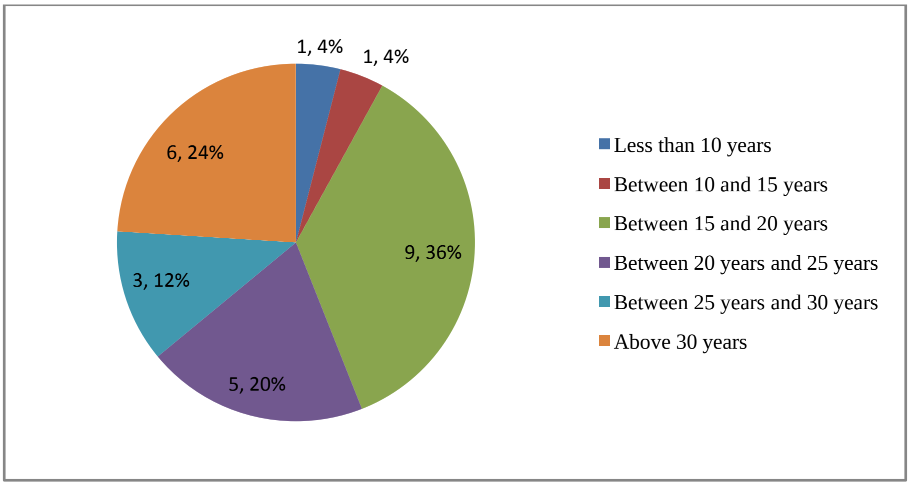

Figure 3. Participants' range of experience

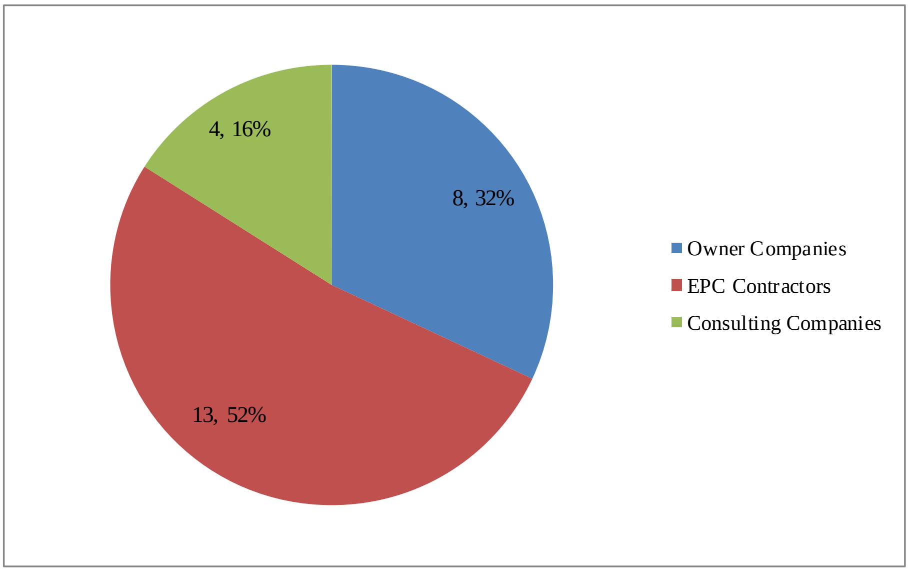

Figure 4. Breakdown of participants by the type of organizations

5.1. Data Collection

The interview was chosen as the major instrument to collect the required data and information. Interviewees were selected among those who represent the typical perceptions and perspectives of the research scope. Executive managers, project managers, technical mangers, contract managers, project consultants, and project control managers participated in the study. The grounded theory study requires enough data to generate concepts, patterns, categories, and dimensions of the subject under the study and, therefore; it is essential to obtain an appropriate sample size that will generate sufficient data. Thomson conducted a study on one hundred articles that used grounded theory and utilized interviews as a data collection method [19]. The findings of his study indicate that the average sample size suggested for the grounded theory study was twenty-five interviews. Thus, in this study, the sample size was decided to be 25 in compliance with an acceptable sample size for grounded theory methodology. Figure 2 shows the breakdown of participants by their position.

Figure 3 provides the participants' range of experience in the oil and gas industry.

Participants were selected from various type of organizations including owners, contractors, and consultants to incorporate different perspectives in constructing the theoretical framework. Figure 4 shows the breakdown of participants by the type of organizations.

5.2. Data Analysis

In a grounded theory study, basic-level concepts are the conceptual names given by the researcher to raw data that provide the foundation of a theory [20]. Categories are higher-level concepts and more abstract terms that represent the major theme of a group of basic-level concepts. These higher-level concepts provide the structure or framework of the theory.

Coding methods can be used to conceptualize raw data. Codes are the conceptual names given to the raw data. The collected data were analysed through open coding, axial coding, selective coding, and theoretical integration to develop a theoretical framework for conversion process [21]. Analytic memos and diagrams were also used as effective analytic tools in all levels of analysis. Memos and diagrams preserve the dialogues that occurred in the researcher's mind while interacting with data [20].

Table 1. Coding Raw Data

Code	Coding Method
Open book estimate (OBE)	Process
Front end engineering design (FEED)	Process
Level of contractor involvement	Descriptive
Purchase of piping and steel structures	Process
"Canada market is not ready for lump sum contract."	In vivo
"It's always definition of the scope which is the driver not the maturity of the engineering."	In vivo
"Engineering definition is for sure an indication to know if it is the right time to convert the contract."	In vivo
Piping and instrumentation diagrams (P&IDs) – Issue for HAZOP (IFH)/Issue for design (IFD)/Issue for construction (IFC)	Process
Fast tracking	Process
Site preparation and underground (UG) IFC	Process
"Concrete and piling due to weather constrains are very uncertain, so the minimum level of definition for these activities are 80%."	In vivo
Phased conversion	Process
"Long lead items (LLIs) should be purchased before conversion"	In vivo
"Risk is the key factor in conversion process."	In vivo
Reliability in Quantities	Descriptive
"Conversion period must be between 60% to 90% model review."	In vivo
Estimating Quantities	Descriptive
"Conversion after 8–10 months from the start of detailed engineering."	In vivo
"In Alberta the main concern is poor productivity and efficiency."	In vivo
"At 60% it maybe 5%–10% contingency for engineering and procurement but for construction you may have bigger percentage."	In vivo
Partnering/alliancing relationship between contracting parties	Descriptive

Table 2. Open Coding Results

Category	Examples of identified codes
Contractual relationship	Level of contractor involvement
	Partnering/Alliancing relationship between contracting parties
Contract types	"Lump sum turnkey"
	Cost reimbursable contract
	Phased conversion
Scope definition	"It's always definition of the scope which is the driver not the maturity of the engineering."
	Freezing design basis by client before conversion is critical
Engineering completeness	"Around 55%–60% of engineering could be suitable to convert, but generally is about to define the scope of work."
	Front end engineering Design (FEED)
	"Conversion after 8–10 months from the start of detailed engineering."
	"Engineering definition is for sure an indication to know if it is the right time to convert the contract."
	"Conversion period must be between 60% to 90% model review."
Estimating accuracy	Estimating quantities
	Open book Estimate (OBE)
	"After FEED the accuracy of estimate is about 30%."
Major deliverables	P&IDs – IFH/IFD/IFC
	Site preparation and UG IFC
	Purchase of piping and steel structures
	The long lead items (LLIs) should be purchased before conversion
	"Concrete and piling due to weather constrains are very uncertain, so the minimum level of definition for these activities are 80%."
Risk/Uncertainties	Risk of low productivity
	"Risk is the key factor in conversion process."
	Risk of fast tracking
Contingencies	"If start conversion after FEED you might consider 25%–30% contingency."
	"At 60% it maybe 5%-10% contingency for E and P but for construction you may have bigger percentage." Early conversion means more contingency in lump sum price

5.2.1. Open Coding

Open coding is to identify codes and categorize them to a further level of analysis during the initial coding process. Different coding methods can be used during the initial coding cycle depending on the nature of the qualitative study. Descriptive, process, and in vivo coding methods were used in this study for initial coding of the interview transcripts and relevant documents. Descriptive coding summarizes the basic topic of a passage of qualitative data in a word or short phrase and in vivo refers to a word or short phrase from the actual language found in the qualitative data [22]. Process coding specifies words or phrases that capture actions. Examples of coding interview transcripts are shown in Table 1.

After giving the conceptual names to the raw data, they were categorized to more abstract terms presenting higher levels of concepts. By showing some codes and relevant categories, Figure 5 presents the categorizing approach during the open coding process.

As a result of the open coding process, identified codes were grouped in eight categories, as shown in Table 2.

After categorizing the codes and concepts, analytic memos and diagrams were also created for each category. The following examples are memos and figures created for "engineering completeness" and "major deliverables" categories during the open coding process:

Category: Engineering completeness

Analytic memo: "The basic level of concepts extracted from interviews and relevant documents indicate that the level of engineering maturity is an essential factor in deciding conversion points. The reliability of material take off (MTO) and subsequently the accuracy of estimating highly depend on the level of engineering definition.

Although most experts have emphasized that the degree of engineering completeness is not the only factor to decide the conversion time and project scope as a whole should be taken into consideration, there are several in vivo codes that suggest specific engineering milestones to convert the contract. In particular, end of FEED or start of detailed engineering when engineering completeness is around 30%, between 60% and 90% MR sessions, or after 90% MR session are engineering milestones frequently suggested to convert the contract."

Figure 6 provides a pictorial support for the written memo for the "engineering completeness" category.

Category: Major deliverables

Analytic memo: "Some specific engineering, procurement, fabrication, construction, and installation deliverables were frequently mentioned by participants to justify their proposed conversion points. Piping and instrumentation diagrams (P&IDs), piling and foundations design for pipe racks and equipment, equipment data sheets, and piping isometric drawings are examples of these deliverables.

Similarly, purchase orders (POs) for piping and structural steel materials and POs for long lead items (LLIs) are significant procurement activities that influence the decision of conversion time.

Specific fabrication, construction, and installation activities also impact the conversion process. The level of uncertainty in site preparation, piling, and concrete civil works is quite high because of weather conditions and productivity issues in Alberta. Piping fabrication, pipe racks module assembly, equipment module assembly, and equipment installation are other important deliverables to be considered in deciding contract price arrangements."

The written memo for the "major deliverables" category has been summarized in Table 3 by showing engineering, procurement, fabrication, and construction deliverables that influence the conversion process.

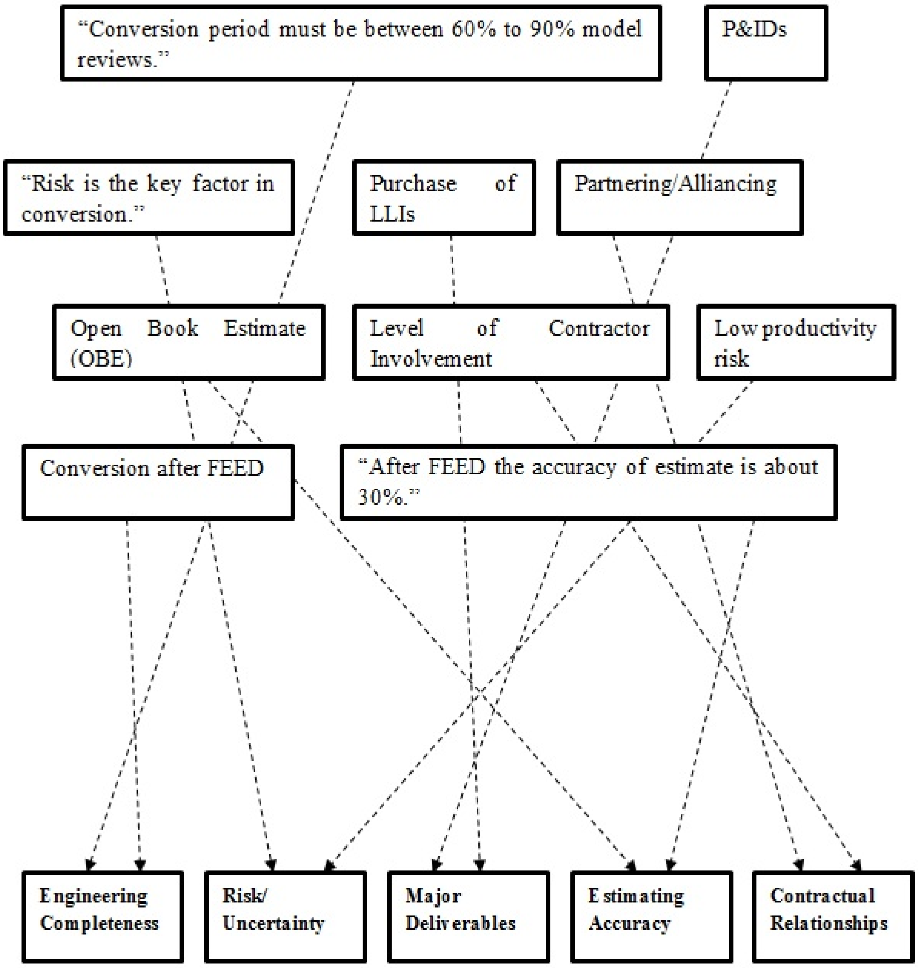

Figure 5. Categorizing the identified codes and concepts

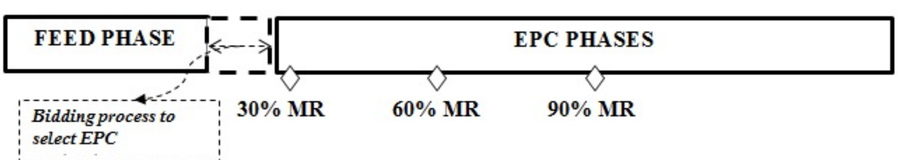

Figure 6. Analytic diagram for "engineering completeness" category

Table 3. Major Deliverables Influencing the Conversion Process.*

Project Phases	Major Deliverables
Engineering	P&IDs Equipment data sheets Grading/paving/UG drawings Piling design for pipe racks Piling design for equipment Foundation design for pipe racks Foundation design for equipment Piping ISOs for pipe racks Piping ISOs for on-module piping Piping ISOs for off-module piping Vendor data
Procurement	Piping materials POs Structural steel materials POs Equipment POs LLIs POs
Fabrication	On-module piping fabrication Off-module piping fabrication Pipe rack module assembly Equipment module assembly
Construction	Site preparation Pile installation Foundations for pipe racks and equipment Equipment and module installation

*P&ID, piping and instrumentation diagrams; IFD, issue for design; IFC, issue for construction; ISO, isometric; LLI, long lead item; PO, purchase order; UG, underground

5.2.2. Axial Coding

Axial coding, as a form of intermediate coding, facilitates exploring the interconnections among categories. Figure 7 depicts the axial coding process with possible examples of action–interaction between categories.

During the axial coding process some memos and diagrams were also created to develop the concepts and provide more abstract terms by discovering the interconnections between categories.

5.2.3. Selective Coding

Selective coding is an advanced coding process that unifies all categories around a core or central category that has the greatest explanatory power and the ability to link the other categories to it and to each other [20]. The results of analysing collected data through open coding and axial coding show that the engineering completeness is the core category which can be used as a central explanatory concept tying all other categories together. Most of codes and concepts extracted from different categories can be linked together to justify the conversion timing at different levels of engineering completeness. Also, the concept of engineering completeness has been mentioned in most of interviews and a high number of codes and concepts point to this concept. In fact, inherent meaning extracted from actual data represent the engineering completeness as the principal explanatory concept and choosing this category is consistent with the collected data and fulfils the requirement of the core category.

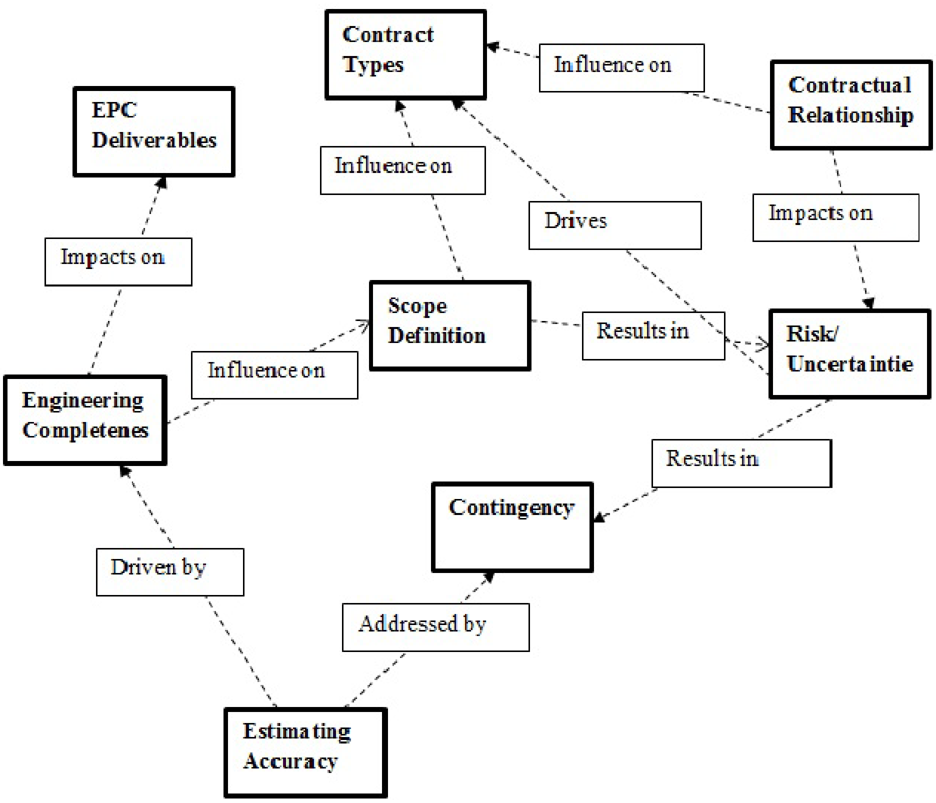

Figure 7. Axial coding approach

5.2.4. Theoretical Integration

Theoretical integration generates the final product of the grounded theory study by integrating the findings around the core category. Corbin and Strauss suggest writing descriptive/conceptual summary memos (story line) and integrative diagrams to facilitate the integration process [20]. As an example, following summary memo was created to aid theoretical integration in this study.

Theoretical integration: Story line techniques

Summary memo: "The conversion process may occur from FEED and through the EPC phases, depending on the level of contractor involvement in project phases.

In this study, influencing concepts in deciding conversion points were identified, developed, and linked through data analysis. Identified concepts were grouped through open coding in the main categories of scope definition, major EPC deliverables, engineering completeness, estimating accuracy, contractual relationships, contract price arrangements, risks, and contingencies. After the concepts were categorized, the interconnections between them were explored through the axial coding.

"Engineering completeness" has been identified as the core category of this study. Certain engineering milestones, including end of the FEED phase, after 60% model review session, between 60% and 90% model review sessions, and after 90% model review session are proposed milestones / periods to convert the contracts.

These suggested points for conversion have been justified by linking the level of engineering completeness to the estimate of project quantities and delivery of major procurement and construction components. In fact, selecting contract types during the conversion is closely related to the level of residual risks at conversion points, which is driven by engineering progress. Based on the level of engineering definition during the conversion, different contract price arrangements may be used for the same deliverables, work packages, or project phases.

Effective management of convertible contracts needs collaborative relationships and a high level of trust in the project environment. Partnering and alliancing strategies can improve the performance of convertible contracts."

This summary memo provides a base for the results of data analysis steps through the open coding, axial coding, selective coding, and theoretical integration have been presented as the theoretical framework in the next section.

6. Theoretical Framework

The theoretical framework, as the final product of this study, introduces important factors that influence deciding the conversion points, provides practical recommendations to enhance the conversion process, and presents some of the possible conversion strategies in the application of convertible contracts in oil and gas projects.

6.1. Important Factors that Influence Deciding the Conversion Points

- Risk is a key driver in managing convertible contracts. Deciding conversion points are highly influenced by the risk attitude of contracting parties.
- The degree of engineering completeness is one of the most important factors in deciding the conversion points. Significant engineering milestones such as conducting model review sessions at 30%, 60%, and 90% of engineering completeness are key indicators in deciding conversion points.
- Particular deliverables in engineering, procurement, and construction phases such as issue of P&IDs, MTOs for bulk piping and structural steels, ordering LLIs, and subcontracting civil works can influence deciding the conversion points.
- Engineering development is a major element of the project scope, but there are other important aspects such as market condition, execution strategy, and the level of complexity that may affect the conversion strategy.
- The values of major equipment and key bulk materials that should be purchased before conversion influence deciding the conversion points.
- The amounts of the construction work packages that should be sub-contracted before conversion influence deciding the conversion points.
- In construction, the main challenge (risk) for the EPC contractor is that it has to commit on quantities and productivity under the lump sum contract while it does not necessarily have the same commitment from subcontractors.
- The level of involvement of the EPC contractor in pre-execution phases of the project can affect the conversion timing.
- The performance of the conversion process is highly affected by the level of relationships between contracting parties.

6.2. Recommendations

- Convertible contracts require a strict risk management approach. Realistic risk analysis is essential in successfully managing the convertible contracts.
- Risks associated with the market condition including regulatory requirements, availability of skilled resources, productivity, local subcontractors, and weather conditions should be evaluated accurately and considered in the conversion process.
- Although the percentage of engineering completion is an important indicator for determining the conversion points, the level of scope definition as a more comprehensive factor should be taken into consideration.
- Certain engineering milestones, including end of the FEED phase, between 60% and 90% model review sessions, and after 90% model review sessions, are

proposed milestones/periods to convert the contracts.

- Conversion to a single lump sum contract after FEED is too risky and usually will result in allocating a high amount of contingencies in the lump sum price.
- It is recommended to place POs for all LLIs before conversion to lump sum.
- It is recommended to place POs for structural steel and piping bulk materials before conversion to lump sum.
- It is suggested to placing 70%–80% of equipment POs and 50%–60% of bulk materials POs before conversion to lump sum. This usually happen between 60% and 90% engineering completeness.
- Owing to the high level of uncertainty, civil works such as site preparation, piling, and concrete works are suggested to be performed under a unit rate scheme before converting the whole project to the lump sum.
- Unit rate is also recommended for pipe and module fabrication activities before conversion to lump sum.
- Contracting parties should develop and agree on a change management procedure that accommodates different contracting phases during the project life cycle.

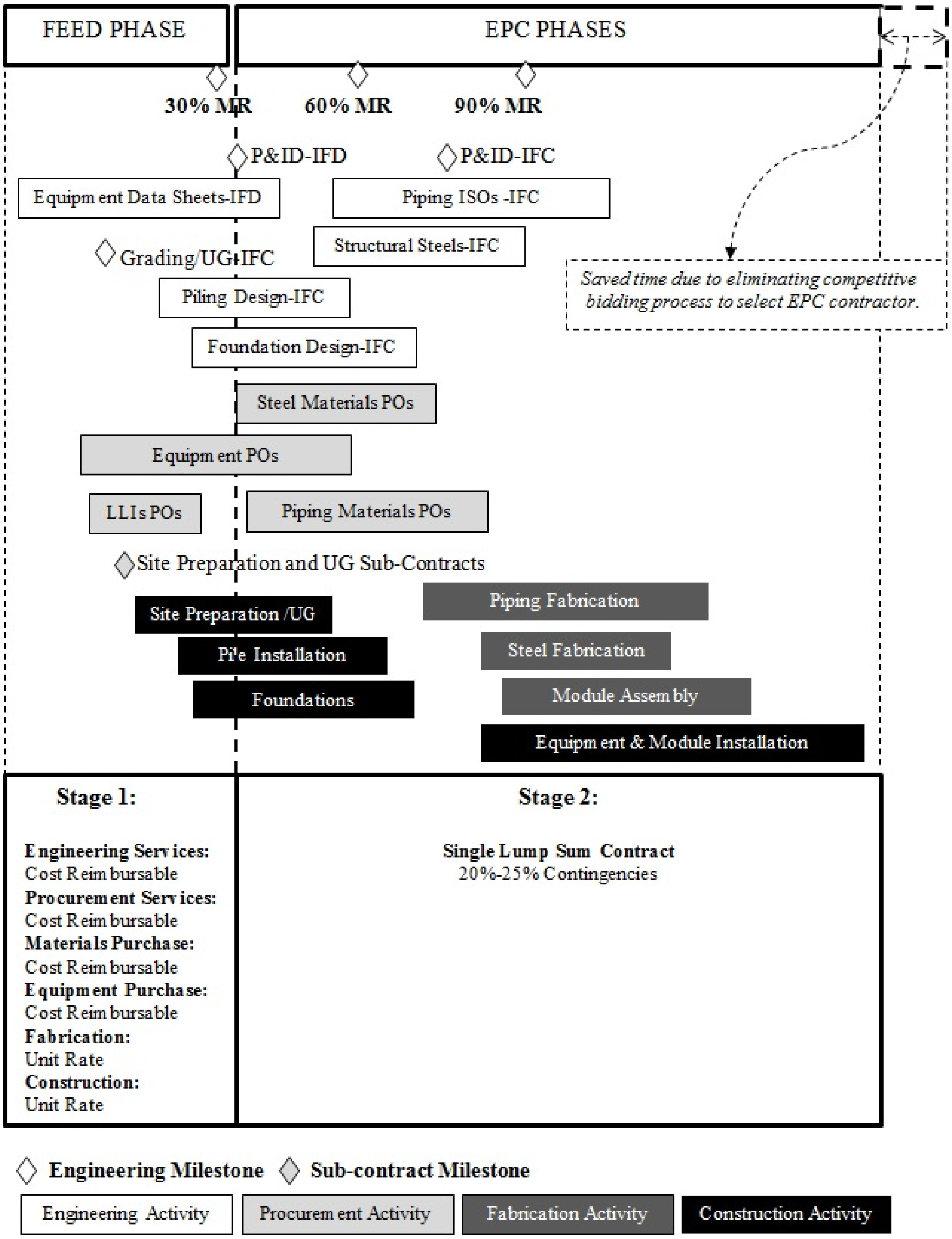

Figure 8. Conversion process: strategy 1

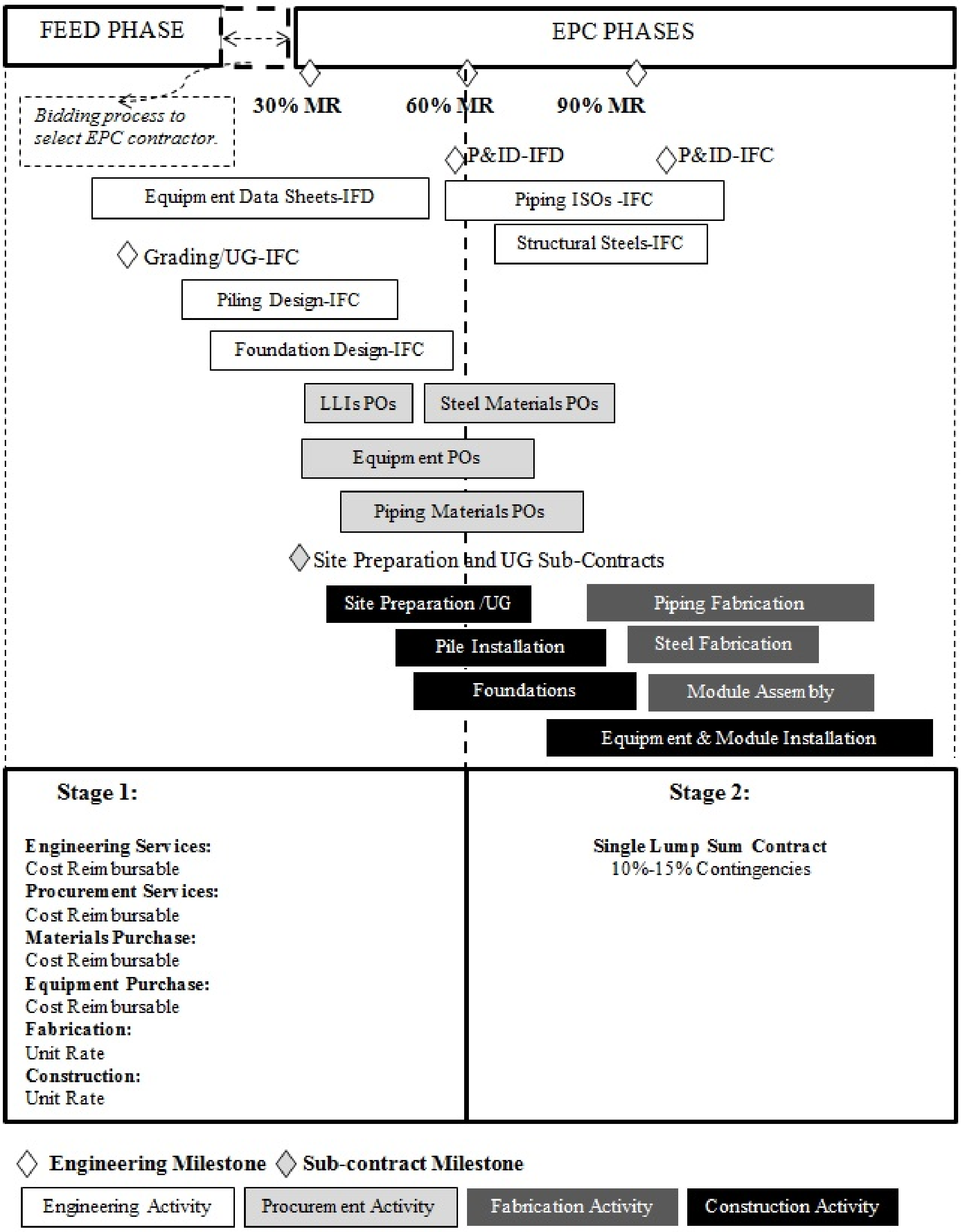

Figure 9. Conversion process: strategy 2

- Using the same contractor for both FEED and EPC phases can result in early conversion and less contingency in the lump sum price.
- A successful conversion process requires a collaborative and trustworthy environment. Alliancing and partnering strategies are recommended to provide the required environment for convertible contracts.

6.3. Conversion Strategies

Based on the results of the study and through use of the analytical memos and diagrams created through the data analysis, some of possible strategies to convert the contract are presented as follows:

Strategy 1: With the assumption that contractor involvement is started from the FEED phase, this strategy suggests two contractual stages, as shown in Figure 8. The first stage covers the FEED phase of the project with a mixed contract price arrangement. In the second stage the entire EPC will be performed under a single lump sum contract.

In the first stage, cost reimbursable is recommended to compensate engineering services, procurement services, purchasing materials, and supplying equipment while unit rate is the suggested compensation method for fabrication, construction, and installation activities.

Using the same contractor for FEED and EPC and eliminating the formal bidding/award process for selecting the EPC contractor may result in saving time in the overall project duration.

Since the contractor has been engaged in the design development phase before EPC, it is possible to achieve 30% engineering level by the end of FEED. At this level, engineering information is sufficient to issue POs for LLIs during FEED. Also, sub-contract packages for site preparation and underground activities can be finalized during the first stage. However, scope definition is not mature enough at the end of FEED to estimate a confident lump sum price for the entire fast-track EPC with overlapping phases.

By purchasing major bulk materials such as piping and structural steel, and performing fabrication, construction, and installation activities under lump sum contract, the contractor takes a high level of cost risk in the execution phase. In this case, the lump sum price usually includes a range of 15% to 20% contingencies to address the high level of risk and uncertainties.

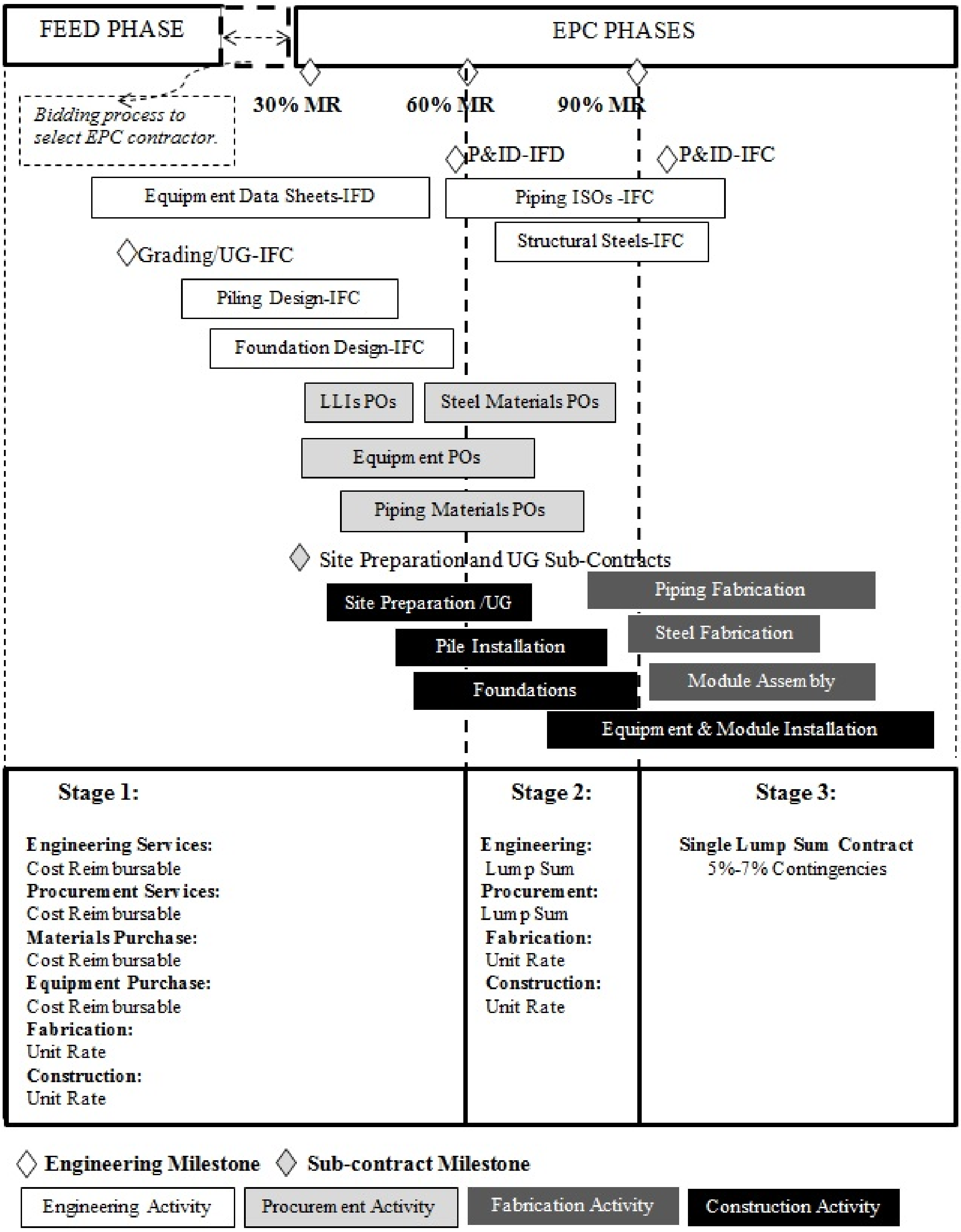

Figure 10. Conversion process: strategy 3

Strategy 2: By this strategy, as shown in Figure 9, the conversion to the single lump sum contract occurs after 60% engineering completion. In this approach, contractor may or may not have been engaged in pre-execution phases. With contractor involvement after a formal bidding/award process and from the start of the EPC, the 30% engineering level is more likely to be achieved during the detailed engineering.

Based on the results of the study, by achieving the 60% engineering milestone, approximately 70% of equipment and 50% of bulk materials can be estimated and purchased and major civil works including piling and foundations for pipe racks and equipment have been subcontracted. At 60% engineering, the level of accuracy in estimating is high enough to bid a reliable lump sum price for the rest of the project works. The suggested contingency amount in the lump sum price at this point of conversion is between 10% and 15%.

Strategy 3: This approach offers three contract phases during the project life cycle. As shown in Figure 10, the first phase covers the FEED phase of the project. The second phase will be between the start of detailed engineering and the 90% model review session, and the last phase will be after the 90% model review session to the end of the EPC. The suggested contingency amount in the lump sum estimate at 90% engineering would be approximately 7%. Although late conversion to the lump sum price is not a favourable option for the client, a higher level of scope definition minimizes the contingency and risk premiums included in the lump sum price by the contractor.

Each of above conversion strategies might be chosen based on the risk attitude of contracting parties, level of scope definition, and the acceptable range of contingencies.

7. Conclusions

Through a grounded theory study, a theoretical framework has been developed in this paper to enhance the conversion process in convertible contracts. The study focused on EPC fast-track projects in the oil and gas industry. The theoretical framework provides:

- important factors that influence deciding the conversion points
- practical recommendations to enhance the conversion process
- possible conversion strategies in application of convertible contracts

To optimize the risk taking/rewarding concept, a phased conversion approach is suggested to use cost reimbursable, unit rate, and lump sum contract price arrangements through the project phases.

The results of this study indicate that the engineering completeness is an essential factor in the conversion process. Major engineering milestones such as 60% and 90% of engineering progress are key indicators in deciding the conversion points. However, the degree of engineering completeness is not the only factor to influence deciding the conversion time and the level of scope definition as a whole should be taken into consideration.

Although project owners prefer early conversion to minimize the costs risk, immature scope definition may result in higher contingency in the lump sum estimate. The acceptable range of contingency by the project owner is an important factor in deciding the early conversion. Conversion to a single lump sum contract after the FEED phase and from the start of EPC is a highly risky approach.

It is recommend to purchase all LLIs and key bulk materials, including piping and structural steels, before conversion to the lump sum. Also, it is recommended to perform the civil work packages, including site preparation, piling, and concrete pouring, under the unit rate contract.

An effective risk management approach and realistic risk assessment are vital in successful management of convertible contracts and deciding the right conversion strategy. Project risks should be monitored closely and evaluated through a reliable risk analysis process to accurately estimate the amount of contingencies.

Since the conversion process needs a high level of cooperation and transparent interactions between contracting parties, alliancing and partnering strategies are recommended to establish the required project environment. These strategies build effective communications and trust between the project owner and the EPC contractor and expedite the conversion process.

In addition, the theoretical framework presents three possible conversion strategies through the project life cycle. Contract price arrangements fit for different scopes of work are suggested in different stages based on the level of scope definition and engineering completeness. Also, the acceptable range of contingencies are suggested for each strategy.

Considering its importance, developing an effective and systematic estimating process to reach a more accurate lump sum price in a convertible contract would be a potential subject for a future study on convertible contracts.

ACKNOWLEDGEMENTS

The authors of this paper gratefully acknowledge all project experts who participated in interviews and supported this study by their valuable knowledge and experience.

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