

**Determinants of Value Benefits in Adopting an Engineering
Procurement and Construction Management (EPCM) –
ABU DHABI Oil and Gas, UAE**

محددات فوائد القيمة في اعتماد نموذج التعاقد لإدارة الهندسة والمشتريات
والإنشاءات (EPCM)
أبو ظبي للنفط والغاز - الإمارات العربية المتحدة

by

ABDULLA RASHED ALZAABI

**A thesis submitted in partial fulfilment
of the requirements for the degree of**

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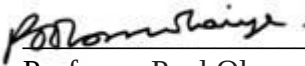
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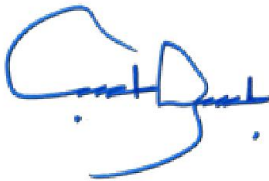
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ABSTRACT

The requirement for modern businesses to develop complex projects has forced businesses to consider opportunities for application of specific contracting models which would guarantee adequate distribution of responsibility in the project team among stakeholders and minimise risks for the project owner. This study aims to analyse the main characteristics of the EPC and EPCM contracting models for the Abu Dhabi oil and gas sector, and determine opportunities and risks related to the application of both contracting models. Specific results had to be associated with the definition of optimal guidelines for application of the EPCM contracting model in the target sphere of practice. The results of the prior literature review demonstrated that, though the EPCM contracting model is generally considered as more effective compared to the EPC approach, practitioners lack reliable recommendations for application of this method in practice. The methodology of the thesis included a quantitative study of a large sample of employees and managers in the target industry to gain understanding of their perception of the EPCM contracting model. The results of the study demonstrate the main features and factors of successful application of the EPCM contracting model in the target industry, together with practical guidelines for future implementation. It was found that the EPCM contracting model could be the optimal approach to large project management if properly arranged. The novelty of this research can be viewed from two perspectives:

- One is from a theoretical point of view where the research will challenge existing theories of value and contracting strategies. The research proposes ways in which value and contracting strategies and theories can be enhanced within the context of the oil and gas sector.
- Two, from a practical point of view, the research ascertained key practical EPCM determinants which can be used as guidelines for senior project practitioners in delivering large oil and gas programmes and mega projects in Abu Dhabi for better value through using the EPCM model.

Keywords: EPCM contracting model, EPC contracting model, Project management, Oil and gas sector, Risk management, Project owner.

الملخص

تقتضي متطلبات سوق العمل الحالي المعنية بتطوير المشروعات الاستراتيجية من الشركات انتهاز فرص تطبيق نماذج تعاقدية محددة من شأنها أن تضمن التوزيع العادل لمسؤوليات فريق المشروع بين ذوي الصلة، والحد من المخاطر التي تواجه مالك المشروع.

تهدف هذه الدراسة لتحليل الخصائص الرئيسية لنماذج عقود الهندسة والمشتريات والبناء (EPC) وإدارة الهندسة والمشتريات والبناء (EPCM) بقطاع النفط والغاز في أبو ظبي، وتحديد الفرص والمخاطر التي ينطوي عليها تطبيق كلا نموذجي التعاقد. يتعين أن تكون النتائج وفقاً لتعريف المبادئ التوجيهية المثلّى لتطبيق نموذج عقود إدارة الهندسة والمشتريات والبناء (EPCM) في مجالات محددة. وقد خُصّصت الأبحاث السابقة في هذا المجال إلى أنه على الرغم من أن تأثير نموذج عقود إدارة الهندسة والمشتريات والبناء (EPCM) يكون أكثر فاعلية مقارنة بنموذج الهندسة والمشتريات والبناء (EPC)؛ إلا أن الممارسين للنموذج يفتقرون لتوصيات موثوقة لتطبيق هذا النموذج.

تشمل منهجية البحث والاستبانة دراسة كميةً لثريحة كبيرة من الموظفين والمدراء في المجال المستهدف لتقييم اطلّاعهم على نموذج عقود إدارة الهندسة والمشتريات والبناء (EPCM). وقد نجحت الدراسة في تحديد السمات والعوامل الرئيسية للتطبيق الناجح لنموذج عقود إدارة الهندسة والمشتريات والبناء (EPCM) في المجالات المحددة، ووضع الإرشادات العملية للتنفيذ المستقبلي. كما كشفت الدراسة أن نموذج عقود إدارة الهندسة والمشتريات والبناء (EPCM) قد يكون النهج الأمثل لإدارة المشروعات الاستراتيجية إذا تم إعداده على نحو سليم. ويتبين تفرد هذا البحث من جانبين:

- الجانب النظري، حيث يناقش البحث نظريات القيمة واستراتيجيات التعاقد الحالية. ويضع بعض الطرق لتعزيز استراتيجيات ونظريات القيمة والتعاقد في قطاع النفط والغاز.
- الجانب العملي، حيث أكد البحث المحددات العملية الرئيسية لإدارة الهندسة والمشتريات والبناء (EPCM) التي يمكن اعتبارها مبادئ توجيهية لكبار مديري المشروعات لدى تنفيذ مشاريع النفط والغاز الاستراتيجية والمشروعات الكبرى في أبو ظبي للحصول على قيمة أفضل من خلال استخدام نموذج إدارة الهندسة والمشتريات والبناء (EPCM).

المصطلحات الأساسية: نموذج عقود إدارة الهندسة والمشتريات والبناء - نموذج عقود الهندسة والمشتريات والبناء - إدارة المشروع - قطاع النفط والغاز - إدارة المخاطر - مالك المشروع.

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TABLE OF CONTENTS

TABLE OF CONTENTS	i
LIST OF ILLUSTRATIONS.....	vii
LIST OF TABLES.....	viii
CHAPTER ONE: INTRODUCTION TO THE RESEARCH	1
1.0. Introduction	1
1.1. Problem statement	2
1.2. Research aim.....	5
1.3. Research objectives	6
1.4. Research questions	7
1.5. Research novelty.....	7
1.6. Summarisation of the research method adopted.....	9
1.7. Key findings of the research study	10
1.8. Structure of the thesis	11
CHAPTER TWO: UAE, ABU DHABI OIL AND GAS SECTOR, EPCM AND EPC	14
2.0. Introduction	14
2.1. Review of the United Arab Emirates (UAE) Market	17
2.1.1. Overview of Abu Dhabi	17
2.1.1.1. Political Factor	18
2.1.1.2. Economic Factor	20
2.1.1.3. Environmental Factor	22
2.1.1.4. Social Factor.....	23
2.1.1.5. Legal Factor.....	25
2.1.2. Overview of the oil and gas sector – Abu Dhabi.....	26
2.1.2.1. Characteristics of the oil and gas sector in Abu Dhabi	27
2.1.2.2. Challenges of the oil gas sector in Abu Dhabi	29
2.1.2.3. Performance of the Abu Dhabi oil and gas sector	32
2.1.2.4. Policies of the Abu Dhabi oil and gas sector.....	33
2.1.2.5. Initiatives of the Abu Dhabi oil and gas sector	34

2.1.2.6. Legal framework of the Abu Dhabi oil and gas sector.....	34
2.1.2.7. Projects	38
2.2. Overview of Engineering, Procurement and Construction Management (EPCM)	39
2.2.1. Definition and contract type of EPCM.....	40
2.2.2. Previous research on EPCM.....	45
2.2.3. Recent changes on EPCM	47
2.2.4 Current views on EPCM	49
2.2.5. Key benefits that can be obtained from EPCM.....	52
2.2.6. EPCM's relationship to the oil and gas sector	56
2.3. Overview of Engineering, Procurement and Construction (EPC).....	60
2.3.1. EPC definition and contract type.....	60
2.3.2. Review of previous research on EPC	63
2.3.3. Recent changes in EPC	64
2.3.4. Current views on EPC	65
2.3.5. Key benefits that can be obtained from EPC	68
2.3.6. EPC relationship to the oil and gas sector	71
2.4. Theoretical underpinnings and practical differences of EPCM and EPC	73
2.4.1. Viewpoints of EPCM and EPC theory and practice.....	73
2.4.2. Theoretical differences of EPCM and EPC.....	73
2.4.3. Practical differences of EPCM and EPC.....	75
2.4.4. Reconciliation between the differences.....	77
2.4.5. The way forward	79
2.5. Research on EPCM and EPC	79
2.5.1. Variances in EPCM and EPC models	79
2.5.2. EPCM and EPC risk management.....	81
2.5.3. EPCM sustainability.....	84
2.6. Overview of success in EPCM	86
2.6.1. Definition of success in EPCM	86
2.6.2. Previous research on success in EPCM.....	87
2.6.3. Recent changes in success in EPCM.....	89

2.6.4. Current views on success in EPCM	93
2.6.5. Emerging theories on success in EPCM.....	93
2.6.6. Guidelines for success in EPCM.....	93
2.7. Overview of value in Engineering, Procurement and Construction Management (EPCM)	94
2.7.1. Definition of value in EPCM	94
2.7.2. Previous research on value in EPCM.....	95
2.7.3. Recent changes in value in EPCM	99
2.7.4. Current views on value in EPCM.....	100
2.7.5. Emerging theories	100
2.7.6. Guidelines for value maximisation in EPCM.....	103
2.8. Key research problems identified from the literature reviewed	104
2.9. Chapter summary.....	106
CHAPTER THREE: PROPOSED CONCEPTUAL FRAMEWORK.....	109
3.0. Definition of the research problem.....	109
3.1. Theoretical coherence.....	111
3.2. Research strategy and conceptual framework	118
3.3. Proposed conceptual framework	121
3.4. Chapter summary.....	125
CHAPTER FOUR: RESEARCH METHODOLOGY.....	127
4.0. Introduction	127
4.1. Research background.....	127
4.2. Overview of the qualitative research method	128
4.3. Overview of the quantitative research method	129
4.4. Justification for using a quantitative research method	131
4.5. Philosophical view of the research study	133
4.6. Research approach.....	134
4.7. Research strategy.....	135
4.8. Pilot study.....	135
4.9. Sample study	137
4.10. Sampling strategy	141

4.11. Ethical considerations of the research	143
4.12. Data collection methods used	143
4.13. Data analysis.....	146
4.14. Validation and verification	146
4.15. Chapter summary.....	148
CHAPTER FIVE: QUANTITATIVE ANALYSIS AND FINDINGS OF THE STUDY ...	149
5.0. Introduction	149
5.1. Demographics.....	150
5.1.1. Work location.....	151
5.1.2. Region/nationality	151
5.1.3. Gender	152
5.1.4. Age	153
5.1.5. Years of work experience.....	154
5.1.6. Education level.....	155
5.1.7. Job position and level.....	155
5.1.8. Skills and competencies	156
5.2. Data collection tools	157
5.2.1. Objective 1: Analyse and compare the characteristics of the EPCM and EPC contract models 157	
5.2.2. Objective 2: Benefits of the EPCM contracting model for project management	160
5.2.3. Objective 3: Achievement of cost-effectiveness through the adoption of the EPCM model..	167
5.2.4. Objective 4: Identification of the key categories of risks associated with the EPCM model..	178
5.2.5. Objective 5: Key success factors for the application of the EPCM model.....	196
5.2.6. Objective 6: Guidelines for the adoption of the EPCM model	199
5.3. Summation of data analysis and findings	202
5.4. Chapter summary.....	204
CHAPTER SIX: DISCUSSION OF STUDY FINDINGS	206
6.0. Introduction	206
6.1. Realisation of study objectives	207
6.1.1. Objective 1: Analyse and compare the characteristics of the EPCM and EPC contract models 207	

6.1.2. Objective 2: Benefits of the EPCM contracting model for project management	210
6.1.3. Objective 3: Achievement of cost-effectiveness through the adoption of the EPCM model ..	222
6.1.4. Objective 4: Identification of the key categories of risks associated with the EPCM model..	227
6.1.5. Objective 5: Key success factors for the application of the EPCM model.....	231
6.1.6. Objective 6: Guidelines for the adoption of EPCM model	235
6.2. Chapter summary.....	239
CHAPTER SEVEN: MODEL DEVELOPMENT, VALIDATION AND VERIFICATION	
.....	241
7.0. Introduction	241
7.1. Aim of the chapter	242
7.2. The need for the model.....	244
7.3. Verification and validation objectives.....	246
7.4. Verification and validation process	248
7.5. Verification and validation results.....	251
7.6. Model development	253
7.7. Model implications.....	258
7.8. Chapter summary.....	262
CHAPTER EIGHT: CONCLUSIONS AND RECOMMENDATIONS	264
8.0. Introduction	264
8.1. Contribution of the research	265
8.1.1. Objective 1: Establish theoretical and practical differences that exist between EPCM and EPC contracting models.....	266
8.1.2. Objective 2: Ascertain how key benefits that are aligned to the EPCM project contracting model can be adopted by senior project practitioners delivering oil and gas projects in Abu Dhabi; and	266
8.1.3. Objective 3: Determine how senior project practitioners delivering oil and gas project in Abu Dhabi can achieve cost effectiveness through the adoption of the EPCM model.....	266
8.1.4. Objective 4: Identify key risks that are associated with the EPCM model and propose mitigation strategies that can be adopted by senior project practitioners in Abu Dhabi; and.....	267
8.1.5. Objective 5: Identify key success factors for EPCM model in the oil and gas sector.....	267
8.2. Recommendations to the industry	268

8.3. Recommendations to policymakers.....	270
8.4. Recommendations for further research.....	271
8.5. Limitations of the research study.....	274
REFERENCES	277
APPENDIX 1: CONSENT LETTER.....	297
APPENDIX 2: QUESTIONNAIRE	299

LIST OF ILLUSTRATIONS

Figure 1: Structure of the thesis.....	11
Figure 2: EPCM contract	41
Figure 3 : Independent variables of the study	62
Figure 4: EPC and EPCM contracts	80
Figure 5: Proposed Conceptual Framework.....	124
Figure 6 : Proposed model	256
Figure 7: Independent variables of the study	257

LIST OF TABLES

Table 1 : Definitions of the Key Variables	125
Table 2: Krejcie and Morgan’s Table	140
Table 3: Work location demographics	151
Table 4: Region/nationality demographics	152
Table 5: Gender demographics	153
Table 6: Age demographics	154
Table 7: Years of work experience demographics.....	154
Table 8: Education level demographics.....	155
Table 9: Job position and level demographics	156
Table 10: Skills and competencies demographics.....	156
Table 11 : Shorter bidding time	162
Table 12: Standardised work packages.....	162
Table 13: Fast-track schedule alignment.....	162
Table 14: Optimised material procurement cost.....	162
Table 15: Controlled project cost.....	162
Table 16: Adoption of new technologies.....	163
Table 17 : Mark-up costs removal	163
Table 18 : Controlled change orders.....	163
Table 19: Trust among project parties	163
Table 20 : Faster system completion.....	164
Table 21: Correlation analysis	166
Table 22: Correlation analysis	169
Table 23: Optimised material procurement cost regression analysis 1.....	170
Table 24: Optimised material procurement cost regression analysis 2.....	171
Table 25: Controlled project cost regression analysis 1.....	174
Table 26 : Controlled project cost regression analysis 2.....	175
Table 27 : Removal of mark-up cost on material and execution regression analysis 1	176
Table 28 : Removal of mark-up cost on material and execution regression analysis 2	177

Table 29 : Regression analysis.....	180
Table 30 : Work packaging design and subcontracting.....	182
Table 31 : Change orders, permits, and show drawings' submission and approval.....	182
Table 32: Schedule of engineering, procurement and construction, and approval of completed tasks	182
Table 33 : Company standard operating procedures	183
Table 34 : Government auditing protocols and procedures	183
Table 35 : Experience with local laws and other government regulations and modification in laws and regulations.....	183
Table 36 : Experience with building codes, by-laws, statutes and other government regulations definition of projects boundaries at an early stage of the project.....	183
Table 37 : System completion requirements	183
Table 38 : Alignment among work breakdown structure (WBS), contracting work breakdown structure (CWBS), cost breakdown structure (CBS), and organisation breakdown structure (OBS)	186
Table 39: Project cost estimate.....	186
Table 40 : Project construction schedule, cost and quality.....	186
Table 41 : Experience of the project teams	186
Table 42: Knowledge of new technological techniques and materials.....	186
Table 43 : Environmental circumstances, climate and local weather conditions.....	187
Table 44 : Knowledge about site circumstances by the project team members	187
Table 45 : Accurate work drawings and specifications	187
Table 46: Materials and labour availability and cost.....	187
Table 47 : Geotechnical circumstances.....	187
Table 48 : Defining a sufficient level of delegation of authority within the client project management team.....	190
Table 49 : Setting a steering committee for decision-making at the procurement phase ...	190
Table 50 : Introduction of specific terms and conditions for control over purchase orders and work packages	190

Table 51 : Defining an appropriate expenditure limit for the procurement phase assigned for the project director	190
Table 52: Defining an incentive scheme for the contractor for outperforming at the engineering and procurement phases	190
Table 53 : Setting liquidated damages %ages for each phase of execution	191
Table 54 : Introduction of a child contract strategy under the EPCM contract	191
Table 55 : Outlining coordination of the design and construction works between different work package contractors.....	191
Table 56 : Ensuring management, administration, and supervision of the work packages	192
Table 57 : Delivery of the project by defining certain key milestone dates	192
Table 58 : Introducing terms and conditions discouraging unnecessary claim submissions by contractors	192
Table 59 : Limiting the role of the company in contractors’ insurance claims	192
Table 60 : Identifying the EPCM strategy for the right scope of work provides resilience in project execution.....	194
Table 61 : Flexibility in the detailed design changes	194
Table 62: Agility in the introduction of new mitigation for the introduced risks	194
Table 63 : Flexibility in the assignment of work packages to the benefit of the project need	195
Table 64: Flexibility in defining construction sequences based on the project need.....	195
Table 65 : Flexibility in defining the procurement strategy based on the project need	195
Table 66 : Flexibility in introducing additional work package contractors based on the project need	195
Table 67 : Flexibility for the exit strategy within a phase of execution	196
Table 68 : Descriptive statistics – objective 2.....	212

CHAPTER ONE: INTRODUCTION TO THE RESEARCH

1.0. Introduction

The so-called energy industry, and mainly the oil and gas sector, in Abu Dhabi, plays a major role in the United Arab Emirates' (UAE's) economy and the strategies set forth for projects more than any other sector in the country (US-UAE Business Council 2019). The decision makers and practitioners in mega projects and organisations, in general, execute their projects in two different ways, one is Engineering, Procurement, and Construction (EPC), and the other is Engineering, Procurement and Construction Management (EPCM).

PwC (2016) suggested that *“delivering an EPCM project means different things to many participants”* (p.21). Abu Dhabi's oil and gas sector lacks the true benefit and knowledge of EPCM, and there are no specific determinants for adopting EPCM to gain the full benefits of such contracting model. Moreover, the oil and gas industry is a complex environment with variations in international involvement and project size that put limitations on control of costs, quality, associated risks and time constraints. The EPC-type contract involves a single point approach that includes all design, engineering, procurement, construction, and installation works – in addition to commissioning, start up, training, acceptance, and testing activities. It is the culmination of all tasks required to complete HOTO (hand over-turn over) to the owner, as stated by Huse (2002).

In contrast, an EPCM contract involves engineering, procurement, and construction and management services. The EPCM contractor assists the owner in the execution of the project and therefore the cost and risk of the project are borne by the owner. The ownership of the project

therefore remains directly with the owner as they can influence EPCM project outcomes, as stated by Loots and Henchie (2007). The EPCM contractor is more involved with the design, execution, and procurement process on behalf of the owner. They also assist the owner with negotiations and contribute to creating direct relationships with the owner and construction contractors and material suppliers. Thus, the owner needs to have an experienced in-house team to approve the EPCM contractor's managing of the complex task, as stated by Oosterhof (2018). Generally, mega projects vary by industry, by public-private ownership, by risk of technology and development, and by a host of other elements. These points regarding EPCM contracts particularly in the oil and gas industry should help in sorting out the guidelines for the qualities that an owner may want to consider in their choice options and subsequently what to include in their ultimate agreement, as stated by Singh and Tiwari (2015).

1.1. Problem statement

The EPCM contractor develops the front-end engineer design (FEED) and carries on or starts from a detailed design, then starts the procurement process, and manages the entire construction process by executing contracts on behalf of the client. At the same time, the EPCM contractor could start the post-FEED phase and carry it on. McNair (2016) suggested that “delivering an EPCM project means different things to many participants”. The fact that there is a confusion among project practitioners on the meaning of EPCM contracting method dedicate a need to secure this gap in the industry to maximize on the value creation in utilization of the subject contract method. According to Loots and Henchie (2007), “the key confusion which often arises is that whilst the “C” in “EPCM” stands for “Construction”, this is in the context of “CM” i.e. Construction Management”. Moreover, it was established from the reviewed literature that over the last 10 years, all Abu Dhabi

Oil and Gas projects within ADNOC are based on EPC turnkey lumpsum contracts, and nothing executed as EPCM (ADNOC, 2013). There is a substantial quantum of value addition that could be realised in the execution of the EPCM contracts model once the processes are standardised and differences with EPC contracts are fully exploited (Aldhaheeri *et al.* 2018; Al-Sulaiti *et al.* 2021; Olaniran 2017). Such contracts provide owners and lenders of limited-recourse projects with cost and time certainty and also provide a single point of responsibility for the design, construction, and procurement of the works. From the position of the study author, the provision of opportunities for the active engagement in the project management activities might be considered as a value for the project owner, so the EPCM contract was definitely a more attractive alternative for management.

This study is premised on factors of competitive advantages on EPCM-type contractual obligations and execution in the oil and gas industry in the UAE. Berends (2007) highlighted EPCM contracting opportunities, factors that determine the choice of such contracts among owners and identify key competitive advantages in the EPCM approach with relevance to the oil and gas industry, as stated by Bedair (2014). Literature studies indicated that the key determining factors for a mega industry in choice of contracting model would have been the level of involvement of the selected parties and subsequent contracting strategies that varied where risk lay. According to Ron Douglas, Ausenco's Executive Vice President, Global Project Delivery, factors influencing such transition have been an increase in demand of engineering and related services, complexity of execution with sufficient cost control and professional deficiencies (Douglas 2016).

From the literature reviewed, it has been shown that key determining factors for a mega industry in choice of contracting model would be the level of involvement of the selected parties and

subsequent contracting strategies that vary where risk lies. One could suggest that the problem of project management in the conditions of rising complexity of effective control and realisation of separate tasks and objectives would require active engagement of independent contractors, which leads to the rising relevance of the chosen study theme. In the case of the oil and gas industry, such factors had to be closely reviewed as time, budget, success parameters, and decision-making units, involving top management, are essential in choice of one strategy over another.

Optimising oil and gas value chains has become more stringent with the recent chain of unfortunate events in the Gulf of Mexico where a major producer faced huge damages in project implementation, making the industry more risk averse than before (Singh *et al.* 2015). In effect, oil and gas industry players needed to “up their game” by focusing on things that they do efficiently and improved their own in-house capabilities for win-win outcomes (Contracting Out Risk and Optimising Oil and Gas Value Chains 2015). It could therefore be suggested that the effective diversification of project management resources would require effective division of responsibilities and resources between project owners and independent contracts. The success in this sphere would depend on the quality of the chosen contracting strategies.

The selected theme targeted the existing research gaps in the study of the contractual management process for large projects in different industries, including the oil and gas sector. Serious knowledge gaps exist in the field of recognition of existing relationship between the contractual management model and the performance of the project. Muhammad *et al.* (2019) argued that the impacts of the specific contractual terms on the key project management characteristics (quality, cost, and schedule) are not clear, and the current studies provide highly contradictory results (p.1289). Another study by Glas *et al.* (2017) also determined the issue of lack of research in the field of

performance management via contracting measures. Altogether, the question about the selection of optimal contracting model for the needs of the specific project and industry remains to be relevant. The current study aimed to consider the role of the EPCM contracting model for performance management in the context of the oil and gas industry' construction projects. The utility of the EPCM contracting model from the point of performance outcomes improvement was compared to the similar impact of the EPC contracting approach.

1.2. Research aim

Abu Dhabi is a major exporter of oil and gas products with a worldwide market reach. The upstream of petrochemical projects, such as oil and gas projects, are classified as complex in nature and do indeed require sufficient balance of choice between time, cost and quality in their execution. The effort in such balance cost carried with it the potential combinations of a strict quality control, tough completion schedule, and lowest initial and long-term expenditure for their desired facility (Wai and Han 2012). While the parameters of quality, time, and expenditure control are traditionally considered as the most valuable characteristics of the project management procedure, it is also sensible to consider the parameter of engagement of different stakeholders for assessment of contracting and project management strategy effectiveness. In this way, the problem of careful assessment and inclusion of expectations of different stakeholders in the process of project realisation is an important task that required careful discussion in the context of contracting strategy development.

- The research aims to identify key success factors that would lead to the achievement of an EPCM value benefit realisation model. The research compares and assesses the

effectiveness of the EPCM model over the EPC model; and proposes practical EPCM guidelines that can be adopted by senior project practitioners delivering large oil and gas projects in Abu Dhabi. These guidelines can be used by programme owners and practitioners in mega projects in Abu Dhabi's oil and gas sector.

Moreover, a result of high-value projects is often determined by the metrics of their industry, type of ownership, the amount of risk of new technologies and developments, along with many other factors. The points suggested here, especially in regard to the EPCM projects in the oil and gas industry, can lay the foundation for contract choice and attributes required for the adoption of the model. The guidelines and requirements can help in deciding the final contents of the agreement that the owners enter into (Chattopadhyay and Mo 2010; Singh and Tiwari 2015).

1.3. Research objectives

The objectives of the research were to:

1. Establish theoretical and practical differences that exist between EPCM and EPC contracting models;
2. Ascertain how key benefits that are aligned to the EPCM project contracting model can be adopted by senior project practitioners delivering oil and gas projects in Abu Dhabi;
3. Determine how senior project practitioners delivering oil and gas projects in Abu Dhabi can achieve cost-effectiveness through the adoption of the EPCM model;
4. Identify key risks that are associated with the EPCM model and propose mitigation strategies that can be adopted by senior project practitioners in Abu Dhabi;
5. Identify key success factors for the EPCM model in the oil and gas sector;

6. Propose EPCM guidelines that can be adopted by senior project practitioners delivering large oil and gas projects in Abu Dhabi.

1.4. Research questions

The formulated research questions were the following:

1. What are the theoretical and practical differences that exist between the EPCM and EPC contracting models?
2. How does the EPCM contracting model give the owner sufficient time for FEED processes as well as exit strategy and options during project phases for better value benefit outcomes?
3. How does the EPCM contracting model offer a better legal and regulatory framework through an intellectual property regime through ensuring appropriate IP warranties and indemnities in the works that leverage value benefit of the project?
4. How does the EPCM contracting model enable optimisation of project costs due to enhanced owner influence on cost control measures that enhances value benefit?
5. How do various key success factors of the EPCM model affect the cost-effectiveness of investment for a given project?
6. How do key success factors of the EPCM model balance the distribution of the risks of a project?

1.5. Research novelty

Projects in oil and gas are classified as complex in nature and thus require an appropriate balance of choice between time, cost and quality. The effort of such a balancing of cost carried with it the prospective combinations of a strict quality control, tough completion schedule, and lowest initial

and long-term cost for company's desired facility, as stated by Wai and Han (2012). Several project management teams executing EPCM projects in the oil and gas industry of Abu Dhabi predominantly faced challenges of time and cost overrun, human capital management, change management, wasteful efforts, risk evaluation and mitigation, and standardisation of engineering practice. It is imperative that strategic guidelines are readily available focusing on providing high value to engineering processes amidst a lean management, in order to create value addition to the existing plethora of knowledge and experience prevailing in the business environment. The key issues that require a manager's attention from the inception through to the project delivery are essential for adoption as guidelines and likewise key success factors for successful implementation of EPCM contracts in the oil and gas industry. The research proposes guidelines for project practitioners for better value in executing the EPCM model.

The novelty of this research can be viewed from two perspectives:

- One is from a theoretical point of view, where the research will challenge existing theories of value and contracting strategies. The research proposes ways of how value and contracting strategies theories can be enhanced within the context of the oil and gas sector.
- Two, from a practical point of view, the research ascertained key practical EPCM determinants which can be as guidelines for senior project practitioners in delivering large oil and gas programmes and mega projects in Abu Dhabi for better value through using the EPCM model.
- Gaps in overall project governance and a clear line of accountability need to be satisfactorily maintained in EPCM among project managers and project team (Berends, 2015). Clarity of management structure is a key element in the proper functioning and

ability to stem emerging conflicting areas in regard to authority and responsibility. For instance, in many jurisdictions, the functions of the PM should have been ranged from training, mentoring, supporting and coordinating to improving communication and compliance levels. Strategies should have been adopted to improve the competency of the owners, as it is of high priority for EPCM projects. A proper engineering team would advise and consult the owners on important decisions. The EPCM contractor can offer such support to the client (Kimelfeld 2014). Since the EPCM model as a contracting strategy offers a better leverage of control to the owner, the manner in which the control was exercised remains imperative in order to deliver the best outcomes. Within the frame of this research and the observed emerging success factors, the project management team (PMT) could create fundamental principles to ensure the end objective is achieved in a well-timed phase of execution while increasing financial benefits or enhancing economic returns.

1.6. Summarisation of the research method adopted

The methodology of the study included the application of a quantitative research design to guarantee objectivity and high generalisation validity of the study outcomes. The specific methodology of the study included a quantitative survey study for collection of data from the study sample. The population sample of the research study included employees and contractors operating in the Abu Dhabi oil and gas sector whose work was associated with the accumulation of the specific knowledge about the methods of contracting model application. Total sample size for the study was 248 respondents. For the aims of data analysis, the methodology of statistical analysis was applied. The SPSS software platform served as the main instrument for the organisation of the data analysis procedure. The regression method of data analysis was applied to the quantitative data collected during the study. For the assessment of effectiveness of the selected research

methodology, a validation and verification procedure engaging experts in the selected field of the study was performed.

1.7. Key findings of the research study

The findings of the study can be presented on the basis of the discussion of answers to each earlier stated research question. For the first question of the study, the stated findings include definition of the main differences between the EPC and the EPCM contracting models. It is stated that the EPCM contracting model guarantees a higher level of project owner involvement and control over the project in general. This conclusion makes the EPCM model more attractive for practitioners who aim to control major part of the project aspects.

The second important finding of the study is related to the definition of the most important characteristics of the EPCM contracting model that should be applied in the process of contracting strategy development: Project Legal and Regulatory Guidelines; Project Technical Specifications; Extra-Contractual Mechanisms; and Resilience Parameters.

The final result of the study was related to the definition of the mediating factors that play the leading role in the realisation of the desired result of the EPCM contracting model application for the project. The following factors were highlighted as worth attention: effective stakeholder communication; reliable method of contractor selection; risks and responsibility distribution model; and the engagement of the project owner. These findings were applied to develop specific insights and guidelines for future utilisation in the Abu Dhabi oil and gas sector.

1.8. Structure of the thesis

The structure of the thesis was developed in the format that contributed to the realisation of the stated objectives of the thesis. The structure is also summarised in Figure 1.

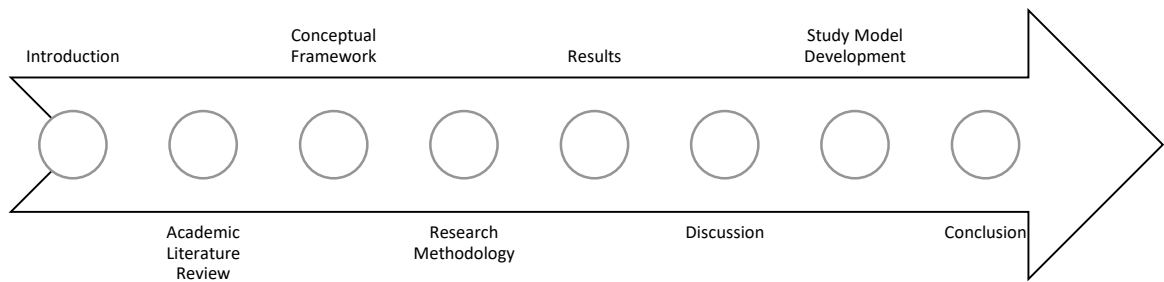


Figure 1: Structure of the thesis

Chapter one: provides a summary of the introduction to the research study. It presents information about the problem, aims, objectives and questions of the study. The novelty of the research applied methodology and the main findings of the study are briefly presented. On the basis of the study of this chapter, the audience could gain a general impression about the research in general.

Chapter two: summarises the outcomes of the academic literature review performed during the study. Specific aspects of the study problem addressed in the literature review include questions of UAE oil and gas sector review, overviews of the oil and gas sector in Abu Dhabi, overview of the EPC and the EPCM contracting models, and analysis of success and value of the EPCM contracting

model. Outcomes of the literature review can enable the audience to form a general understanding of the object under study.

Chapter three: of the thesis presents the proposed conceptual framework of the study. This is followed by a discussion of the research methodology in Chapter four.

Chapter four: provides an analysis of the research methodology including a discussion of the research background, study philosophy, research strategy, pilot study description, sampling strategy, ethical considerations of the study, methods of data collection and analysis, and validation and verification techniques applied.

Chapter five: of the research study summarises the quantitative findings of the research. The findings of the study are demonstrated in a format following the list of key study objectives.

Chapter six: provides a discussion of the study findings. The main outcomes of the research are also presented in the format of a discussion of the main study objectives and means of their realisation.

Chapter seven: describes the procedure of the study model development, validation and verification. The implications of the model are also considered.

Chapter eight: summarises the key conclusions and recommendations of the research. Specific recommendations are developed for three categories of recipients: industry, policy makers and further research practice.

CHAPTER TWO: UAE, ABU DHABI OIL AND GAS SECTOR, EPCM AND EPC

2.0. Introduction

The development of a modern business depends on the successful realisation of strategic projects as a source of long-term growth and an increase of profitability together with its sustainability. In the conditions of economic globalisation, the level of rivalry in global markets keeps growing, and companies have to develop opportunities for stable growth and expansion to maintain strong competitive positions. The absence of potential for effective growth and expansion can serve as a basis for the removal of players from the global markets and their acquisition by stronger ones. The same rules are relevant for companies operating in the global oil and gas markets. The volatility of demand for energy resources in the global markets today creates conditions for the increase in risk and uncertainty levels for global players in the oil and gas industry. Under these circumstances, organisations should adapt their performance to the needs of the market, improve their operational models and remove their competitors. The fulfilment of these objectives requires the development and realisation of strategic construction projects as a basis for the rise in the production capabilities of the oil and gas companies.

The presented strategic development trend is relevant for all major oil and gas-producing regions, including the Abu Dhabi Emirate. Traditionally, the oil and gas sector has played an important role in the economic structure of the region, serving as one of the main generators of export profits for its economy (US-UAE Business Council 2019). The rising level of interest in this sector of the regional economy demonstrated by domestic and international economic actors has defined the

need for the implementation of the set of strategic construction projects. At the same time, the high level of expenses and funding requirements for the realisation of these schemes has made it clear that proper project management is necessary in order to guarantee successful fulfilment of all the chosen initiatives and maximisation of the project value for investors. The achievement of this objective is associated with the search for and application of the optimal project management model.

Among the variety of existing contract models, the following were selected for the purpose of analysis – EPC and EPCM models (PwC 2016b). Each of them has its strengths and weaknesses associated with the opportunities that are generated for the successful implementation of a project on the basis of concrete model application. The researcher oriented on these contracting models due to their popularity among practitioners, which defined the importance of their assessment for the development of practical recommendations for project management. The model of the EPC contract is traditionally considered to be the optimal solution for project owners oriented at the minimisation of the risks and personal responsibility in the process of the scheme's realisation. This format allows the project owners to deliver full responsibility to independent contractors, forcing them to perform a full set of activities related to project management and implementation.

Compared to this, the format of the EPCM contract is traditionally oriented at a flexible approach to the distribution of the responsibility for project realisation and management among the project owner and the contractors. The EPCM contractor serves as one of many other contractors in the project that bear liability for the management of all key steps of the project (Han *et al.* 2012). At the same time, opposite to the EPC contract form, the role of the project owner in the project

management process is not passive, and his/her level of influence on the final results and procedures of project realisation depends on the character of the agreement reached in the EPCM contract. On one hand, such an approach gives opportunities for a higher level of flexibility in decision-making for the parties and the potential improvement of the project outcomes and project value for the owner. On the other hand, an ineffective choice of the responsibility distribution model can serve as a source of additional risks and a potential basis for the failure of the project in general. Due to the existing problems in understanding of the optimal format of the contracting strategy, the presented study aimed to assess the key parameters of both contract models and contribute to the definition of the optimal contracting strategy for the purpose of the realisation of strategic projects in the Abu Dhabi region.

The process of analysis and comparison of different contracting strategies included the assessment of their key characteristics, advantages and limitations. The overarching objective of the proposed study is to identify the opportunities and risks related to the orientation on the specific contract model for the project owners of the construction initiatives. The definition of the key characteristics of the chosen contract models had to serve as the basis for the determination of the optimal contracting strategy for the specific conditions of the construction projects in the oil and gas industry. The peculiar principles and parameters of project success and maximisation of project value were also considered to become a part of the final study implications. Based on the performed analysis, the optimal model of the contracting strategy for the construction projects was identified. In the context of the study, it was also important to discuss the existing problems of the current format of the concrete contract model and to offer recommendations for potential improvement of the chosen model following on from the results of the prior studies. The orientation on such a

format of analysis was supposed to provide the researcher with a complex understanding of the required improvements to the current model of contracting strategy development for the chosen project. On the basis of the definition of the recommendations for potential improvement of the contract model, the further research process was organised to identify the specific solutions that should be applied in this sphere. It was also important to show that the definition of optimal contracting model and development of specific recommendations for project owners in the context of the study depended on the specifics of the study format and key assumptions that were accepted by the study author. In this way, the outcomes of the study should be considered based on analysis of these characteristics, and critically discussed from the position of their reliability.

In the upcoming sections of this chapter, an in-depth review of literature in the Emirate of Abu Dhabi, the sector of oil and gas in the Emirate of Abu Dhabi, contracting and legal framework within the country, contracting strategies for oil and gas projects, and the value benefit in the contracting models for large programmes in Abu Dhabi oil and gas is provided. The aim of the following sections is to build comprehensive knowledge in the subject research area identifying the gaps that dictate the need for EPCM guidelines.

2.1. Review of the United Arab Emirates (UAE) Market

2.1.1. Overview of Abu Dhabi

Abu Dhabi is the capital and the second most populated city of the United Arab Emirates (after Dubai). It is the capital of the Emirate of Abu Dhabi, one of the most developed and largest regions in the UAE. Abu Dhabi as a city is located on an island in the Arabian Gulf and can be accessed from the shore by three main bridges, while most of the city and Emirate reside on the mainland.

As of 2019, Abu Dhabi's urban area had an estimated population of 1.45 million (World Population Review 2019). Abu Dhabi is the location of the local and federal government offices and is the seat of the United Arab Emirates Government and the Supreme Oil Council. The city is home to the President of the UAE, who is a member of the Al Nahyan family. Abu Dhabi's rapid development and urbanisation, coupled with the massive oil and gas reserves and production and relatively high average income, have transformed it into a large, advanced metropolis. It is the country's centre of politics and industry, and a major culture and commerce centre.

For the aims of analysis, the author performed PESTLE analysis, describing the specific factors in environment of Abu Dhabi.

2.1.1.1. Political Factor

The analysis of the business environment of the Abu Dhabi Emirate should include an assessment of the opportunities and risks for foreign and local businesses in the sphere of politics. To answer the question about the political opportunities and risks for business in Abu Dhabi, it is sensible to consider the structure of the political system of the state and analyse the intentions of the political elites in Abu Dhabi related to foreign investments and business initiatives. As for the political identity and structure of the UAE, the country gained independence in 1971 (UAE Government 2019b). Its political structure includes seven Emirates: Abu Dhabi, Dubai, Sharjah, Ras Al Khaimah, Ajman, Umm Al Quwain, and Fujairah (UAE Government 2019b). The UAE operates in the format of a federation, with the UAE Constitution as a key element of its political system. The ruler of the Abu Dhabi Emirate is the President of the UAE and the head of state, occupying one of the leading positions in the executive branch of power in the state. The highest ruling institute in the UAE is the Federal Supreme Council, which includes the individual rulers of all

seven Emirates. This institution is responsible for the development of a strategic vision of state development, which is followed by the separate Emirates.

The executive power in the UAE, including the Abu Dhabi Emirate, is represented by the Cabinet of the UAE and ministers in the Abu Dhabi Emirate (UAE Government 2019b). The Abu Dhabi Emirate has an independent executive council that is provided with opportunities for the realisation of decisions independently from the federal executive institutions and operates in direct connection with them. As for the legislative power in the UAE, it is exercised by the Federal National Council, where each Emirate has an equal level of representation (UAE Government 2019b). In this way, similarly to other Emirates in the country, the Abu Dhabi Emirate has the potential to influence change of the political situation in the state, which is granted by the UAE Constitution.

Speaking about the judicial system in the UAE, it operates on the basis of the integration of the Western judicial tradition and the Islamic Sharia Law. This combination defines the specific conditions of performance for foreign businesses in the UAE. Companies should assess the character of their performance in the context of the norms stated in the Sharia Law. This requirement can become a challenge for Western businesses which are not adapted to the specific cultural conditions of the Islamic judicial tradition. Together with the consideration of the political system and structure in the UAE and the Abu Dhabi Emirate, it is sensible to perform an analysis of the existing political views of Abu Dhabi's elite in the sphere of foreign business development and promotion in the UAE. The understanding of the perspectives and risks of operations in Abu Dhabi should be based on clear comprehension of the vision of the UAE's future among the political elite of the state. Interesting findings in this sphere have been presented in a research paper

by Miller and Verhoeven (2019). Currently, the political elite of the UAE aim to effectively use the state's resources, and geographical and economic potential to increase the influence of the UAE on the processes taking place in the Middle East region (Miller and Verhoeven 2019). This vision of the future of the UAE and the Abu Dhabi Emirate defines the importance of the state's active participation in international economic and political processes. Based on this fact, the political elite are highly interested in attracting investments and foreign businesses to the state, especially to the Abu Dhabi Emirate as the country's economic and political centre. Altogether, the results of the analysis of the political environment in the UAE provide the basis for the argument about the positive opportunities for foreign businesses and investors in the Abu Dhabi Emirate.

2.1.1.2. Economic Factor

Together with the assessment of the political environment of the Abu Dhabi Emirate, it is important to be aware of the economic situation in the region for businesses and investors to understand future perspectives concerning operations in the Emirate, encourage investments into this region's development, and establish strong economic ties with the local society and authorities. In general, it is significant to analyse the prospects of Abu Dhabi's market, and the long-term outcomes for the business organisations that are up to deciding about investing in this area's development. The consideration of the economic environment in Abu Dhabi and the UAE, in general, has demonstrated significant perspectives of future economic growth and opportunities generated for foreign business in the region. The economy of the UAE is highly dependent on the development of the international trade system, and the level of unemployment in the country is currently historically low (Empyrean Advisors 2019). As for the economy of the Abu Dhabi Emirate, it presents a diversified structure of sectors and industries, which minimises the risks of economic

decline in the medium-term perspective. Although Abu Dhabi's dependency on international trade creates certain risks in the long-term perspective, the analysis of the prior progress in the sphere of economic development has demonstrated the capability of the UAE economy to effectively overcome this threat (Empyrean Advisors 2019). Further, the issue of uncontrolled inflation had an impact on the operations of businesses in the UAE in the past, but by the period of 2019 the impact of inflation is expected to be minimal (Empyrean Advisors 2019).

Together with the analysis of the key macroeconomic parameters, it is important to present the structure of the UAE economy. Currently, the oil and gas industry occupy the leading position in the structure of the state's national economy. In 2018, the share of the oil and gas industry in the national economy of the UAE equalled 26 % (Empyrean Advisors 2019). This defines the significant role of the energy sector in the state's economy and also demonstrates the effectiveness of the process of economic structure diversification in the UAE. The process of rapid economic development in the Abu Dhabi Emirate has led to the situation when the economy has almost doubled since the period of 2000 (Empyrean Advisors 2019). The analysis of the dependencies between oil and gas prices and the tendencies of the UAE's economic growth has demonstrated the fact that the state's economy is not dependent on the volatility of prices for energy resources (Empyrean Advisors 2019). The fastest-growing sectors in the economy of the UAE and the Abu Dhabi Emirate include the following: accommodation and food, education, information and communication, arts and recreation, and real estate (Empyrean Advisors 2019). Compared to these sectors, where the annual growth level is at the level of 5-6.7 %, the growth in the oil and gas sector amounts to 1.9 % (Empyrean Advisors 2019). Additionally, the country's economy has one of the

lowest rates of unemployment in the world (Empyrean Advisors 2019). These parameters show the positive perspectives of investing in its economy.

2.1.1.3. Environmental Factor

It is important to mention the fact that, among the key global risks for the modern world that were determined in 2019, those related to the sphere of the environment occupied the leading positions in the list (Empyrean Advisors 2019). The situation in the Abu Dhabi Emirate and the UAE in general in the sphere of environment can be characterised as dominated by a variety of risks. Compared to other earlier-assessed segments, the environmental conditions for the business organisations in the Abu Dhabi Emirate are highly unattractive and challenging. This can be explained by the fact that the geographical location of the UAE defines the significant impact of climate change processes. The average temperature level in this region is considerably higher compared to the majority of other modern states (Empyrean Advisors 2019). Thus, it is necessary to consider the conditions that have a major impact on the development of the Abu Dhabi Emirate and the perspectives of foreign businesses there.

The key environmental challenges faced by the Abu Dhabi Emirate today are the following: failure of climate change mitigation and adaptation to this process, the rising relevance of extreme climate events in the region, the increasing probability of natural disasters occurring as a result of the serious change of climate in the world, and the problems connected with obtaining water resources in the Abu Dhabi region (Empyrean Advisors 2019). Altogether, these issues create significant risks for companies operating in the UAE. Among the negative impacts of climate change and natural disasters, it is important to mention the fact that the Abu Dhabi Emirate is located in a

coastal area, and the increase in the world's sea levels due to the process of glaciers melting can result in flooding of its coastal areas. This risk can have a vital impact on Abu Dhabi's society and economy since a major part of the production, infrastructure and trade facilities there is situated in the coastal areas. In addition to the mentioned risks, another source of challenges is related to the perspectives on the water crisis in the UAE in the future (Empyrean Advisors 2019). Owing to the desert character of a part of the territories of the Abu Dhabi Emirate, the provision of the required resources for the survival of the local population is complicated. As was earlier mentioned, the absence of an effective means of delivery of such resources to the UAE market can generate significant threats for the sustainability of the system in general in the future. In these conditions, the companies entering the Abu Dhabi market should consider the mentioned risks as a part of their planning procedure.

2.1.1.4. Social Factor

The analysis of the social environment of the Abu Dhabi Emirate includes the assessment of the key challenges and opportunities related to the structure of the population in the UAE, labour force potential and payable customer demand level. As for the UAE's population structure, it is important to say that the country in general, including the Abu Dhabi Emirate, is highly dependent on the inflow of immigrants. The share of local citizens in the country is significantly low, and immigrants form the basis of the national wellbeing and state's economic growth (Empyrean Advisors 2019). The structure of the immigrant community in the Abu Dhabi Emirate includes citizens from different developing and developed states, depending on the requirements for qualifications in the Abu Dhabi Emirate. The immigrants from the Asian states work in the spheres of construction and simple services provision, while the educated and qualified immigrants from the developed states

lie at the core of the intellectual elite in the country, being responsible for the development of new technologies and services in the Abu Dhabi Emirate.

The structure of the population in the Abu Dhabi Emirate also impacts the level of payable customer demand and the economic potential of the society. In general, the level of economic and social inequality in the UAE is considerably higher compared to other countries (Empyrean Advisors 2019). While the educated and experienced labour force is provided with optimal working conditions and high benefits, the personnel from Asian states with a low level of qualifications receive a considerably worse level of compensation, reducing the overall level of GDP per capita in the UAE (Empyrean Advisors 2019). The mentioned high level of income inequality in the UAE and the Abu Dhabi Emirate should be considered as one of the significant factors for understanding the socio-economic perspectives of the region.

At the same time, it is necessary to highlight the fact of an absence of serious barriers to the attraction of a foreign labour force for businesses entering the market of the Abu Dhabi Emirate. According to the existing legal regulations in the country (Empyrean Advisors 2019), foreign businesses are forced to provide employment only for certain categories of workers from within the Abu Dhabi Emirate, while a major part of the employee base can be formed from immigrants and experts with the required qualifications. Among the main risks that can be identified in the social sphere of the Abu Dhabi Emirate, the following should be mentioned: unemployment or underemployment, terrorist attacks, and resource crises that can impact the wellbeing of the local population (Empyrean Advisors 2019). The problem of unemployment is currently resolved in the UAE, and the perspectives in this sphere are quite positive. As for the situation in the field of

security, the Middle East region is characterised by a negative situation due to the development of the terrorist movement. At the same time, the analysis of the UAE's prior experience in this sphere has demonstrated the fact that terrorist security risks for the country are of low relevance.

2.1.1.5. Legal Factor

Together with all the earlier-mentioned elements of the business environment in the Abu Dhabi Emirate, it is obligatory to assess the legal framework of the state to identify the existing opportunities and challenges for business organisations entering the sphere of contract partnership here. As stated earlier, each Emirate in the UAE is characterised by a high level of autonomy and independence with regard to the legal framework operations. Each of the Emirates operates a two-tier system, comprising the Court of First Instance and the Court of Appeal (Baker 2017). The practice of judicial system organisation in the UAE is different from the Western tradition. As a result, judges in the Abu Dhabi Emirate are provided with a high level of flexibility and autonomy in decision-making. In fact, Abu Dhabi is one of the Emirates in the UAE that has a unique local court structure which allows local authorities to consider and solve a major part of the legal cases in the Emirate.

The analysis of the positions of the legal framework in relation to the foreign investments in the UAE has revealed the fact that direct foreign investments in the Emirates are quite limited, and the business organisations in the state should be owned by locals, with a share of at least 51 % (Baker 2017). This situation creates challenges for foreign actors entering the Abu Dhabi Emirate market. While the new foreign investment law that is supposed to give foreign investors more opportunities for independent operations in the Abu Dhabi Emirate is currently being discussed, there is no

reliable information about the actual perspectives for the adoption of the law in a short-term perspective (Baker 2017). Since 2017, no major changes in the law took place. Under the circumstances, foreign businesses in the Abu Dhabi Emirate still face serious barriers to effective development. Along with that, the opportunities for the companies operating on the territory of the Abu Dhabi Emirate are connected with the practice of application of the business's home country law in the case of entering into contracts on the territory of the UAE (Baker 2017). Commonly, English law is applied for the resolution of disputes regarding the issues that are not directly connected to the sphere of interest of the Islamic Sharia Law.

As for the taxation system, the existing regulations in the UAE create opportunities for the definition of the key taxation rules to be made at the level of Emirates. As for the relevant changes to the taxation system in the Abu Dhabi Emirate, the integration of value-added tax (VAT) is an instrument of accumulation of tax revenues for the Emirates and federal budget (Baker 2017). Moreover, it is important to mention the fact that there is no single anti-bribery and corruption law in the UAE, while separate legal documents still provide certain regulations in this sphere (Baker 2017). Altogether, the existing legal framework in the Abu Dhabi Emirate can be characterised as lacking many important elements; thus, its improvement is required.

2.1.2. Overview of the oil and gas sector – Abu Dhabi

The petrochemical and, specifically, the oil and gas sector in Abu Dhabi Emirate represents a major role in redirecting the market and project strategies more than any other sectors in the UAE for many reasons, one of which is the mega size of projects and cost associated with them, and second is the amount of investment in billions of US dollars that is connected with them. ADNOC, a UAE

oil and gas producer, unveiled plans to invest US \$45 billion over the next five years, to become a leading global downstream player (ADNOC 2018). Owners, decision makers, and project practitioners in large projects and organisations, in general, execute their projects in two different ways, one is Engineering, Procurement and Construction (EPC), and the other is Engineering, Procurement and Construction Management (EPCM). A project in the oil and gas industry generally falls under two main sectors, upstream and downstream. The upstream sector is about obtaining oil and gas crude from natural resources, such as exploration of crude reserves or building production facilities. The downstream sector, in contrast, relates to refining and purifying the crude oil received from the upstream sector, thus providing end products to users ready for distribution and sales (PSAC 2019).

2.1.2.1. Characteristics of the oil and gas sector in Abu Dhabi

The discussion of the characteristics of the oil and gas sector in Abu Dhabi should start from the presentation of the general position of the UAE in the global oil and gas production. According to the most relevant statistics, the UAE holds the seventh-largest proven oil reserves that equal approximately 97.8 billion barrels (US-UAE Business Council 2019). As for the location of these reserves inside the UAE, approximately 96 % of them are situated in the Abu Dhabi Emirate, making this region a key source of development for the state's oil and gas industry (US-UAE Business Council 2019). One of the largest offshore oil fields in the world is the Upper Zakum field located in the Abu Dhabi Emirate (US-UAE Business Council 2019). These statistics make Abu Dhabi an important location for the global oil markets.

Speaking about the natural gas sector, the proven reserves of the UAE include approximately 215 trillion cubic feet, which is also the seventh-largest value in the world (US-UAE Business Council 2019). Since 2015, the average value of annual exports of natural gas for the UAE has equalled 466 billion cubic feet (US-UAE Business Council 2019). While the situation in the oil sector is stable for the UAE, the existing problems in the management of the gas production facilities are explained by the fact that there is an absence of balance between the growth of internal consumption and the production of natural gas. While the annual growth of gas production amounts to approximately 2.1 %, the growth of domestic demand for this resource equals 6 % (US-UAE Business Council 2019). In these conditions, the domestic market for natural gas in the UAE is highly dependent on the import of foreign gas. The resolution of this problem can be considered a serious opportunity for companies operating in the UAE. Together with the general overview of the resource base for the oil and gas sector in the Abu Dhabi Emirate, it is important to consider the key companies and actors currently operating in this market. The discussion of the current players should contribute to better understanding of the existing level of competition and challenges those new players can face and cooperation between the existing actors. Among the key companies working in the Abu Dhabi oil and gas sector, the following should be mentioned (US-UAE Business Council 2019):

- National Oil Companies (NOC)
 - Abu Dhabi National Oil Company (ADNOC);
 - Mubadala Petroleum;
 - Emirates National Oil Company (ENOC);

- International Oil Companies (IOC)
 - Occidental Petroleum;
 - BP;
 - ExxonMobil;
 - Royal Dutch Shell;
 - Total
 - Chevron.

As can be seen, based on the analysis of the basic characteristics of Abu Dhabi's oil and gas industry, this is a complex market with significant opportunities, where a high number of domestic and international players currently operate. The future development of the sector depends on the clear identification of issues and challenges that limit opportunities for growth, and the development of recommendations for their removal. In this context, it is important to determine the role of the main challenges in the performance of the oil and gas sector in the Abu Dhabi Emirate.

2.1.2.2. Challenges of the oil gas sector in Abu Dhabi

The previous analysis of the key characteristics of the oil and gas sector in Abu Dhabi has made it possible to identify several serious challenges that currently exist in the industry in the UAE. It is important to provide a wider vision of the issue and key problems in this sphere to use them as a basis for future research and the definition of solutions. In this context, the following challenges can be considered as the major ones concerning the oil and gas sector in the Abu Dhabi Emirate and the UAE in general: high level of energy consumption in the UAE, price volatility in the oil and gas sector, influence of changes in the taxation model on the field, orientation on active

integration of renewable energy sources as a technology for energy generation, and the attraction of young and talented employees into the oil and gas industry in the Abu Dhabi Emirate. The first problem is related to the issue of a high level of energy resources consumption inside the UAE. As it was stated, currently the UAE oil and gas sector provides the required volume of petroleum production to meet the internal demand for this resource, and the generation of a sufficient level of exports to the world's markets (Betancourt-Torcat 2018). At the same time, the existing value of gas production in the UAE meets only about 26 % of the country's natural gas demand (Betancourt-Torcat 2018). The resolution of the issue of dependency on imported gas resources is vital as it is a serious problem for the oil and gas industry in the UAE and the Abu Dhabi Emirate. The reliance on oil resources cannot be considered as a reliable and effective solution due to the costs of such a decision and its ecological impacts.

The problem of price volatility in the global oil and gas markets is explained by the factors of political uncertainty and trade confrontation between states (KPMG 2019). The recent changes in the sphere of global politics have generated new sources of risks for the global energy markets – unpredicted nature of changes in global production and trade systems, the rising level of economic and political confrontation between states, policies of trade wars and sanctions applied by countries. All these factors lead to the reduction of demand for energy resources in world markets, and the inability of international organisations including OPEC to control the level of prices globally (KPMG 2019). As a result, the actors in the oil and gas sector cannot effectively predict future changes regarding the level of demand and adapt business strategies to a reliable and realistic expectations model. To continue, one of the considerably new challenges for the oil and gas sector in the Abu Dhabi Emirate is related to the recent changes in the taxation policies applied by the

UAE government. Until recently, the UAE was characterised as a region largely free of taxes (KPMG 2019). Recent changes in this situation include the integration of value-added tax, and the changes in the corporate tax regulations defined by the Abu Dhabi Income Tax Decree (KPMG 2019). As a consequence, the companies operating in the oil and gas sector will have to seriously reassess their prior business strategies and operations plans that included the idea of the absence of serious tax pressure on them.

The development of renewable energy sources and technologies is an objective strategic move approved by the UAE government in response to the earlier-presented environmental risks and challenges. The UAE society and government have no alternative solution but to invest in renewable and green energy projects to minimise future risks generated by climate change processes. However, the focus on renewable energy sources will lead to changes in the context of the oil and gas sector in Abu Dhabi and the UAE in general (KPMG 2019). The reduction of future demand for the oil and gas sector products is an obvious result of the current strategic shift. Together with this, the implementation of the green energy schemes is likely to become an obligation for the oil and gas industry players, leading to new costs in the sphere of research and development (KPMG 2019). Thus, the companies should adequately assess the existing opportunities and risks and adapt their performance to the new situation.

The final challenge that will have to be addressed in the future development of the oil and gas industry in the UAE is related to the effective attraction of young and talented specialists to work in the sector. According to the results of the relevant study, the younger generation does not share the same values as the ones that were common to the oil and gas industry players in the past (KPMG

2019). As a consequence, the companies will have to find new values that will motivate young people for cooperation and active involvement in the process of reforming the oil and gas sector. This is one of the most important challenges that have to be dealt with since the absence of the inflow of new talents and specialists may cause a reduction in the effectiveness of innovations developed in the oil and gas industry in the future. Altogether, the future development of the oil and gas industry in the Abu Dhabi Emirate will be related to the high number of new challenges. In these conditions, the ability of the companies to effectively address these issues will define their long-term competitive perspectives and chances for success in the industry. To evaluate the perspectives of the sector in Abu Dhabi, it is sensible to assess the current performance in the field.

2.1.2.3. Performance of the Abu Dhabi oil and gas sector

The consideration of the performance of the Abu Dhabi oil and gas industry has demonstrated the significant impact of the external environment's factors on it. Special attention should be paid to the factor of prices for energy resources. The analysis of the statistics for the parameter of the level of generated GDP by the industry showed a reduction from 315,535 million AED in 2010 to 298,814 million AED in 2017 (SCAD 2018). At the same time, the level of GDP generated by the oil and gas sector at constant 2007 prices demonstrated the growth from 302,138 million AED to 377,886 million AED (SCAD 2018). As can be seen, in conditions of fixed prices, the oil and gas sector of the Abu Dhabi Emirate is characterised by a serious increase in production and sales. Yet, the volatility of prices has an adverse impact on companies' performance. This risk should be adequately assessed. As for the annual growth rate in GDP by the oil and gas industry in the Abu Dhabi region, the parameter equalled 23.9 % in 2017 (SCAD 2018). In the structure of the foreign trade of goods and services, the export of oil and gas products share changed from 71.8 % in 2010

to 52.8 % in 2017 (SCAD 2018). According to this result, the impact of the oil and gas sector on the economy of the Emirate significantly reduced during the last decade. Nevertheless, its influence is still quite serious, and the local actors are interested in the productive development of this industry in the future. The oil and gas industry remains one of the key destinations for foreign investments in the region, experiencing competition only from the manufacturing and real estate sectors (SCAD 2018). Capital formation level in the field also increased, from 2.2 % of GDP at current prices in 2014 to 6.3 % in 2017 (SCAD 2018). Therefore, the current performance of the industry provides the basis for positive expectations regarding the future development of the oil and gas sector in the Abu Dhabi Emirate.

2.1.2.4. Policies of the Abu Dhabi oil and gas sector

The analysis of the perspectives of the oil and gas sector in the Abu Dhabi Emirate should include an assessment of the policies that will be realised by the government to support the local business and foreign investors. In the sphere of the oil and gas sector development, the future changes with regard to the state's policy are related to the improvement of business conditions and the provision of new means of indirect support for business. Among the programme documents that can contribute to better understanding of this issue, the following should be mentioned: Abu Dhabi Economic Vision 2030 (The Government of Abu Dhabi 2019) and the Abu Dhabi Environment Vision 2030 (UAE Government 2019a). The implementation of the Abu Dhabi economic vision programme should contribute to the development of an effective business environment, improve the efficiency of labour and infrastructure facilities, and offer new opportunities for the application of financial markets' resources by business actors. As for the outcomes of the Abu Dhabi Environment Vision 2030, they will be related to the regulation of oil and gas industry players'

performance in the aspect of environmental impact. The new regulations will create strict rules in the sphere of environmental outcomes' monitoring and control. Altogether, the performance of the oil and gas business in the UAE will be much more beneficial but also associated with a higher level of demands and requirements for the companies' performance.

2.1.2.5. Initiatives of the Abu Dhabi oil and gas sector

The specific initiatives that can be implemented in the oil and gas sector in the Abu Dhabi Emirate are related to the earlier-discussed Abu Dhabi Economic Vision 2030 programme (UAE Government 2019a). The list of prospective initiatives that will be realised can be associated with the creation of opportunities for improved personnel productivity and performance, reduction of the expenses and removal of barriers for domestic and foreign business in the region, and the creation of new infrastructural capabilities and opportunities for business in the region. Altogether, the future initiatives will contribute to the increase of the oil and gas industry's attractiveness and the effectiveness of its performance.

2.1.2.6. Legal framework of the Abu Dhabi oil and gas sector

The regulation of the oil and gas sector in Abu Dhabi is performed on the basis of the Emirate and federal laws. According to the UAE Constitution, the natural resources located on the territory of the state are considered to be public property, and the federal laws are supposed to regulate the activity in the sphere of their extraction and utilisation (Comyn and Tiller 2019). The key regulatory institution that controls the activities of the oil and gas companies in the Emirate is the Abu Dhabi Supreme Petroleum Council (SPC) (Comyn and Tiller 2019). Its representative is integrated into the structure of the board of directors of the ADNOC as the largest player in the oil and gas sector

of Abu Dhabi (Comyn and Tiller 2019). According to the defined competencies of the ADNOC, the organisation is supposed to fulfil the following objectives (Comyn and Tiller 2019):

- Formulate and control the realisation of the petroleum policy in the Emirate;
- Promulgate regulations in the sphere of petroleum resources;
- Control proper collection of taxes and royalty;
- Issue strategic decisions for the management of ADNOC and other petroleum companies.

The main law that has been applied to regulate the oil and gas industry operations is the Abu Dhabi Law Number 8 (The Oil and Gas Law) (Comyn and Tiller 2019). It includes specific requirements for the business organisations to comply with regarding energy resources collection and utilisation. It regulates the procedures of the oil and gas companies, including all upstream, downstream and midstream operations (Comyn and Tiller 2019). According to the requirements of the law, the companies operating in the oil and gas industry in the UAE are required to provide month-to-month production reports, including information about the volumes of production and energy resources collection, work conditions and influence of their operations on the natural resources of the Abu Dhabi Emirate (Comyn and Tiller 2019). The regulations of the Oil and Gas Law are oriented at the creation of specific working conditions for the domestic and international companies to guarantee the effective and sensible utilisation of the natural resources of the Abu Dhabi Emirate, to avoid the predatory and irresponsible use of the Emirate's natural resources, and to preserve the national wealth for future generations. Under the circumstances, companies that aim to effectively operate on the territory of the UAE and the Abu Dhabi Emirate should be able to adopt the performance model that will satisfy the needs of the Oil and Gas Law.

Concerning the existing international treaties in the sphere of the oil and gas sector operations, the Abu Dhabi Emirate and the UAE, in general, consented to the New York Arbitration Convention on the Recognition of the Foreign Arbitral Awards in 2006 (Comyn and Tiller 2019). This fact means that the international players operating in the UAE and the Abu Dhabi Emirate are provided with equal opportunities for protection of their interests and rights. At the same time, the domestic companies operating in the Abu Dhabi Emirate mainly rely on Abu Dhabi law with regard to resolution of disputes with their foreign partners. Finally, the Abu Dhabi Emirate's administration has signed reciprocal agreements with more than 50 countries, which makes the UAE market an attractive and affordable location for foreign companies (Comyn and Tiller 2019). In general, the results of the performed analysis show that the legal framework of the oil and gas industry in the Abu Dhabi Emirate is structured and includes a wide range of regulations and rules for the players to follow. Nevertheless, the structure is quite transparent, and the players are faced with a low level of risk during operations.

Specific attention should also be paid to the discussion of the role of concessions and licensing of the oil and gas companies' operations in the Abu Dhabi Emirate. According to the existing law, the key role in the field of the licensing of oil and gas companies' operations is played by the SPC, both for the national and international oil businesses (Comyn and Tiller 2019). Pursuant to the existing regulations, new players, especially international businesses, are required to enter joint venture agreement with the ADNOC and hold a share of the interest in the operations of the oil and gas company at the level lower or equal to 40 %, with 60 % of the share held by the ADNOC (Comyn and Tiller 2019). Together with this, foreign companies that aim to work in the Abu Dhabi Emirate should agree to provide technological support for the operations of the ADNOC and

support different Abu Dhabi institutions – Petroleum Institute, Masdar Institute and others (Comyn and Tiller 2019). In this way, the existing regulations maximise the benefits Abu Dhabi business and society receive from the engagement of the foreign capital in the sphere of oil and gas resources utilisation.

A similar model of regulations is applied in the gas sector. Abu Dhabi Law Number 4 provides ADNOC with a monopolist right to exploit and use all gas resources of the Emirate, alone or in partnership with other companies. In any situation, the share of ADNOC in gas concessions should equal at least 51 % (Comyn and Tiller 2019). Furthermore, the SPC is provided with the authority to define the production restrictions for the oil and gas sector. Since the ADNOC serves as a key player in the Emirate, it is possible for the SPC to perform active regulation of production volumes in cooperation with it. In these conditions, the international players cannot impact the sphere of production seriously since the share of the ADNOC in the joint venture capital structure provides it with ultimate power in the process of decision-making (Comyn and Tiller 2019). Finally, it is important to mention the role of the Environmental Protection Law, which directly impacts the operations of the oil and gas sector in the Abu Dhabi Emirate (Comyn and Tiller 2019). As a result, though the Abu Dhabi Emirate administration provides attractive conditions for foreign companies, the control over the processes of natural resources utilisation is strictly maintained.

PwC (2016) mentioned that, more recently, there has been a significant increase in the EPCM contract type. The EPCM contracting model in Abu Dhabi's oil and gas sector, which barely counts the number of EPCM-type projects in Abu Dhabi, is lacking the true awareness and knowledge among the practitioners of how it works and provides true benefits such as cost saving with faster

delivery and agile in scope amendments compared to EPC. Loots and Henchie (2007) clearly stated that EPCM is still relatively unknown amongst a large part of the construction fraternity. At the same time, it is important to highlight the fact that this conclusion was made in 2007, and no later assessment of the answer to this question was found by the researcher. At the same time, the discussion of relevant sources that assessed the application of the EPCM model in construction projects demonstrated the fact that this approach has become quite common in practice recently. This fact defined the importance of its analysis.

Bringing EPCM to Abu Dhabi's oil and gas sector, which barely counts the number of EPCM-type projects executed in Abu Dhabi, and showing the true benefit of it, the realisation of such benefits, will result in a cost saving and a faster delivery for decision makers to take on board in their upcoming projects/programmes.

2.1.2.7. Projects

An analysis of the perspectives of the market should integrate a discussion of the perspectives of projects that are likely to be realised in the nearest future. Among such initiatives, it is important to consider the relevant schemes presented by the senior management of ADNOC. The analysis of this organisation's projects allowed the researcher to collect information about the most complex and perspective projects in the chosen industry in Abu Dhabi. The examination of the legal framework of the oil and gas sector operations in the Abu Dhabi region has demonstrated the fact that ADNOC is the key institution when it comes to sector development, which forms international cooperation projects and serves for effective regulation of natural resources utilisation. The main

role of ADNOC in the oil and gas sector of the Abu Dhabi Emirate has defined the need for orientation on the projects of this particular organisation (ADNOC 2013).

Among the recent projects presented by ADNOC, the following should be mentioned: Integrated Gas Development Project, Shah Gas Development Project, Sahil-Asab-Shah Full Field Development Project, and Upper Zakum Full Field Development Project (ADNOC 2013). All these initiatives are oriented at the increase of oil and gas production volumes in specific locations of the company's operations. It is possible to say that the company's business and administration in the Abu Dhabi Emirate develop all the projects based on the following key criteria: the minimisation of the negative environmental impact and exploitation of natural resources of the region; optimisation of production costs; and the increase of production volumes together with exports (ADNOC 2013). All these projects have already been realised and have had a positive impact on the oil and gas sector. As for promising schemes that will be implemented in the nearest future (2020), the Bu Haseer Oil and Gas Field initiative should be mentioned (ADNOC 2013). Altogether, the management of ADNOC aims to develop new production facilities and increase production volumes with minimal costs and negative environmental impacts.

2.2. Overview of Engineering, Procurement and Construction Management (EPCM)

An EPCM contract presented the sequence of the following operations: engineering, procurement and construction and management services. The EPCM contractor is supposed to support the owner of the project throughout its realization, while the cost and risk of the project are borne by the owner. The owner maintains control over the key processes as they can influence EPCM project outcomes, as stated by Loots and Henchie (2007). The EPCM contractor is responsible for the

design, execution, and procurement process on behalf of the owner. The owner requires the professional team inside its organization to approve the EPCM contractor's managing, as stated by Oosterhof (2018).

2.2.1. Definition and contract type of EPCM

The engineering, procurement, and construction management (EPCM) contract format is applied by project owners that aim to attract an external contractor that will be able to perform the key management functions in the process of the project implementation. In these conditions, the format of the EPCM contract is supposed to allow the project owner to identify the optimal management institution that will solve the issues of project management that cannot be effectively addressed by the project owner (Carillo 2005; PwC 2016b). As a result, the realisation of the EPCM contract can support the project owner in the process of project management. The model of the EPCM contract is presented in Figure 2. Figure 2 provides the description of the basic theoretical model of the EPCM contract organisation in modern organisations. It is possible to observe the following key elements of the EPCM contract format: detailed design, procurement, module fabrication and construction. This model divides the process of EPCM contract application to the specific project into separate elements and tasks. Such an approach to the definition of the EPCM contract structure allows the audience to identify the major steps that should be implemented for successful realisation of the EPCM contract model.

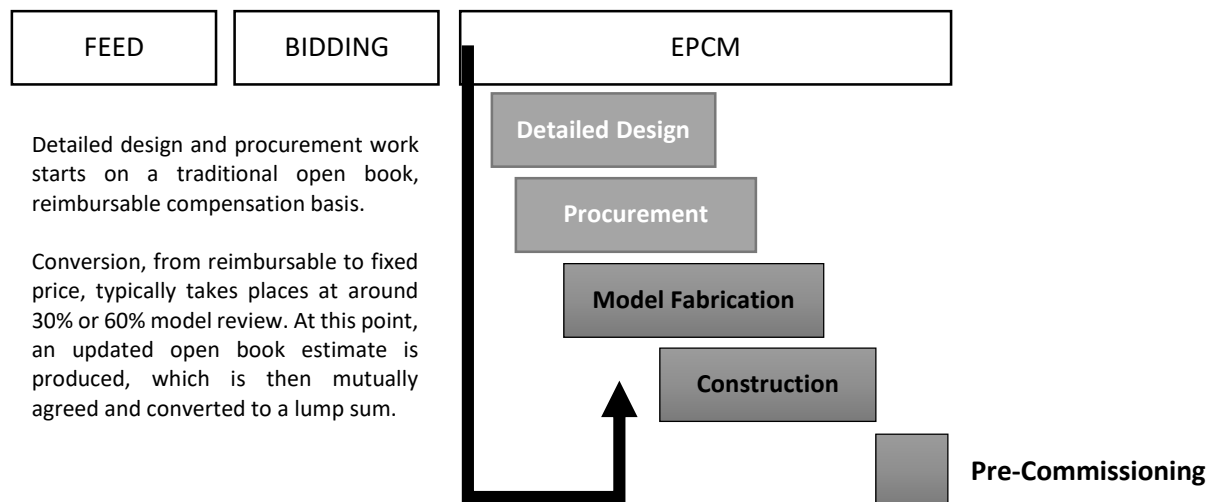


Figure 2: EPCM contract

Source: COAA (2018)

The definition of the EPCM contract form requires the presentation of the key phases and mechanism of the realisation of the contract in the context of a specific project. Prior studies related to the sphere of the EPCM contract analysis demonstrated the orientation of the researchers on the discussion of questions regarding the effective application of this format of contracting to the significant mega projects in the conditions of shortages of reliable contractors and the proper quality and scale of resources and materials (Chavan *et al.* 2021; PwC 2016b). In these conditions, it is possible to say that the problem of the EPCM contracting model development was initially related to the improvement in quality of complex project management under negative external conditions. As a result, the EPCM contracting model was applied as an effective format for business and project management adoption in negative external conditions.

Figure 2 shows the process of executing the EPCM model in a project. The EPCM contractor will kick start the detailed design phase of the project and carry on with the initial procurement process

on a reimbursable basis. That means, all the workforce time spent on the engineering work will be based on progress and with a cost impact; however, once the design reaches 30 % or 60 % of the model review stage, a stage at which the detailed design reached a maturity level to proceed to the next phases, the owner will request the EPCM contractor to move to a fixed price/lump sum basis for the execution of the project. The fixed lump sum will mainly be fabrication, construction packages and pre-commissioning.

Looking at Figure 2, its clear that value realisation is considered in the success of the five stages within EPCM, which are detailed design (engineering), procurement, model fabrication, construction and pre-commissioning. The success of those stages will form the conceptual model required for the research study, as independent variables, such as project bidding and contracting, project information and management process, project legal and regulatory guidelines, project technical specification, extra contractual mechanism, and resilience parameter. The EPCM contractor develops the front-end engineering design (FEED) and/or starts from a detailed design stage, then proceeds to the procurement phase, and manages the entire construction process by executing work on behalf of the owner/client. A substantial amount of value addition can be realised in the execution of the EPCM model as far as the processes are standardised and differences with the EPC model are fully exploited (Kabirifar and Mohammad 2019); Olaniran, 2017). Such contracts provide owners and lenders of limited-recourse projects with cost and time certainty and provide a single point of responsibility for the design, construction and procurement of the works. The EPCM agreement can do many things, but it is most readily adapted to a project in which the owner wants a representative of its interests and an entity to take the lead in designing the project. As may be apparent, an owner wishing a greater role in procuring the equipment, in

selecting contractors for distinct parts of the work, and in retaining more project control should consider the EPCM approach (Hong Pham and Hadikusumo 2014; Zhang and Zhang 2011). Among the opportunities for project owners who implement the EPCM model, the orientation on the single responsible contractor might be considered as one of the key advantages. In this way, there is no need for a project owner to search for the responsible party that should be asked about the reason for failure, as the EPCM contractor accepts all the responsibility for the failures of other contractors.

Since the EPCM engineer acts on behalf of the owner and directly involves the owner in making major decisions throughout the project, the service nature of EPCM comes through. Such service requires an equal measure of responsibility and responsiveness from the owner, to provide the strategic decisions (on matters regarding major equipment, crucial contractors, and proactive interaction with governing authorities, for example). Apparently EPCM project costs are less than any other model as the contractors' fee drops by a significant margin. Such cutback in cost is enormously realised only when the players fielding the EPCM model cut out bureaucracy of decision-making and eliminate inefficiencies of layering during planning and conceptual design of the project (Ishi et al. 2014; PwC 2016). In these conditions, it is sensible to assess opportunities for the removal of bureaucracy risks from the contracting model. Unfortunately, it is important to highlight the fact that the question of the bureaucracy risk reduction was poorly addressed in prior studies.

The definition of the EPCM contract form requires the presentation of the key phases and mechanism of the realisation of the contract in the context of a specific project. Mainly, the EPCM

contract is divided into several phases: design and engineering, procurement and construction management (Nguyen and Hadikusumo 2017; PwC 2016b). At the stage of the design and engineering, the role of an engaged contractor can be associated with the Front-End Engineering and Design (FEED) task that is the identification of the proposed design of the facility and the final product in the project. This task can be considered as vital for the project in general since the project design will be the element that the project owner will demonstrate to the prospective contractors responsible for the practical realisation of the project. At the FEED stage, the project schedule, budget and work packages are identified, so the selection of the proper contractor in the context of the EPCM contract can define the success of the project in general (Nguyen and Hadikusumo 2018; PwC 2016b). At the same time, the orientation on a prospective contractor can allow the project owner to implement the FEED plan that will significantly reduce the time and financial costs needed to implement the project.

In the phase of project procurement, the functions of the EPCM contractor include the organisation of material purchasing and delivery procedures, the attraction of contractors for production tasks, and the development of strategies for effective monitoring and control of the project realisation procedures (Shen *et al.* 2017; PwC 2016b). At the stage of construction management, the EPCM contractor is responsible for the management, monitoring and control of the construction tasks' fulfilment, and guarantees proper realisation of the project according to the defined budget and schedule (PwC 2016b). In specific cases, the EPCM contractor can take part in the process of dispute resolution with other contractors of the project owner after the final presentation of results and identification of defects that were not mentioned in the contract. Overall, the task of the EPCM

contractor is to provide full managerial support to the project owner throughout the procedure of the project's implementation.

2.2.2. Previous research on EPCM

The discussion of the role of the EPCM contracting format was oriented at the definition of the key parameters that form the difference of this format from the other ones due to partnership organisation and coordination of actions between contractors. In this context, the results of the study by Han *et al.* (2012) can be considered as a valuable source of information. Prior to the discussion of the key findings of this study related to the discussion of positive aspects of EPCM contract model application for construction projects, it is important to discuss the research approach and vision of the EPCM contracts demonstrated by other researchers. According to the case study of Han *et al.* (2012), and work by Sangroungrai *et al.* (2018), the EPCM contract model was considered as a more effective and flexible alternative to the majority of previously existing contract project management models. From this perspective, the discussion of the chosen literature source can provide the author of the study with valuable information about the positive aspects and benefits of the EPCM contracting model's application. At the same time, it is important to remember that this source of information lacks a critical approach to the discussion of the stated issue.

They demonstrate the fact that the main beneficial difference of the EPCM format from the other ones is that it allows the project owner to take an active part in all aspects of the project's realisation. Compared to this, the EPC format of contracting provides contractors with a full scale of capabilities to impact the project and bear the associated risks, while the project owner is limited in possibilities to affect the project itself and all the associated procedures. Such a format of

coordination might be considered as less effective compared to the EPCM contract form, where the project owner can actively participate in the decision-making process at different stages of the project, leading to a reduction of cost and time expenses for the implementation of the final result (Han *et al.* 2012; Toutouchian *et al.* 2018)). From this perspective, the prior studies considered EPCM as one of the most effective alternative solutions for project management. At the same time, it is important to remember the fact that the discussed study oriented on the assessment of effectiveness of EPCM contract model application for warehouse projects, so the relevance of the study findings can be considered as under question for other spheres of practical application.

Opposite to this position, the study by Olayinka (2016) highlighted the fact that the EPCM contracting format is optimal for the realisation of projects that are aimed at the minimisation of time expenses, while the quality of such projects is in question. The researcher discusses several complex construction projects that were realised using different project management approaches and reaches a conclusion that the application of the EPCM contracting format is not the most beneficial and effective strategy. Therefore, it was important to perform additional analysis of the issue to resolve the conflict of positions and identify the party that was closest to the objective decision. The study by Olayinka (2016) aimed to compare the effectiveness of different contracting models in application to complex construction projects. From this perspective, the presented study can be characterised by a higher level of complexity and reliability of findings compared to the study by Han *et al.* (2012), since it aimed to consider a wider range of contracting models and compare them to achieve an objective conclusion about the optimal contracting model. Compared to traditional approaches to the issue of assessment of the contracting model's effectiveness, the

research presented by Olayinka (2016) oriented on the analysis of the impact of different contracting models on the changes in the chosen projects.

2.2.3. Recent changes on EPCM

The resolution of the earlier-discussed dispute between different groups of scientists on the issue of the actual role of the EPCM contract format for the realisation of projects was presented in research by Wembe (2015). It aimed to assess the role of the application of the EPCM contract format while implementing complex projects in two different regions – China and Africa. The discussion of the experience of the realisation of complex projects in the conditions of such different cultural and economic contexts was supposed to contribute to the objectivity and reliability of the study findings.

The approach to the issue of EPCM contracting model assessment in the research by Wembe (2015) was based on the review of the current body of knowledge in the sphere of stakeholder management theory and the application of this knowledge to the sphere of contracting model quality assessment. From this perspective, Wembe (2015) aimed to consider the contracting model application process from the position of stakeholder management theory. This theoretical approach to the chosen research problem is quite new and should be considered as important for discussion and application in the study process. The decision to orient on the positions of different stakeholders in the process of the contracting model selection and realisation can become a useful practice for project management teams, leading to an increase in the productivity of contract realisation due to a higher level of stakeholder engagement. At the same time, Wembe (2015) presented the most useful practical findings of the EPCM contracting model application in the conditions of both China and

Africa, leading to the collection of useful findings regarding the practical effectiveness of this contracting model in different conditions.

According to the results of Wembe's (2015) research, it was found that the principle of direct coordination of actions and decisions between the project owner and the contractor had a significant positive impact on the project outcomes. Together with the increase in the project realisation effectiveness, the active involvement of all the engaged parties in the monitoring and decision-making procedures led to an increase of their satisfaction with all stages and the final result of the implementation of the scheme (Pal *et al.* 2017; Wembe 2015). Compared to the approach that presupposed the passive position of the project owner in the process of the realisation of the project, the application of the EPCM format of contracting demonstrated considerably better outcomes for the engaged parties and general results. Together with this, the findings of the study revealed the fact that the actual distribution of the project risks in favour of the contractor, when part of the risks were taken by the project owner, did not lead to a lower level of satisfaction with the project procedures or results for the project owner, or the reduction of project results' quality (Wembe, 2015). Contrary to this, the realisation of the EPCM format of contracting allowed the parties to build more effective cooperation in the process of the project implementation. At the same time, Wembe (2015) demonstrated the fact that the orientation on the EPCM contracting model can contribute to more effective coordination of efforts and communications between the stakeholders. This conclusion is important for the development of a complex position about the effectiveness of the EPCM contracts, including varied positions and arguments.

2.2.4 Current views on EPCM

The analysis of different positions on the role of the EPCM format of contracting for the realisation of complex business projects has led to the conclusion about the prospective benefits of this format's application. Together with the productive distribution of risks between the stakeholders, it allows them to form an effective cooperation model that contributes to the development of efficient and reliable decisions in the sphere of practical realisation of the project (Wembe 2015). Additionally, the orientation on the model that allows the productive integration of different parties into the decision-making process should reduce the level of conflicts between project owners and contractors, resulting in the development of more productive decisions and minimisation of time and financial expenses spent on the project. Altogether, the discussion of the alternative positions on the issue of perspectives of the EPCM model application has demonstrated the positive perspectives of such a decision in the conditions of modern megaprojects. At the same time, it is important to remember the role of the project owner's literacy in project management and the impact of bureaucracy risks during the assessment of the EPCM contract's quality and effectiveness. Without the effective removal of existing issues, the optimisation of results for the project owner might not be reached.

The findings of the study by Wembe (2015) could be enriched through their comparison with the positions of other academic studies. Among recent views on the issue of EPCM contract application, the position of Thomson (2010) was related to the definition of the EPCM contracting model's impacts for successful realisation of complex construction projects. Thomson (2010) highlighted the importance of ethical behaviour between project owners and major contractors as a factor of project success. The researcher found it necessary to develop the optimal contracting

model that would allow parties to reach mutual trust and understanding, avoiding suspicions and conflicts. The EPCM contracting model was considered as one of the optimal approaches to this question since it allows project owners to define the key partner responsible for the management of complex tasks with other contractors. The EPCM contractor of the project owner takes responsibility for the complex tasks, guaranteeing protection of the owner's interests. A limitation of such an approach as defined by Thomson (2010) is that it lacks assignment of responsibility for the satisfaction of all project terms to the major contractor. To avoid delays, cost overrun or quality issues, the project owner should clearly state the obligations of the contractor in the EPCM contracting model.

The position about the risks caused by the EPCM contracting model was supported by Whitehead and Walters (2014). These scholars argued that the EPCM contracting model is efficient in the context of modern megaprojects, which require the attraction of a significant number of contractors for specific tasks. Each contractor aims to minimise their liability for the end project's result, understanding the scope of damage compensation that might be caused by high liability status. The EPCM contracting model allows the project owner to improve the quality of contractors' coordination. Nevertheless, the researchers argued that the lack of experience in EPCM contracting could cause severe damage to the project owner, associated with the absence of a responsible party that could be asked about the failure (Whitehead and Walters 2014). This issue should be carefully monitored and targeted.

Research by Lahti (2018) argued that the success of the EPCM contracting model's application is in a major way dependent on the productivity of cooperation between the project owner and

contractor. For example, the EPCM contractor should be informed about the specific requirements of the owner about the aspects of project outcome (Lahti 2018 p.16). Failure to deliver proper details, which is the owner's responsibility, could lead to the overall project failure. Such conditions lead to the conclusion about the rising significance of communication and coordination mechanisms under the EPCM contracting approach (Zhou *et al.* 2015). The EPCM contractor should demonstrate their readiness to stay in touch with the client from the first day of cooperation. Otherwise, the benefits of this model would be reduced.

The research by Zhou *et al.* (2015) assessed the role of EPC and EPCM contracting models in the context of electrical instrumentation control projects. The findings of the study argued that both traditional contracting methods have high limitations in the aspect of project management quality. For the EPCM model, the main source of criticism was the low level of contractors' liability and the need for the company to face rising costs despite the low quality of the delivered service (Zhou *et al.* 2015, p.142). The researchers recommended that practitioners shift to the relationship-based procurement model, which is not a part of the current study (Zhou *et al.* 2015, p.150). Nevertheless, the outcomes of this research demonstrate the existence of criticism regarding the aspect of the EPCM model's utilisation.

The final position, which was presented by Hosie and Natoli (2009), argued that the EPCM contracting model could be productive for energy-sector projects due to opportunities for reduction of project costs and increased flexibility of project management for the owner. Nevertheless, the researchers also argued that the problem of the limited liability of the EPCM contractor is a serious challenge for the project owner that should be addressed (Hosie and Natoli 2019). The findings of

the literature review of recent sources show that the EPCM contracting model should be applied with high caution and attention to the liability distribution details. If the project owner aims to build a more flexible project management model, it is also important to guarantee a clear and transparent approach to the definition of parties responsible for each outcome of the project.

2.2.5. Key benefits that can be obtained from EPCM

In the process of the discussion of the EPCM contract, it is sensible to define the advantages of its application in the process of the project's realisation. The key benefits that have been identified for the EPCM contract include the following: low level of cost of project realisation; flexibility of project management; high speed of project realisation; effective funding format; and final quality of the project results (Bilfinger 2019). The benefit of reduced costs of project realisation while using the EPCM contracting format is related to the fact that the orientation on the contractor that can support the project owner in the process of project management allows the project owner to develop cost-effective solutions at all stages of the project implementation including planning of production procedures, purchase of materials and their delivery, management, and control of the processes. This advantage is directly connected to the second factor – the flexibility of project management in the case of the EPCM contract (Bilfinger 2019). In particular, the cooperation with the EPCM contractor allows the project owner to develop cost-effective managerial decisions under real-time conditions, adapting them to the specific conditions in the market at a specific period of time. The decisions of the project owner, in this case, are not limited due to the earlier-approved agreements and solutions. As for the EPCM contractor, he/she is supposed to support the project owner in the process of selection of the best available alternative at that moment in time. At the same time, it is important to understand that the effectiveness of cost reduction for the project can

depend on the distribution of responsibilities among stakeholders and their cost-effectiveness level (Salah and Moselhi 2016). In the case where the project owner is provided with equal opportunities for cost management in the project, but its cost-effectiveness level is low, it is not difficult to predict that the influence of this stakeholder can reduce the cost-effectiveness of the project in general.

The high speed of project realisation is explained by the fact that the project owner can initiate its implementation before all its aspects are properly discussed and planned. The attraction of the EPCM contractor as a specialist allows the project owner to discuss the specific aspects of the project plan together with the realisation of its initial phases. Compared to the situation when all the decisions should be made prior to the initiation of the project, such an approach makes it possible for the management to reduce time expenses (Bilfinger 2019). Nevertheless, it is important to remember that the early initiation of the project can lead to the generation of unexpected and unplanned risks. From this perspective, it is important to pay high attention to the mitigation of this risk when project management seeks opportunities to reduce project realisation time. In the context of an effective funding strategy, the EPCM contract format defines the step-by-step logic of the project realisation. The permanent procedure of cooperation between the contractor and project owner allows them to determine financial expenses for each stage of the project separately, without the need for the provision of the full value of the project budget prior to its initiation (Bilfinger 2019).

As a result, the EPCM contract format allows project owners to start the procedures even in conditions when the full amount of required finances for the project is unavailable. Such a solution can be risky, but it also saves a serious amount of time if the management is sure that the necessary

funding will be found. Here again, the question about effective risk management procedure should be raised, for the project management to be sure that the early initiation of the project will not lead to failure as a result of the lack of required resources. Finally, the application of the EPCM contract format ensures that the project owner effectively controls and influences the quality of the final results of the scheme. In this way, the procedure of permanent cooperation between the contractor and the project owner makes it easy for the owner to control all the results at different phases, integrate the required improvements and regulations before the specific issues occur, and guarantee the highest available quality of the obtained result. Altogether, the EPCM contract format serves as a flexible instrument for project realisation that is aimed at the minimisation of risks and maximisation of positive outcomes for the project owners.

The realisation of the mentioned benefits is directly associated with the organisation of the efficient project control mechanism. The research by Chandran and Purayil (2020) performed in the UAE argued that the mentioned benefits of the EPCM contracting model can be achieved only if the project owner paid the highest attention to the implementation of the reliable project control measures, which would guarantee permanent and effective oversight of the contractor's activity. It was important to consider the risks related to the low effectiveness of project control in the EPCM model.

The understanding of the benefits related to the application of the EPCM contracting model should be followed by a discussion of the specific risks and challenges that must be considered. The research by Read (2010) argued that EPCM contracting leads to the concentration of the contractor's attention on the specific small elements of the project, and the absence of a complex

view of all required activities (p.305). While the level of a contractor's liability for project success is limited, their key motivation is to deliver their particular part of the work properly, without attention to the larger picture. The research by Prieto demonstrated that such format of a contractor's attitude to the work processes in the project can usually lead to cost overestimation (p.45). This situation can also lead to the problem of an increase in control costs for the project owner. The price of rising flexibility in project management is an increase of the control costs for the owner (Read 2010, p.305). For the EPC model, the owner can deliver full responsibility to the contractor, while the EPCM model obliges the manager to stay cautious and control all the aspects of the process.

Another study, by Love *et al.* (2017), assessed the benefits of the EPCM model as confronting the challenge and risk of information redundancy and errors in the contractor's operations. Analysis of the case study related to the organisation of the procurement tender by the EPCM contractor demonstrated the presence of high information redundancy risk and errors in the contractor's actions (Love *et al.* 2017, p.182). The main source of concern was that the study demonstrated the probability of opportunistic behaviour followed by the contractor, which aimed to maximise personal profits at the cost of the owner's interests. Such a conclusion demonstrated that the management should always consider the liability risks of the EPCM contract.

Research by Veldman (2011) argued that the realisation of the benefits and mitigation of the related risks in the EPCM contract requires the application of specific contracting solutions. One of the best options is the utilisation of incentive contracts, which encourage a specific model of contractors' attitudes and favour them for behaviour that contributes to the realisation of the project

owner's objectives (Veldman 2011, p.149). Altogether, the discussion of the EPCM model's benefits argued that they can be achieved solely in the case of effective distribution of liability and integration of proper incentives for responsible behaviour of contractors.

2.2.6. EPCM's relationship to the oil and gas sector

The analysis of the effectiveness of the EPCM contracting format in the context of the oil and gas sector requires the assessment of the relevant cases related to the successful or unsuccessful application of this instrument in the projects related to this sphere of activities. Unfortunately, it was difficult to find the description of relevant business cases in the oil and gas sector that effectively applied the EPCM contract format for the realisation of business projects. Such a result is explained by the fact that the engineering, procurement and construction (EPC) contracts have become a more usual format of project realisation organisation. Nevertheless, the report of the Ernst & Young (2018) should be considered as an interesting source of information regarding the effectiveness of EPCM contracts in the oil and gas industry. According to the position of the experts of Ernst & Young (2018), the modern companies in the oil and gas industry suffer from the poor quality and effectiveness of business project realisation. Mainly, the issues are related to the implementation of megaprojects which are connected to significant costs for business organisations and high expectations with regard to future business growth. The failure in project realisation leads to serious losses in terms of financial resources and worsening of their competitive position on the market for business organisations. Thus, it is sensible to define the sources of such failures.

Among the key internal issues identified for a major part of megaprojects in the oil and gas industry, the following have been defined as those related to the sphere of EPCM contract realisation:

inadequate project planning, poor procurement of contractors, and poor contractor management (EY 2018). The experts of the Ernst & Young (2018) agreed that the absence of opportunities for the attraction of qualified contractors with proper capabilities to guarantee the effective management of megaprojects is one of the major barriers to successful development for market leaders in the oil and gas industry. This argument supports the earlier statement of the study's author about the importance of the selection of stakeholders with proper competencies and knowledge. From the review, it was observed that key determining factors for a mega industry in the choice of a contracting model would be the level of involvement of the selected parties and subsequent contracting strategies that vary where risk lies. According to Ron Douglas, Ausenco's Executive Vice President, Global Project Delivery, factors influencing such transition have been an increase in demand of engineering and related services, complexity of execution with sufficient cost control and professional deficiencies (Hirvonen 2018).

In the case of the oil and gas industry, such factors need to be closely reviewed as time, budget, success parameters and decision-making units, involving top management, are essential in the choice of one strategy over another. The realisation of this strategy would depend on the ability of project management to properly distribute functions and responsibility in the EPCM team, delivering tasks to the teams that can effectively implement them. In nearly all cases, the appointed EPCM contractor who has conducted the front-end engineering design (FEED) phase, also manages the detailed engineering phase (Whitehead 2010). Such a case saves a lot of time by removing the need for another tender and award cycle, and therefore reduces the duration of the project overall. The EPCM contracting strategy, or so-called model, provides the benefit of permitting the contractor to conduct both FEED and detailed engineering phases at one go, which

allows owner and clients to produce an accurate cost estimate for procurement and construction part of the project (Loots and Henchie 2007). Nevertheless, during the discussion of this advantage, it is important to remember that the result of this advantage's realisation will depend on the ability of the project contractor to provide adequate competencies and solve the stated issue effectively. In a case where the EPCM contractor fails to provide proper quality in the FEED phase, the project in general can become a failure.

One of the major disadvantages of the EPCM model, which is a considerable barrier to its adoption, is the risk allocation to the owners. They are rightfully wary of such a model and thus may not find the model appealing despite the benefits. Another major drawback of the model is the requirement of knowledge in the field in order to use this model effectively. Project practitioners are not necessarily subject experts and would not be able to make use of all the benefits that the model promises. The quality of the materials in the EPCM model is closely controlled by the owners, who have exclusive discretion on decisions on the quality and the materials to be used. Nevertheless, such exclusivity puts the risk of material procurement and the associated quality on the client's shoulder, as any delays in the process of procurement, poor or unfit quality of materials purchased, will be the sole fault of the client (Jergeas 2001). It was mentioned that the rigid procurement process does not allow for agility in the scope of the project, which leads to delays in construction due to the underestimation of the project, or to useless purchases of procurement items that were carried out in the anticipation of such changes in scope, which in consequence will reduce the cost-effectiveness (Boswell and Walker 2004).

High-value projects are often determined by the metrics of their industry, type of ownership, the amount of risk of new technologies and developments, along with many other factors. The points

suggested here, especially in regard to the EPCM projects in the oil and gas industry, can lay the foundation for contract choice and attributes required for the adoption of the model. The guidelines and requirements can help in deciding the final contents of the agreement that the owners enter into (Singh and Tiwari 2015). This project, therefore, aims to explore these success factors of the model, and create guidelines for the adoption of the model as the industry standard. The project will conduct a review of the available literature on the subject and complement the basic consensus with questionnaire surveys to establish key advantages of the model and create guidelines for its implementation.

The use of skill and experience as well as knowledge in new technological techniques and materials should be an enabling factor for the front-end engineering and design (FEED) stage, where engineers set the design parameters and define the scope of the works that will give way to the subsequent tender process. The subsequent phase of detailed design development of the FEED stage should have proper alignment among work breakdown structure (WBS), contracting work breakdown structure (CWBS), cost breakdown structure (CBS), and organisation breakdown structure (OBS). Improved structuring of funds utilisation framework shall provide better management process under EPCM and building EPCM innovation to the higher versions shall effectively contribute to fine tuning of project objectives. Fund allocation in a company's own human resources for skill advancement raises human capital and is an addition to the company's long-term assets (Walker 2015).

The presented findings have led researchers to several important conclusions and implications. First, it is obvious that the large players in the oil and gas sector require the support of qualified

and experienced contractors that will assist them in the process of megaproject realisation. In this way, the lack of internal capabilities in the companies to implement such initiatives should be considered as a reliable basis for an argument about the importance of the EPCM contract format in the oil and gas sector today. At the same time, the fact that the companies cannot find contractors with an adequate level of qualifications and project realisation capabilities means that the successful realisation of the EPCM contracting format requires a change in contractors' quality. As a conclusion, the format of EPCM contracting for the purpose of the project realisation in the oil and gas industry is relevant and supported by project owners' demand. Furthermore, the inability of the market to provide an adequate supply for the existing demand should be considered as a basis for serious changes in the future. Nevertheless, the existing challenges in the sphere of the application of the EPCM contract for the benefit of the project owners do not mean that the format itself should be rejected as ineffective.

2.3. Overview of Engineering, Procurement and Construction (EPC)

2.3.1. EPC definition and contract type

The engineering, procurement and construction (EPC) contracts are considered to be the most usual format of contract applied for the realisation of construction tasks for large-scale and complex infrastructure projects. The defined format of the contract presupposes that a contractor is required to provide the specific facility and infrastructure for its operations at a certain cost and by a particular date (DLA Piper 2018). At the same time, the second part of the contract is not supposed to require additional work or time expenses for the successful utilisation of the acquired facility and infrastructure. It should be possible for the second party to effectively use the received facility in its own operations on the same day when the EPC contract ends. The engineering and

construction contractors are required to perform all the activities related to the production of the facility – design and planning of the project, purchase of the required materials and equipment, and the construction of the final project facility (DLA Piper 2018). The realisation of the EPC contract usually follows the phase of the front-end engineering when a project owner or a client has already obtained the basic project of the required facility and gives it to the contractor for improvement and practical realisation. The format of EPC contract is presented in Figure 3.

The scheme in Figure 3 demonstrates the structure of connections between key contractors and their functions in the context of the EPC contract model. As specified in Figure 3, the project company orients on the set of contractors, including the EPC contractor. Compared to the EPCM contract model, where all the work for the project is led by a single, external contractor, here the range of contractors is considerably wider, which defines significant requirements for the quality of coordination of their work for the project.

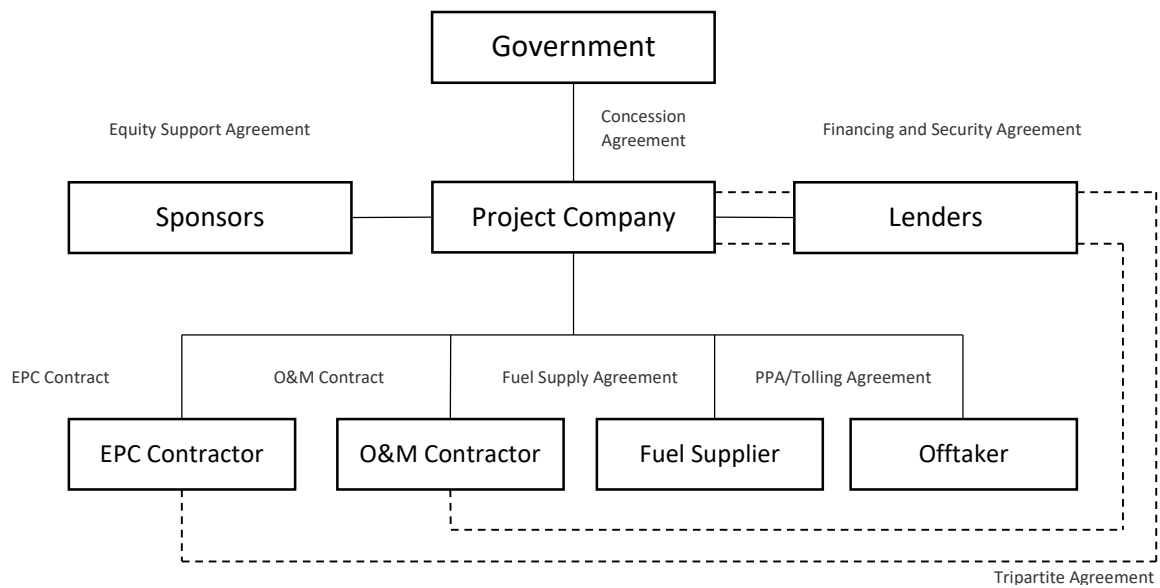


Figure 3 : Independent variables of the study

Source: DLA Piper (2018)

Figure 3 explains the relationship between the EPC contractor and the industry that s/he works with; it explicitly shows the link of the contractor and the owner being the sole responsible entity for executing a specific phase of a programme, which is the execute phase in this model. Moreover, it shows the triparty link with lenders since the EPC contractor does not fund him/herself. The type of contract realised in the case of the EPC agreement is commonly defined as the Lump Sum Turnkey (LSTK) contract (DLA Piper 2018). It implies that the contractor is required to deliver the defined scale of work by a certain period of time and at a certain cost. Under these circumstances, the realisation of the LSTK contract creates schedule and budget risks for both parties of the contract, especially the project owner or the client (DLA Piper 2018). To minimise the risks, the project owner is provided with opportunities to position his/her controllers in the offices of the contractor and on the territory of the planned facility. Such a format of activities coordination allows the project owner to control the procedures related to the project

implementation and identify existing challenges and potential sources of risk in the process of the plan realisation. It was also found that the careful understanding of the associated risks of project realisation by the EPC contractor can lead to positive results for project owners (Picha *et al.* 2015). In this way, similar to the EPCM contract, the success of the EPC contract requires the realisation of a set of requirements and conditions.

2.3.2. Review of previous research on EPC

The prior discussion of the EPC contract format application has allowed the researcher to identify the core sources of risk related to it, and the issues regarding the distribution of risks among the contract parties. According to the position of Galloway (2008), the main parameter of the EPC contract is that a major part of risks is accumulated in the position of the contractor that is responsible for the practical implementation of the project. While the terms of the project such as schedule and budget expenses are defined at the beginning phase of the EPC contract realisation, the risks for the project owner are minimal (Galloway 2008). The contractor is required to apply flexible strategies to comply with the contract terms, especially in conditions of a changing market environment. The change of material costs, potential mistakes of subcontractors and unexpected external influence are the factors that can limit opportunities for the contractor to meet the initial contract agreement terms. In the past, the existing methods of environment analysis made it difficult for the contractor to predict future risks and build the EPC contract on the basis of future expectations. Since the EPC contracts are mainly applied for long-lasting construction projects, the analysis of long-term risks is vital. It is also important to show that the decision to concentrate responsibility in the hands of a single contractor can be considered as a source of risks, since such a model places additional pressure on a single actor.

In addition, the analysis performed by Picha *et al.* (2015) outlines the existence of a wide range of conditions in the EPC contract that can create a conflict of interests between the project owner and contractor. According to the study findings, the contractor is limited in opportunities for manoeuvre, from the perspectives of both costs and project schedule (Picha *et al.*, 2015). From the project owner's position, the fact of the importance of project quality for the business revenues defines the need for additional pressure on the contractor, which can also serve as a source of conflicts (Picha *et al.* 2015). Altogether, the situation when the project owner has an unbalanced strong position in negotiations creates conditions for the absence of consensus decisions in the EPC contract format negotiations (Picha *et al.* 2015). The analysis of the prior studies concerning the EPC contract has been oriented at the definition of the negative sides of this format and aimed to designate recent changes that might lead to the improvement of the EPC contract form effectiveness.

2.3.3. Recent changes in EPC

Among the recent changes that have impacted the effectiveness of the EPC contract application in a positive way, the role of improved business planning should be mentioned. The recent improvements in the sphere of project costs and risk planning have made it possible for contractors to productively assess the existing risks of the project and develop the terms of the EPC contract that are more beneficial and less risky for the contractor that is responsible for the project realisation (Galloway 2008). The research by Galloway (2008) provided an interesting conclusion about the shifting character of risk in the conditions of the application of the EPC contracting model to construction project management. At the same time, the development of new accounting methods has allowed the project owner to perform more productive monitoring of the contract realisation

procedures without the risk of tensions among counterparties (Picha *et al.* 2015). Overall, the recent changes in the application of the EPC contracts form have led to the effective utilisation of modern technologies for the improvement of the balance of interests among counterparties, and the minimisation of risks for them. Nevertheless, the successful realisation of the EPC contracting model was found to be associated with a certain level of risk that cannot be ignored in the light of modern conditions.

2.3.4. Current views on EPC

The analysis of the current situation in the sphere of the EPC contract application has revealed the fact of the prevalence of serious issues in the field of the practical realisation of concrete projects based on this contract format. It is important to state that, despite the fact that the problem of project quality was addressed in the past, the modern format of the EPC contract realisation does not integrate effective means of quality planning and control (Kabirifar and Mojtahedi 2019). In the current situation, a major part of EPC contracts still focuses on the parameters of budget and schedule risks, ignoring the needs of final project quality (Kabirifar and Mojtahedi 2019). The existing situation requires careful discussion of the limitations with regard to the EPC contract form application, and development of alternative solutions. Another factor that is usually ignored in the relevant studies of the EPC contract format is related to the effective distribution of responsibilities among stakeholders, and the impact of this parameter on project outcomes.

While the position of Kabirifar and Mojtahedi (2019) on the current vision of the EPC contracting model was highly critical, it is sensible to present alternative visions of the issue to gain a balanced and inclusive discussion of the question. The research by Lee *et al.* (2018) addressed the problem

of trust management in EPC contracting. It was stated that the high level of trust among stakeholders in terms of the EPC contract is as significant as the trust among parties in the EPCM model. The research argued that, despite the higher strictness of the EPC contracting model compared to the EPCM approach, it still can be modified to guarantee a sufficient level of stakeholder inclusion and trust among them (Lumineau 2017). To guarantee a high level of trust among the engaged parties, the project owner should concentrate on the following elements of the EPC contracting model: safeguarding provisions, coordination provisions, and contingency adaptability provisions (Lee *et al.* 2018, p.4). These provisions allow the project owner to raise the level of the project management process adaptability and efficiency, mitigating potential risks of excessive control over the project in the hands of the EPC contractor.

Another study, by Jinru (2011), addressed the question about the applicability of different methods for an increase of the EPC contracting model cost-effectiveness. Jinru (2011) argued that the excessive concentration of risks and liability for project success in the hands of the EPC contractor could lead to the rising motivation for a high estimation of project costs, leading to the low cost-effectiveness of the EPC contracting approach (p.50). The main requirements for the performance of the EPC contractor include the sufficient quality of the result delivered within a specified schedule (Zhang and Chen 2009). While this solution reduces the workload for the project owner, it also creates conditions for excessive manipulation of the project price for the EPC contractor. The research by Jinru (2011) highlighted the specific methods of budgetary control that could be applied by the project owner to guarantee effective control of costs on the contractor's side. Specific interventions included the following:

“Reasonable determination of EPC contracting price based on the budget estimate of preliminary design; controls on budgetary estimate of preliminary design; strict examination of budgetary estimate of preliminary design; preferred application of selective tendering in procurement; regulation of reasonable range of optimized design in construction in EPC contract or bidding documents” (Jinru 2011, pp.51-53).

The discussion of the role of effective cost control in the EPC contracting model demonstrated that this contracting approach can be effectively applied to address major parts of issues highlighted by scholars. On the issue of a lack of project owner’s control over management processes, the careful negotiation of the contractual terms can help management to mitigate the risks of excessive power concentration in the EPC contractor’s hands (Steinberg 2017). On the side of cost minimisation for the EPC contract, the application of regulation and control measures can help the project owner to raise the level of control over the actions of the contractor.

The discussion of the relevant publications on the issue of the EPC contracting model development demonstrated that this model of contractual relations development underwent serious evolution recently. It can be applied with a sufficient level of flexibility and adaptation to the needs of the concrete contractor. Such a conclusion reduces differences between the EPC and EPCM contracting models, making the EPC approach more favourable in certain conditions. Such result raised the significance level for further study of the EPCM contracting model and its benefits from the point of potential application in the Abu Dhabi oil and gas sector.

2.3.5. Key benefits that can be obtained from EPC

The realisation of the EPC contracts is connected to the specific set of advantages for each of the engaged parties, namely the project owner (client) and contractor organisation that is responsible for the implementation of the project and the contract terms. As for the benefits of the EPC contract format for the project owner, the experts have identified the following advantages: high level of visibility and centralised control over the project costs and schedule; higher adequacy in assessment of the delivery and procurement risks; full assignment of the project risks to a single contractor; and high effectiveness of contract management due to the existence of a single counterparty in the contract (PwC 2016a). The application of the EPC contract allows the project owner to benefit from the cooperation with a single contractor liable for the realisation of all aspects and stages of the project. In these conditions, the absence of a high number of contractors makes the negotiations procedure easier for the project owner and makes it possible for the project owner to create an effective centralised control structure to monitor all the processes taking place in the contractor company (PwC 2016a). While cooperation with a single contractor can be a serious benefit for the project owner, it can also become a source of significant risk if the level of the contractor's capabilities and competencies is low. Under the circumstances, cooperation with several contractors might ensure minimisation of the risk of project failure in the production phase. Finally, the effective monitoring of the progress of a single contractor makes it possible for the project owner to identify the potential budget and project schedule risks long before the actual losses take place. It is also important to remember about the role of the project owner's own literacy parameter, which will impact their ability to perform careful control and assessment of the EPC contractor's performance. In a case where no opportunities for the reliable assessment of the contractor are present, it is difficult to estimate project management quality.

Other benefits that are available for the project owners utilising the EPC contract form include the following: fixed budget and schedule; performance guarantees; variations in the project; and defects liability (PwC 2016a). The clear fixation of budget expenses and a planned schedule means that the required result will be achieved by a certain date and with a certain level of expenses. In the case of the orientation on the EPC contract form, the additional risks in this sphere are minimised. Additionally, the cooperation with a single contractor also gives the project owners an opportunity to discuss the widest range of opportunities for project variation. The project owner is not limited in the specification of specific elements of the project, while the discussion of similar issues in the context of a larger number of contractors would make the planning procedure much more complicated (Picha *et al.* 2015). Lastly, the EPC contract makes it clear that the contractor is responsible for the removal of defects identified after the presentation of the final facility to the project owner. In the case of orientation on a single contractor, the project owner can easily determine the counterparty that will have to remove the flaws. Contrary to this, cooperation with several counterparties could lead to a situation when they argue with each other regarding the responsibility for the defects. It is important to say that the fact of existing opportunities for defects removal should not be considered as a serious advantage. In the case of serious projects, the defects can generate significant risks, and the fact that the contractor will have to remove them without additional costs does not remove associated risks for the project owner. In these conditions, a more reliable strategy would be one that integrates opportunities for prevention of defects as a practice.

From the perspective of the contractor that is responsible for the project realisation, the application of the EPC contract form is also associated with a number of benefits. Among them, the following should be mentioned: high level of flexibility in selection of the project design, planning and

attraction of subcontractors; high efficiency of decision-making and project management due to the absence of need for the contractor to negotiate the project issues with other contractors; and the reduction in price of the final project for the project owner as a result of the absence of a need to cooperate with a high number of contractors (PwC 2016a).

Concerning the flexibility of decision-making, the application of the EPC contract format removes one of the key challenges that are relevant for complex projects – the need to reach consensus in decision-making among a high number of contractors. If a project owner attracts several contractors for separate tasks in a specific project, their fulfilment will depend on the ability of the contractors to reach a consensus while planning key activities (PwC 2016a). This process is associated with additional time and financial expenses. The ability of a single contractor to make all the decisions about project design and planning independently from other potential contractors can guarantee the minimisation of project risks, but only in a case where the contractor's level of experience and production capabilities is adequate with regard to the needs of the project. Finally, the minimisation of the number of contractors taking part in the process of project planning and realisation can reduce the costs of the project. At the same time, it is important to avoid a situation when the requirement for cost optimisation leads to the formation of an ineffective team (PwC 2016a).

Altogether, the discussion of the existing benefits of the EPC contract format demonstrates the fact that this form of cooperation between the project owner and a single contractor can be quite effective. Nevertheless, success in the application of this form of contract requires the existence of an adequate level of qualifications, experience, and production capabilities of the chosen contractor (PwC 2016a). In a case where the characteristics of the contractor are not adequate, the choice of

the EPC contract form and orientation on a single counterparty can lead to the failure of the project due to the objective inability of the contractor to implement it.

2.3.6. EPC relationship to the oil and gas sector

The analysis of the effectiveness of the EPC contract format for the oil and gas industry should be performed on the basis of a discussion of the specific cases of its application in practice. In the context of the stated task, the results of the research performed by Aldhaheeri (2016) can be considered as important since this researcher has assessed the effectiveness and existing issues in the sphere of the EPC contract application in the oil and gas industry of Abu Dhabi. The outcomes of the mentioned study have contributed to the clear identification of the main advantages and challenges related to EPC contract use in the oil and gas industry of the Abu Dhabi Emirate. According to the study findings (Aldhaheeri 2016), the importance of the EPC contract application in the oil and gas industry is based on the fact that it allows the project owner to perform careful control of key processes in the production phases of the required facility (Aldhaheeri, 2016). At the same time, the research highlights the fact that, while the contractor is required to follow the defined budget and project schedule, the utilisation of the EPC contract form reduces and limits opportunities for the project owner to take part in the procedures at the stage of design planning and definition of project costs and schedules.

Additionally, the discussion of the prior experience of the EPC contract application in the Abu Dhabi oil and gas sector reveals the fact that it did not contribute to the realisation of the highest potential quality of the project (Aldhaheeri 2016). While the schedule and costs requirements were mainly met in the majority of EPC contracts, the quality of the final project was usually lower

compared to the desired level (Aldhaheeri 2016). At the same time, the defined risks of the EPC contract realisation led to the definition of the high probability of an undesirable outcome for project owners (Hosie 2016). Therefore, the existing EPC contract format should be optimised to guarantee the integration of a parameter of results quality into the key processes of production and control.

Finally, the research states that the application of the EPC contract format can effectively contribute to the fulfilment of the cost and schedule requirements of the project owner, but this format of cooperation with contractors provides limited opportunities for strategic coordination of actions and decisions between the counterparties (Aldhaheeri 2016). This fact means that the orientation on the EPC contract format should be considered as a decision with limited effectiveness in the aspect of the realisation of the strategic objectives set by the project owner. This factor was found to be one of the key sources of risks for EPC projects (Hosie 2016). Currently, the analysis of the EPC contract format demonstrates the fact that no reliable solutions to this issue were provided earlier.

In general, the analysis of the perspectives of the EPC contract utilisation in the process of project realisation in the oil and gas industry has demonstrated the limited efficiency of this approach. While the EPC contracts can remove a certain part of the issues and challenges in the process of cooperation between the contractor and project owner, the variety of existing challenges that have been defined on the basis of the practical experience of the utilisation of this tool have defined the need for a more careful discussion of this instrument and its optimisation.

2.4. Theoretical underpinnings and practical differences of EPCM and EPC

2.4.1. Viewpoints of EPCM and EPC theory and practice

The definition of theory and practice can be effectively presented on the basis of the analysis of the interconnection of these basic terms of modern science. The basic idea behind the link between these two notions is that theory serves as the abstraction of practice, while practice is the application of theory. Thus, theory and practice are two interconnected approaches applied to understand the nature of objects and their relationship in science (Priede 2017). The role of theory in the process of cognition is related to the definition of the potential and perspective connections between objects and their elements, which can be applied to form the prediction of outcomes of certain manipulations with the objects of interest. At the same time, the role of practice is related to the assessment of the theoretical concepts on the basis of practical experience to identify the relevance of the theoretical concept and existing mistakes in the prediction of the object's behaviour. As a result, both theory and practice complement each other and serve as integral elements of the cognition process. The single element cannot effectively exist without another one. The development of theoretical concepts without the assessment of the practical experiment results cannot serve as a means of reliable theory development. Along with that, the realisation of practical experiments without the application of their results in the process of theory development cannot lead to the effective accumulation of useful knowledge (Priede 2017).

2.4.2. Theoretical differences of EPCM and EPC

The literature review regarding the nature of the EPCM and EPC contracts performed in the prior section of the study can serve as a basis for the definition of the theoretical differences between the two types of contracts when it comes to the realisation of large construction projects (Priede, 2017).

This sub-section will provide a summary of earlier presented knowledge and analysis of differences between the two types of contracts. The nature of the EPC contract is that it is supposed to provide the project owner with the format of a partnership when the contractor takes responsibility for all the construction processes in the project, and the role of the project owner in the decision-making is minimised. The project owner can only monitor the current progress, define potential risk factors, and negotiate with the contractor to develop solutions for the minimisation of risks and defects (Priede 2017). The final decision-making competence remains in the hands of the contractor. The contractor is responsible for the results of his/her work and is required to remove any flaws identified after the completion of the project. Such format leads to additional challenges for the project owner and raises questions about project risks.

In the case of the EPCM contract, the format of cooperation between the project owner and the contractor is different. Here, the role of the contractor is related to the complex management of the realisation of project tasks in direct cooperation with the project owner. Compared to the EPC contract where the project owner performs initial planning of project design and makes all strategic managerial decisions before resorting to the contractor's services, the EPCM format of contracting implies that the project owner does not obtain the required managerial competencies to govern the project effectively, and the contractor should perform all the managerial activities in cooperation with the owner (Singh and Tiwari 2015). This format of cooperation provides the project owner with a higher level of influence on the process and final results of the project realisation. Moreover, the contractor does not take part in the realisation of the construction tasks but has general management and control over all the activities for the implementation of the project. Prior discussion of this format demonstrated the fact that its success is dependent on the effective

distribution of responsibilities in teams and the presence of proper qualifications among stakeholders. As can be seen, the presented contracting formats differ in the form of organisation of cooperation between the contractor and the project owner, and the distribution of responsibility for the project success. To gain a deeper understanding of the nature of each stated type of contracting, it is important to discuss the practical differences in their application.

2.4.3. Practical differences of EPCM and EPC

In the context of the given study, the analysis of the practical differences between the chosen contract formats included the consideration and assessment of the practical outcomes of the application of each contracting form. It was especially important to understand and compare the issues that can arise as a result of orientation on the specific contract type. While the key elements of cooperation regarding each contract type were discussed earlier in the analysis of theoretical differences, the examination of specific issues is sensible. As for the EPCM contract, the main challenges and risks for the project owner that were defined in the process of analysing the outcomes of its application were found to be related to the process guarantee, the potential cost-ineffectiveness, open budget and potential procrastination of the contractor (Singh and Tiwari 2015). The problem of process guarantee means that, due to the owner's lack of adequate project management experience, the contractor is free to apply any format of management, including an ineffective one. Format ineffectiveness can only be identified at the stage of the obvious failure of the project. The risk of cost ineffectiveness is related to the fact that the EPCM contracts presuppose the format of cooperation between parties on the basis of the hourly compensation for consulting (Singh and Tiwari, 2015). Consequently, the contractor is interested in the maximisation of his/her benefits. Further, the format of the open budget may result in the practical misuse of the contract

terms by the contractor, which can lead to losses for the project owner. Finally, the risk of procrastination can occur since this type of contract does not specifically consider any requirements relating to the contractor's performance, leaving space for his/her control over processes. Altogether, the analysis of the practical side of the EPCM contracts demonstrates the fact that this format should be applied with a high level of caution from the project owner's perspective. It is important to clearly understand the existing risks and adapt to them.

Concerning the EPC contract, the assessment of the practical issues has contributed to the definition of the following risk factors: the absence of control over project management for the owner, quality risks, and high risk of mistakes caused by the significant influence of a contractor on the project (Singh and Tiwari 2015). It was earlier stated that one of the main challenges in the context of the EPC contract format is that the contractor is provided with ultimate influence on decision-making processes in terms of project realisation, while the responsibility of the project owner is extremely limited. Thus, the success of the project depends only on the contractor's professional level and his/her ability to make adequate managerial decisions. Additionally, the fixation of project costs and schedule can serve as a source of risks in the case of an unpredicted environment. Under these circumstances, the contractor that faces difficult conditions such as rising materials costs or failures in timely delivery of materials is likely to provide a lower-quality final result to meet the initial requirements of the project. These aspects should be considered in the process of decision-making regarding the format of contracting used for the project.

2.4.4. Reconciliation between the differences

The assessment of the existing differences between the chosen contracting formats has demonstrated the serious challenges and risks related to their application. At the same time, it is difficult to identify the specific type of contract that might be considered as more effective or attractive for the project owner. The final choice of a contract type should depend on the peculiar conditions of the project and the owner's expectations. Overall, it is obvious that both contract types consider the following parameters of partnership as a source of their differences: the project owner's level of responsibility, the contractor's level of responsibility, the level of severity of the contract terms and the details of the description of the final result.

The discussion of opportunities for reconciliation of EPC and EPCM contracting models should present the assessment of the issues that could be effectively solved via the application of the specific traits from both contracting models. The research by Picha *et al.* (2015) discussed the benefits of the turnkey EPC contract application in international power projects. The main idea of the turnkey EPC contracting model is that the key contractor should demonstrate the sufficient operations of the energy facility following its launch and the ending of the project. In a case where the facility does not operate according to the initial requirements of the project, the project owner can consider the quality of work as poor and apply specific sanctions to the EPC contractor (Gloria *et al.* 2011). The costs of the project using a turnkey approach could be regulated using the fixed or target price approaches, delivering a specific level of flexibility to the contractor. The applicability and efficiency of the turnkey EPC contracting model has been demonstrated for projects involving public-private partnerships (Chowdhury *et al.* 2011, p.248; Bourne 2009), which is an important finding in the context of the energy sector's development. The turnkey approach

should be actively applied in the future to guarantee the maximisation of project owner benefits from the project.

Such an approach could be productive in the mitigation of risks of limited EPCM contractor's liability. If the project owner is able to set specific requirements for the quality of project outcomes and determine the contractor's liability for the expected result, the quality of work could be increased. From this perspective, the application of the EPC contracting approaches can be beneficial for the EPCM model. Nevertheless, the EPCM model was also considered as contributing to the improvement of the EPC contract application utility. Research by Sharma and Malhotra (2012) stated that the EPCM contracting model can help the contractor to reduce the level of risks pressure on its performance. From this perspective, the capability of the EPCM contractor to move part of the liability to secondary contractors is beneficial for the project in general, while it still does not mean that the obligation for the final project result should be removed from the senior contractor (Daverna and Kamish 2010). Such vision of the problem contributes to the perception of interoperability and interconnection between the EPC and EPCM contracting models.

The final aspect of EPC and EPCM contracting models' interconnection that should be considered is related to the search for an effective risk allocation model. The research by Tang *et al.* (2020) addressed the question regarding the definition of the optimal risk allocation strategy in the contractual cooperation process. It was found that the utilisation of the EPC contracting model can be beneficial mainly if the appropriate outcome control mechanism is applied, which would reduce the level of liability pressure on the EPC contractor and guarantee efficient control over project progress for the owner (Tang *et al.* 2020, p.195). From this perspective, the provisions of the EPCM

contracting model can be beneficial in the aspects of risk allocation and concentration of control functions in the owner's hands (Shi *et al.* 2018). While it was initially supposed that the EPC contracting model could reduce the control costs for the project owner, recent studies (Shi *et al.* 2018) have demonstrated that efficient control of the contractor's performance is required despite the specifics of the selected contracting model.

2.4.5. The way forward

The assessment and comparison of the differences between the EPC and EPCM contract types has made it possible to identify the existing risks and challenges associated with their realisation. This fact means that neither of them offers an absolutely reliable and effective solution for the project owner, and they require improvement for successful application. Future research in the chosen sphere should be related to the identification of the format of integration for these two contract types that would allow the project owner to maximise his/her benefits, take all the advantages of each format, and avoid the existing risks. Among the advantages of the EPCM contract, the following are relevant: high level of influence of a project owner on the result and effective support in managerial tasks. The benefits of the EPC contract are high level of contractor's responsibility, fixed terms of cooperation and defined final result. All these advantages should be integrated into a single improved format for future contracts.

2.5. Research on EPCM and EPC

2.5.1. Variances in EPCM and EPC models

The discussion of the existing models of construction contracts should be based on the assessment of the differences in the following parameters that were discussed earlier: the project owner's level of responsibility, the contractor's level of responsibility, the level of severity of the contract terms

and the details of the description of the final result. On the basis of a comparison of these parameters for the chosen contracting formats, it is possible to identify the differences between the existing models. The differences between contract types are presented in Figure 4. The schemes in Figure 4 present the interconnection of contractors in the context of the EPC and EPCM contract models. Here, the main difference can be seen in the aspect of division of responsibilities between the external contractors for the project. In the conditions of the EPCM contract format, the EPCM contractor is integrated into the project as a separate specified agent, who has no direct or strong influence on other of the project owner's contractors. Such an approach provides more opportunities for the project owner to manage and monitor the processes of project realisation. Compared to this, the EPC contract model orients on the concentration of managerial and monitoring influence in the hands of a single EPC contractor. In such conditions, the project owner faces the reduced risk of project failure caused by their own mistakes in management, but also lacks instruments for effective management of the performance of other contractors.

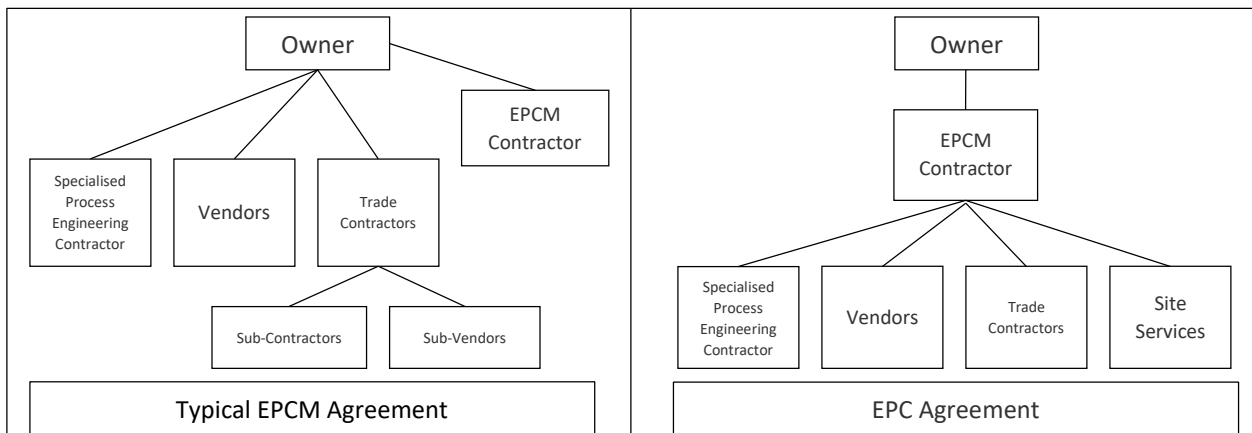


Figure 4: EPC and EPCM contracts

Source: Loots and Henchie (2007)

Figure 4 has stipulated, in block diagrams, the EPCM and EPC contracting model setup. In the EPCM arrangement, the owner appoints the EPCM contractor, who reports directly to him, and at the same maintains a direct contractual relationship with other entities for the project execution. Such entities are vendors, construction/trade contractors and specialised engineering services. On the other hand, the EPC arrangement differs in the fact that the owner has only one single point of contact and relationship, which is with the EPC contractor. The EPC contractor will have his/her own relationship with each and every other entity to execute the project to the owner's requirement. Concerning the EPC contracts, the model variances are defined by such parameters as the level of severity of the contract terms and the details of the description of the final result. While the EPC contractor is always responsible for the provision of a detailed description of the work schedule and budget, the given format of cooperation with the project owner presupposes a certain level of contractor's freedom and flexibility in the choice of the specific results for these parameters (Bali and Apte 2014). Depending on the ability of the project owner to meet funding needs and project schedule conditions, the level of freedom in decision-making for the contractor is defined. In EPCM contracts, the variation of models depends on parameters such as the project owner's level of responsibility and the contractor's level of responsibility (Loots and Henchie 2007). In this case, the combination of these actors' responsibilities varies according to the terms of specific contracts (Chakrabarti 2018). Therefore, the EPCM contract type is characterised by a higher level of model variances. This is the source of opportunities and risks in the sphere of project management.

2.5.2. EPCM and EPC risk management

The assessment of the effectiveness of risk management procedures in the context of the EPCM and EPC contracts should be based on the consideration of the potential sources of risks in the

complex megaprojects, and the comparison of the results of the application of each of the contract formats in addressing these challenges. Among the key challenges and risks faced in the process of complex project implementation, the following should be mentioned: “project scope and feasibility risk, design and specification risk, quality risk, time overrun risk, cost overrun risk, leadership risk, organisational risk, physical resource mobilisation and utilisation risk, technology risk, contractual risk, force majeure, political and legal risks, financial and economic risks, funding failure risk, communication risks, project execution risk, installation and purchase risks” (Bali and Apte 2014, p.8). Such a wide range of existing threats for the successful realisation of the construction project requires the application of a complex and effective management model, which depends on the proper choice of the contractor and the format of cooperation with him/her.

The application of the EPC contract type allows the project owner to address the existing risks through the set of activities performed in cooperation with the contractor in the following spheres: work breakdown structure identification, product specification, method statement for typical activities and resource plan presentation (Bali and Apte 2014). The EPC contractor aims to solve the existing issues and minimise potential risks by means of a detailed specification of all aspects of future work at an early stage, and development of the unified solutions for all future challenges (Chakrabarti 2018). Such an approach is optimal in a case where the future risks are adequately assessed, and no certain challenges are left misunderstood or unaddressed. In such terms, the EPC contractor can provide a detailed plan of reaction to future risks on the basis of prior experience of similar project realisation. Nevertheless, the occurrence of unexpected risks and challenges in the process of project implementation creates significant threats for the project in general. From this perspective, the low level of flexibility of the risk management model for the EPC contractor can

lead to additional problems concerning project realisation effectiveness (Bali and Apte 2014). Overall, the effectiveness of this format of risk management depends on the character of existing risks. Together with this, it was found that the concentration of responsibility in the hands of a single contractor, ignoring even the project owner, is a serious source of risks and problems for the project, mainly due to the fact that the failure of a single stakeholder can cause the failure of the project in general. Compared to this, the EPCM model provides a safer model of risk distribution.

As for the application of the EPCM contracting format for the minimisation of the project realisation risks, it is important to present the contractor's key liabilities and the opportunities for risk management based on these responsibilities. While the EPC contract supposes the contractor has full responsibility for the project, the EPCM contractor is liable only for the following tasks: design work performance, budget cost estimation and presentation, duration of work estimation and presentation of results, trade contracts, management and procurement, and coordination between the purchase and construction activities of subcontractors (Loots and Henchie 2007). In these conditions, the role of the EPCM contractor with regard to risk management is considerably lower compared to the EPC contractor that is considered to be the major responsible party for the success of the project, and the minimisation of risks is one of the main incentives of his/her performance (Loots and Henchie 2007). Moreover, the EPCM contractor is responsible for the management of the project, but he/she is just one of the many contractors engaged in the process of project realisation (Loots and Henchie 2007). This fact means that the level of the EPCM contractor's responsibility for the mitigation of potential risks is considerably lower compared to that of the EPC contractor. As was mentioned earlier, the factor of competencies distribution is also important for mitigation of EPCM risks (Alade 2016). In this way, though the risks are

distributed more effectively compared to in the EPC format, their mitigation still requires the presence of proper stakeholders' competencies.

The discussed findings point to the fact that the application of the EPC contracting format can be considered as a more effective and reliable alternative from the perspective of the minimisation of the project owner's risks. While the EPC contractor is interested in the minimisation of risks due to the fact that it will be the single responsible party to be held accountable for the failures, the EPCM contractor is one of many contractors engaged in the project. This fact gives the latter an opportunity to present the existing failures as a result of the ineffective performance of other contractors whose activities are not directly related to the sphere of his/her responsibility. The project owner can avoid such a situation in practice by defining clear borders of liability for the EPCM contractor. In this case, the question will be related to the assessment of the contractor's readiness to accept such terms of the agreement and sign the contract with such a level of requirements.

2.5.3. EPCM sustainability

The assessment of the sustainability level for the EPCM contracts should be based on the understanding of the nature of the sustainability parameter for the construction projects, and the opportunities for the application of the EPCM contracting format for the realisation of this parameter. In the context of construction projects, the parameter of sustainability is related to the ability of the project owner and contractor to reach the practical realisation of the project despite the existing risks and challenges in the environment (Loots and Henchie 2007). From this perspective, the format of the cooperation between the project owner and the contractor should

allow the organisation to achieve success in the project implementation despite the permanent risky changes in the environment. The character of the project environment as the main source of risks is characterised by permanent changes in the influence type. While, in the specific moment of time, the existing environmental impact is positive for the project, changes can occur in a short period of time, generating risks and challenges. In these conditions, contractors should be able to provide a flexible model of project management, integrating the positions of the contractor and the project owner to develop reliable solutions for project realisation. In this way, a larger number of actors taking part in the decision-making process is considered to be the source of higher sustainability of the project (Loots and Henchie 2007). Together with this, the decision-making process should be properly structured and formalised to avoid situations where the actions of the contractors in the process of decision-making generate more problems than solutions (Alade 2016). Without careful distribution of tasks and functions in the project management team, the performance of the organisation can face serious obstacles and lack effectiveness.

From this perspective, the application of the EPCM contract type can be considered as a basis for the realisation of a flexible model of management which effectively distributes responsibility between the project owner and the contractor. While the EPCM contractor is one of many contractors in the project, it is easier for the project owner to influence the process of decision-making in negotiations with the pool of contractors. The EPCM contractor is not authorised to influence all the other contractors engaged in the project implementation, which reduces opportunities for misuse of the EPCM contractor's competencies. At the same time, as was earlier stated, the limited responsibility of the EPCM contractor in the project can serve as a source of ineffective risk management procedures. Consequently, the objective of the project owner is to

build a format of cooperation with the contractor that will guarantee the proper level of control over his/her activities and effective engagement of the contractor in the process of risk management and mitigation. In this light, the EPCM contracting format is more effective compared to the EPC contract type owing to the flexibility of decision-making for risk mitigation and sustainability of the project. Along with that, the realisation of this advantage requires the adequate selection of cooperation format by the project owner.

2.6. Overview of success in EPCM

2.6.1. Definition of success in EPCM

The discussion of the question about the role of the EPCM contract format application for the successful realisation of the project should be based on a clear understanding of the nature and definition of the term “success” in the context of the activity that is oriented at the implementation of the construction project. The key parameters of construction project success that have been defined in the context of the study include the following: the contractors’ ability to attain the result with the proper level of quality that will satisfy the customer’s needs; the contractors’ ability to follow the time schedule and the project budget requirements stated at the stage of project planning; and the contractors’ ability to minimise and mitigate the negative impact of the risk factors in the process of the project realisation. In this context, the parameter of high-quality project outcomes is considered to be the key priority for project management. In conditions where the quality of the obtained result is lower compared to the expected level defined at the planning stage, the project cannot be considered successful (Bostock 2014). Concerning the schedule and budget expenses realisation, success in the attainment of this objective affects the overall outcomes of the project, from both the perspectives of the final quality and the funding requirements’ fulfilment. Finally,

the question of risk management in the process of project realisation was carefully addressed in prior sections of the study and can be considered as one of the important parameters for the definition of the level of success for construction projects.

2.6.2. Previous research on success in EPCM

The prior research in the sphere of the effectiveness of the EPCM contract type application for the successful realisation of projects was partly based on the definition of the specific parameters for the assessment of project success. In this context, the main finding of the previous studies was related to the importance of the definition of the success criteria for the analysis of the specific critical success factors (Han *et al.* 2012). The prior research divided the success factors into the following categories: “factors related to the project, factors related to the project manager and team members, factors related to the organisation, and factors related to the external environment” (Han *et al.* 2012, p.25). Among the particular success factors for the assessment of the construction project outcomes, the following parameters were identified: “comprehensive facility team, teamwork boosting policy, sufficient experience in handling various aspects of facilities, and optimisation of information in the planning and design stage” (Han *et al.* 2012, p.24). Additionally, the factors of time, cost and quality were also considered among the main parameters of project success (Han *et al.* 2012). As a result, it is possible to say that, despite the variety of positions expressed regarding the project success estimation, the earlier-presented view about the importance of orientation on quality, time, costs and risk management can be considered as a sensible approach, and thus it was applied in this study.

The assessment of the application of the EPCM contract type as a factor of megaproject success was based on the analysis of prior cases of EPCM contract format application in construction projects. Here, the research by Han *et al.* (2012) discussed three different cases that were related to the implementation of three construction projects with different scale characteristics. The results of the examination of these cases revealed that the EPCM contract format should be considered as an effective instrument for construction project realisation (Salah and Moselhi, 2016). As for the aspect of project results quality, the assessment of the outcomes of all the mentioned projects demonstrated an adequate level of quality that satisfied all the project owners (Han *et al.*, 2012). As for the parameter of time, no time schedule extension was experienced in either of the discussed projects. On the basis of this information, it is possible to conclude that the EPCM contract format can be applied to realise the timely completion of complex projects.

Finally, the question about costs as a factor of project success led to the most serious contradictions. Among the discussed projects, the first one was realised with a cost performance that was 9.6 % higher compared to the expected expenses (Han *et al.* 2012). With regard to the second project, the level of actual costs was 19.8 % higher compared to the initial one (Han *et al.* 2012). As for the third project, the final costs of its realisation were 0.2 % lower in comparison with the planned ones (Han *et al.* 2012). Against this background, it is important to highlight the fact that the final project was the least complex from the position of practical realisation compared to the other initiatives. Nevertheless, it is important to remember that the associated risks of the EPCM contract application can cause a serious increase of costs in the case of poor quality of stakeholders' coordination and control (Salah and Moselhi 2016). Consequently, the EPCM contract format was found to be effective for the realisation of projects with low to moderate levels of complexity, while the

implementation of more complex and structured projects led to an increase in costs compared to the planned costs.

Such findings can be considered as a reason for the statement about the contradictory nature of the EPCM contract type from the point of guaranteeing the final success of the project. Nevertheless, the same study by Han *et al.* (2012) defined the main reason for the identification of the EPCM contract format as the most effective instrument for the successful project realisation. For the researchers, the fact that the EPCM contract format provided opportunities for the active integration of the project owner into the decision-making process led to the higher sustainability of the project and its higher probability (Han *et al.* 2012). From this perspective, the fact that the project owner can take part in the management procedures but is not forced to perform specific construction tasks gives him/her opportunities for complex assessment of the different phases of the project, timely identification of risks and development of effective alternative solutions in case of need. On the basis of the presented case analysis, it is possible to say that the prior studies considered the EPCM contract type to be a reliable strategy for the successful implementation of any type of project. With regard to this, it was important to examine the alternative positions of scholars who also discussed the role of the EPCM contracts concerning project success. It was important to understand whether the recent studies developed arguments for or against the statement about the significant role of the EPCM contract format for project success.

2.6.3. Recent changes in success in EPCM

In addition to the earlier-presented outcomes of the case analysis to understand the impact of the EPCM contract format on the final success of the project, a recent study oriented at the assessment

of the effectiveness of EPCM contracts from the perspective of case analysis was also considered. In the research by Oosterhof (2018), five different cases related to the analysis of the role of the EPCM contracts for the success of the construction projects were studied. Each of these cases should be discussed separately to understand the effectiveness of the EPCM contract type as a factor of project success in modern practice. According to the outcomes of the analysis of the first project, it is possible to say that, in general, it was successful. Yet, several factors were considered as sources of the ineffective realisation of the projects' full potential. In particular, it was found that the project owner and the contractor did not manage to reach the highest level of cooperation in the process of project realisation mainly because the project owner did not have adequate experience of similar project realisation in the past, while the contractor did not manage to provide the proper level of consulting support in the process of decision-making (Oosterhof 2018). Furthermore, the level of cooperation in the process of project realisation and control of project progress did not satisfy the project owner, leading to doubts concerning the contractor's level of competency (Oosterhof 2018). Altogether, it is obvious that the application of the EPCM contracting format allowed the parties to successfully implement the project, though the quality of cooperation was in question.

The consideration of the outcomes of the second case study also demonstrated the success of the project. However, there were two main problems in the process of its realisation. The first one was related to the absence of an effective mechanism for coordination of the actions of the project owner and the EPCM contractor (Han *et al.* 2012). The second issue was the excessive concentration of influence in the contractor's hands (Oosterhof 2018). Similar to the prior case, the main source of dissatisfaction felt by the project owner was associated with the inability to develop

an effective format of cooperation and coordination of activities among the project parties. This problem was earlier addressed in the prior sections of the study where it was stated that a discussion of all terms of cooperation is required prior to signing the EPCM contract (Han *et al.* 2012). Unfortunately, earlier-presented cases demonstrated the project owners' lack of experience in the sphere of contract planning and management. Despite the long history of EPCM contract format application, the discussed problem remains relevant.

The study of the third project demonstrated the role of the factor of inadequate choice of contractor for the realisation of the project objectives. According to the outcomes of the analysis, the chosen contractor failed to implement the objectives set by the project owner mainly due to the fact of the absence of adequate competencies (Oosterhof 2018). The given case shows that, despite the effectiveness of the EPCM contracting mechanism, it still cannot guarantee mitigation of the risk of preference for an ineffective and incompetent contractor. The same problem can be formulated for the EPC contract format (Han *et al.* 2012). In these conditions, the results of the study prove the importance of improving the contractor selection procedure to guarantee project success. The fourth case study showed that mistakes in the definition of the scope of the contractor's responsibility for the project can lead to the removal of opportunities for successful project realisation. In the presented case, the contractor managed to control planning and implementation procedures effectively, while the control over budget utilisation activities was not mentioned as a part of his responsibility (Oosterhof 2018). As a result, the problem of budget costs management was overseen by both parties, the project owner and the EPCM contractor, which eventually led to the failure of the project from the position of the cost parameter (Han *et al.* 2012). Thus, the

argument about the importance of carefully discussing the parties' responsibilities can be expressed once again.

Finally, the analysis of the fifth project pointed to another problem – the issue of inadequate presentation of the parties' competencies in the EPCM contract. In this particular situation, the EPCM contractor successfully fulfilled all his duties according to the contract but did not manage to contribute to the overall success of the project mainly due to his limited responsibilities and competencies (Oosterhof 2018). This can be explained by the fact that the project owner did not give the contractor an adequate level of authority to put pressure on the contractors responsible for the construction procedures. As a consequence, the contractor could not impact the resolution of the issues he observed, while the project owner ignored them all the way (Oosterhof 2018). The problem of an adequate definition of the EPCM contract terms was discussed from a wider perspective. Altogether, the outcomes of the complex case study analysis have contributed to a better understanding of the impact of EPCM contracting format issues on project success. It has been demonstrated that project realisation highly depends on the effective division of responsibilities, including the adequate provision of competencies and authority of the parties. The case studies have also highlighted that the main issues that have to be addressed are related to the selection of competent and capable contractors for the EPCM contracts, and the provision of an adequate model of responsibilities distribution. Even if a promising EPCM contractor is selected, the lack of provided competencies for his/her work can lead to the failure of the project in general.

2.6.4. Current views on success in EPCM

The summary of the prior findings regarding the analysis of the role of EPCM contracts in the successful realisation of a project has contributed to the definition of current challenges concerning the application of this instrument as a basis of project success. The list of key challenges for the utilisation of EPCM contracts in complex projects includes the following: control over the contractor; reactive construction management; and accountability in relations between a project owner and a contractor (Oosterhof 2018). All these issues should be effectively addressed to guarantee the improvement of the EPCM contract format in the future.

2.6.5. Emerging theories on success in EPCM

The discussion of the challenges related to the application of EPCM contracts for project success has defined the role of the parameter of contract development. In this context, a recent theory that has been developed to address the issue of EPCM contract development is the theory of organisation. This theoretical approach does not only aim to answer a question about the optimal means of contract format selection for the specific project but also addresses the issue of the structuring of the EPCM contract as a separate contract type (Turner and Simister 2001). The discussion of the findings concerning this theory should contribute to the understanding of the principles of EPCM contract management for the purpose of project success.

2.6.6. Guidelines for success in EPCM

The discussion of the prior findings concerning the role of the EPCM contract format in project success has led to a conclusion about the importance of improving the practices of contract terms management and definition. The analysis of the relevant prior cases has persuaded the researcher

that the orientation on the existing practices does not guarantee project success. The main challenges regarding the application of EPCM contracts for project success have been identified, and they are the following: control over contractor; reactive construction management; and accountability in relations between a project owner and a contractor (Oosterhof 2018). It is important to highlight the fact that the absence of effective solutions for the adequate management of the contract development procedure serves as the main source of risks and ineffectiveness in the realisation of this format of project implementation. The improvement of the practices of the EPCM contract development and the definition of the responsibilities and competencies of the parties should be considered as the key priorities for the future enhancement of the EPCM contracting format from the perspective of successful project realisation.

2.7. Overview of value in Engineering, Procurement and Construction Management (EPCM)

2.7.1. Definition of value in EPCM

To determine the role of EPCM contract format in the generation of value to the project owner, it is important to define the nature of the notion “value”. In this case, the value of the project in general means its capability and potential to bring benefits to the project owner in different forms after its realisation (Too and Weaver 2014). The concept of value is directly related to the issue of compliance between the project results and the expectations of the customers for whom the project was realised. The list of consumers does not include only the project owner as the subject that uses the results of the project, but also the customers who are supposed to benefit from the project outcomes and provide payment to the project owner in exchange for the opportunities given (Too

and Weaver 2014). From this perspective, the concept of value differs from the concept of success that was discussed in the previous sub-section of the study.

The concept of success implies the effective attainment of the project objectives, particularly the realisation of the desired outcomes. At the same time, the project success does not mean that its results will generate the required value for the project owner. In fact, the effective realisation of the project objectives without the careful analysis of the end-user's expectations and needs can lead to the situation where the result is without demand among end-users (Too and Weaver 2014). In these conditions, the project owner can find him/herself in a situation where the final result of the project realisation cannot generate the desired value for him/her, and the expenses for its implementation cannot be compensated (Salah and Moselhi 2016). Therefore, the objective of effective project management is to guarantee the achievement of the project outcomes that will serve as a reliable basis for the future generation of value for the project owner. In this context, it is important to understand whether the EPCM contract format can serve as an effective basis for the realisation of projects and maximisation of future value for the project owner.

2.7.2. Previous research on value in EPCM

The discussion of the role of value with regard to the realisation of complex projects in prior studies oriented on the analysis of means of guaranteeing the maximisation of final value generated for the owner. The previous research contributed to the definition of actions and steps that should be taken by the management of the project to ensure the maximisation of the final value for the project owner (Too and Weaver 2014). The given section of the literature review discusses the list of recommended actions and assesses the perspectives of the EPCM contract format application for

their realisation. The most complex evaluation of the steps required for maximisation of the project owner's value in the process of project realisation was presented in the study by the Construction Owners Association of Alberta (COAA) (2018). The research group assessed the opportunities and risks of using different formats of project management in the context of construction project realisation and determined the main steps that should be taken to maximise the benefits and value for the management. The list of the required steps included the following (COAA 2018):

- ✓ Optimisation of risk allocation between the engaged parties with the core principle being that the risk should be allocated to the party that can effectively manage it;
- ✓ Usage of performance specifications as a means of innovation support and promotion;
- ✓ Guaranteeing of a high level of flexibility in project management to reduce the costs of adaptation to the environment changes;
- ✓ Provision of adequate rewards for the innovative and perspective project management decisions;
- ✓ Orientation on the adequate budget costs and time schedule definition for the project;
- ✓ Orientation on the contractors that possess the required skills and competencies for the successful realisation of the project;
- ✓ Adoption of the contracting strategy that suits the needs and specifics of the project.

As can be seen, a part of the stated principles was earlier discussed in the context of the analysis of success factors for projects based on the application of the EPCM contract format. It is important to consider the principles that were not mentioned earlier to build a complex image of the required basis for the maximisation of the project owner's value. The findings should be compared with the opportunities provided by the EPCM contract format to define its appropriateness for the purpose

of project value maximisation. The first principle states the importance of the adequate distribution of risks associated with the project realisation among the engaged parties. In this case, the risk parameter is related to the capability of the specific project stakeholder to successfully perform his/her part of the work for the project. The discussion of the business cases in the previous subsection of the literature review provided information about situations when the project failure was caused by the party's inability to fulfil the scope of tasks and responsibilities assigned to it by the project management (COAA 2018). The effective distribution of risks is important, and the EPCM contract format seems to provide the optimal tools for the fulfilment of this objective as a basis of project owners' value maximisation. Compared to the EPC contract format, the EPCM contract presupposes the definition of the format of distribution of responsibility between the contractor and project owner at the stage of contract planning (Salah and Moselhi 2016). Thus, the format of the EPC contract can become a losing strategy from the position of project owner's value maximisation, since the concentration of responsibility and risks in the hands of a single contractor may not be an effective strategy in a concrete scenario.

As for the second principle, it points to the importance of the performance specifications to integrate innovative decisions into the project. With regard to this, the project manager's priority should be related to the search for innovative solutions to the existing challenges, permanently adapting to the external conditions. Considering the characteristics of the EPC and EPCM models, the orientation on a single decision-making actor in the context of the EPC contract model provides lower opportunities for the effective implementation of innovations (COAA 2018). In contrast, the orientation on two decision-making actors in the EPCM contract model can serve as a basis for more effective and productive development of innovations in the process of project realisation. The

third principle of project management for value maximisation highlights the need to ensure the flexibility of decision-making to provide changes at a reasonable cost. From this perspective, the benefits of the EPCM model of contracting are obvious, since the EPC model offers limited opportunities for contractors' flexibility in decision-making (Han *et al.* 2012). In addition, the orientation on fixed parameters of budget costs and time schedule also reduces opportunities for contractors to manoeuvre in the conditions of a changing environment. In this light, the EPCM contract model provides more opportunities for contractors to use a flexible management format and adapt the decisions to the needs of the moment. At the same time, it is important to control the contractors' actions to avoid the misuse of their status for personal benefit instead of the maximisation of project value. Under these circumstances, the principle of adequate rewarding for better performance should be considered as a basis for the promotion of best management practices as a means of project value maximisation.

The principle of adequate definition of the budget and schedule for a project implies that the maximisation of project value can be reached only in the conditions of correct and clear understanding of the project scope and the main characteristic of the project realisation procedure (COAA 2018). Considering this fact, it is important to determine the optimal balance between the needs of adaptation to the market conditions and the strict definition of contract terms. From this perspective, the EPCM contract model seems to be a more reliable alternative compared to the EPC format. The final principles of project value maximisation require the project owner to orient towards the best contractors with adequate skills and competencies, and to adopt the contracting strategy pertinent to the project conditions. Both principles were discussed in detail in the previous section of the study. It is important to state that both the EPC and EPCM models of contracting can

be adapted for the realisation of these principles (COAA 2018). Overall, it is necessary to consider and analyse the recent findings in the sphere of the definition of means of project value maximisation to understand the relevance of the idea about the optimal nature of the EPCM contract model for this objective.

2.7.3. Recent changes in value in EPCM

The recent changes concerning the role of the EPCM contract model for the maximisation of project value took place in the sphere of the perception of different motivation models for contractors that allow project owners to maximise project value in the process of its realisation. The principle of provision of adequate reward was considered to be one of the main sources of project value maximisation in the prior discussion. From this perspective, the research by PwC (2016b) contributed to the definition of the optimal practices in the context of the EPCM contract model that can be applied to guarantee the maximisation of project value. Among the specific recommendations in the sphere of contractors' motivation, the main recommendation of the study was related to the definition of optimal connections between the project objectives and the reward format for the EPCM contractor. In this context, the particular reward should be provided in such a way as to motivate the EPCM contractors to operate in a way that will maximise effectiveness with regard to the project objective fulfilment. For example, if the aim of the project owner is to provide the final result based on the specific time schedule requirements, the value of the reward for the EPCM contractor should depend on his/her ability to satisfy this demand (PwC 2016b). Altogether, the presented study offered a flexible model of the contractor's motivation and encouragement. This approach can be considered as a reliable basis for the successful maximisation of project value in the context of the EPCM contract model. The discussion of the associated risks

of the EPCM contract demonstrated potential weaknesses of this approach (Salah and Moselhi 2016), though the expected positive outcomes were found to be much more significant.

2.7.4. Current views on value in EPCM

The discussion of the prior findings in the context of project value maximisation has shown the role of the set of key principles that have to be followed by the project manager to maximise project value. The basic principles that were mentioned earlier in this section remain relevant, and no significant changes regarding their specification or removal have been introduced by researchers (Salah and Moselhi 2016). As a result, it is possible to conclude that the successful realisation of the stated principles should be considered as a basis for the maximisation of project value. Moreover, the specific recommendations regarding the realisation of specific principles have recently been developed by scientists in support of effective practical performance (PwC 2016b). The results of the prior research demonstrate the effectiveness of the EPCM model of contracting for the maximisation of project value and the benefits for the project owners. Yet, the attainment of the desired result requires the improvement of the existing EPCM contract model and the development of best principles in the sphere of contracting management.

2.7.5. Emerging theories

Concerning the assessment of the recent theories related to the evaluation of the factors of project value maximisation, the same theory of organisation that was mentioned in the previous section of the literature review should be applied. This theory aimed at an analysis of the best practices that have to be applied for the development of a reliable contracting model for the realisation of construction projects (Turner and Simister 2001). The results of the performed analysis have

demonstrated the significant role of effective contracting strategy development for the maximisation of project value. Similar to the positive impact of the theory of organisation on guaranteeing the success of a project, its findings can be applied for the maximisation of project value.

The discussion of the emerging theories related to the study of the EPCM model should be based on the findings of the relevant academic studies. The research by Wembe (2015) provided a detailed discussion of the EPCM contracting model's role in the context of contemporary stakeholder theory. The scholar analysed the impact of EPCM contracting model utilisation for the satisfaction of different stakeholder groups' needs. Such an approach to the analysis of the problem shows opportunities for EPCM contracting model utilisation as an instrument for addressing multiple stakeholders' needs and satisfaction (Wembe 2015). The further study of this aspect of EPCM contracting model practice could contribute to the provision of recommendations in the aspect of the model's optimisation to perfectly fit the needs of different stakeholder groups.

An interesting approach to the development of the contracting models in the context of emerging theories was demonstrated in a study by Eikeland and Nilsen (2016). This research integrated the following theories to determine the impact of the geographic location of a business on the choice of the contracting model: theory of local content and emergency of growth poles theory (Eikeland and Nilsen 2016, p.13). The findings of the study demonstrated that the local environmental context could impact the efficiency and productivity of specific contracting models' utilisation. Differences in the realisation of the contracting models were mainly explained by the influence of the local cultural environment and legal norms (Eikeland *et al.* 2010; Nilsen *et al.* 2013). From this

perspective, the emerging theory demonstrated that the utility of the specific contracting models should be assessed based on the discussion of the local environmental conditions.

Concerning the objective of the current study, the application of the emerging theory demonstrated the significance of research for theory and practice. The analysis of the application of the EPCM contracting model in the energy sector of Abu Dhabi should contribute to the understanding of the local environmental conditions that increase or reduce the influence of this specific contracting model on the realisation of large construction projects. At the same time, the provisions of the emerging theory argue that similar EPCM contracting practices might not lead to similar outcomes in other conditions. Another important contribution to the emerging theory of EPCM contracting model development was made in the study by Yang *et al.* (2020). This study aimed to apply the cup-of-water theory in its perception of IT technologies' role for future business development to assess the role of blockchain for the implementation of complex construction projects. Yang *et al.* (2020) analysed the case of blockchain technology application in large construction projects based on the EPCM contracting model. The findings of the analysis demonstrated the utility of blockchain contracting technology for flexible solutions development and increase of project owner's control over the project flow (Institution of Civil Engineers 2019; Koulouri-Fyrigou 2019). The findings of the cup-of-water theory study about the EPCM contracting model development can inform researchers and practitioners about the available opportunities for future improvement of EPCM model efficiency. The assessment of the emerging theories in the sphere of EPCM contracting model application led to the definition of opportunities for significant development of this sphere in the future. Based on the recent findings in the sphere of theory, managers can determine directions for future development of EPCM contracting practice.

2.7.6. Guidelines for value maximisation in EPCM

The discussion of the key principles of project value maximisation for the owners has demonstrated the need for the development of a flexible and adaptive approach to the project management model. The effective distribution of responsibility and risks among project stakeholders are required to guarantee the attainment of the best result and maximisation of project value (Too and Weaver 2014). With regard to the stated argument, the development of the EPCM contract model seems to be the most reliable decision among the contract formats that are discussed in the presented research. However, the maximisation of project value using the EPCM contract model requires the resolution of the challenges that were defined earlier in the previous sections. First, it is important to develop an effective strategy for the distribution of risks among the contractors in a construction project. This principle is considered as one of the most important in the process of project value maximisation. In this way, the EPCM model of contracting provides opportunities for flexible distribution of risks and responsibilities among project participants. Additionally, it contributes to the flexible development of strategic solutions. It is necessary to optimise the existing format of contract development to maximise the project value created with the application of the EPCM contract model. The question about distribution of risks among stakeholders should be considered as one of the most important for practice.

Furthermore, the future development of the EPCM contract model should be connected with the development of an effective means of rewards definition and assessment of the prospective contractors in the process of their selection for the purpose of project realisation. The issue of the criteria for the evaluation of the prospective contractors was discussed in a previous section of the literature review (PwC 2016b). It was important to show that the results of the analysis of the

principles of project value maximisation led the researcher to the same findings as for the consideration of success factors in the process of project realisation. As a result, the main priorities of future development of the EPCM contracting model for the implementation of megaprojects in the sphere of construction have been identified.

2.8. Key research problems identified from the literature reviewed

The performed literature review has allowed the researcher to gain a better understanding of the following issues: the nature and role of the oil and gas industry in the Abu Dhabi Emirate, the nature and differences between the EPCM and EPC contract formats in the realisation of the construction projects, and the perspectives of the application of EPCM contracts as a means of successful project realisation and maximisation of project value. With regard to the perspectives of the oil and gas industry in the Abu Dhabi Emirate, the results of the analysis have demonstrated the key role of this economic sector in the region despite the recent changes in the structure of the regional economy. The development of the oil and gas sector is also considered to be one of the key priorities for the future economic development of the area, and the existing policies are oriented at the increase of the productivity of personnel performance and realisation of the prospective construction projects aimed at the increase of oil and gas production volumes in the Abu Dhabi Emirate (US-UAE Business Council 2019). The current economic, political, and social situation in Abu Dhabi can serve as strong support to the initiatives in this sphere, and it is sensible to expect the growth of the oil and gas industry in the region in the nearest future.

In these conditions, the realisation of the prospective construction projects in the oil and gas sector of Abu Dhabi will definitely require the application of innovative solutions, especially in the sphere of contracting strategy development. The present study will assess the role and functions of the

EPC and EPCM contracting models as key approaches to the organisation of construction project management (Han et al. 2012). The outcomes of the research will show the strong and weak sides of each model of contracting strategy realisation. At the same time, the prior studies did not answer the question about the most promising model of contracting strategy for the development of the oil and gas sector. The current study will contribute to the development of the answer to this question. Finally, the results of the study have identified the role of the EPCM contract model for the successful realisation of projects and maximisation of project value for the owner. In the process of the literature review, the key challenges in the sphere of the EPCM model application have been identified together with the required improvements for the future (Han *et al.* 2012). In this way, the present study has stated an issue regarding the search for the optimal strategy for the future development of the EPCM contracting format. The research will contribute to the identification of the most promising solutions for the improvement of the effectiveness of the EPCM contracting model as a potential basis for the realisation of strategic initiatives in Abu Dhabi's oil and gas sector. Without the resolution of this issue, there is a question about whether the existing format of the EPCM contracts can provide the best opportunities for the effective realisation of the mentioned projects or not.

On the basis of the key findings of the literature review, it was possible for the researcher to identify the importance of the factor of contract type selection for the aims of successful project realisation in the UAE oil and gas industry. The discussion of the relevant projects that are currently implemented in the UAE oil and gas industry and the future perspectives in this sphere demonstrated the fact that the further development of the sphere of knowledge about practical application of different contract types would be required for successful development of the chosen

industry. From this perspective, the present research oriented on the discussion of the research problem of analysis and comparison of different contracting models' application for the aims of project development in the UAE oil and gas industry. First, it will be important to identify the theoretical and practical differences between the EPC and EPCM contracting models and define the specific characteristics of both contracting styles that can be found useful in the UAE oil and gas sector. Second, it will be important to focus more attention on the discussion of the perspectives of EPCM contracting model application in the conditions of the UAE oil and gas sector, and presentation of associated opportunities and benefits. The results of the study analysis should provide the researcher with information about the role of the EPCM contracting model for increasing cost-effectiveness and reducing contractual risks for constructing projects in the oil and gas sector. As a final result of the research, the EPCM guidelines should be developed to support the management and practitioners of the UAE oil and gas sector construction projects to guarantee the improvement of final results and minimisation of associated risks.

2.9. Chapter summary

The examined literature provides a reliable basis for an understanding of the current state of the oil and gas industry in the Abu Dhabi Emirate of the UAE, complex understanding of the nature of and differences between various formats of contracting strategies for the realisation of construction projects, namely EPC and EPCM, and defines the required improvements to the format of the EPCM contracts to guarantee the successful realisation of construction project objectives and maximisation of project value. Altogether, the findings of the literature review are significant for understanding the current situation in the sphere of contracting strategy development for successful realisation of strategic initiatives in the oil and gas sector of Abu Dhabi and contribute to the

definition of future opportunities for the optimisation of the EPCM contract format as a basis for the strategic development of the industry.

In the sphere of oil and gas industry development in the Abu Dhabi Emirate, the results of the performed analysis have allowed the researcher to define the strategic role of this sector in the regional economy, and significant opportunities related to its development in the future. From this perspective, it is sensible to expect the active creation of new projects in this industry in the nearest future. To come up with the best solutions for the effective realisation of such projects, different contracting strategies have been discussed. The analysis of the EPC and EPCM contract models has made it possible for the researcher to determine the key parameters and differences between them. According to the literature review findings, the main benefit of the EPC model for the project owner is that it allows him/her to avoid any responsibility for and risk associated with the success of the project and maximise its value. At the same time, it has been found out that the EPC contract model reduces the flexibility of decision-making and actually removes the project owner from the sphere of project management.

Compared to this, the analysis of the EPCM contract format has demonstrated its attractive nature from the perspective of the flexibility of decision-making and engagement of the project owner in project management. In addition, the assessment of the existing barriers for project success and maximisation of project value has resulted in the definition of the importance of further improvements in the sphere of contracting strategy development and the organisation of cooperation with the selected EPCM contractors. The current situation is far from optimal, and further improvements in the EPCM contract model are required to guarantee successful realisation

of strategic objectives of projects in the oil and gas sector of the Abu Dhabi Emirate. This will help to maximise project utility and mitigate the negative impact of existing risks. The results of the literature review have formed a reliable basis for further discussion and resolution of the stated issues.

CHAPTER THREE: PROPOSED CONCEPTUAL FRAMEWORK

3.0. Definition of the research problem

The development of a modern economy is related to the successful implementation of strategic heavy engineering construction projects, which pursue the objective of developing production and service facilities for business stakeholders. This argument is especially relevant for the oil and gas industry, where the success of heavy engineering construction projects is expected to contribute to the development of new production and distribution facilities for energy resources. The presented research analyses the effectiveness and efficiency of different models of construction project management in the UAE oil and gas sector.

From the historical perspective, the structure of the UAE economy is characterised by the high importance of the oil and gas sector for the economic development of the state (US-UAE Business Council 2019). The same position is relevant for the Abu Dhabi Emirate since the oil and gas sector plays the role of a significant source of income from exports for the regional economy (US-UAE Business Council 2019). Despite the effective diversification of the economic structure of the UAE and Abu Dhabi Emirate, the oil and gas sector remain an important source of income and the sphere of realisation of important strategic construction projects. Among the heavy engineering construction projects that were successfully developed in the UAE and the Abu Dhabi region for the oil and gas sector, the following can be mentioned: Integrated Gas Development Project, Shah Gas Development Project, Sahil-Asab-Shah Full Field Development Project, and Upper Zakum Full Field Development Project (ADNOC 2013). At the same time, the Bu Haseer Oil and Gas

Field Initiative is one of the important future projects of ADNOC (2013), which should be implemented to guarantee effective development of the oil and gas sector in Abu Dhabi.

On the basis of the presentation of the importance of oil and gas sector in the structure of the UAE economy and the discussion of previous and future projects, the researcher concludes that there is a need to find an effective instrument for project management that can be applied to the existing and future initiatives in the sector. While the mentioned projects have a serious economic, social and environmental impact, it is important to organise them so as to minimise potential challenges, issues and risks for all the engaged stakeholders. The presented study aims to examine the existing alternatives in the field of project management objectives realisation and provide the stakeholders in the oil and gas sector of the Abu Dhabi Emirate with detailed recommendations and insights into the optimal project management procedures that can be applied in practice.

In the context of the stated research aim, the researcher examined two different models of project management that are currently applied in the oil and gas sector of the UAE, namely the engineering, procurement and construction (EPC) model (PwC 2016a) and the engineering, procurement and construction management (EPCM) model (Oosterhof, 2018). A specific feature of the latter is that it allows the project owner to identify the external party which will be responsible for all elements of the construction project and avoid the risk of mistakes caused by ineffective project management (PwC 2016b). As for the EPC contract model, this format of project management provides project owners with a higher level of involvement in the decision-making process at different phases of the project (DLA Piper 2018). In the process of the literature review, the researcher identified the specific advantages and limitations of each project management model applied to the UAE oil and

gas sector. In these conditions, it is important to determine the preferable contract model that should be applied for the aims of project management in the UAE oil and gas sector.

In the context of the stated research problem, the study aims to present findings characterised by novelty from both practical and theoretical perspectives. From the theoretical perspective, the objective of the research study is to challenge the existing value and contracting strategy theories to assess their relevance and reliability in the conditions of the UAE oil and gas sector. The results of the study are expected to help in the modification and enhancement of the value and contracting strategy theories for their effective application in the UAE oil and gas sector. It is also important to identify the theoretical and practical differences between the EPC and EPCM contracting models and define the effectiveness and reliability of each chosen format for the conditions of projects in the UAE oil and gas sector. As for the practical perspective of the study, the research study aims to develop and propose guidelines for the effective application of the EPCM contract format in construction projects in the UAE oil and gas sector. The results of the study are intended to contribute to the maximisation of benefits and minimisation of the risks and challenges associated with project management for the senior management in the Abu Dhabi oil and gas sector who decide to use the provided EPCM contract guidelines (Olayinka 2016). In addition, the findings of this study are intended to contribute to the improvement of the quality of project management in the UAE oil and gas sector using the EPCM contracting model format.

3.1. Theoretical coherence

The resolution of the research problem regarding the development of reliable guidelines for the application of the EPCM contract model in the conditions of the UAE oil and gas sector should be

based on a clear definition of the theoretical perspectives that effectively integrate and contribute to the realisation of the research objectives and resolution of the research problem. In the context of the presented study, the researcher focuses on the analysis and integration of theories and theoretical perspectives that can be considered as correlating with the practical field of project management. In this way, several important theoretical perspectives are identified by the researcher as appropriate for integration into the research. This is important to show the existing coherence between the chosen theoretical perspectives and the research problem stated in the previous section.

The first theoretical perspective that is chosen as appropriate for the aims of research is the complex system theory (CST). CST was created as a theoretical instrument for the planning and realisation of complex projects and effective organisation of project management functions. From the perspective of its initial functions, this theoretical perspective can be considered as coherent with the chosen research problem. According to the main ideas of CST, a complex construction project should be considered as a complex system, or a system-of-systems (Zhu 2016, p.7). As a result, the analysis of complex projects should be based on the discussion of the study object not as a monolithic system but as a complex of systems characterised by the parameters of dynamics and interdependence (Zhu and Mostafavi 2014). The complex system theory should also be considered as one of the most reliable theoretical approaches to the explanation of the nature of new value generation in the process of project management. According to Zhu (2016), the products of project management should be considered as emergent properties. This is a broad definition that serves to describe any form of new value generated as a result of interaction between the elements of a complex system and the environment. In the context of CST, emergent properties also function and pursue objectives that cannot be accomplished by each of the components of the complex system

as individual objects. According to such a vision of project management activity, the role of the project manager should be connected with the maximum development of the emergent properties of the system as a result of its modernisation and improvement in the project (Ventroux *et al.* 2017). As a result, the presented study should apply the concept of emergent properties for an assessment of the effectiveness and reliability of different contracting models from the perspective of their usage for the maximisation of emergent properties of project owners and other construction project stakeholders.

Among a wide range of emergent properties of the complex system that might be assessed in the context of the presented study, the researcher defines a specific role of the resilience parameter as a key indicator of project management effectiveness. Its application as a parameter of the conceptual model of the study is expected to contribute to the reliability and productivity of project management outcomes assessment. In this way, resilience as a property is the result of interconnection between separate elements of a complex system, none of which can be perceived as an independent object (Zhu 2016, p.8). The concept of resilience describes the ability of a complex system to effectively deal with any types of risks in its operations, overcome them and return to a balanced performance in the shortest period of time (Linnenluecke 2017). According to this definition, resilience is not common for the assessment of an organisation's performance under conditions of business-as-usual. It is expected to describe the effectiveness of organisational performance in extraordinary and risky conditions when the environment poses significant challenges to the system.

The application of the resilience parameter to the assessment of the effectiveness of project management can be observed from the perspective of comparison of the impact of risk and resilience management procedures. In the context of the risk management paradigm, which is traditionally applied in the sphere of project management, the objective of project management is to identify the potential risks and provide effective reactions to them in the future on the basis of improvement of the complex system's characteristics (Aven 2016). By comparison, orientation on the resilience parameter for an assessment of the project management results' effectiveness allows the project management to adapt a complex system not only to expected but also to unexpected risks and challenges, improving the sustainability level of the complex system (Bosetti *et al.*, 2016). As a result, the presented study will utilise the resilience parameter for the assessment of the project management quality and the development of guidelines that can potentially minimise risks and maximise benefits for organisations in the oil and gas sector of the UAE.

In addition to the complex system theory, the agency theory and the transaction costs economy (TCE) theory are applied for the assessment of risks and potential challenges in the process of construction project realisation. These theories will be applied for the analysis of the existing risks and sources of problems for project owners when entering into contracting relations with the external providers of services and goods for the construction project (Sanderson *et al.* 2015). The results of the theoretical background analysis demonstrated that, in both EPC and EPCM contracting models, external contractors perform a significant role in the process of construction project realisation (PWC, 2016). The agency and TCE theories are applied for the analysis of situations when the business or project owner is required to delegate a part of the responsibility for the successful realisation of the project to an external contractor. Both theories hold that the

independent contractor in the project management procedure demonstrates different elements of opportunistic behaviour oriented on the maximisation of their benefit instead of the benefit of the project owner and other project stakeholders (You *et al.* 2018). In these conditions, the objective of the contracting strategy realisation for the project owner is to minimise the risk of opportunistic behaviour from the contractor's side (Aminian *et al.* 2018). In the context of both agency and TCE theories, independent contractors mainly act in their own interests and are likely to neglect the interests of the project owners.

The discussion of the opportunities for the effective development of contracting strategies in the context of the agency and TCE theory is based on the analysis of the issue of actor rationality in the contracting relations. According to the agency theory, both project owners and contractors are completely rational in their decision-making and capable of developing a reliable contracting strategy for the maximisation of mutual benefits prior to the beginning of the project (Sanderson *et al.* 2015). In contrast, the TCE theory holds that the effective development of the contracting strategy at the beginning of the project is impossible due to the influence of two parameters – information asymmetry and cognitive capacity of the project owner (Sanderson *et al.* 2015). In this way, the project owner cannot develop a contracting model that would maximise benefits and minimise risks at the initial phase of project management mainly due to their cognitive capacity limitations. As a result, they cannot predict all potential outcomes of cooperation with the contractor during the project in the absence of important information in the decision-making process due to information asymmetry (Bergh *et al.* 2018). As can be seen, the two theories seriously differ in their perception of the challenges related to the practice of contracting strategy development.

In this way, it is important to compare the theoretical approaches of both theories to the issue of contracting strategy development to effectively integrate this knowledge into the conceptual model of the research. According to the agency theory, since both parties are initially rational in their decision-making, the application of the contractual mechanism is an appropriate and sufficient basis for the effective mitigation of project management risks for project owners (Sanderson *et al.* 2015). In contrast, the TCE theory suggests that, due to the information asymmetry and cognitive capacity limitations of the project owners, the initial contracting terms cannot be considered as a reliable basis for the effective mitigation of the project owners' risks and prevention of contractors' opportunistic behaviour. As a result, the contract developed in the initial phase of a project can contain serious gaps and weaknesses, which will be used by the contractor for their benefit and incur losses for the project owner. To avoid this risk, project owners should define the conditions for the application of extra-contractual mechanisms to prevent contractors' opportunistic behaviour (Sanderson *et al.* 2015). Such mechanisms can include financial penalties and punishments for contractors in the case of failure to meet the terms of the contract.

This approach was found to be effective in the conditions of the contracting model's application for goods development. The central problem related to the adequate contracting management of goods development (mainly IT products) is that the outcomes of the contractor's work can be assessed only after the final result has been delivered for a long period of time (Sanderson *et al.* 2015). As a result, the project owner cannot assess the quality of the contractor's work during or directly after project realisation. In these conditions, extra-contractual mechanisms of contracting strategy development can become a useful tool for project owner's risk mitigation (Kapsali *et al.*

2019). These findings should be effectively applied in the process of the conceptual model development for the presented study.

As a result of the analysis of the agency and TCE theories in application to the chosen research problem, the researcher identifies the importance of paying specific attention to the procedure of contracting strategy development on the basis of the specific contracting model and effective integration of extra-contractual mechanisms for the mitigation of project owner's challenges. In this way, the parameter of the inclusion of extra-contractual mechanisms into the final contracting strategy is considered an important element integrated into the list of independent variables of the conceptual model of the study.

The final theoretical concept that the researcher finds useful for assessment is the relational contract theory. This theoretical concept is in some way related to the agency and the TCE theories, in which the customer also integrates into the conceptual framework of the study. The main idea of the relational contract theory is that an organisation's contracting strategy cannot consider all the potential challenges and risks to be solved in the context of the project. Therefore, the relationship between the contractor and the project owner is considered as a valuable resource in the process of successful project realisation (Diathesopoulos 2010). In these conditions, the objective of the contracting strategy is to include other forms of control over the project outcomes for the project owner to mitigate their risks. One form of risk mitigation that was discussed earlier is the application of extra-contractual mechanisms. At the same time, the relational contract theory states that project owners can impact the behaviour of the contractors to minimise challenges and avoid risks in the form of relational and reputational losses in case of opportunistic behaviour by the

contractors (Mouzas and Blois 2008). In this way, the effectiveness of the contracting model applied by the project owner should be assessed on the basis of discussion of the existing opportunities for the generation of reputational and relational losses and risks for the contractor in the case of improper realisation of their contract responsibilities and poor-quality project management.

3.2. Research strategy and conceptual framework

The results of the analysis of the chosen theoretical perspectives and their connection with the researcher's chosen problem facilitate the process of research strategy definition and development. In this way, the research strategy of the study is oriented on the analysis of the requirements to the contracting model that will allow the project owner to reach the highest level of efficiency in the cost benefits of the project management procedure. The specific requirements for the improvement of the EPCM contracting model to maximise the benefits of the project owners and other construction project stakeholders should be defined in the process of the study. According to these requirements for the research strategy and the identified theoretical concepts that should be included in the research procedure, the research strategy of the study is based on the quantitative research design and the questionnaire format of data collection attached in **Appendix 1**. The most important element of the research strategy, which should be coherent with the conceptual model of the study, is related to the integration of the chosen theoretical concepts into the questionnaire format for the researcher to identify the advantages and limitations of the EPCM contracting model application from the position of maximisation of costs benefits for the project owners and minimisation of associated risks.

In this way, the first theoretical concept that is integrated into the questionnaire format of the research strategy is the concept of resilience in project management. According to the results of the theoretical concept discussion in Chapter two, the realisation of a high level of project resilience should minimise future risks for the complex system in case of emergencies and unexpected situations. Minimisation of risks is also associated with the reduction of potential additional costs required for the project owners to overcome the negative impact of these risks. From such a perspective, the parameter of resilience should be considered as a basis for the assessment of the potential project outcomes if the project owner aims to apply the EPCM contracting model. In the context of the research strategy, it is important for the researcher to determine whether the existing format of the EPCM contracts can be applied to maximise the resilience level for the project outcomes, and the existing or improved EPCM contracting model should be integrated into the final EPCM guidelines for the management in the UAE oil and gas industry.

Another parameter that the research study will integrate into the research strategy is the level of extra-contractual mechanisms and relational mechanisms integration into the EPCM contracting model. In this way, it is important to establish whether the current EPCM contracting model practices in the Abu Dhabi oil and gas sector provide adequate opportunities for the application of the extra-contractual mechanisms and relational tools of control over the risks of contractors' opportunistic behaviour. It will also be important for the research study to establish whether the EPCM contracting model in the chosen industry and organisations contributes to the mitigation of the risks of opportunistic behaviour from the contractors. Without the analysis of this question, the final EPCM contracting model guidelines will lack relevance and reliability in the context of the chosen research problem. The research study aims to provide comprehensive recommendations for

the application of the extra-contractual mechanisms and relational tools of control over contractors' behaviour during the project realisation procedures and after the end of the project.

In the context of the resolution of the issue of extra-contractual mechanisms application in the Abu Dhabi oil and gas sector, it is also important for the researcher to assess the current level of information asymmetry and cognitive capacity of the project owners and other stakeholders engaged in the process of cooperation with the contractors. The objective of this element of the research strategy will be to gain a better understanding of the current situation in the sphere of the effectiveness of cognitive capacity utilisation and the level of information asymmetry common for project owners in the Abu Dhabi oil and gas sector. While the problems of information asymmetry and cognitive capacity limits can serve as a source of serious challenges in the process of contracting strategy development for the project owners, the objective of the research study is to identify the level of relevance of these issues, present relevant solutions to the project owners in the Abu Dhabi oil and gas sector and integrate the most effective solutions to these issues into the EPCM contracting model guidelines.

The research strategy of the study focuses on the collection and analysis of information from the Abu Dhabi oil and gas sector. In this way, the companies and employees operating in this sphere will be considered as a single source of information for the aim of the study. The study object is EPCM contracting model characteristics, which are defined as the characteristics of participants that should be engaged by and attracted to the study procedure. Target participants should obtain sufficient knowledge and experience in the field of the practice of EPCM contract application in the Abu Dhabi oil and gas sector. The data collection procedure will include the development of a

questionnaire on the Likert scale and the distribution of this questionnaire among project practitioners in the Abu Dhabi oil and gas sector. The orientation on this format of data collection is expected to contribute to the collection of the most relevant and reliable information about the key parameters of the cognitive study model for the aims of the research.

Prior to the organisation of the mentioned data collection procedure, the researcher will conduct a small-scale preliminary pilot study to assess the feasibility, duration and the number of questionnaires required. In this way, the results of the pilot study should help the researcher define the limitations of the chosen survey format and the needs for its improvement. The final questionnaire format is the basis of the data collection procedure for the researcher to apply in cooperation with the representatives of the Abu Dhabi oil and gas sector. The procedure of data analysis applied in the study includes utilisation of the SPSS statistical software instrument and orientation on the regression technique to identify the impact of the chosen variables in the conceptual model. On the basis of the results of regression analysis, the researcher gains useful insight and develops recommendations in the form of guidelines for the optimisation of the practice of EPCM contracting model application in the Abu Dhabi oil and gas sector. The SPSS mechanism is applied for the validation and verification of data and strategies, which are the result of the study.

3.3. Proposed conceptual framework

Based on discussion of the theoretical framework and specific theoretical concepts that can be included in the final conceptual framework, the final conceptual framework of the study is presented in Figure 5. In this context, it is important to consider the independent and dependent variables as the most important elements that define the potential outcomes of the research. The

choice of the independent variables affects the potential opportunities for the production of useful insights and recommendations in the context of the EPCM contracting model guidelines as the main product of the study. In this way, the researcher selects parameters that are considered the most useful for the improvement of the EPCM contracting model. Independent variables of the study include project bidding and contracting parameters, project information and management process, project legal and regulatory guidelines, project technical specifications, extra-contractual mechanisms, and the resilience parameter. Project bidding and contracting parameters are the elements of the conceptual model that are selected to assess the quality of the contracting procedures currently applied in negotiations in the Abu Dhabi oil and gas sector. The parameter of the project information and management process is applied to characterise the quality of project management procedures applied in the Abu Dhabi oil and gas sector. At the same time, this parameter characterises the variables of information asymmetry and cognitive capacity limitations, which are considered useful theoretical concepts. In the process of assessment of this parameter, the researcher aims to identify the level of cognitive capacity common for organisations in the Abu Dhabi oil and gas sector and the level of relevance of the information asymmetry issue in the chosen industry.

The project legal and regulatory parameters are applied for the assessment of the legal procedures and instruments applied in the process of contracting strategy development in the Abu Dhabi oil and gas sector. From the perspective of this parameter, it is important to understand whether the current legal procedures of contracting strategy development in the Abu Dhabi oil and gas sector provide a reliable basis for the minimisation of the risk of contractors' opportunistic behaviour. In the context of this study question, extra-contractual mechanisms of the contracting model in the

Abu Dhabi oil and gas sector are also considered in the conceptual framework. The final parameters of the conceptual model are the project technical specifications and resilience. From this perspective, the presented research estimates the role of the resilience parameter in the definition of technical specifications and requirements for the project. It is important to understand whether the management in the Abu Dhabi oil and gas sector pays proper attention to the parameter of resilience in the planning of heavy engineering construction projects. The main dependent variable of the study is the value of the contracting model application for the Abu Dhabi oil and gas sector. The main indicator of the generated value is the cost-benefit level. On the basis of the study findings, specific recommendations and guidelines will be provided.

To explain the key variables of the conceptual framework in more detail, the key definitions were provided in Table 1.

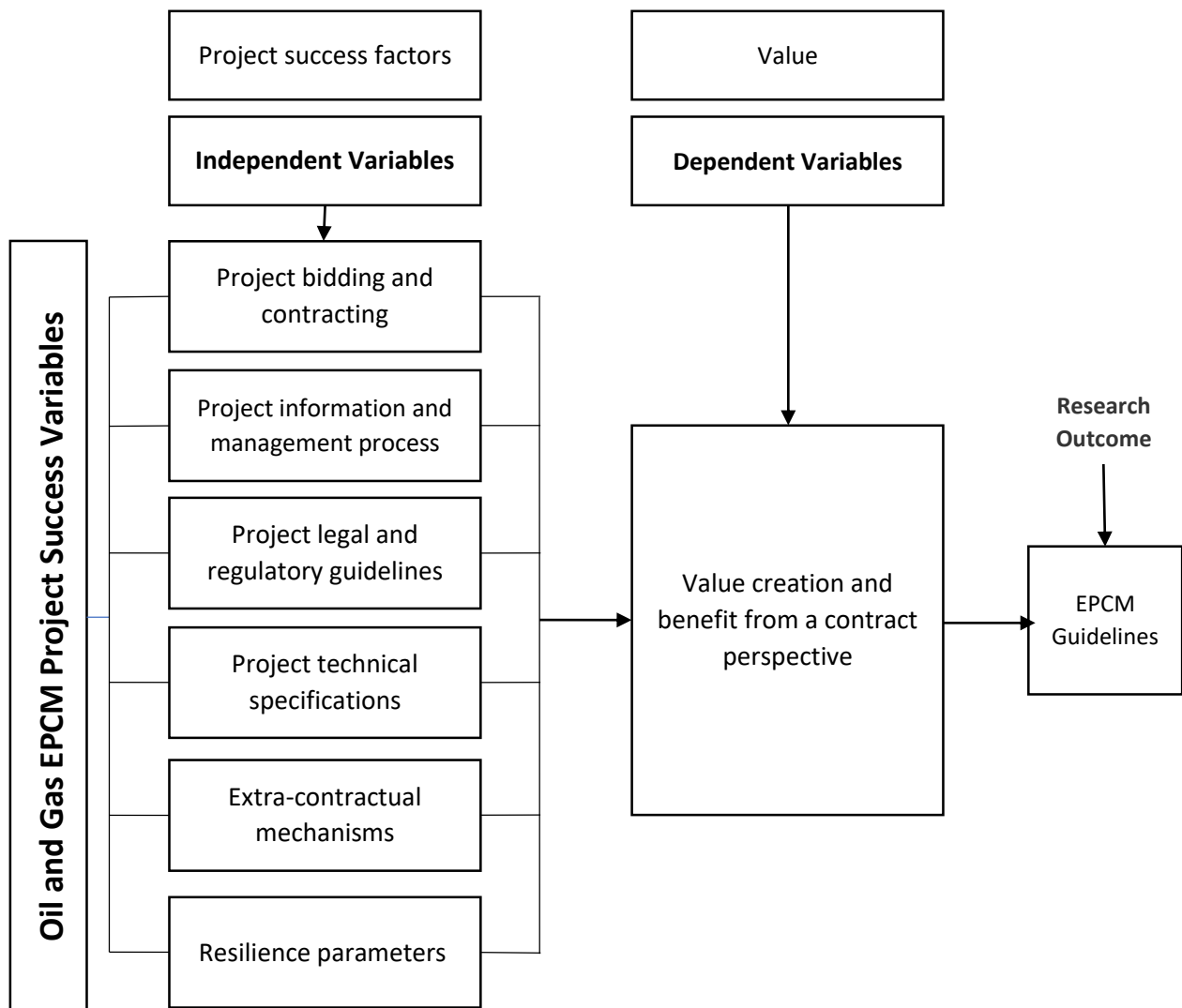


Figure 5: Proposed Conceptual Framework

Source: Author

Table 1 : Definitions of the Key Variables

Term	Definition	Citation
Project bidding and contracting	A process of project proposal submission by the contractor to the client to conduct or manage a specific project	Prajapati et al. (2015)
Project information and management process	Application of specific methods, skills, knowledge and experience to reach project realization criteria under the previously identified set of terms using the available information	Whyte and Levitt (2011)
Project legal and regulatory guidelines	Project management team's performance in adherence to the existing laws, regulations and guidelines relevant to the industry and business processes	Akhigbe et al. (2016)
Project technical specifications	A set of requirements to the technical characteristics and capabilities of the product that shall be created as an outcome of project management activities	Akhigbe et al. (2016)
Extra-contractual mechanisms	A set of methods applied by project owners to manage relations with the contractors in the way leading to successful project implementation, excluding the contractual management methods	Balaji and Brown (2010)
Resilience parameters	A set of parameters describing the project management team's capability of adopting to challenging and difficult conditions in the process of the project outcomes' realization	Southwick et al. (2014)
Value creation and benefit from a contract perspective	The realization of the expected project outcomes specified in the contract. Contracting sides determine the value they expect to achieve in the end of cooperation process.	Akhigbe et al. (2016)

3.4. Chapter summary

The presented chapter discussed the theoretical and conceptual framework of the study, which can be considered as the basis for the research planning procedure. First, the theoretical framework of the study was summarised. In the context of the research, scholars oriented on the discussion of the following theories were appraised: complex system theory (CST), agency theory, the transaction

costs economy (TCE) theory, and relational contract theory. Each of these theoretical concepts contributed to the definition of the final image of the study. The research methodology of the study was also considered, and the researcher presented the idea of orientation on the quantitative research methodology in order to realise the study objectives. Finally, the conceptual framework of the study was formulated. The proposed framework comprises the following variables: project bidding and contracting, project information and management process, project legal and regulatory guidelines, project technical specifications, extra-contractual mechanisms, and resilience parameter. The main dependent variables of the study are the value creation and benefit from the contract perspective, leading to the creation of EPCM guidelines. The proposed method for this study is examined in the next chapter.

CHAPTER FOUR: RESEARCH METHODOLOGY

4.0. Introduction

The overarching aim of the proposed study was to estimate the quality of the EPCM contracting model in the Abu Dhabi oil and gas sector, identify the existing issues and limitations in the contracting strategy development practice, and propose a set of guidelines that could be effectively applied to improve the EPCM contracting model application practice in the Abu Dhabi oil and gas sector. According to the defined objectives of the study, the research methodology included the quantitative research design and application of the questionnaire format of data collection. For the aim of data collection, project practitioners in the Abu Dhabi oil and gas sector were selected as study participants. The data analysis procedure was based on the application of the SPSS statistical software platform and the regression method of analysis of impact between the chosen statistical parameters.

4.1. Research background

As stated in the previous section, the objective of the presented study was to assess the utility and effectiveness of different contract management models applied in relation to the oil and gas sector construction projects in the UAE. For the purpose of analysis, two key construction models were selected – the engineering, procurement and construction management (EPCM) and the engineering, procurement and construction (EPC) contracts. In the conditions of the rising importance of the successful realisation of construction projects for successful competition in the global oil and gas industry, it was important to provide a reliable and science-based position about the advantages of the specific heavy engineering construction management model in relation to the

needs of target organisations. In the previous part of the study, the specific characteristics of the oil and gas industry in the UAE, EPC and EPCM construction models were discussed. On the basis of the performed analysis, it was possible to conclude that each of the contract management models had its specific advantages and limitations. Since the results of the literature review and analysis of the previous studies did not allow the researcher to solve the stated research problem, the proposed research method was developed to satisfy the research objectives and improve the researcher's knowledge in the field of heavy engineering construction contract management models.

4.2. Overview of the qualitative research method

The qualitative research methodology is grounded on the analysis of specific information that could not be quantitatively formalised and was collected from a small sample of study participants. Qualitative research methods allow the researcher to collect more detailed information about the specific subjects of the study and could be considered as the optimal approach to the analysis of narrow cases and problems engaging a limited number of objects. Qualitative research methods are most usually applied to analyse the behaviour and attitudes of individual respondents (Busetto *et al.* 2020). The following qualitative research methods are most usually applied: interviews, focus groups, case study research, record keeping and observations.

The main advantage of the qualitative research method is that it provided the researcher with the opportunity to collect data from the respondents about their personal opinions and perceptions about the problem under study. At the same time, the serious limitation of qualitative research is that it is mainly oriented on the collection of subjective data, giving limited opportunities for the

development of objective findings from the research (Busetto *et al.* 2020). In addition to this, the outcomes of qualitative study provide limited capabilities for generalisation of the study findings, which does not allow the researcher or practitioner to apply them in different practical conditions.

Altogether, the presented limitations were considered as the main argument against the application of qualitative research methods in this research. Orientation on the limited sample size was considered as inappropriate for the development of reliable and generalised outcomes of the study. Since the researcher aimed to develop insights and guidelines that could be applied in different organisations and in the industry in general, a quantitative research design was considered to be the optimal alternative.

Specific qualitative research methods that could be applied during the study included interviewing, case study analysis, secondary research, focus groups and open-ended surveys. The application of any of these methods would result in low opportunities for generalisation of the study findings. Also, orientation on any of these approaches to data collection and analysis could lead to higher risks of selection and subjective bias, which had to be minimised for the study outcomes. Altogether, the researcher decided to avoid the application of qualitative research methods to deliver reliable and generalised study findings on the issue of EPCM contracting model application.

4.3. Overview of the quantitative research method

The quantitative research method could be characterised as a systematic analysis of specific natural or social phenomena in the format of the collection of quantifiable, numerical data and realisation of statistical, mathematical and computational analysis of the collected data (Apuke 2017).

Application of the quantitative research design is related to the collection, utilisation and analysis of numerical data with the application of specific statistical analysis methods (Apuke 2017, p.41). The main characteristic of the quantitative research method is that it mainly deals with numerical, quantifiable data. At the same time, the quantitative research method contributes to the effective generalisation of study results for a larger population, which is an important advantage in the aspect of the analysis of mass social and natural events and objects.

The overview of the quantitative research method also included analysis of the key types of quantitative research methods and the discussion of the key advantages and limitations of this research design utilisation for the researcher. In regard to the key types of quantitative research methods, the following ones can be mentioned: survey research, correlational analysis, experimental research and causal-comparative research (Apuke 2017, p.43). The survey format of the quantitative study refers to the development of the questionnaire form and collection of primary information from the target population using this survey format. The research questionnaire is attached in **Appendix 1**. In the next phase of the study, statistical methods of data analysis are applied to the collected data. The correlational analysis method is applied to assess the existing level of connection between separate variables using the method of statistical analysis. The experimental method of quantitative study involves performing an experiment on the target population or the target object, the collection of quantitative data about the key characteristics of the experiment and its quantitative analysis. The causal-comparative analysis includes the definition of the causes that led to the specific outcome for the object of the study.

Altogether, the quantitative research method is characterised by a wide range of tools and opportunities for the collection and analysis of the research data. Nevertheless, it was important to consider the advantages and limitations of this research design prior to making the final decision about the research method for the present study. The quantitative research method has the following advantages: randomised character of the study sample, application of reliable and repeatable information, opportunities for generalisation of the study findings, anonymous and remote character of research, and the opportunity to apply the research data collection format to a larger sample size (Almeida *et al.* 2017). Obviously, the application of the quantitative research method was associated with substantial benefits for the researcher, making the research process simpler and potentially more productive. At the same time, it is associated with specific limitations: lack of opportunity to obtain additional details for specific questions, inability to control the quality of the answers, and the cost factor in the quantitative study organisation (Rahman 2017). Altogether, the quantitative research design gives no opportunity for the collection and analysis of qualitative data from the participants or more details for specific questions in case of the researcher's need. Nevertheless, the problem of cost management in a quantitative study was effectively solved in modern conditions using the instruments of new communication technologies.

4.4. Justification for using a quantitative research method

The selection of a quantitative research method was justified based on the discussion of the key elements of the research strategy and the comparison of quantitative and qualitative research methods. While the key characteristics of the quantitative research method have been presented earlier in this chapter, the key characteristics of the qualitative research design should be summarised. Compared to a quantitative study, the main objective of a qualitative study is to

understand and interpret social interactions (Yousaf 2012). The target population of a qualitative study is smaller compared to that of a quantitative study and is not randomly selected. Application of a qualitative research design does not allow the researcher to assess specific variables. The results of a qualitative study are quite subjective, and the data analysis procedure cannot be based on numerical data and statistical analysis methods (Yousaf 2012). While the results of the study are quite subjective, they are not effectively generalisable (Yousaf 2012). In these conditions, application of a qualitative research method could cause specific practical issues, where no large organisations or complex systems are assessed.

In the context of the present study, the objective was to assess the existing situation in the sphere of EPCM contracting model application for large construction projects in the Abu Dhabi oil and gas sector. The specifics of the research problem and the object of the study required the use of a large sample size and give an opportunity for generalisation of the study outcomes. Analysis of the situation existing in the sector required the researcher to focus on the position of a large number of participants, leaving limited opportunities for the effective collection of qualitative data using the instruments of qualitative research methods. In addition, the advantage of the quantitative research method is that it serves the aims of description, explanation and prediction of the performance of the studied object, while a qualitative study focuses on exploration, discovery and construction of the study object (Yousaf 2012). In the context of the stated research problem and objectives, application of a quantitative research method could be considered as a more effective and reliable decision in terms of the potential study outcomes.

4.5. Philosophical view of the research study

Prior to the development of the research strategy, the philosophical views of the researcher were summarised. The importance of the philosophical views can be explained by the fact that the procedure of research organisation and the development of implications are based on the philosophy that is followed by the researcher. In this way, the philosophical views of the researcher include the following elements: axiology, epistemology, ontology and phenomenology (Bryman 2016). The aspect of axiology served the purpose of presenting the values of the researcher during the study. In the present study, the researcher holds the following values: generalisability of the study findings; complex discussion of the stated research issue; inclusion of the widest range of positions on the stated research problem; inclusion and diversity of the study sample; and practical orientation of the study results and recommendations. The study procedure presents a complex and detailed analysis of the research problem and provides a reliable basis for decision-making.

Epistemology describes the relation between the explorer and the object of the study. This aspect of the study philosophy serves the objective of the definition of what is known to be true in the research (Bryman and Bell 2003). For the present study, epistemology includes knowledge about the existing theories and practices of contracting strategy development, relationship between the contractors and project owners, and different aspects of opportunities and risks for project management. The epistemology of the study includes the key findings from the analysis of academic literature and relevant theories.

Ontology is an element of the researcher's philosophy that constitutes the key characteristics of a scientific fact that can be included in the research for the aims of analysis and results development

(Bryman 2016). From this perspective, ontology is considered as a system of beliefs that constitutes the key characteristics of the fact (Saunders *et al.* 2009). In the context of the study, the following characteristics constitute a scientific fact: the statement of the study participant in the questionnaire and statements in academic literature sources published in authorised academic journals. The phenomenology of the study includes statements of the study participants that were based on their experience of contracting strategy development and management (Bryman 2016). In this way, the studied phenomena include any type of statement about the quality and characteristics of the research problem in the studied organisations. From this perspective, the positions of the study participants were assessed without their comparison with the external or physical reality.

4.6. Research approach

The final question that should be considered in this section of the research is the difference between the inductive and deductive approaches in research organisation. The main characteristic of the inductive approach to the study process is that the researcher moves from specific empirical observations for the definition of the general theory, which is a basis of the scholarly knowledge. As for the deductive approach, it supposes the movement of the researcher from the specified theory to the definition of concrete empirical facts or arguments that should support the existing knowledge or lead to the definition of new ideas in science (Woiceshyn and Daellenbach 2018). In the case of the presented study, since the final theory that could be applied for understanding the role of the EPCM contracting model in the development of project management in the Abu Dhabi oil and gas sector was not yet developed, it was sensible to apply an inductive approach to the study process. Such an approach guaranteed effective collection of empirical facts that describe the field

of study and allowed the researcher to incorporate specific empirical findings into the theoretical model, which could be applied for the development of new knowledge.

4.7. Research strategy

The research strategy is based on an inductive and pragmatic approach. The main idea of the inductivism paradigm in research is that new knowledge is generated inductively from observations (Woiceshyn and Daellenbach 2018). As for the pragmatic approach to the study organisation, it involved application of the method that was the most common to the research problem (Iluah and Eaton 2013). In the context of the study, the principle of inductivism was implemented as the final study findings were based on the results of the questionnaire analysis, so only empirical observations were considered as the basis for study results and implications development. In terms of the pragmatic approach, the researcher applied only the most useful tools and instruments of data collection and analysis. A focus on the questionnaire format of data collection was found to be optimal from the position of the collection of primary and generalisable data for the aims of the study. As for the methods of data analysis, statistical analysis using SPSS software and regression method of analysis was found to be most useful and effective for the aims of the research.

4.8. Pilot study

For the purpose of optimisation of the questionnaire form as one of the key instruments of data collection, a pilot study with a small group of target participants who worked in the Abu Dhabi oil and gas sector was performed. Within the context of this study, the objective of carrying out a pilot study was to assess the quality of the developed questionnaire format and its optimisation and improvement for the aims of the final study organisation. The researcher aimed to assess the

consistency of the questionnaire in target audience's perception and to estimate the potential respondents' ability to understand the main survey questions unambiguously. The format of the pilot study supposed the direct communication with the pilot study participants during the period of the survey questions' review. The researcher asked the pilot study respondents about their understanding of the specific question to estimate the risk of misinterpretations. In case if the scholar found that the concrete question was interpreted by the respondents in the way different from the initial survey objectives, this question would have been carefully considered together with the respondents to determine the form of question that would have delivered the meaning that was initially supposed by the scholar.

The pilot study participants included a small group of five employees from different organisations in the Abu Dhabi oil and gas sector. It is worth mentioning that these participants comprised representatives of different companies and departments, whose work was related to the application of the EPCM contracting model in construction project management. The procedure of participant selection included the target search of participants via the LinkedIn social network. The study participants were asked to fill in the main questionnaire form as if they were taking part in the study and a short additional questionnaire in the form of feedback about the quality of the survey procedure.

The findings from the second short questionnaire were applied by the researcher to assess the quality of the developed questionnaire form and improve it for better participant feedback. The outcomes of the pilot study demonstrated that the major part of initially developed questions were clear for the respondents, and their perception of these questions' meaning was similar to the initial

objectives set for these questions by the author. For small part of the questions, differences between the respondents' perception and the scholar's intentions were found. For each of such cases, the researcher carefully discussed the initial question objective with the audience to identify the question format that would have led to the proper understanding of the raised theme among the potential respondents. Each of the questions that caused misinterpretation was carefully reviewed and rewritten according to the insights provided by the study respondents. The use of such a format of pilot study result assessment guaranteed reduced pressure on the pilot study participants and their readiness to cooperate in such a format. Also, the scholar minimized the risk of misinterpretations among respondents during the study, which could lead to false responses and misleading outcomes of the study.

4.9. Sample study

The structure of the Abu Dhabi oil and gas sector was assessed. In this way, the target population for the study included employees and contractors operating in the Abu Dhabi oil and gas sector. Among the leading players in this sphere in Abu Dhabi, the Abu Dhabi National Oil Company (ADNOC) was considered as a key case study for this research along with its contractors. To define the required sample size for the study, it was important to understand the overall level of the target population that was potentially included in the study process. To achieve the study objectives, it was sensible to focus on the analysis of the positions of the senior management at ADNOC since this category of participants hold useful information and competencies that can be utilised by the researcher to formulate guidelines for the proposed study.

It was vital to present the overall value of a number of employees in the ADNOC and define the number of senior management employees in the organisation. According to the relevant statistics, the overall number of employees at ADNOC was approximately 55,000 (ADNOC 2020). At the same time, this number could not be applied to define the overall level of the target population in the study. At this stage of the study, it was quite difficult to define the number of senior management representatives in the organisation using official statistics. At the same time, the indirect information from the official publications of the organisation made it possible for the researcher to identify the potential number of employees at ADNOC. According to a recent publication of the organisation on its LinkedIn account, approximately 700 senior managers took part in the discussion of the company's strategic priorities for 2030.

As a consequence, the researcher accepted the assumption that the overall number of management employees at the ADNOC company was equal to approximately 700 people. This number could be applied in the context of the Krejcie and Morgan (1970) sample size determination method. The idea of this method is that the researcher compares the overall number of potential study participants with the defined standards of sample size in the Krejcie and Morgan (1970) sample size determination table. The sample size standards are presented in Table 2. According to the results of the application of the chosen method for establishing the required sample size, the presented study had to include a minimum number of 248 participants. The number of responses collected from the participants was equal to 303. In the context of the characteristics of the target population, the chosen sample size was expected to guarantee a high level of reliability and relevance for the study results for the aims of providing recommendations and developing insights.

The definition of the sample for the study also included assessment of the pilot study outcomes. The results of the pilot study demonstrated the high efficiency and relevance of the selected survey questions. All the members of the pilot study sample successfully finished the survey form without specific challenges or the need for additional explanation of the questions. The findings of the pilot study demonstrated the reliability of the applied survey form and opportunities for its utilisation in the end data collection procedure.

Table 2: Krejcie and Morgan's Table

N	S	N	S	N	S
10	10	220	140	1200	291
15	14	230	144	1300	297
20	19	240	148	1400	302
25	24	250	152	1500	306
30	28	260	155	1600	310
35	32	270	159	1700	313
40	36	280	162	1800	317
45	40	290	165	1900	320
50	44	300	169	2000	322
55	48	320	175	2200	327
60	52	340	181	2400	331
65	56	360	186	2600	335
70	59	380	191	2800	338
75	63	400	196	3000	341
80	66	420	201	3500	346
85	70	440	205	4000	351
90	73	460	210	4500	354
95	76	480	214	5000	357
100	80	500	217	6000	361
110	86	550	226	7000	364
120	92	600	234	8000	367
130	97	650	242	9000	368

140	103	700	248	10000	370
150	108	750	254	15000	375
160	113	800	260	20000	377
170	118	850	265	30000	379
180	123	900	269	40000	380
190	127	950	274	50000	381
200	132	1000	278	75000	382
210	136	1100	285	1000000	384

Source: Krejcie and Morgan (1970)

4.10. Sampling strategy

One of the important elements of the data collection procedure and research in general is the development and realisation of an effective sampling strategy. The procedure of the sampling strategy development includes the following elements: definition of the target population, identification of the accessible population, identification of the eligibility criteria for the targeted sample, development and realisation of the sampling plan (Taherdoost 2016). As for the first element of the sampling strategy, the defined target population included the senior management of the ADNOC Company in Abu Dhabi. The choice of the senior management as the target population of the study was explained by the fact that this category of employees in the Abu Dhabi oil and gas sector is provided with the most useful and reliable information about the research problem. Hence, the collection of this data could contribute to the realisation of the study objectives.

The definition of the value of the accessible population included assessment of the overall level of senior management in the organisation using indirect methods of assessment and the definition of the required sample size using Krejcie and Morgan's (1970) sample size determination method. On the basis of the analysis of the target population, the required sample size included 248 senior management representatives in the chosen organisation and the Abu Dhabi oil and gas sector. In the next phase of the sampling strategy development, the eligibility criteria were identified. For the purpose of this study, the following eligibility criteria were used: first, the study participants should have relevant experience in the sphere of contracting strategy management in their business organisation. Second, they should occupy senior management positions in an organisation that is a part of the Abu Dhabi oil and gas sector. Third, the sample size should have equal numbers of participants of different genders.

One of the important elements of the sampling strategy was the development of the sampling plan. The researcher intended to utilise the following methods for sample participant selection and attraction: search and selection via LinkedIn social network and direct cooperation with the senior management in the chosen business organisation in the Abu Dhabi oil and gas sector. The application of the social network instrument in the process of participant selection and attraction was an effective solution because it allows the researcher to apply specific instruments for the search and selection of the participants, reducing time expenses for the selection of the target population. The participant recruitment procedure included initial communication with them via LinkedIn or other official communication networks, delivery of the consent form to them and collection of agreement from them. Altogether, the sampling strategy guaranteed the high quality of the final result in the form of attraction of the most useful sources of primary information.

4.11. Ethical considerations of the research

In the context of the study, the researcher had to collect primary quantitative information from the study participants, mainly the management of the construction projects in the UAE oil and gas sector of the economy. As a result, a set of ethical norms for the research were followed. First, it was important to guarantee the anonymous status of the study participants and avoid mentioning their names in the study procedure or during the presentation of the final report with the results of the study. Each study participant was provided with clear and detailed guarantees that participation in the study would not inflict any harm on them. The interests of the study participants should not have been jeopardised as a result of their decision to participate in the study. Finally, to guarantee that the data collection procedure complies with the ethical research norms, the researcher provided the study participants with the consent forms, informing them about the objectives and procedures of the study. Each participant was required to confirm that they had been given information about the study format and to sign a consent form as a demonstration of their willingness to be part of the research study.

4.12. Data collection methods used

Primary data about the effectiveness of different contract management models in the UAE was collected. Surveys were used to collect participants' views about the effectiveness of different contracting models, the role of the contracting model in effective project management, existing issues in the sphere of the contracting policy development and challenges related to the realisation of complex contracting projects. It was important to define the position of study participants about key characteristics and limitations of existing contracting models applied in their organisations. Quantitative data that presented the position of the study participants about existing specifics and

issues in the contracting model of the organisation was collected during the study. This information provided a reliable basis for the assessment of the quality of the contracting model and the development of recommendations for future practice.

As was stated earlier in the research design section of the thesis, the method of data collection that was selected for the aims of the study was questionnaire analysis. This method was chosen mainly due to the fact it allowed the researcher to collect and analyse information from a large number of participants and guarantees high opportunities for generalisation of study outcomes. Together with this, the questionnaire analysis format allowed the researcher and study participants to simplify the process of data collection, performing it in an online format. The procedure of questionnaire completion and results collection was performed in an online format, using Google Forms software application. This instrument allows researchers to develop questionnaire forms online and distribute them among study participants using special links. At the end of the data collection process, the researcher receives the final results in a structured form and might not have spent additional time in processing the results. As a result, the data collection procedure was expected to take about 10-15 minutes for each participant, and the researcher was able to receive results from questionnaires without additional expenses of time and other resources.

For the aims of the study, the data collection procedure first answered the question about the means of data collection and participant selection. For this aim, the researcher selected and attracted the study participants using the social network platform LinkedIn. Using this resource, it was possible to select and find potential participants using information about the personal and professional characteristics of the network users. The researcher selected and accessed the potential study

participants using communication instruments of the LinkedIn social network. Each study participant received a consent form to study and fill in, providing his/her official agreement for participation in the study. The consent form included information about the terms of participation in the study. The next step of data collection included the distribution of links to the online questionnaire among the study participants via LinkedIn. Each participant was provided with a special link that would send him/her to the online questionnaire form, which he/she had to complete during a period of one week. The researcher provided participants with enough time to fill out the survey form at any time and place they found most comfortable for themselves. In the final stage of data collection, the researcher received the completed forms and primary results of the statistical analysis of participants' responses performed by Google Forms software.

Steps taken in collecting secondary data

Specific methods were also applied for the collection of secondary data for the aims of the research study. Secondary sources of data for the research mainly included academic papers and official documents of the organisations operating in the oil & gas sector of Abu Dhabi. To collect these sources of information, it was important first to identify the criteria for selection of specific papers. The following criteria were applied: high relevance of the papers (each source had to be published within the last 10 years); reliability of the source and correlation with the research problem – each paper had to be published in a respected journal or database, and the contents of the article had to correlate with the objectives of the research. Following the definition of the key criteria for literature sources of secondary data, specific sources of data collection had to be considered. They had to include reliable academic journals and databases that contained articles relevant to the theme of contracting model development.

The most important step in the selection of secondary data sources was to develop the initial sample of sources that would be further analysed. For this aim, the researcher applied search engines existing in databases and journals, applying a set of search keywords. The following keywords were applied: EPCM contracting model; EPC contracting model; project management; oil and gas sector; energy sector. On the basis of the initial search, a high sample of articles was defined. Following the definition of the initial sample, a smaller set of sources was developed using the means of title and abstract analysis. On the basis of this step, the least relevant sources were excluded. On the basis of the described sequence of steps, the final sample of secondary data sources was determined.

4.13. Data analysis

A statistical analysis procedure was applied in this study. The software platform utilised for data analysis was SPSS software. It allowed the researcher to import the results of the primary data collection in the questionnaire form using the numerical format of statistical data. As for the method of data analysis, the regression method was used. It is an effective instrument for the assessment of the impact between the chosen parameters of the study that were mentioned in the conceptual model of the research. As a result, the researcher aimed to apply the regression method of statistical analysis for the assessment of the existing level of impact between dependent and independent variables of the study on the basis of the primary statistical information. The results of the data analysis were transformed into numerical or graphical form.

4.14. Validation and verification

The final element of the proposed research method was to validate and verify the findings of the study. The procedure of validation and verification of the study results was a quantitative format,

which included the following components: identification of the usefulness of the study method and results in relation to the chosen research problem; identification of the impact of the chosen research method for the generation of the required usefulness; and determining whether the usefulness of the chosen study method is beyond the specific case study. In this way, the chosen validation and verification approach allowed the research to demonstrate that the adopted research method was appropriate for the generalisation of study outcomes. The findings of the validation and verification analysis are presented in Chapter seven.

The procedure of validation and verification of the research methodology included assessment of the quality of methodology by the focus group of researchers engaged in the chosen sphere of the study. Responsible independent experts were used provide an assessment of the research method's validity and reliability in the context of the chosen research problem. As for the requirement for the generalisation of the study outcomes using the chosen research method, the procedure of assessment included the estimation of the study results and key recommendations by senior management representatives in the Abu Dhabi oil and gas sector.

Another aspect of the research methodology that had to be addressed included the selection of the survey data reliability assessment approach. The most usually applied model of reliability assessment for the collected survey data includes the Cronbach's alpha measurement. In the current study, the researcher applied the inter-rater reliability assessment method, comparing the results of survey data collection for selected groups of respondents. The advantage of this approach was that it allowed an author to estimate the compared similarities and differences in the vision of the survey

questions among the respondents. The researcher compared the results collected from different companies, managers operating in different departments and sectors.

4.15. Chapter summary

The researcher has provided information about the research background, key research problem and the objectives of the study. Along with the presentation of the relevant information about the study objectives, the key characteristics of the qualitative and quantitative research methods as the main approaches to the organisation of the research procedure have been summarised. The application of the quantitative research method was found to be the most effective and common decision in the conditions of the stated research problem and research objectives due to the opportunities for analysis of a large sample size and generalisation of the study findings. The research strategy, pilot study, sampling strategy, data collection, analysis, validation, verification, and reliability have been examined.

CHAPTER FIVE: QUANTITATIVE ANALYSIS AND FINDINGS OF THE STUDY

5.0. Introduction

The previous sections of the thesis contributed to the definition of the general context of the study, the summarisation of the literature findings, the definition of the theoretical framework of the research, and the presentation of the specific research methods applied in the study. This chapter of the thesis presents and summarises the results of the quantitative data collection and analysis. Moreover, it was important to present the demographic characteristics of the population taking part in the study and to discuss the findings of the data collection and analysis. The discussion of the specific findings of the research was based on the resolution of the earlier-defined objectives and questions of the study. This chapter of the thesis presents the outcomes of the data collection and analysis in the context of the research methods specified in the previous chapter. The data collection and analysis procedure was divided into several sections in order to simplify the process of learning about the study outcomes for the audience.

Firstly, it was important to consider the demographic characteristics of the study sample to develop a complex understanding of its quality. It was imperative to show that the study respondents presented a diversified group of specialists who could provide reliable and relevant positions on the stated questions of the survey. The quality of the sample's demographics impacted the reliability of the study findings and the opportunities for the generalisation of the study outcomes. The following section of this chapter presents the specific findings of the data collection process.

The discussion of the data collection outcomes took place in the format of realisation of the key study objectives. For each of the stated objectives of the research, specific data collection and analysis methods were applied, contributing to the realisation of the optimal result and resolution of the stated objective. After the summarisation of the data collection procedure results, the following section of the chapter addresses the question about the outcomes of data analysis during the research. In this way, it was important to define key findings of the study in the format of resolution of the stated research questions. For each of the six study questions, specific data analysis instruments were applied, and the specific findings were highlighted. The results of this chapter include the presentation and summarisation of the key study findings in the context of the previously identified research questions and objectives. This chapter serve as a basis for the discussion of the study results and the development of theoretical and practical recommendations in the following chapters of the thesis.

5.1. Demographics

Before the demonstration of the specific outcomes of data collection and analysis, it is important to present demographic characteristics of the study sample, which allowed the researcher to conclude the overall level of the sample's relevance and reliability. In the context of the survey analysis procedure, the following elements of the respondents' demographics were considered: work location, region/nationality, gender, age, years of work experience, education level, job position and level, skills and competencies, and marital status. For each of the stated parameters, the data analysis findings should be considered.

5.1.1. Work location

In the context of the assessment of the study respondents' work location, seven potential options were provided, similar to the number of Emirates in the UAE; however, focusing on the known emirates for oil and gas, and paying further attention to the specific region of Abu Dhabi Emirate, which is the UAE hub for oil production. Study respondents had to identify one specific Emirate/region as the location of their workplace: Al Dhafra, Al Ain, Abu Dhabi, Dubai, Sharjah, Ras Al Khaimah and Fujairah. The outcomes of sample distribution by this parameter are presented in Table 3. According to the results of the demographics analysis, the majority of the study respondents (206 people or 68% of the sample) came from the Abu Dhabi Emirate. Nevertheless, a significant number of respondents also came from the Al Dhafra region (86 people or 28.4% of the sample) which is part of the Emirate of Abu Dhabi. Therefore, senior management of the oil and gas organisation from two parts of the UAE was represented, together with a small number of employees from other regions of the UAE.

Table 3: Work location demographics

		Frequency	%	Valid %	Cumulative %
Valid	Al Dhafra	86	28.4	28.4	28.4
	Abu Dhabi	206	68.0	68.0	96.4
	Dubai	8	2.6	2.6	99.0
	Sharjah	3	1.0	1.0	100.0
	Total	303	100.0	100.0	

5.1.2. Region/nationality

The following demographic characteristic applied during the study was the region of the respondents' origin or their nationality. The outcomes of data analysis for this parameter are summarised in **Table 4**. According to the sample analysis outcomes, the majority of the respondents

(181 people or 59.7% of the sample) came from the Middle East region. A high number of study respondents also came from Asia (104 respondents or 34.3% of the sample). Thus, a small number of executives from Africa took part in the study. The distribution of the study sample mainly represented the experience of the oil and gas executives who had experience of working and living in the Middle East region, guaranteeing homogeneity of the sample's vision of the study questions.

Table 4: Region/nationality demographics

		Frequency	%	Valid %	Cumulative %
Valid	Middle East	181	59.7	59.7	59.7
	Africa	9	3.0	3.0	62.7
	Europe	9	3.0	3.0	65.7
	Asia	104	34.3	34.3	100.0
	Total	303	100.0	100.0	

5.1.3. Gender

An important element in the description of the study sample is related to the assessment of the respondents' gender. To guarantee the high reliability and validity of the study outcomes, it was important to provide conditions for gender equality in the formation of the sample. Executives of different genders could provide interesting insights into the problem under study could affect the study outcomes. The summary of demographic data analysis for the parameter of gender is presented in **Table 5**. According to the data analysis findings, the majority of the study sample (298 respondents or 98.3% of the sample) represented male executives of the company. Such a distribution of the sample can be explained by the fact that the majority of executive positions in the chosen company were held by male employees. In the context of the study, the researcher was limited with this objective condition, and so was unable to maximise the potential level of the sample's gender diversity.

Table 5: Gender demographics

		Frequency	%	Valid %	Cumulative %
Valid	Male	298	98.3	98.3	98.3
	Female	5	1.7	1.7	100.0
Total		303	100.0	100.0	

5.1.4. Age

Analysis of the age characteristic of the sample also played an essential role in the definition of the potential representative power of the chosen respondents. It is important to guarantee equal distribution of the sample by the parameter of age. Such a condition should guarantee high-quality representation of the sample's positions, together with the discussion of positions of the executives from different age groups. While the factor of age is also directly associated with the previous working experience, the engagement of younger categories of executives is important to define innovative ideas that might contribute to the general understanding of the study questions. A summary of demographic analysis for the parameter of age is provided in **Table 6**. According to the demographic analysis findings, equal shares of the study population were aged 31-39 years (41.6% of the sample) and 40-49 years (42.2% of the sample). A certain share of the sample also represented executives aged 50-59 years (12.9% of the sample). Finally, the shares of the youngest and oldest categories were considerably low. Therefore, the presented sample was mainly based on the positions of executives with moderate to high levels of working and life experience, which still contributed to the high reliability of the study outcomes.

Table 6: Age demographics

		Frequency	%	Valid %	Cumulative %
Valid	30 or less	7	2.3	2.3	2.3
	31-39	126	41.6	41.6	43.9
	40-49	128	42.2	42.2	86.1
	50-59	39	12.9	12.9	99.0
	60 or more	3	1.0	1.0	100.0
	Total	303	100.0	100.0	

5.1.5. Years of work experience

The following demographic parameter of the sample focused on years of work experience for the study participants. In this context, it was important to understand whether the majority of the study sample had obtained a sufficient level of work experience that would guarantee the reliability and validity of the study outcomes. The summary of analysis outcomes is presented in Table 7. According to the findings of the analysis, the majority of the sample (89.1% of the sample) was represented by executives of the oil and gas organisation with more than 11 years of experience in their chosen position. Such a result is an argument for the high validity and reliability of the sample. While, for the previous characteristics of the sample's demographics, the factor of equal representation was important in the sample, here the prevalence of respondents with the highest level of work experience was an essential factor in the assessment of the sample's quality.

Table 7: Years of work experience demographics

		Frequency	%	Valid %	Cumulative %
Valid	1 or less	2	.7	.7	.7
	From 2-4	3	1.0	1.0	1.7
	From 5-7	5	1.7	1.7	3.3
	From 8-10	23	7.6	7.6	10.9
	11 or more	270	89.1	89.1	100.0
	Total	303	100.0	100.0	

5.1.6. Education level

It was important to form a sample that would include the majority of people with a sufficient education level, which would allow them to form a high-quality and reliable position concerning the study questions. The results of the data analysis for this parameter are summarised in **Table 8**. The highest shares of the sample were represented by executives with Master's (34% of the sample) and Bachelor's (58.1% of the sample) education levels. Respondents with a PhD or Diploma made up only a small proportion of study respondents.

Table 8: Education level demographics

		Frequency	%	Valid %	Cumulative %
Valid	PhD	7	2.3	2.3	2.3
	Master	103	34.0	34.0	36.3
	Bachelor	176	58.1	58.1	94.4
	Diploma	17	5.6	5.6	100.0
Total		303	100.0	100.0	

5.1.7. Job position and level

The following parameter of the sample's demographics served for the assessment of the job position and level of the study respondents. It was important to guarantee equal distribution of the sample for the specific executive positions for the study. Such a result guaranteed a fair representation of the positions and arguments from the executives specialising in different aspects of contract management in the company. The results of the sample's analysis for this parameter are presented in Table 9. The highest share of the study respondents (57.1% of the sample) was represented by project engineers, which served as a strong argument for the validity of the study sample in the aspect of the EPCM contract model-specific discussion. Therefore, high shares of project managers (23.8% of the sample) and technical managers (11.2% of the sample) were

engaged during the study. The low number of respondents from the procurement and contract management departments could be considered as a specific limitation of the study since these elements of the contract management process are also important for the assessment of the general effectiveness of the EPCM model.

Table 9: Job position and level demographics

		Frequency	%	Valid %	Cumulative %
Valid	Project Manager	72	23.8	23.8	23.8
	Technical Manager	34	11.2	11.2	35.0
	Procurement Manager	7	2.3	2.3	37.3
	Contract Manager	17	5.6	5.6	42.9
	Project Engineer	173	57.1	57.1	100.0
	Total	303	100.0	100.0	

5.1.8. Skills and competencies

A separate aspect of the sample analysis represented the distribution of the respondents' skills and competencies. The results of the sample analysis are presented in Table 10. According to the analysis findings, the majority of the study sample (293 respondents or 96.7%) represented executives with technical skills. Such a distribution of the sample guaranteed the high-quality assessment of the EPCM model as an instrument of technical aspects management in the modern construction projects for the oil and gas industry. Nevertheless, the lack of interest from executives with human relations skills could lead to low attention to the question of human relations management during the contracting process.

Table 10: Skills and competencies demographics

		Frequency	%	Valid %	Cumulative %
Valid	Technical Skills	293	96.7	96.7	96.7
	Human Relation Skills	10	3.3	3.3	100.0
	Total	303	100.0	100.0	

The findings of the analysis performed on the demographic information demonstrated a high level of the sample population's quality and reliability for the stated objectives of the research. In the case where a high level of diversity in the representation of respondents' characteristics was required, a sufficient result was demonstrated. Thus, the represented sample could be considered as a reliable basis for the development of the study results and outcome formation.

5.2. Data collection tools

This section of the study discusses the key results of the data collection process for the specific objectives stated during the study (as specified in Chapter one). For each of the research objectives, specific data collection tools were applied, together with the demonstration of the specific findings. This section of the research is divided into a number of sub-sections, each of them addressing the specific research objectives with reliable primary data from the survey analysis outcomes.

5.2.1. Objective 1: Analyse and compare the characteristics of the EPCM and EPC contract models

The first objective of the study was to analyse and compare the characteristics of the EPCM and EPC contract models to identify key theoretical and practical differences between these models of contract organisation. The following research problem was addressed in the format of the literature review and did not presuppose the application of quantitative research methods.

To describe the difference between EPC and EPCM contracting models, the key characteristic of each approach is summarised. In the context of the EPC contracting model application, the basic idea of the partnership for the realisation of a specific project is that the contractor takes all responsibility for the success of the project, and the project owner is mainly removed from the

process of decision-making (Priede 2017). All the functions of the project owner under such a model of cooperation include the monitoring of the current progress, the definition of the potential risk factors, and the negotiation with the contractor to develop the optimal strategy that would minimise risks and challenges in the future (DLA Piper 2018; Picha *et al.* 2015). The functions of decision-making and project completion are concentrated in the hands of the contractor, together with the responsibility of problem removal in the case of failure (Galloway 2009). While such a model seems to provide high guarantees for the project owner, the case of failure is not properly regulated. Even if the contractor is forced to remove problems after project completion, the parameters of final quality and the schedule for the project are under question.

If compared to the format applied under the EPC contract model, the EPCM approach presupposes a different format of responsibility and power distribution between the project owner and the contractors. In the context of the EPCM approach, the project owner might not be capable of performing initial planning and engineering of the construction project independently, and the whole process is performed with cooperation between the project owner and the contractors (Singh & Tiwari 2015). While the EPC model concentrated power and decision-making authority in the hands of the contractor, the EPCM model gives the general influence on the processes to the project owner, allowing this actor to form an independent pool of contractors, which would include specialists with competencies required by the project owner (PwC 2016). The project owner is capable of performing general management and control functions, removing lags in the assessment of risks and their prevention (Wai *et al.* 2012). According to the findings of the theoretical aspects' comparison for both contracting models, each of them has specific strong and weak sides, which should be considered in the context of the end-user's needs.

The comparison of practical aspects of both methods' application was based on the assessment of benefits and risks faced by practical users of the EPC and the EPCM models. Among the practical risks of the EPCM model application, the following were identified during the study: process guarantee, potential cost-ineffectiveness, open budget, and potential procrastination of the contractor (Singh and Tiwari 2015). The process guarantees issue is caused by the potential lack of project owner experience in the construction project, and the ability of the contractor to make decisions without proper control. The cost ineffectiveness of the EPCM model could take place if the compensation for the contractor's work is performed on an hourly basis. Finally, open budget and procrastination challenges are caused by the absence of strict formal regulation of the relationship between the contractor and the project owner, which can cause improper usage of the available resources by the contractors (Too and Weaver 2014). Therefore, the success of the EPCM model application seems to be dependent on the proper utilisation of the available resources by the project owner. Without adequate competencies and skills, the project owner might be a victim of ineffective contractor performance.

When compared to the practical outcomes of the EPCM model application, the following risks were identified for the EPC contracts: the absence of control over project management for the owner, quality risks, and high risks of mistakes caused by the significant influence of a contractor on the project (Singh and Tiwari 2015). The fact that the contractor has the ultimate influence means that the project owner is completely dependent on the contractor's decisions, which is not an option for modern large construction projects (Ventroux *et al.* 2017). Moreover, cost and schedule fixation issues could lead to unexpected risks in an uncontrolled environment. Future contracting models should be much more flexible and adaptive to environmental factors, and the

EPC model lacks these qualities. From the analysis, it was found that both methods of contracting have specific limitations and barriers to their active and efficient usage in the chosen sphere of practice. Large oil and gas construction projects in the UAE should be dependent on more flexible and adaptive methods, with a diversified model of responsibilities distribution between the project owner and the contractors (Wembe 2015). The following parameters were defined as the main sources of difference between EPC and the EPCM contracts: the project owner's level of responsibility, the contractor's level of responsibility, the level of severity of the contract terms, and the details of the description of the final result.

5.2.2. Objective 2: Benefits of the EPCM contracting model for project management

The second objective of the study addressed the question about the role of specific benefits of the EPCM contracting model for project management and the methods of realising the discussed benefits. To implement the stated objective of the research, it was important first to consider the specific categories of the benefits created by the EPCM model for the senior management of the company. In the context of the literature review, a set of benefit criteria was applied in the questionnaire, including the following: shorter bidding time, standardised work packages, fast-track schedule through the alignment of procurement and work packages, optimised material procurement cost, controlled project cost, the adoption of new technologies, mark-up cost on material and execution are almost removed, controlled change orders, trust among different project parties, as well as faster system completion achievement with client involvement. For all the stated criteria, a specific section of the study questionnaire was developed, and a summary of the respondents' responses is provided in Table 11 to 20.

From the data presented in Table 11 to 20, the relevance of each specific category of benefits from the realisation of the EPCM contracting model was developed. In this way, for the criterion of the ‘reduced bidding time due to the application of the EPCM model’, 210 respondents (69.4%) of the sample agreed that the benefit was extremely or very important for the success of construction projects in the oil and gas industry. For the criterion of ‘standardised work packages realisation’, 249 respondents (82.2%) of the sample expressed the extreme or high importance of this benefit generated by the realisation of the EPCM contract model. The fast-track schedule alignment result was considered as extremely or very important as a result of the EPCM model realisation by 267 respondents (88.1%) of the sample.

Optimised material procurement cost as a category of benefit was considered as extremely or very important by 278 respondents (91.7%) of the sample. Controlled project cost result as an outcome of the EPCM model application was considered as extremely important or very important by 284 respondents (93.8%) of the sample. The adoption of new technologies as a result of the EPCM model application was found to be an extremely or very important benefit by 251 respondents (82.8%) of the sample. The mark-up costs removal was regarded as an extremely important or very important benefit of the EPCM model application by 225 respondents (74.3%) of the sample. The controlled change order outcome of the EPCM model utilisation was estimated as an extremely or very important outcome by 263 respondents (86.8%) of the sample. Trust among project parties as an outcome of the EPCM model utilisation was regarded as an extremely or very important outcome by 276 respondents (91.1%) of the sample. Finally, faster system completion as an outcome of the EPCM model utilisation was considered as an extremely or very important outcome of the chosen contracting model application by 285 respondents (94%) of the sample.

Table 11 : Shorter bidding time

		Frequency	%	Valid %	Cumulative %
Valid	Extremely Important	125	41.3	41.3	41.3
	Very Important	85	28.1	28.1	69.3
	Somewhat Important	42	13.9	13.9	83.2
	Neutral	41	13.5	13.5	96.7
	Somewhat Unimportant	7	2.3	2.3	99.0
	Very Unimportant	2	.7	.7	99.7
	Extremely Unimportant	1	.3	.3	100.0
	Total	303	100.0	100.0	

Table 12: Standardised work packages

		Frequency	%	Valid %	Cumulative %
Valid	Extremely Important	157	51.8	51.8	51.8
	Very Important	92	30.4	30.4	82.2
	Somewhat Important	43	14.2	14.2	96.4
	Neutral	8	2.6	2.6	99.0
	Somewhat Unimportant	2	.7	.7	99.7
	Very Unimportant	1	.3	.3	100.0
	Total	303	100.0	100.0	

Table 13: Fast-track schedule alignment

		Frequency	%	Valid %	Cumulative %
Valid	Extremely Important	161	53.1	53.1	53.1
	Very Important	106	35.0	35.0	88.1
	Somewhat Important	25	8.3	8.3	96.4
	Neutral	8	2.6	2.6	99.0
	Somewhat Unimportant	3	1.0	1.0	100.0
	Total	303	100.0	100.0	

Table 14: Optimised material procurement cost

		Frequency	%	Valid %	Cumulative %
Valid	Extremely Important	174	57.4	57.4	57.4
	Very Important	104	34.3	34.3	91.7
	Somewhat Important	17	5.6	5.6	97.4
	Neutral	7	2.3	2.3	99.7
	Somewhat Unimportant	1	.3	.3	100.0
	Total	303	100.0	100.0	

Table 15: Controlled project cost

		Frequency	%	Valid %	Cumulative %
Valid	Extremely Important	179	59.1	59.1	59.1
	Very Important	105	34.7	34.7	93.7
	Somewhat Important	13	4.3	4.3	98.0
	Neutral	6	2.0	2.0	100.0
	Total	303	100.0	100.0	

Table 16: Adoption of new technologies

		Frequency	%	Valid %	Cumulative %
Valid	Extremely Important	137	45.2	45.2	45.2
	Very Important	114	37.6	37.6	82.8
	Somewhat Important	46	15.2	15.2	98.0
	Neutral	5	1.7	1.7	99.7
	Somewhat Unimportant	1	.3	.3	100.0
	Total	303	100.0	100.0	

Table 17 : Mark-up costs removal

		Frequency	%	Valid %	Cumulative %
Valid	Extremely Important	135	44.6	44.6	44.6
	Very Important	90	29.7	29.7	74.3
	Somewhat Important	30	9.9	9.9	84.2
	Neutral	41	13.5	13.5	97.7
	Somewhat Unimportant	3	1.0	1.0	98.7
	Very Unimportant	3	1.0	1.0	99.7
	Extremely Unimportant	1	.3	.3	100.0
	Total	303	100.0	100.0	

Table 18 : Controlled change orders

		Frequency	%	Valid %	Cumulative %
Valid	Extremely Important	149	49.2	49.2	49.2
	Very Important	114	37.6	37.6	86.8
	Somewhat Important	21	6.9	6.9	93.7
	Neutral	18	5.9	5.9	99.7
	Extremely Unimportant	1	.3	.3	100.0
	Total	303	100.0	100.0	

Table 19: Trust among project parties

		Frequency	%	Valid %	Cumulative %
Valid	Extremely Important	173	57.1	57.1	57.1
	Very Important	103	34.0	34.0	91.1
	Somewhat Important	18	5.9	5.9	97.0
	Neutral	9	3.0	3.0	100.0
	Total	303	100.0	100.0	

Table 20 : Faster system completion

		Frequency	%	Valid %	Cumulative %
Valid	Extremely Important	194	64.0	64.0	64.0
	Very Important	91	30.0	30.0	94.1
	Somewhat Important	15	5.0	5.0	99.0
	Neutral	3	1.0	1.0	100.0
	Total	303	100.0	100.0	

The results of comparison of the data collection outcomes for the stated benefits of the EPCM contracting model application demonstrated that the study respondents highly assessed the role of each category of benefits for the future success of construction projects in the oil and gas sector. Nevertheless, among the list of specified benefits, the following factors should be highlighted: fast-track schedule alignment, optimised material procurement cost, controlled project cost, trust among project parties, and faster system completion. All these categories of benefits were considered as extremely or very important by more than 90% of the sample.

The first part of the stated study objective was addressed in the presentation of the key categories of the EPCM model's benefits for project management. The second part of the study objective was related to the definition of means that could be applied by senior management in the Abu Dhabi oil and gas sector to implement the stated benefits of the EPCM contracting model. For the realisation of the second part of the stated study objective, it was important to analyse key determinants of the EPCM model application in project management and assess the existing connection between the determinants and the outcome in the form of realisation of the specific EPCM model benefits. The following categories of determinants of the EPCM model application were identified during the study: project bid and contracting, technical specifications and capabilities, project information and process management, as well as legal and regulatory framework. Therefore, specific variables of

the study included extra-contractual measures and resilience parameters. These categories of determinants of the EPCM model application's effectiveness were compared to the benefits of the EPCM model in the context of correlation analysis. The findings of correlation analysis are presented in **Table 21**.

In the context of the realisation of the stated objective of the study, it was imperative to compare correlation ratios for the dependent variable and all other parameters of the correlation analysis. In this way, the highest levels of correlation were identified for the dependent variable and the following parameters: project information and process management, legal and regulatory framework, technical specifications, and capabilities. This finding of the study implied that, to identify optimal solutions for the maximisation of the organisational benefits of project management in the oil and gas sector, it is important to concentrate on the analysis of the stated categories of the EPCM model determinants. Moreover, management should focus on the search for optimal solutions in the fields of project information and process management, legal and regulatory framework, technical specifications, and capabilities to reach optimal outcomes of project management using the EPCM contracting model.

Table 21: Correlation analysis

		Project Bid and Contracting	Project Information and Process Management	Legal and Regulatory Framework	Technical Specifications and Capabilities	Extra-Contractual Measures	Resilience Parameters	Dependent Variable: Value Benefit Realisation in the Contract of EPCM	Independent Variable: (Success)
Project Bid and Contracting	Pearson Correlation	1	.645**	.570**	.651**	.605**	.569**	.575**	.730**
	Sig. (2-tailed)		.000	.000	.000	.000	.000	.000	.000
	N	303	303	303	303	303	303	303	303
Project Information and Process Management	Pearson Correlation	.645**	1	.813**	.824**	.716**	.634**	.665**	.897**
	Sig. (2-tailed)	.000		.000	.000	.000	.000	.000	.000
	N	303	303	303	303	303	303	303	303
Legal and Regulatory Framework	Pearson Correlation	.570**	.813**	1	.795**	.711**	.596**	.674**	.858**
	Sig. (2-tailed)	.000	.000		.000	.000	.000	.000	.000
	N	303	303	303	303	303	303	303	303
Technical Specifications and Capabilities	Pearson Correlation	.651**	.824**	.795**	1	.816**	.676**	.750**	.921**
	Sig. (2-tailed)	.000	.000	.000		.000	.000	.000	.000
	N	303	303	303	303	303	303	303	303
Extra-Contractual Measures	Pearson Correlation	.605**	.716**	.711**	.816**	1	.751**	.810**	.915**
	Sig. (2-tailed)	.000	.000	.000	.000		.000	.000	.000
	N	303	303	303	303	303	303	303	303
Resilience Parameters	Pearson Correlation	.569**	.634**	.596**	.676**	.751**	1	.834**	.829**
	Sig. (2-tailed)	.000	.000	.000	.000	.000		.000	.000
	N	303	303	303	303	303	303	303	303
Dependent Variable: Value Benefit Realisation in the Contract of EPCM	Pearson Correlation	.575**	.665**	.674**	.750**	.810**	.834**	1	.845**
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000		.000
	N	303	303	303	303	303	303	303	303
Independent Variable: (Success)	Pearson Correlation	.730**	.897**	.858**	.921**	.915**	.829**	.845**	1
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	
	N	303	303	303	303	303	303	303	303

** . Correlation is significant at the 0.01 level (2-tailed).

5.2.3. Objective 3: Achievement of cost-effectiveness through the adoption of the EPCM model

The third objective of the study aimed to address the question about the means of cost-effective result realisation through the usage of the EPCM contracting model. In the context of the stated objective, it was imperative to analyse the relationship between the specific characteristics of the EPCM contracting approach and the potential result in the form of cost-effectiveness achievement. For the realisation of the stated objective, a questionnaire data collection instrument was applied. Firstly, it is important to present the findings of data collection that represented the relevance of the EPCM model application for the realisation of the cost-effectiveness result. For this aim, part of the information from Table 11 to 20 was applied, specifically the information about the benefits related to the cost-effectiveness of project management. Among the 10 specific benefits identified, a number were relevant to the theme of cost-effectiveness: optimised material procurement cost, controlled project cost, and removal of mark-up cost on material and execution. Other categories of benefits that were considered as contributing to the realisation of the cost-effective outcomes for the project management team were not considered in the context of the stated objective, since the potential impact of these parameters for the cost-effective result would be indirect. Thus, it was difficult to identify direct connections between the dependent and independent variables of the study.

Similar to the previous objective of the study, the instrument of correlation analysis was applied to identify the correlation between the dependent variables, specific categories of the EPCM benefits, and the categories of the EPCM determinants (see Table 22). For this aim, the integrated assessments for the independent variables of the study were applied. All the results of respondents'

scoring for separate categories of determinants were summed up, and the integrated estimate for each specific category of the determinants was developed. In the context of correlational analysis, specific benefits of the EPCM model related to cost-effectiveness results were compared to the integrated assessments of the determinants of the EPCM. The results of the correlation analysis are presented in Table 22.

According to the results of the correlation analysis, a weak connection between separate benefits of the EPCM model related to cost-effectiveness and the determinants of the EPCM model application could be identified. Among the key determinants of the EPCM model application, a strong correlation could be identified only for the parameter of technical specifications and capabilities. To provide a more detailed analysis of the relationship between concrete determinants of the EPCM model application and the realisation of benefits in the form of cost-effectiveness of the EPCM, a regression analysis instrument was utilised. Each category of benefit associated with the cost-effectiveness of the EPCM model application was considered separately. Outcomes of regression analysis for the parameter of optimised material procurement cost are presented in Table 23. Together with the results for the initial regression model, the findings of regression analysis for the model that excluded the parameter of the legal and regulatory framework as the least significant independent factor in the initial regression model are summarised in Table 24. The findings of the regression analysis demonstrated that, for the realisation of the optimised material procurement, cost-benefit could be mainly associated with specific activities in the spheres of project bid and contracting, project information and process management, technical specifications, and capabilities. Thus, senior project practitioners need to emphasise the specified elements of the EPCM contracting model application for the realisation of the optimal result

Table 22: Correlation analysis

		Value benefit realisation in the contract of EPCM 4	Value benefit realisation in the contract of EPCM 5	Value benefit realisation in the contract of EPCM 7
Project Bid and Contracting	Pearson Correlation	,522**	,403**	,344**
	Sig. (2-tailed)	,000	,000	,000
	N	303	303	303
Project Information and Process Management	Pearson Correlation	,525**	,552**	,446**
	Sig. (2-tailed)	,000	,000	,000
	N	303	303	303
Legal and Regulatory Framework	Pearson Correlation	,519**	,517**	,459**
	Sig. (2-tailed)	,000	,000	,000
	N	303	303	303
Technical Specifications and Capabilities	Pearson Correlation	,618**	,604**	,517**
	Sig. (2-tailed)	,000	,000	,000
	N	303	303	303
Extra-Contractual Measures	Pearson Correlation	,715**	,618**	,647**
	Sig. (2-tailed)	,000	,000	,000
	N	303	303	303
Resilience Parameters	Pearson Correlation	,662**	,573**	,705**
	Sig. (2-tailed)	,000	,000	,000
	N	303	303	303
Value Benefit Realisation in the Contract of EPCM 4	Pearson Correlation	1	,739**	,576**
	Sig. (2-tailed)		,000	,000
	N	303	303	303
Value Benefit Realisation in the Contract of EPCM 5	Pearson Correlation	,739**	1	,516**
	Sig. (2-tailed)	,000		,000
	N	303	303	303
Value Benefit Realisation in the Contract of EPCM 7	Pearson Correlation	,576**	,516**	1
	Sig. (2-tailed)	,000	,000	
	N	303	303	303

**. Correlation is significant at the 0.01 level (2-tailed).

Table 23: Optimised material procurement cost regression analysis 1

Model summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,746 ^a	,557	,548	,49453

a. Predictors: (Constant), Resilience Parameters, Project Bid and Contracting, Legal and Regulatory Framework, Extra-Contractual Measures, Project Information and Process Management, Technical Specifications, and Capabilities

Coefficients ^a						
Model		Unstandardised Coefficients		Standardised Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-,154	,112		-1,375	,170
	Project Bid and Contracting	,037	,018	,110	2,036	,043
	Project Information and Process Management	-,013	,009	-,110	-1,390	,165
	Legal and Regulatory Framework	-,003	,014	-,017	-,231	,818
	Technical Specifications and Capabilities	,015	,014	,092	1,057	,292
	Extra-Contractual Measures	,046	,008	,461	6,023	,000
	Resilience Parameters	,038	,009	,272	4,483	,000

a. Dependent Variable: Value Benefit Realisation in the Contract of EPCM 4

Table 24: Optimised material procurement cost regression analysis 2

Model summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,746 ^a	,557	,549	,49374

a. Predictors: (Constant), Resilience Parameters, Project Bid and Contracting, Project Information and Process Management, Extra-Contractual Measures, Technical Specifications and Capabilities

Coefficients ^a						
Model		Unstandardised Coefficients		Standardised Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-,156	,111		-1,404	,161
	Project Bid and Contracting	,037	,018	,110	2,044	,042
	Project Information and Process Management	-,014	,008	-,119	-1,663	,097
	Technical Specifications and Capabilities	,014	,014	,087	1,033	,302
	Extra-Contractual Measures	,046	,008	,458	6,052	,000
	Resilience Parameters	,038	,009	,272	4,492	,000

a. Dependent Variable: Value Benefit Realisation in the Contract of EPCM 4

A similar approach to the organisation of the regression analysis procedure was applied for the benefits of the controlled project cost and the removal of mark-up cost on material and execution. Firstly, the initial regression model that united all the independent variables of the study was developed for the benefit of controlled project cost (see Table 25). The analysis of the *adjusted R square* parameter and the *t* ratios for the key parameters of the regression model demonstrated the low quality of the regression and the irrelevance of the presented model of independent variables for the description of changes in the dependent parameter.

To improve the quality of the solution, an alternative regression model was developed (see Table 26). This model excluded the parameters of project bid and contracting, legal and regulatory framework as the least reliable in the context of the dependent parameter. The results of the regression model definition showed low improvements in the aspect of the general reliability of the scheme and opportunities for the generalisation of the study findings. Nevertheless, it was demonstrated that, for the realisation of the specific practical results in the aspect of controlled project cost, the management of large oil and gas projects in the UAE should focus on the determinants of project information and process management, together with technical specifications and capabilities. Furthermore, it is worth mentioning that the activities in these aspects of project management should allow the leadership of the selected oil and gas organisation and other companies to succeed with large construction projects using the EPCM model of contracting.

The final aspect of the stated research objective was to analyse the connection between the determinants of the EPCM model application and the benefit of removal of mark-up cost on

material and execution. In a similar format, a general regression model including all the parameters of the study was developed (see Table 27). According to the results of the analysis of the *R square* parameter and the *t* ratio, the quality of the presented regression model is under serious question. Low representative power and negative *t* ratio results for the key determinants of the EPCM model application showed that a major part of determinants should be removed from the final model. Moreover, specific attention should be paid to the parameters of the project bid and contracting, project information and process management, technical specification, and capabilities.

An improved regression model that excluded all the stated parameters was developed and is presented in Table 28. According to the presented results of the regression analysis, the parameter of the legal and regulatory framework should not be considered as reliable for the definition of the potential impact on the benefit of the removal of mark-up cost on material and execution. This fact meant that neither of the selected determinants of the EPCM model's effectiveness could be applied in order to influence the realisation of this specific format of benefit. The only determinants that should be considered in the context of the realisation of the benefit of the removal of mark-up cost on material and execution were extra-contractual measures and resilience parameters.

Table 25: Controlled project cost regression analysis 1

Model summary				
Model	R	R square	Adjusted R square	Std. error of the estimate
1	,661 ^a	,437	,426	,51182

a. Predictors: (Constant), Resilience Parameters, Project Bid and Contracting, Legal and Regulatory Framework, Extra-Contractual Measures, Project Information and Process Management, Technical Specifications, and Capabilities

Coefficients ^a					
Model		Unstandardised coefficients		Standardised coefficients	Sig.
		B	Std. Error	Beta	
1	(Constant)	,015	,116		,129
	Project Bid and Contracting	-,027	,019	-,085	,160
	Project Information and Process Management	,013	,010	,121	,176
	Legal and Regulatory Framework	-,003	,015	-,017	,837
	Technical Specifications and Capabilities	,033	,015	,220	,026
	Extra-Contractual Measures	,023	,008	,254	,003
	Resilience Parameters	,028	,009	,215	,002

a. Dependent Variable: Value Benefit Realisation in the Contract of EPCM 5

Table 26 : Controlled project cost regression analysis 2

Model Summary				
Model	R	R square	Adjusted R square	Std. error of the estimate
1	,658 ^a	,433	,426	,51183

a. Predictors: (Constant), Resilience Parameters, Project Information and Process Management, Extra-Contractual Measures, Technical Specifications and Capabilities

Coefficients ^a						
Model		Unstandardised coefficients		Standardised coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-,023	,113		-,202	,840
	Project Information and Process Management	,010	,009	,089	1,129	,260
	Technical Specifications and Capabilities	,029	,014	,195	2,080	,038
	Extra-Contractual Measures	,022	,008	,244	2,865	,004
	Resilience Parameters	,026	,009	,201	2,973	,003

a. Dependent Variable: Value Benefit Realisation in the Contract of EPCM 5

Table 27 : Removal of mark-up cost on material and execution regression analysis 1

Model Summary				
Model	R	R square	Adjusted R square	Std. error of the estimate
1	,741 ^a	,550	,541	,80774

a. Predictors: (Constant), Resilience Parameters, Project Bid and Contracting, Legal and Regulatory Framework, Extra-Contractual Measures, Project Information and Process Management, Technical Specifications, and Capabilities

Coefficients ^a						
Model		Unstandardised coefficients		Standardised coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-,129	,183		-,707	,480
	Project Bid and Contracting	-,080	,030	-,146	-2,692	,008
	Project Information and Process Management	-,018	,015	-,091	-1,135	,257
	Legal and Regulatory Framework	,012	,024	,036	,491	,624
	Technical Specifications and Capabilities	-,007	,023	-,027	-,313	,755
	Extra-Contractual Measures	,061	,012	,378	4,899	,000
	Resilience Parameters	,128	,014	,559	9,152	,000

a. Dependent Variable: Value Benefit Realisation in the Contract of EPCM 7

Table 28 : Removal of mark-up cost on material and execution regression analysis 2

Model Summary

Model	R	R square	Adjusted R square	Std. error of the estimate
1	,729 ^a	,531	,526	,82046

a. Predictors: (Constant), Resilience Parameters, Legal and Regulatory Framework, Extra-Contractual Measures

Coefficients^a

Model	Unstandardised coefficients		Standardised coefficients	t	Sig.
	B	Std. Error	Beta		
1 (Constant)	-,381	,170		-2,239	,026
Legal and Regulatory Framework	-,022	,018	-,067	-1,185	,237
Extra-Contractual Measures	,050	,011	,311	4,500	,000
Resilience Parameters	,117	,014	,511	8,455	,000

a. Dependent Variable: Value Benefit Realisation in the Contract of EPCM 7

The results of the performed data collection and analysis demonstrated that the specific recommendations could be delivered for the realisation of the following benefits – optimised material procurement cost and controlled project cost. For the outcome of optimised material procurement cost, the following aspects of the EPCM model application should be targeted: project bid and contracting, project information and process management, technical specifications, and capabilities. For the result of controlled project cost, it was important to emphasise project information and process management, as well as technical specifications and capabilities. In terms of the benefit of the removal of mark-up cost on material and execution, no practical findings and recommendations could be provided based on the outcomes of data collection. For all of the stated benefits related to the cost-effectiveness of the project, parameters of the extra-contractual measures and resilience parameters were found to play a significant positive role.

5.2.4. Objective 4: Identification of the key categories of risks associated with the EPCM model

The following objective of the study was related to the identification of the key categories of risks existing for the practical application of the EPCM contracting model, and the proposition of the specific practical methods of their mitigation. To address this specific objective, a logically complicated model of the solution was proposed. Firstly, the instrument of regression analysis was applied to estimate the role of the key categories of EPCM model determinants for the realisation of the stated benefits of the EPCM. In the following step of data collection and analysis, it was important to demonstrate what specific aspects of the main determinants of success in the application of the EPCM model should be monitored by the management of corporations. The

discussion of the question from this perspective contributed to the identification of the key sources of risk for project management in the UAE oil and gas industry.

The outcomes of regression analysis for the key determinants and benefits of the EPCM model application are summarised in Table 29. The outcomes of the assessment of the general quality of the regression model demonstrated a high *R square* level, which is an indicator of the high reliability of the selected regression model and opportunities for the generalisation of the findings. For the specific determinants of the regression model, the t-statistic parameter was compared. According to the findings of the performed analysis, the most important determinants of benefit in the application of the EPCM model were legal and regulatory framework, together with technical specifications and capabilities, extra-contractual measures, and resilience parameters. From this perspective, it was imperative to concentrate on the definition of the most important parameters in these four groups of determinants to identify the most significant sources of risk for the project management team that aimed to apply the EPCM contracting model. The data describing the key parameters of the legal and regulatory framework of the EPCM model application was summarised. For this aim, the descriptive statistics method was applied to summarise the positions of study respondents concerning each specific element of the legal and regulatory framework determinant for the EPCM model. The findings of descriptive statistics application are presented in Table 30 to 45. The presentation of the findings of these descriptive statistics should demonstrate what specific elements of legal and regulatory framework determinants of the EPCM model application were considered vital by the project management in the Abu Dhabi oil and gas sector.

Table 29 : Regression analysis

Model Summary				
Model	R	R square	Adjusted R square	Std. error of the estimate
1	.887 ^a	.787	.782	3.61136

a. Predictors: (Constant), Resilience Parameters, Project Bid and Contracting, Legal and Regulatory Framework, Extra-Contractual Measures, Project Information and Process Management, Technical Specifications, and Capabilities

Coefficients ^a						
Model		Unstandardised coefficients		Standardised coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-1.211	.819		-1.479	.140
	Project Bid and Contracting	.021	.133	.006	.161	.872
	Project Information and Process Management	-.086	.069	-.069	-1.253	.211
	Legal and Regulatory Framework	.243	.106	.115	2.295	.022
	Technical Specifications and Capabilities	.246	.104	.143	2.366	.019
	Extra-Contractual Measures	.301	.055	.287	5.417	.000
	Resilience Parameters	.734	.063	.493	11.736	.000

a. Dependent Variable: Dependent Variable: Value Benefit Realisation in the Contract of EPCM

The key criterion applied for the comparison of the importance of each specific parameter of the legal and regulatory framework was the total number of the share of respondents' responses that identified the specific parameter as extremely or very important. For the parameter of work packaging design and subcontracting, the total number of respondents who considered this parameter as extremely or very important was equal to 290 respondents (95.7% of the sample). For the parameter of change orders, permits, and show drawings' submission and approval, the total number of respondents who considered this parameter as extremely or very important was equal to 292 respondents (96.4% of the sample). For the parameter of the schedule of engineering, procurement and construction, and approval of completed tasks, the total number of respondents who considered this parameter as extremely or very important was equal to 299 respondents (98.7% of the sample). For the parameter of company standard operating procedures, the total number of respondents who regarded this parameter as extremely or very important was equal to 285 respondents (96% of the sample). For the parameter of government auditing protocols and procedures, the total number of respondents who considered this parameter as extremely or very important was equal to 276 people (91.1% of the sample).

For the parameter of experience with local laws and other government regulations and modification in laws and regulations, the total number of respondents who regarded this parameter as extremely or very important was equal to 271 respondents (89.4% of the sample). For the parameter of experience with building codes, by-laws, statutes and other government regulations definition of projects boundaries at an early stage of the project, the total number of respondents who considered this parameter as extremely or very important was equal 281 respondents (91.7% of the sample). For the parameter of system completion requirements, the total number of respondents who

considered this parameter as extremely or very important was equal to 287 respondents (94.8% of the sample). Based on a comparison of the specific results of descriptive statistics for the key parameters of legal and regulatory framework, all the identified determinants of the EPCM model application were found to be of great significance based on the positions of the majority of respondents. The results of the descriptive statistics showed that all the identified elements of the legal and regulatory framework determinant could serve as a serious source of risk for the successful realisation of the EPCM contracting model in large construction projects in the oil and gas sector of Abu Dhabi. Moreover, specific risk mitigation solutions should be identified based on the chosen determinants of the legal and regulatory framework for the EPCM contracting model.

Table 30 : Work packaging design and subcontracting

		Frequency	%	Valid %	Cumulative %
Valid	Extremely Important	204	67.3	67.3	67.3
	Very Important	86	28.4	28.4	95.7
	Somewhat Important	10	3.3	3.3	99.0
	Neutral	3	1.0	1.0	100.0
	Total	303	100.0	100.0	

Table 31 : Change orders, permits, and show drawings' submission and approval

		Frequency	%	Valid %	Cumulative %
Valid	Extremely Important	180	59.4	59.4	59.4
	Very Important	112	37.0	37.0	96.4
	Somewhat Important	10	3.3	3.3	99.7
	Neutral	1	.3	.3	100.0
	Total	303	100.0	100.0	

Table 32: Schedule of engineering, procurement and construction, and approval of completed tasks

		Frequency	%	Valid %	Cumulative %
Valid	Extremely Important	200	66.0	66.0	66.0
	Very Important	99	32.7	32.7	98.7
	Somewhat Important	3	1.0	1.0	99.7
	Neutral	1	.3	.3	100.0
	Total	303	100.0	100.0	

Table 33 : Company standard operating procedures

		Frequency	%	Valid %	Cumulative %
Valid	Extremely Important	171	56.4	56.4	56.4
	Very Important	114	37.6	37.6	94.1
	Somewhat Important	16	5.3	5.3	99.3
	Neutral	2	.7	.7	100.0
	Total	303	100.0	100.0	

Table 34 : Government auditing protocols and procedures

		Frequency	%	Valid %	Cumulative %
Valid	Extremely Important	132	43.6	43.6	43.6
	Very Important	144	47.5	47.5	91.1
	Somewhat Important	19	6.3	6.3	97.4
	Neutral	8	2.6	2.6	100.0
	Total	303	100.0	100.0	

Table 35 : Experience with local laws and other government regulations and modification in laws and regulations

		Frequency	%	Valid %	Cumulative %
Valid	Extremely Important	148	48.8	48.8	48.8
	Very Important	123	40.6	40.6	89.4
	Somewhat Important	26	8.6	8.6	98.0
	Neutral	6	2.0	2.0	100.0
	Total	303	100.0	100.0	

Table 36 : Experience with building codes, by-laws, statutes and other government regulations definition of projects boundaries at an early stage of the project

		Frequency	%	Valid %	Cumulative %
Valid	Extremely Important	137	45.2	45.2	45.2
	Very Important	141	46.5	46.5	91.7
	Somewhat Important	20	6.6	6.6	98.3
	Neutral	4	1.3	1.3	99.7
	Somewhat Unimportant	1	.3	.3	100.0
	Total	303	100.0	100.0	

Table 37 : System completion requirements

		Frequency	%	Valid %	Cumulative %
Valid	Extremely Important	175	57.8	57.8	57.8
	Very Important	112	37.0	37.0	94.7
	Somewhat Important	10	3.3	3.3	98.0
	Neutral	6	2.0	2.0	100.0
	Total	303	100.0	100.0	

The next category of the EPCM contracting model determinants that was considered vital for the success of the EPCM model application was technical specifications and capabilities. Similar to the previous category of determinants, descriptive statistics analysis was performed (see Table 38 to 46). It was important to identify specific parameters of technical specifications and capabilities that could be considered as vital for the success of the EPCM model, failures in which could be regarded as key sources of risk for the project in general. Similar to the previous section of descriptive statistics collection, the findings for the extremely important and very important assessments were provided. For the parameter of alignment among work breakdown structure (WBS), contracting work breakdown structure (CWBS), cost breakdown structure (CBS), and organisation breakdown structure (OBS), the total number of respondents who considered this parameter as extremely or very important was equal to 278 respondents (91.7% of the sample). For the parameter of the project cost estimate, the total number of respondents who considered this parameter as extremely or very important was equal to 294 respondents (97.1% of the sample). For the parameter of project construction schedule, cost and quality, the total number of respondents who regarded this parameter as extremely or very important was equal to 298 respondents (98.5% of the sample). For the parameter of experience of the project teams, the total number of respondents who considered this parameter as extremely or very important was equal to 296 respondents (97.7% of the sample).

For the parameter of knowledge on new technological techniques and materials, the total number of respondents who considered this parameter as extremely or very important was equal to 269 respondents (88.8% of the sample). For the parameter of environmental circumstances, climate and local weather conditions, the total number of respondents who regarded this parameter as extremely

or very important was equal to 242 respondents (79.9% of the sample). For the parameter of knowledge of site circumstances by the project team members, the total number of respondents who considered this parameter as extremely or very important was equal to 271 respondents (89.4% of the sample). For the parameter of accurate work drawings and specifications, the total number of respondents who regarded the following parameter as extremely or very important was equal to 299 respondents (98.7% of the sample).

For the parameter of materials and labour availability and cost, the total number of respondents who considered this parameter as extremely or very important was equal to 290 respondents (95.7% of the sample). For the parameter of geotechnical circumstances, the total number of respondents who regarded this parameter as extremely or very important was equal to 270 people (89.1% of the sample). Similar to the previous determinant of the EPCM model application, all the parameters demonstrated a high level of significance for the success of the project management, as was stated by the study respondents. This fact means that all the stated parameters of technical specifications and capabilities were considered as sources of risk in the case of poor management in current project processes. The important characteristic of this group of EPCM model determinants was that they were dependent on the performance of the project team. A single group of determinants that could be considered as independent from the influence of the project team included environmental circumstances, climate and local weather conditions, as well as geotechnical circumstances. For these categories of risks, specific attention and the most accurate management approach should be applied. From the position of management, it is important to monitor and control these sources of risk, predict potential losses, and offer efficient mitigation strategies.

Table 38 : Alignment among work breakdown structure (WBS), contracting work breakdown structure (CWBS), cost breakdown structure (CBS), and organisation breakdown structure (OBS)

		Frequency	%	Valid %	Cumulative %
Valid	Extremely Important	181	59.7	59.7	59.7
	Very Important	97	32.0	32.0	91.7
	Somewhat Important	18	5.9	5.9	97.7
	Neutral	7	2.3	2.3	100.0
	Total	303	100.0	100.0	

Table 39: Project cost estimate

		Frequency	%	Valid %	Cumulative %
Valid	Extremely Important	199	65.7	65.7	65.7
	Very Important	95	31.4	31.4	97.0
	Somewhat Important	3	1.0	1.0	98.0
	Neutral	6	2.0	2.0	100.0
	Total	303	100.0	100.0	

Table 40 : Project construction schedule, cost and quality

		Frequency	%	Valid %	Cumulative %
Valid	Extremely Important	217	71.6	71.6	71.6
	Very Important	81	26.7	26.7	98.3
	Somewhat Important	2	.7	.7	99.0
	Neutral	3	1.0	1.0	100.0
	Total	303	100.0	100.0	

Table 41 : Experience of the project teams

		Frequency	%	Valid %	Cumulative %
Valid	Extremely Important	199	65.7	65.7	65.7
	Very Important	97	32.0	32.0	97.7
	Somewhat Important	5	1.7	1.7	99.3
	Neutral	2	.7	.7	100.0
	Total	303	100.0	100.0	

Table 42: Knowledge of new technological techniques and materials

		Frequency	%	Valid %	Cumulative %
Valid	Extremely Important	145	47.9	47.9	47.9
	Very Important	124	40.9	40.9	88.8
	Somewhat Important	30	9.9	9.9	98.7
	Neutral	3	1.0	1.0	99.7
	Somewhat Unimportant	1	.3	.3	100.0
	Total	303	100.0	100.0	

Table 43 : Environmental circumstances, climate and local weather conditions

		Frequency	%	Valid %	Cumulative %
Valid	Extremely Important	95	31.4	31.4	31.4
	Very Important	147	48.5	48.5	79.9
	Somewhat Important	53	17.5	17.5	97.4
	Neutral	4	1.3	1.3	98.7
	Somewhat Unimportant	4	1.3	1.3	100.0
	Total	303	100.0	100.0	

Table 44 : Knowledge about site circumstances by the project team members

		Frequency	%	Valid %	Cumulative %
Valid	Extremely Important	133	43.9	43.9	43.9
	Very Important	138	45.5	45.5	89.4
	Somewhat Important	27	8.9	8.9	98.3
	Neutral	4	1.3	1.3	99.7
	Somewhat Unimportant	1	.3	.3	100.0
	Total	303	100.0	100.0	

Table 45 : Accurate work drawings and specifications

		Frequency	%	Valid %	Cumulative %
Valid	Extremely Important	193	63.7	63.7	63.7
	Very Important	106	35.0	35.0	98.7
	Somewhat Important	4	1.3	1.3	100.0
	Total	303	100.0	100.0	

Table 46: Materials and labour availability and cost

		Frequency	%	Valid %	Cumulative %
Valid	Extremely Important	162	53.5	53.5	53.5
	Very Important	128	42.2	42.2	95.7
	Somewhat Important	12	4.0	4.0	99.7
	Neutral	1	.3	.3	100.0
	Total	303	100.0	100.0	

Table 47 : Geotechnical circumstances

		Frequency	%	Valid %	Cumulative %
Valid	Extremely Important	90	29.7	29.7	29.7
	Very Important	180	59.4	59.4	89.1
	Somewhat Important	26	8.6	8.6	97.7
	Neutral	6	2.0	2.0	99.7
	Somewhat Unimportant	1	.3	.3	100.0
	Total	303	100.0	100.0	

The following step of descriptive statistics collection served for the assessment of the parameters of extra-contractual measures. For this category of determinants of the EPCM model effectiveness, 12 parameters were delivered during the questionnaire analysis phase. The results of analysis for this specific category of determinants are summarised in Table 48 to 59. For the parameter of defining the sufficient level of delegation of authority within the client project management team, the total number of respondents who considered this parameter as extremely or very important was equal to 288 respondents (95% of the sample). For the parameter of setting a steering committee for decision-making at the procurement phase, the total number of respondents who regarded this parameter as extremely or very important was equal to 259 respondents (85.5% of the sample). For the parameter of introduction of specific terms and conditions for control over purchase orders and work packages, the total number of respondents who considered the following parameter as extremely or very important was equal to 271 respondents (89.4% of the sample).

For the parameter of defining an appropriate expenditure limit for the procurement phase assigned for the project director, the total number of respondents who regarded this parameter as extremely or very important was equal to 274 people (90.5% of the sample). For the parameter of defining an incentive scheme for the contractor for outperforming at the engineering and procurement phases, the total number of respondents who regarded the following parameter as extremely or very important was equal to 248 respondents (81.8% of the sample). For the parameter of setting liquidated damages %ages for each phase of execution, the total number of respondents who considered this parameter as extremely or very important was equal to 250 respondents (82.5% of the sample). For the parameter of introduction of a child contract strategy under the EPCM contract,

the total number of respondents who considered this parameter as extremely or very important was equal to 169 respondents (55.8% of the sample).

For the parameter of outlining coordination of the design and construction works between different work package contractors, the total number of respondents who considered this parameter as extremely or very important was equal to 285 respondents (94.1% of the sample). For the parameter of ensuring management, administration, and supervision of the work packages, the total number of respondents who regarded this parameter as extremely or very important was equal to 296 respondents (94.1% of the sample). For the parameter of delivery of the project by defining certain key milestone dates, the total number of respondents who considered this parameter as extremely or very important was equal to 296 respondents (97.7% of the sample). For the parameter of introducing terms and conditions discouraging unnecessary claim submissions by contractors, the total number of respondents who regarded this parameter as extremely or very important was equal to 259 respondents (85.5% of the sample). For the parameter of limiting the role of the company in contractors' insurance claims, the total number of respondents who considered this parameter as extremely or very important was equal to 226 people (74.6% of the sample). Based on the results of the performed data collection, a set of parameters of extra-contractual measures could be removed from the list of critical success factors and potential sources of risk for the project team. Among such parameters, the following must be mentioned: limiting the role of the company in contractors' insurance claims, and the introduction of a child contract strategy under the EPCM contract. For these specific parameters, a low level of significance was identified by the study respondents. In this way, all other parameters of the determinant's group should be regarded as potential sources of risks, with the requirement for development of adequate mitigation strategies.

Table 48 : Defining a sufficient level of delegation of authority within the client project management team

	Frequency	%	Valid %	Cumulative %
Valid Extremely Important	178	58.7	58.7	58.7
Very Important	110	36.3	36.3	95.0
Somewhat Important	11	3.6	3.6	98.7
Neutral	4	1.3	1.3	100.0
Total	303	100.0	100.0	

Table 49 : Setting a steering committee for decision-making at the procurement phase

	Frequency	%	Valid %	Cumulative %
Valid Extremely Important	146	48.2	48.2	48.2
Very Important	113	37.3	37.3	85.5
Somewhat Important	34	11.2	11.2	96.7
Neutral	9	3.0	3.0	99.7
Extremely Unimportant	1	.3	.3	100.0
Total	303	100.0	100.0	

Table 50 : Introduction of specific terms and conditions for control over purchase orders and work packages

	Frequency	%	Valid %	Cumulative %
Valid Extremely Important	158	52.1	52.1	52.1
Very Important	113	37.3	37.3	89.4
Somewhat Important	16	5.3	5.3	94.7
Neutral	14	4.6	4.6	99.3
Somewhat Unimportant	2	.7	.7	100.0
Total	303	100.0	100.0	

Table 51 : Defining an appropriate expenditure limit for the procurement phase assigned for the project director

	Frequency	%	Valid %	Cumulative %
Valid Extremely Important	149	49.2	49.2	49.2
Very Important	125	41.3	41.3	90.4
Somewhat Important	21	6.9	6.9	97.4
Neutral	6	2.0	2.0	99.3
Somewhat Unimportant	1	.3	.3	99.7
Extremely Unimportant	1	.3	.3	100.0
Total	303	100.0	100.0	

Table 52: Defining an incentive scheme for the contractor for outperforming at the engineering and procurement phases

		Frequency	%	Valid %	Cumulative %
Valid	Extremely Important	147	48.5	48.5	48.5
	Very Important	101	33.3	33.3	81.8
	Somewhat Important	37	12.2	12.2	94.1
	Neutral	17	5.6	5.6	99.7
	Somewhat Unimportant	1	.3	.3	100.0
	Total	303	100.0	100.0	

Table 53 : Setting liquidated damages %ages for each phase of execution

		Frequency	%	Valid %	Cumulative %
Valid	Extremely Important	106	35.0	35.0	35.0
	Very Important	144	47.5	47.5	82.5
	Somewhat Important	22	7.3	7.3	89.8
	Neutral	23	7.6	7.6	97.4
	Somewhat Unimportant	1	.3	.3	97.7
	Very Unimportant	2	.7	.7	98.3
	Extremely Unimportant	5	1.7	1.7	100.0
	Total	303	100.0	100.0	

Table 54 : Introduction of a child contract strategy under the EPCM contract

		Frequency	%	Valid %	Cumulative %
Valid	Extremely Important	76	25.1	25.1	25.1
	Very Important	93	30.7	30.7	55.8
	Somewhat Important	53	17.5	17.5	73.3
	Neutral	47	15.5	15.5	88.8
	Somewhat Unimportant	16	5.3	5.3	94.1
	Very Unimportant	17	5.6	5.6	99.7
	Extremely Unimportant	1	.3	.3	100.0
	Total	303	100.0	100.0	

Table 55 : Outlining coordination of the design and construction works between different work package contractors

		Frequency	%	Valid %	Cumulative %
Valid	Extremely Important	176	58.1	58.1	58.1
	Very Important	109	36.0	36.0	94.1
	Somewhat Important	15	5.0	5.0	99.0
	Neutral	3	1.0	1.0	100.0
	Total	303	100.0	100.0	

Table 56 : Ensuring management, administration, and supervision of the work packages

		Frequency	%	Valid %	Cumulative %
Valid	Extremely Important	173	57.1	57.1	57.1
	Very Important	123	40.6	40.6	97.7
	Somewhat Important	5	1.7	1.7	99.3
	Neutral	2	.7	.7	100.0
	Total	303	100.0	100.0	

Table 57 : Delivery of the project by defining certain key milestone dates

		Frequency	%	Valid %	Cumulative %
Valid	Extremely Important	202	66.7	66.7	66.7
	Very Important	96	31.7	31.7	98.3
	Somewhat Important	3	1.0	1.0	99.3
	Neutral	2	.7	.7	100.0
	Total	303	100.0	100.0	

Table 58 : Introducing terms and conditions discouraging unnecessary claim submissions by contractors

		Frequency	%	Valid %	Cumulative %
Valid	Extremely Important	154	50.8	50.8	50.8
	Very Important	105	34.7	34.7	85.5
	Somewhat Important	24	7.9	7.9	93.4
	Neutral	16	5.3	5.3	98.7
	Somewhat Unimportant	2	.7	.7	99.3
	Very Unimportant	2	.7	.7	100.0
	Total	303	100.0	100.0	

Table 59 : Limiting the role of the company in contractors' insurance claims

		Frequency	%	Valid %	Cumulative %
Valid	Extremely Important	100	33.0	33.0	33.0
	Very Important	126	41.6	41.6	74.6
	Somewhat Important	22	7.3	7.3	81.8
	Neutral	49	16.2	16.2	98.0
	Somewhat Unimportant	3	1.0	1.0	99.0
	Very Unimportant	2	.7	.7	99.7
	Extremely Unimportant	1	.3	.3	100.0
	Total	303	100.0	100.0	

The final element of the performed analysis included a discussion of the specific parameters of the final determinant group found to be relevant to the development of the EPCM model benefits –

resilience parameters. Findings of the descriptive statistics are presented in Table 60 to 67. For the parameter of identifying the EPCM strategy for the right scope of work provides resilience in project execution, the total number of respondents who considered this parameter as extremely or very important was equal to 284 respondents (93.8% of the sample). For the parameter of flexibility in detailed design changes, the total number of respondents who regarded this parameter as extremely or very important was equal to 246 respondents (81.2% of the sample). For the parameter of agility in the introduction of new mitigation for introduced risks, the total number of respondents who considered this parameter as extremely or very important was equal to 263 respondents (86.8% of the sample). For the parameter of flexibility in the assignment of work packages to the benefit of the project need, the total number of respondents who regarded this parameter as extremely or very important was equal to 266 respondents (87.8% of the sample).

For the parameter of flexibility in defining construction sequences based on the project need, the total number of respondents who considered the parameter as extremely or very important was equal to 280 respondents (92.4% of the sample). For the parameter of flexibility in defining the procurement strategy based on the project need, the total number of respondents who considered this parameter as extremely or very important was equal to 283 respondents (93.4% of the sample). For the parameter of flexibility in introducing additional work package contractors based on the project need, the total number of respondents who regarded this parameter as extremely or very important was equal to 262 respondents (86.4% of the sample). For the parameter of flexibility for the exit strategy within a phase of execution, the total number of respondents who considered the parameter as extremely or very important was equal to 249 respondents (82.2% of the sample). The results of the study demonstrated that a major part of the resilience parameters played a significant

role in the potential success of the EPCM contracting model. Thus, it might be of great significance to question the relevance of the following parameters as the sources of risk for the EPCM project: flexibility in the detailed design changes and flexibility for the exit strategy within a phase of execution. These specific parameters demonstrated the lowest level of respondents' support. Nevertheless, all the stated parameters of resilience in the context of the study might be considered as important sources of risk for the project in general.

Table 60 : Identifying the EPCM strategy for the right scope of work provides resilience in project execution

		Frequency	%	Valid %	Cumulative %
Valid	Extremely Important	189	62.4	62.4	62.4
	Very Important	95	31.4	31.4	93.7
	Somewhat Important	14	4.6	4.6	98.3
	Neutral	5	1.7	1.7	100.0
	Total	303	100.0	100.0	

Table 61 : Flexibility in the detailed design changes

		Frequency	%	Valid %	Cumulative %
Valid	Extremely Important	146	48.2	48.2	48.2
	Very Important	100	33.0	33.0	81.2
	Somewhat Important	46	15.2	15.2	96.4
	Neutral	9	3.0	3.0	99.3
	Somewhat Unimportant	2	.7	.7	100.0
	Total	303	100.0	100.0	

Table 62: Agility in the introduction of new mitigation for the introduced risks

		Frequency	%	Valid %	Cumulative %
Valid	Extremely Important	160	52.8	52.8	52.8
	Very Important	103	34.0	34.0	86.8
	Somewhat Important	26	8.6	8.6	95.4
	Neutral	14	4.6	4.6	100.0
	Total	303	100.0	100.0	

Table 63 : Flexibility in the assignment of work packages to the benefit of the project need

		Frequency	%	Valid %	Cumulative %
Valid	Extremely Important	159	52.5	52.5	52.5
	Very Important	107	35.3	35.3	87.8
	Somewhat Important	29	9.6	9.6	97.4
	Neutral	7	2.3	2.3	99.7
	Somewhat Unimportant	1	.3	.3	100.0
	Total	303	100.0	100.0	

Table 64: Flexibility in defining construction sequences based on the project need

		Frequency	%	Valid %	Cumulative %
Valid	Extremely Important	166	54.8	54.8	54.8
	Very Important	114	37.6	37.6	92.4
	Somewhat Important	19	6.3	6.3	98.7
	Neutral	4	1.3	1.3	100.0
	Total	303	100.0	100.0	

Table 65 : Flexibility in defining the procurement strategy based on the project need

		Frequency	%	Valid %	Cumulative %
Valid	Extremely Important	177	58.4	58.4	58.4
	Very Important	106	35.0	35.0	93.4
	Somewhat Important	15	5.0	5.0	98.3
	Neutral	5	1.7	1.7	100.0
	Total	303	100.0	100.0	

Table 66 : Flexibility in introducing additional work package contractors based on the project need

		Frequency	%	Valid %	Cumulative %
Valid	Extremely Important	148	48.8	48.8	48.8
	Very Important	114	37.6	37.6	86.5
	Somewhat Important	33	10.9	10.9	97.4
	Neutral	6	2.0	2.0	99.3
	Somewhat Unimportant	2	.7	.7	100.0
	Total	303	100.0	100.0	

Table 67 : Flexibility for the exit strategy within a phase of execution

		Frequency	%	Valid %	Cumulative %
Valid	Extremely Important	149	49.2	49.2	49.2
	Very Important	100	33.0	33.0	82.2
	Somewhat Important	31	10.2	10.2	92.4
	Neutral	19	6.3	6.3	98.7
	Somewhat Unimportant	4	1.3	1.3	100.0
	Total	303	100.0	100.0	

The outcomes of the presented section addressed the fourth objective of the research in the presentation of the key categories of the EPCM model determinants that could serve as the sources of risks for the project management team in general. Outcomes of the regression analysis contributed to the definition of four groups of determinants that have a serious impact on the overall benefits and outcomes of the EPCM model application during a large construction project. For the stated categories of determinants, all the parameters mentioned in the context of questionnaire analysis were found to be vital, thus leading to the definition of key sources of risk.

5.2.5. Objective 5: Key success factors for the application of the EPCM model

The fifth objective of the study was to identify the key success factors for the application of the EPCM model in the oil and gas sector of Abu Dhabi. For the realisation of this objective, a combination of data collection methods was applied. Firstly, it was important to collect and analyse the findings of previous academic literature sources. Secondly, it was imperative to address the stated objective in the format of descriptive statistics collection and analysis. However, the question was addressed by a review of specific academic literature sources. The process of changes in the vision of this problem was presented in the context of the literature review. The research by Wai *et al.* (2012) divided the factors of success in the application of the EPCM contracting model into

the following categories: factors related to the project, factors related to the project manager and team members, factors related to the organisation, and factors related to the external environment. Moreover, Wai *et al.* (2012) stated that the following parameters of the EPCM model application played a specific role in the success of project management. In addition to this, a similar research group stated that the EPCM contracting model is efficient for small to moderate-scale projects and might be inefficient for large ones (Wai *et al.* 2012). Such a condition makes it reasonable to consider the question about means of the stated limitations removal.

More recent studies on the issue of the success factor of the EPCM model have demonstrated that the factor of effective communication between the project owner and the contractors is also vital for the success of large construction projects (Oosterhof, 2018). The lack of effective cooperation and communication between project stakeholders could contribute to the mutual dissatisfaction with the working process, and the inability of the parties to reach the desired outcomes. Together with the stated problems, one of the success factors for the EPCM contracting model was found to be associated with the presence of adequate competencies among contractors (Oosterhof, 2018). While it is obvious that without the required competencies any type of contractor would not be capable of achieving the desired outcomes of the project's realisation, the experience of previous cases based on the application of the EPCM contracting model demonstrated that a large number of projects can still face failures due to the lack of competencies among agents. The final finding of the study by Oosterhof (2018) was that there was a lack of adequate understanding of the scope of responsibility for each of the engaged parties during the project. Compared to the EPC contracting model, where the full scope of responsibility and power during the project was concentrated in the hands of the contractor, the EPCM contracting model supposed a flexible

division of responsibilities between the project owner and the contractors. In case the parties fail to reach an efficient model of division of responsibilities, negative outcomes could be reached in the format of project failure.

Based on the stated arguments about the key success factors of the EPCM contracting model, Oosterhof (2018) defined the following actions that should serve as a key to success in complex projects management using the EPCM contracting model: the control over the contractor; reactive construction management and accountability in relations between the project owner and the contractor. These recommendations should be considered as basic principles of the EPCM contracting model organisation for the project owner, based on the findings of the literature review. The results of the literature review did not serve as a single source of insights for the definition of key success factors of the EPCM contracting model. To address the stated objective with the findings of questionnaire analysis, it is important to focus on the findings of the descriptive statistics received during the discussion of the previous objective of the study. Regression analysis of key determinants and benefits of the EPCM model application demonstrated the specific role of the following groups of determinants for the realisation of the EPCM-based projects: legal and regulatory guidelines, technical specifications, extra-contractual mechanisms, and resilience parameters. Based on the discussion of the specific parameters for each of the stated determinants of the EPCM model application, it is possible to identify specific success criteria that should be met by the modern management team that aims to apply the EPCM contracting model.

5.2.6. Objective 6: Guidelines for the adoption of the EPCM model

The final objective of the study was related to the definition of the specific set of guidelines that should be followed by the management of large oil and gas companies in Abu Dhabi to reach success in the field of the EPCM contracting model realisation. Similar to the approaches utilised for the realisation of other objectives of this study, a combination of literature review and quantitative research methods was applied. Furthermore, it was reasonable to summarise the findings of the literature review, which would form the basis for an understanding of the key elements of successful application of the EPCM contracting model in the future. The most complex and reliable position in the context of the stated research objective was stated by Oosterhof (2018). According to the position of this researcher, the utilisation of the EPCM model must be based on the resolution of the following types of challenges: control over contractor, reactive construction management, and accountability in relations between the project owner and the contractor. To address these specific challenges associated with the application of the EPCM contracting model, it is reasonable to deliver a reliable model of risks and responsibility distribution among the actors engaged in the realisation of the EPCM contracting model. The final success factor that should be considered in the practical guidelines for the future is the development of reliable criteria for the selection of prospective contractors for the specific construction project. It is important to understand that the risk of the selection of an improper contractor is always high, and this factor could lead to the failure of the EPCM project in general.

The results of the literature review demonstrated the significant role of effective planning and control during the realisation of the EPCM contracting model. It is important to answer the questions about the selection of the optimal format of risks and responsibility distribution among

the project owners and the engaged contractors, together with the question about the optimal approach to the selection of the candidates that could serve as contractors for each specific project. In the context of questionnaire analysis, specific determinants of the EPCM model application were found to have a more serious impact on the overall effectiveness of this contracting model's application. Among the most important determinants of success, the following were identified: legal and regulatory guidelines, technical specifications, extra-contractual measures, and resilience parameters. These determinants were defined as key for the success of the EPCM contracting model based on the summary of responses to the previous study objectives. These specific determinants demonstrated their relevance to the resolution of the problems of cost-effectiveness, risk mitigation, and benefits maximisation for project owners aiming to use the EPCM contracting model. For the development of reliable guidelines that would serve as a basis for effective usage of the EPCM contracting model in the future, it is of great significance to consider all the parameters from the stated groups of determinants and deliver specific recommendations for their practical realisation.

This section of the study serves as the description of the key findings of data collection in the context of the stated objectives of the study. Six research objectives were considered based on the findings of the literature review and questionnaire analysis. The first objective addressed a question about theoretical and practical differences between the EPC and the EPCM contracting models. It was found that the EPCM model could serve as a more flexible and reliable model of contract organisation in case the project owner and the contractors managed to develop a reliable scheme of cooperation, which would minimise the risk of mistakes and failures throughout the project. This section also addressed the question about the means of realising specific benefit categories through

the utilisation of the EPCM contracting model. It was found that a focus on the specific groups of determinants could serve as a reliable strategy for benefits maximisation, including the realisation of the cost-effective outcomes. Among the specific determinants of the EPCM contracting model success, the following were considered as vital: legal and regulatory guidelines, technical specifications, extra-contractual measures, and resilience parameters. Furthermore, the discussion of the most important groups of determinants contributed to the definition of the key sources of risk for the EPCM projects, and the means of their mitigation. It was found that the management of oil and gas sector projects in Abu Dhabi should place specific emphasis on the improvement of outcomes for key parameters of the EPCM contracting model to mitigate risks and guarantee the full realisation of the potential project benefits.

The final element of discussion in this section was related to the definition of the key success factors that should be targeted by project management in the oil and gas sector of Abu Dhabi. Among the findings of the literature review, it is important to mention factors of control over the contractor, reactive construction management, and accountability in relations between the project owner and the contractor as sources of risks and benefits for the project. In addition, practical guidelines for project management aiming to apply the EPCM contracting model should be based on the efficient utilisation of the earlier-mentioned determinants of EPCM. Future studies will have to address specific issues related to the definition of the best risk mitigation strategies and practices for the realisation of the specific determinants of the EPCM contracting model.

5.3. Summation of data analysis and findings

The final section of this chapter addresses the problem of presenting the data analysis findings. To summarise the data analysis findings, the results of the study were considered in the context of the identified research objectives. A detailed discussion of the key data analysis methods and the research findings was provided. The results of the data analysis procedure contributed to the resolution of all the stated research questions. For each of the questions, specific recommendations and insights were delivered based on the findings of descriptive statistics and regression analysis. The first research objective was related to the definition of the specific theoretical and practical differences between the EPCM and EPC contracting models. The results of the literature review identified the key difference between the two methods and the main source of risk – the need for the project owner to identify the optimal format of the distribution of decision-making power and responsibility in the case of the EPCM contracting model. If the EPC model of contracting leaves limited decision-making power for the project owner, it is not only a serious limitation but also a promising solution for the project owner that lacks experience in the practical realisation of the construction projects. Nevertheless, the application of the EPCM contracting model is not a cure if the project management team is not capable of building a proper balance of responsibilities among actors.

The following research objective addressed the problem of effective application of the EPCM contracting model for the project manager to be capable of implementing flexible exit strategies and mitigate operational risks in cooperation with contractors. In the context of this objective, it was found that the following determinants of EPCM model effectiveness should be applied to reach the desired goal: negotiation and communication and coordination among relevant parties involved

in the project (project information and process management); schedule of engineering, procurement and construction, and approval of completed tasks (legal and regulatory guidelines); outlining coordination of the design and construction works between different work package contractors (extra-contractual mechanisms); flexibility in the assignment of work packages to the benefit of project need; and flexibility for the exit strategy within a phase of execution (resilience parameters).

The third objective of the study aimed to assess legal solutions related to the application of the EPCM contracting model that allows the project team to mitigate intellectual property protection risks. The following activities were considered as key to success: change orders, permits, and shop drawings submission and approval; schedule of engineering, procurement and construction, and approval of completed tasks; and system completion requirements. In the context of the fourth objective of the study, it was important to show the means of cost optimisation through the EPCM model application during the project. The following activities were considered as key to success: setting a steering committee for decision-making at the procurement phase; introduction of specific terms and conditions for control over purchase orders and work packages; defining an appropriate expenditure limit for the procurement phase assigned for the project director; defining an incentive scheme for the contractor for outperforming in the engineering and procurement phases (extra-contractual measures); flexibility in defining procurement strategy based on project needs (resilience parameters); alignment among work breakdown structure (WBS), contracting work breakdown structure (CWBS), cost breakdown structure (CBS), and organisation breakdown structure (OBS); materials, and labour availability and cost (technical specifications); delivery of the project by defining certain key milestone dates (extra-contractual measures); identifying the EPCM strategy for the right scope of work provides resilience in project execution (resilience

parameters); and agility in the introduction of new mitigation for introduced risks (resilience parameters).

For objective five of the study, it was important to demonstrate specific measures in the context of the EPCM contracting model utilisation that could contribute to the realisation of the cost-effective result for the project investors. Finally, objective six addressed the problem of the impact of key success factors of the EPCM model for balancing the risk distribution scheme. Therefore, this section of Chapter five provided detailed responses to the stated research questions, as well as identifying opportunities for further research.

5.4. Chapter summary

Chapter five of the thesis has presented the data collection and analysis outcomes. Several key methods of data collection and analysis were utilised while conducting the study. Firstly, it is important to mention the method of literature review, which formed the conceptual basis of the study in general and contributed to the realisation of the first objective of the research. Theoretical and practical differences between the EPC and EPCM contracting models were identified based on the outcomes of the literature review, supported by the positions of reliable experts in the field of contract management for large construction projects in the oil and gas sector. In addition to the literature review method, an instrument of questionnaire data collection and analysis was applied. This tool of data collection and analysis was applied to analyse the positions of a representative sample of experts in the field of construction project management in the Abu Dhabi oil and gas sector. The description of the demographic information for the study sample demonstrated the high

reliability and representative power of the sample, leading to the conclusion about high opportunities for the generation of reliable insights based on the study findings.

The results of data collection and analysis contributed to the resolution of all the stated research questions, together with the presentation of specific solutions for the earlier stated objectives of the study. It was found that the application of the EPCM contracting model, if arranged based on a reliable set of determinants for each specific case, could contribute to the realisation of the optimal result for all actors engaged in large construction projects. It is possible to reach the cost-effective and risk-mitigating results of project management using the EPCM contracting model. Finally, the opportunities for further research were identified based on the outcomes of the study. Firstly, it was highlighted that the specific risk mitigation strategies should be identified for each specific source of risk related to the application of the EPCM contracting model. Therefore, future studies should address the problem of adequate assessment of contractors for the EPCM model. It was also found that the effectiveness of the EPCM approach is highly dependent on high-quality contractors, and adequate distribution of responsibilities inside the project owner's team and the contractors.

CHAPTER SIX: DISCUSSION OF STUDY FINDINGS

6.0. Introduction

The study aimed to analyse the role of the EPCM contracting model application in the context of large construction projects in the oil and gas sector of the UAE. The research objectives were addressed with the usage of a survey data collection method and statistical analysis techniques. Regression and correlation analysis as well as descriptive statistics analysis served as key instruments of the realisation of the study objectives. In the context of this chapter, it was important to discuss the key findings of the study in the context of the stated research objectives. The previous presentation of the study results concerning specific objectives contributed to a better understanding of the current situation in the field of the study. Nevertheless, the detailed insights into and recommendations for practice could be developed only after careful discussion of the key results in the following section of the research.

This chapter of the thesis presents the key findings of the study and discusses the study outcomes in the context of the set research objectives. The previous chapter presented the key results of the data collection and analysis procedure. This chapter aims to consider the earlier-presented findings to answer the stated research questions and identify the key insights of the study. Furthermore, the discussion of the study outcomes should be considered as a basis for the identification of the existing knowledge gaps, opportunities for further study, and limitations of the thesis. To discuss the key findings of the study, this chapter is divided into several sub-sections. The first section presents introductory information, including information about the objective of this chapter and the

data that was analysed. The following sub-section discusses the key study findings in the context of the stated research objectives. For each specific research objective, a summary of study results is presented, together with a discussion of outcomes of data analysis and practical insights. Therefore, the findings of the study are structured in a format to address all the stated research objectives and questions.

6.1. Realisation of study objectives

6.1.1. Objective 1: Analyse and compare the characteristics of the EPCM and EPC contract models

The first objective of the study was focused on the definition and establishment of key theoretical and practical differences between the EPC and EPCM contracting models from the point of their application for large construction projects in the UAE oil and gas sector. As stated in the previous chapter of the study, for the resolution of this study objective, the instrument of an academic literature review was applied.

The main type of theoretical difference identified for the EPC and EPCM contracting models was found to be associated with the format of power and responsibility distribution among project stakeholders. In the case of the EPC contracting model application, full responsibility for the project and decision-making power is delivered to the key contractor, while the project owner is limited in authority and decision-making power (Priede, 2017). The full list of control and management functions during the construction project is delivered to the project contractor, and the project owner is capable of influencing only the stages of the initial planning of the project. Such an approach was found to be associated with specific limitations and risks in the aspects of

risk management and mitigation (DLA Piper, 2018; Picha *et al.*, 2015). Since any type of project is implemented in the conditions of a changing environment, there is always a risk that specific environmental factors could lead to various challenges for the project in general. In such conditions, the project owner might lack the power to influence the contractor in a way to mitigate or minimise the negative impact of the changing environment. The project contractor relies only on their decision-making mechanism in the field of risk management (Galloway 2009). While the EPC contracting model forces the contractor to remove negative impacts of specific risks' realisation for the project, the time delays and quality challenges taking place in such conditions should not be ignored. Even if the contractor manages to overcome specific risks caused by ineffective risk management, the project owner might not be capable of reaching the desired outcomes within the initial schedule and budget.

An alternative vision of the project management process organisation was observed in the case of the EPCM contracting model application. For this format of contracting model, the method of responsibility and power distribution among key stakeholders is based on the interests and demands of the project owner. For instance, the project owner can leave a significant part of power in the field of project management under their authority, distributing responsibilities among the contractors involved (Singh and Tiwari 2015). In the case of the EPC model application, a single key contractor was identified, and the key responsibilities included a selection of subcontractors, whose services were required for the realisation of specific tasks during project realisation. In the case of the EPCM contracting model, the project owner is able to develop a pool of contractors independently, thus distributing power among them based on his/her decision (PWC, 2016; Wai *et*

al. 2012). Therefore, general management and control functions are still performed by the project owner.

Based on the findings of the literature review about the key theoretical differences between the EPC and EPCM models, it was established that each of the applied methods of contracting could have certain benefits and limits depending on the character of the specific situation. For example, in case the project owner obtains the required skills and competencies for the realisation of the required construction project, it might be sensible to emphasise the application of the EPCM contracting model. Such a solution would allow the project owner to play a key role in the project and effectively mitigate potential risks and challenges in terms of the project. Nevertheless, the EPCM contracting model could be considered as the least reliable and effective solution in case the project owner lacks competencies or experience in the field of large construction project management (Too and Weaver 2014). The results of data collection and analysis presented in the previous chapter of the study identified high requirements for the project owner who aims to apply the EPCM contracting model. Practical risks related to the application of the EPCM contracting model included the following: process guarantees, potential cost-ineffectiveness, open budget, and potential procrastination of the contractor (Singh and Tiwari 2015). The project owner must be capable not only of developing a reliable plan of project realisation using the EPCM contracting model but also of performing regular control of the contractors' performance, preventing cost, schedule and quality challenges, and guaranteeing high productivity of contractors' performance. In the case of EPC contracting model application, these functions would be delegated to the senior contractor.

Among the practical challenges of the EPC contracting model application, the following were identified: the absence of control over project management for the owner, quality risks, and high risk of mistakes caused by the significant influence of the contractor on the project (Singh and Tiwari 2015). A high level of dependency on decisions of senior contractors is the opposite option compared to the model of the EPCM contract (Ventroux *et al.* 2017). If project owners aim to be successful in terms of large construction projects for the oil and gas sector of the UAE, a more flexible contracting strategy should be applied. In this context, the EPCM model seems to be the optimal alternative. Even if the project owner lacks competencies and experience for effective management of large construction projects, it is possible to select a senior contractor agent that will be responsible for the general control and management of the project. However, if compared to the EPC model, where such a senior contractor is provided with ultimate authority and power, the EPCM model allows the project manager to distribute only part of the authority to this agent, removing risks for the project in general.

6.1.2. Objective 2: Benefits of the EPCM contracting model for project management

The second objective of the research addressed a problem about the definition of the specific means that could be applied by senior management in the Abu Dhabi oil and gas sector to utilise key benefits of the EPCM contracting model in the specific construction projects. The previous chapter of the study summarised the information about the key categories of the EPCM contracting model application's benefits. Consequently, the following types of benefits were considered: shorter bidding time, standardised work packages, fast-track schedule through the alignment of procurement and work packages, optimised material procurement cost, controlled project cost, the adoption of new technologies, mark-up costs on material and execution are almost removed,

controlled change orders, trust among different project parties, as well as faster system completion achievement with client involvement. The outcomes of descriptive statistics analysis demonstrated that, for each of the stated categories of benefits, study respondents provided their opinions about the high relevance of their realisation in the chosen industry. From this perspective, specific means for the realisation of the stated benefits of the EPCM model application are recommended to be discussed.

In the previous chapter of the study, the method of correlation analysis was utilised to identify the relationship between specific categories of the EPCM model benefits for large construction projects and the specific techniques of potential realisation of these benefits. Based on the outcomes of correlation analysis, the following methods of realisation were found to be those that contributed most to the desired outcomes: project information and process management; legal and regulatory framework; technical specifications and capabilities; extra-contractual mechanisms. It was found that, for each of the presented categories of the EPCM model determinants, senior management should focus on the application of the specific methods from each category to maximise benefits for the organisation. While the results of data collection and analysis contributed to the definition of the basic elements of the management strategy that should be applied to maximise benefits from the application of the EPCM contracting model, it was also reasonable to describe specific tools and mechanisms from each category of the EPCM determinants that should be applied in practice to guarantee the optimal result for the interested parties. In the context of the stated objective, an instrument of descriptive statistics analysis was applied. Moreover, it was imperative to describe what specific instruments of the EPCM contracting model management could be considered as

most useful and reliable from the point of the respondents engaged in the quantitative study. The findings of data analysis for this objective are summarised in Table 68.

Table 68 : Descriptive statistics – objective 2

Project information and process management 1

		Frequency	%	Valid %	Cumulative %
Valid	Extremely Important	213	70.3	70.3	70.3
	Very Important	81	26.7	26.7	97.0
	Somewhat Important	9	3.0	3.0	100.0
	Total	303	100.0	100.0	

Project information and process management 2

		Frequency	%	Valid %	Cumulative %
Valid	Extremely Important	181	59.7	59.7	59.7
	Very Important	109	36.0	36.0	95.7
	Somewhat Important	10	3.3	3.3	99.0
	Neutral	3	1.0	1.0	100.0
	Total	303	100.0	100.0	

Project information and process management 3

		Frequency	%	Valid %	Cumulative %
Valid	Extremely Important	211	69.6	69.6	69.6
	Very Important	90	29.7	29.7	99.3
	Somewhat Important	1	.3	.3	99.7
	Neutral	1	.3	.3	100.0
	Total	303	100.0	100.0	

Project information and process management 4

		Frequency	%	Valid %	Cumulative %
Valid	Extremely Important	184	60.7	60.7	60.7
	Very Important	110	36.3	36.3	97.0
	Somewhat Important	8	2.6	2.6	99.7
	Neutral	1	.3	.3	100.0
	Total	303	100.0	100.0	

Project information and process management 5

		Frequency	%	Valid %	Cumulative %
Valid	Extremely Important	194	64.0	64.0	64.0
	Very Important	104	34.3	34.3	98.3
	Somewhat Important	3	1.0	1.0	99.3
	Neutral	2	.7	.7	100.0
	Total	303	100.0	100.0	

Project information and process management 6

		Frequency	%	Valid %	Cumulative %
Valid	Extremely Important	186	61.4	61.4	61.4
	Very Important	106	35.0	35.0	96.4
	Somewhat Important	10	3.3	3.3	99.7
	Neutral	1	.3	.3	100.0
Total		303	100.0	100.0	

Project information and process management 7

		Frequency	%	Valid %	Cumulative %
Valid	Extremely Important	156	51.5	51.5	51.5
	Very Important	126	41.6	41.6	93.1
	Somewhat Important	20	6.6	6.6	99.7
	Neutral	1	.3	.3	100.0
Total		303	100.0	100.0	

Project information and process management 8

		Frequency	%	Valid %	Cumulative %
Valid	Extremely Important	130	42.9	42.9	42.9
	Very Important	156	51.5	51.5	94.4
	Somewhat Important	11	3.6	3.6	98.0
	Neutral	6	2.0	2.0	100.0
Total		303	100.0	100.0	

Project information and process management 9

		Frequency	%	Valid %	Cumulative %
Valid	Extremely Important	195	64.4	64.4	64.4
	Very Important	103	34.0	34.0	98.3
	Somewhat Important	4	1.3	1.3	99.7
	Neutral	1	.3	.3	100.0
Total		303	100.0	100.0	

Project information and process management 10

		Frequency	%	Valid %	Cumulative %
Valid	Extremely Important	162	53.5	53.5	53.5
	Very Important	127	41.9	41.9	95.4
	Somewhat Important	11	3.6	3.6	99.0
	Neutral	3	1.0	1.0	100.0
Total		303	100.0	100.0	

Project information and process management 11

		Frequency	%	Valid %	Cumulative %
Valid	Extremely Important	201	66.3	66.3	66.3
	Very Important	97	32.0	32.0	98.3
	Somewhat Important	3	1.0	1.0	99.3

Neutral	2	.7	.7	100.0
Total	303	100.0	100.0	

Project information and process management 12

	Frequency	%	Valid %	Cumulative %
Valid Extremely Important	170	56.1	56.1	56.1
Very Important	112	37.0	37.0	93.1
Somewhat Important	18	5.9	5.9	99.0
Neutral	3	1.0	1.0	100.0
Total	303	100.0	100.0	

Project information and process management 13

	Frequency	%	Valid %	Cumulative %
Valid Extremely Important	139	45.9	45.9	45.9
Very Important	138	45.5	45.5	91.4
Somewhat Important	20	6.6	6.6	98.0
Neutral	4	1.3	1.3	99.3
Somewhat Unimportant	1	.3	.3	99.7
Very Unimportant	1	.3	.3	100.0
Total	303	100.0	100.0	

Project information and process management 14

	Frequency	%	Valid %	Cumulative %
Valid Extremely Important	167	55.1	55.1	55.1
Very Important	113	37.3	37.3	92.4
Somewhat Important	15	5.0	5.0	97.4
Neutral	7	2.3	2.3	99.7
Somewhat Unimportant	1	.3	.3	100.0
Total	303	100.0	100.0	

Project information and process management 15

	Frequency	%	Valid %	Cumulative %
Valid Extremely Important	171	56.4	56.4	56.4
Very Important	108	35.6	35.6	92.1
Somewhat Important	16	5.3	5.3	97.4
Neutral	8	2.6	2.6	100.0
Total	303	100.0	100.0	

Legal and regulatory framework 1

	Frequency	%	Valid %	Cumulative %
Valid Extremely Important	204	67.3	67.3	67.3
Very Important	86	28.4	28.4	95.7
Somewhat Important	10	3.3	3.3	99.0
Neutral	3	1.0	1.0	100.0
Total	303	100.0	100.0	

Legal and regulatory framework 2

	Frequency	%	Valid %	Cumulative %
Valid Extremely Important	180	59.4	59.4	59.4

Very Important	112	37.0	37.0	96.4
Somewhat Important	10	3.3	3.3	99.7
Neutral	1	.3	.3	100.0
Total	303	100.0	100.0	

Legal and regulatory framework 3

	Frequency	%	Valid %	Cumulative %
Valid Extremely Important	200	66.0	66.0	66.0
Very Important	99	32.7	32.7	98.7
Somewhat Important	3	1.0	1.0	99.7
Neutral	1	.3	.3	100.0
Total	303	100.0	100.0	

Legal and regulatory framework 4

	Frequency	%	Valid %	Cumulative %
Valid Extremely Important	171	56.4	56.4	56.4
Very Important	114	37.6	37.6	94.1
Somewhat Important	16	5.3	5.3	99.3
Neutral	2	.7	.7	100.0
Total	303	100.0	100.0	

Legal and regulatory framework 5

	Frequency	%	Valid %	Cumulative %
Valid Extremely Important	132	43.6	43.6	43.6
Very Important	144	47.5	47.5	91.1
Somewhat Important	19	6.3	6.3	97.4
Neutral	8	2.6	2.6	100.0
Total	303	100.0	100.0	

Legal and regulatory framework 6

	Frequency	%	Valid %	Cumulative %
Valid Extremely Important	148	48.8	48.8	48.8
Very Important	123	40.6	40.6	89.4
Somewhat Important	26	8.6	8.6	98.0
Neutral	6	2.0	2.0	100.0
Total	303	100.0	100.0	

Legal and regulatory framework 7

	Frequency	%	Valid %	Cumulative %
Valid Extremely Important	137	45.2	45.2	45.2
Very Important	141	46.5	46.5	91.7
Somewhat Important	20	6.6	6.6	98.3
Neutral	4	1.3	1.3	99.7
Somewhat Unimportant	1	.3	.3	100.0
Total	303	100.0	100.0	

Legal and regulatory framework 8

	Frequency	%	Valid %	Cumulative %
Valid Extremely Important	175	57.8	57.8	57.8

Very Important	112	37.0	37.0	94.7
Somewhat Important	10	3.3	3.3	98.0
Neutral	6	2.0	2.0	100.0
Total	303	100.0	100.0	

Technical specifications and capabilities 1

	Frequency	%	Valid %	Cumulative %
Valid Extremely Important	181	59.7	59.7	59.7
Very Important	97	32.0	32.0	91.7
Somewhat Important	18	5.9	5.9	97.7
Neutral	7	2.3	2.3	100.0
Total	303	100.0	100.0	

Technical specifications and capabilities 2

	Frequency	%	Valid %	Cumulative %
Valid Extremely Important	199	65.7	65.7	65.7
Very Important	95	31.4	31.4	97.0
Somewhat Important	3	1.0	1.0	98.0
Neutral	6	2.0	2.0	100.0
Total	303	100.0	100.0	

Technical specifications and capabilities 3

	Frequency	%	Valid %	Cumulative %
Valid Extremely Important	217	71.6	71.6	71.6
Very Important	81	26.7	26.7	98.3
Somewhat Important	2	.7	.7	99.0
Neutral	3	1.0	1.0	100.0
Total	303	100.0	100.0	

Technical specifications and capabilities 4

	Frequency	%	Valid %	Cumulative %
Valid Extremely Important	199	65.7	65.7	65.7
Very Important	97	32.0	32.0	97.7
Somewhat Important	5	1.7	1.7	99.3
Neutral	2	.7	.7	100.0
Total	303	100.0	100.0	

Technical specifications and capabilities 5

	Frequency	%	Valid %	Cumulative %
Valid Extremely Important	145	47.9	47.9	47.9
Very Important	124	40.9	40.9	88.8
Somewhat Important	30	9.9	9.9	98.7
Neutral	3	1.0	1.0	99.7
Somewhat Unimportant	1	.3	.3	100.0
Total	303	100.0	100.0	

Technical specifications and capabilities 6

		Frequency	%	Valid %	Cumulative %
Valid	Extremely Important	95	31.4	31.4	31.4
	Very Important	147	48.5	48.5	79.9
	Somewhat Important	53	17.5	17.5	97.4
	Neutral	4	1.3	1.3	98.7
	Somewhat Unimportant	4	1.3	1.3	100.0
Total		303	100.0	100.0	

Technical specifications and capabilities 7

		Frequency	%	Valid %	Cumulative %
Valid	Extremely Important	133	43.9	43.9	43.9
	Very Important	138	45.5	45.5	89.4
	Somewhat Important	27	8.9	8.9	98.3
	Neutral	4	1.3	1.3	99.7
	Somewhat Unimportant	1	.3	.3	100.0
Total		303	100.0	100.0	

Technical specifications and capabilities 8

		Frequency	%	Valid %	Cumulative %
Valid	Extremely Important	193	63.7	63.7	63.7
	Very Important	106	35.0	35.0	98.7
	Somewhat Important	4	1.3	1.3	100.0
	Total	303	100.0	100.0	

Technical specifications and capabilities 9

		Frequency	%	Valid %	Cumulative %
Valid	Extremely Important	162	53.5	53.5	53.5
	Very Important	128	42.2	42.2	95.7
	Somewhat Important	12	4.0	4.0	99.7
	Neutral	1	.3	.3	100.0
Total		303	100.0	100.0	

Technical specifications and capabilities 10

		Frequency	%	Valid %	Cumulative %
Valid	Extremely Important	90	29.7	29.7	29.7
	Very Important	180	59.4	59.4	89.1
	Somewhat Important	26	8.6	8.6	97.7
	Neutral	6	2.0	2.0	99.7
	Somewhat Unimportant	1	.3	.3	100.0
Total		303	100.0	100.0	

Extra-contractual measures 1

		Frequency	%	Valid %	Cumulative %
Valid	Extremely Important	178	58.7	58.7	58.7
	Very Important	110	36.3	36.3	95.0
	Somewhat Important	11	3.6	3.6	98.7
	Neutral	4	1.3	1.3	100.0

Total	303	100.0	100.0	
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Extra-contractual measures 2

	Frequency	%	Valid %	Cumulative %
Valid Extremely Important	146	48.2	48.2	48.2
Very Important	113	37.3	37.3	85.5
Somewhat Important	34	11.2	11.2	96.7
Neutral	9	3.0	3.0	99.7
Extremely Unimportant	1	.3	.3	100.0
Total	303	100.0	100.0	

Extra-contractual measures 3

	Frequency	%	Valid %	Cumulative %
Valid Extremely Important	158	52.1	52.1	52.1
Very Important	113	37.3	37.3	89.4
Somewhat Important	16	5.3	5.3	94.7
Neutral	14	4.6	4.6	99.3
Somewhat Unimportant	2	.7	.7	100.0
Total	303	100.0	100.0	

Extra-contractual measures 4

	Frequency	%	Valid %	Cumulative %
Valid Extremely Important	149	49.2	49.2	49.2
Very Important	125	41.3	41.3	90.4
Somewhat Important	21	6.9	6.9	97.4
Neutral	6	2.0	2.0	99.3
Somewhat Unimportant	1	.3	.3	99.7
Extremely Unimportant	1	.3	.3	100.0
Total	303	100.0	100.0	

Extra-contractual measures 5

	Frequency	%	Valid %	Cumulative %
Valid Extremely Important	147	48.5	48.5	48.5
Very Important	101	33.3	33.3	81.8
Somewhat Important	37	12.2	12.2	94.1
Neutral	17	5.6	5.6	99.7
Somewhat Unimportant	1	.3	.3	100.0
Total	303	100.0	100.0	

Extra-contractual measures 6

	Frequency	%	Valid %	Cumulative %
Valid Extremely Important	106	35.0	35.0	35.0
Very Important	144	47.5	47.5	82.5
Somewhat Important	22	7.3	7.3	89.8
Neutral	23	7.6	7.6	97.4

Somewhat Unimportant	1	.3	.3	97.7
Very Unimportant	2	.7	.7	98.3
Extremely Unimportant	5	1.7	1.7	100.0
Total	303	100.0	100.0	

Extra-contractual measures 7

	Frequency	%	Valid %	Cumulative %
Valid Extremely Important	76	25.1	25.1	25.1
Very Important	93	30.7	30.7	55.8
Somewhat Important	53	17.5	17.5	73.3
Neutral	47	15.5	15.5	88.8
Somewhat Unimportant	16	5.3	5.3	94.1
Very Unimportant	17	5.6	5.6	99.7
Extremely Unimportant	1	.3	.3	100.0
Total	303	100.0	100.0	

Extra-contractual measures 8

	Frequency	%	Valid %	Cumulative %
Valid Extremely Important	176	58.1	58.1	58.1
Very Important	109	36.0	36.0	94.1
Somewhat Important	15	5.0	5.0	99.0
Neutral	3	1.0	1.0	100.0
Total	303	100.0	100.0	

Extra-contractual measures 9

	Frequency	%	Valid %	Cumulative %
Valid Extremely Important	173	57.1	57.1	57.1
Very Important	123	40.6	40.6	97.7
Somewhat Important	5	1.7	1.7	99.3
Neutral	2	.7	.7	100.0
Total	303	100.0	100.0	

Extra-contractual measures 10

	Frequency	%	Valid %	Cumulative %
Valid Extremely Important	202	66.7	66.7	66.7
Very Important	96	31.7	31.7	98.3
Somewhat Important	3	1.0	1.0	99.3
Neutral	2	.7	.7	100.0
Total	303	100.0	100.0	

Extra-contractual measures 11

	Frequency	%	Valid %	Cumulative %
Valid Extremely Important	154	50.8	50.8	50.8
Very Important	105	34.7	34.7	85.5
Somewhat Important	24	7.9	7.9	93.4
Neutral	16	5.3	5.3	98.7
Somewhat Unimportant	2	.7	.7	99.3
Very Unimportant	2	.7	.7	100.0
Total	303	100.0	100.0	

Extra-contractual measures 12

	Frequency	%	Valid %	Cumulative %
Valid Extremely Important	100	33.0	33.0	33.0
Very Important	126	41.6	41.6	74.6
Somewhat Important	22	7.3	7.3	81.8
Neutral	49	16.2	16.2	98.0
Somewhat Unimportant	3	1.0	1.0	99.0
Very Unimportant	2	.7	.7	99.7
Extremely Unimportant	1	.3	.3	100.0
Total	303	100.0	100.0	

Extra-contractual measures 13

	Frequency	%	Valid %	Cumulative %
Valid Extremely Important	143	47.2	47.2	47.2
Very Important	126	41.6	41.6	88.8
Somewhat Important	21	6.9	6.9	95.7
Neutral	13	4.3	4.3	100.0
Total	303	100.0	100.0	

To address the second research objective and define specific methods that could allow the project management team to maximise the benefits from the application of the EPCM contracting model, the researcher focused on the selection of the specific determinants of the EPCM model that were characterised with the highest level of support among study respondents. When compared to the approach utilised in the previous chapter of the thesis, the researcher selected only those methods

that were characterised by the major support of respondents as “Extremely important” for the successful realisation of the EPCM contracting model. The results of descriptive statistics analysis demonstrated that the following methods should be applied to reach optimal benefits of the EPCM contracting model application:

- Negotiation and communication, as well as coordination among relevant parties involved in the project;
- Decision-making;
- Materials procurement;
- Planning and scheduling;
- Work packaging design and subcontracting;
- The schedule of engineering, procurement and construction, and approval of the completed tasks;
- Project cost estimate;
- Project construction schedule, cost and quality;
- Experience of the project teams;
- Delivery of the project by defining certain key milestone dates.

The results of the quantitative study allowed the researcher to identify a list of activities and methods that should be applied to guarantee the realisation of the EPCM contracting model’s benefits. The question of coordination and communication among the engaged stakeholders was highlighted as a primary field of interest for the effective realisation of the EPCM benefits. Furthermore, it was found that the decision-making process should be performed by the project owner with high attention to all the existing details and in high cooperation with contractors. This

factor is especially relevant if the project owner lacks experience in the realisation of large construction projects. Specific emphasis should also be placed on the questions of planning and scheduling, as well as the procurement of materials. It was established that, to succeed in the realisation of the EPCM model, project owners and contractors should define optimal solutions to these specific tasks. In addition, the question of work packaging design and subcontracting should not be ignored if the project manager aims to utilise the benefits of the EPCM contracting format. Furthermore, it was found to be important to deliver the schedule of engineering, procurement and construction, as well as the approval of completed tasks. This schedule should serve as a guide for the project team, allowing project owners and contractors to reach success in timely, cost-effective and high-quality realisation of the project stages. Moreover, the key milestone dates should be identified for the project team to reach success. Last but not least, it was established that the experience of project team members plays an important role in the success of the EPCM contracting model. This means that, if the project owner lacks experience in the specific aspects of project management, it is imperative to collect the required competencies by attracting qualified contractors.

6.1.3. Objective 3: Achievement of cost-effectiveness through the adoption of the EPCM model

The third objective of the study dealt with the problem of the cost-effectiveness benefit of the EPCM contracting model. To succeed in the field of the EPCM contracting model realisation, the management of complex construction projects in the UAE oil and gas sector must be capable of identifying the best means of cost-effective result realisation. The previous chapter of the study

served the aims of the definition of the specific determinants of the EPCM model application that could contribute to the realisation of the stated outcome. Among the specific benefits of the EPCM model application that were considered as an outcome of the cost-effective realisation of the construction project, the following were considered: optimised material procurement cost, controlled project cost, and removal of mark-up cost on material and execution. These categories of benefits were selected since they were directly related to cost-effective outcomes of the EPCM contracting model application.

The results of the analysis of key determinants that contribute to the optimised material procurement cost were demonstrated in the previous section of the study. According to the findings of the performed analysis, the optimisation of material procurement costs could be reached mainly through the application of specific determinants of the EPCM model: project bid and contracting project information and process management, technical specifications, and capabilities. Thus, in order to optimise the material procurement costs in the process of general costs optimisation for the aims of the construction project, the management of the company should consider the contracting strategy type applied, negotiation and communication terms, material procurement terms, reporting structure and responsibilities, alignment among work breakdown structure (WBS), contracting work breakdown structure (CWBS), cost breakdown structure (CBS), organisation breakdown structure (OBS), and adequate project cost estimate.

Based on the findings of analysis for the first criterion of the cost-effective realisation of the EPCM model, it is important to indicate that success in the field of the practical application of this instrument could be dependent on the proper choice of the contracting strategy, the development of reliable negotiation and communication methods, reporting scheme, materials procurement

terms included in the contract and the detailed planning of all elements of the project mentioned in the previous paragraph. The realisation of all the stated practices would depend on the experience of the project owner in the field of project management. For instance, in case the manager lacks adequate competencies, it is recommended to attract a qualified advisor responsible for the realisation of the mentioned activities. In any specific case, the cost-effectiveness of the EPCM contracting model application would depend on the capability of project stakeholders to implement the defined recommendations. The following criterion of cost-effectiveness of the EPCM contracting model, the application was the parameter of the controlled project cost. Therefore, it was found that the technical specifications and capabilities, in addition to extra-contractual measures, could serve as a basis for success in the realisation of this specific type of benefit from the EPCM model application. Thus, to reach the desired outcome, the following activities (EPCM determinants) were considered as most important: accurate work drawings and specifications; materials and labour availability and cost; introduction of specific terms and conditions for control over purchase orders and work packages; defining appropriate expenditure limit for the procurement phase assigned for the project director; defining an incentive scheme for the contractor for outperforming in the engineering and procurement phases. These specific activities could be considered as a useful addition to the recommendations provided regarding the first criterion of cost-effectiveness in this section of the chapter.

As seen from the provided insights, the management of the EPCM contract should orient towards the accurate planning and realisation of the project stages, together with an adequate assessment of environmental conditions. The argument concerning the importance of the control of prices and availability of materials was found to be one of the most significant in the context of the controlled

project costs outcome. Therefore, from this perspective, the EPCM contracting model's application should be built not solely on the definition of the format of stakeholders' cooperation but also on the definition of means of adaptation to the changes in the environment. Furthermore, the key stakeholders of the project should adequately assess the existing challenges and risks posed by the environment and implement mutually beneficial solutions to the problems. Such finding leads to the need for the development of a reliable and effective stakeholders' cooperation model during the EPCM project. Such a need is a basis for further study, which should be performed in the future, based on the thesis findings.

However, the findings in terms of the second criterion of cost-effectiveness in the EPCM contract led to the conclusion about the importance of the development of proper incentives and motivation schemes for contractors. The project owners should apply the advantages of the EPCM contracting model to encourage cost-effective performance among contractors. When compared to the EPC contracting model and other methods of project management organisation, the EPCM contracting model allows the project managers to define the format of benefits distribution among contractors based on the set of criteria. In the context of cost-effective project outcomes realisation, it was established that it would be of great significance to build a connection between the level of the project's cost-effectiveness and the specific compensation benefits for contractors. Similarly, a system of penalties should be developed to guarantee adequate punishments of irresponsible and ineffective contractors, hence minimising the risk of similar practice realisation in the future.

For the final criterion of cost-effectiveness, the removal of mark-up cost on material and execution, the regression analysis findings demonstrated that only the means of extra-contractual measures

could be applied. In addition to the earlier-stated recommendations, the following determinants could be highlighted as an effective solution: setting a steering committee for decision-making at the procurement phase; outlining coordination of the design and construction works between different work package contractors. According to the data analysis findings, unexpected costs are usually caused by a lack of cooperation and coordination among project stakeholders. The traditional format of cooperation within large construction projects could lead to the inability of contractors to identify the best alternative solution, generating additional costs for the project owner. Thus, in order to address this question, the instrument of the EPCM contract should be applied to establish a specific format of cooperation among stakeholders. Based on such a solution, it could be possible to encourage contractors to develop more reliable and cost-effective solutions for the project. However, the findings in realising objective 3 in the thesis led to the conclusion about the requirement for a complex approach to the realisation of specific benefits of the EPCM contracting model. This specific contracting strategy is associated with a wide list of benefits that could lead to the cost-effectiveness of the project in general. Nevertheless, the realisation of each of the specific benefits is not guaranteed, and the objective of the project management team is to establish the rules of stakeholders' cooperation that would lead to the desired outcomes. Therefore, the recommendations provided in this section of the chapter should contribute to the realisation of the promising outcomes.

6.1.4. Objective 4: Identification of the key categories of risks associated with the EPCM model

The following objective of the study was related to the definition of the key categories of risks relevant for the modern EPCM contracting model, and the identification of the specific risk mitigation strategies applicable to these risk sources. While considering the question of risk mitigation strategy development, it was found that further study in this field should be conducted. Thus, it is necessary to collect and analyse the data presented in reliable and relevant academic literature sources to identify the best risk mitigation practices applied by researchers and practitioners for the management of EPCM contracts. Nevertheless, the results of the literature review and primary data analysis in this thesis also contributed to the identification of the specific categories of risk and key mitigation practices.

The results of risk sources for complex construction projects led to the definition of the following basic list of risks: project scope and feasibility risk, design and specification risk, quality risk, time overrun risk, cost overrun risk, leadership risk, organisational risk, physical resource mobilisation, and utilisation risk, technology risk, contractual risk, force majeure, political and legal risks, financial and economic risks, funding failure risk, communication risks, project execution risk, as well as installation and purchase risks (Bali and Apte 2014). While this list presents general categories of risks for construction projects, it was important to identify a more specialised list of risks common for the EPCM contracting model. Therefore, to address this question, an instrument of correlation analysis was applied. Based on an assessment of correlation level for key categories of the EPCM model benefits and determinants, it was found what specific categories of the EPCM model determinants were vital for the realisation of overall benefits of this contracting format.

Furthermore, methods of logical analysis led the researcher to the conclusion that the determinants that resulted in the highest probability of benefits realisation in the EPCM contracts should also be considered as key sources of risk. In case of failures with the vital determinants of the EPCM contract success, it was obvious that the risk of project failure could, in general, be increased.

The outcomes of correlation analysis of the data presented in the previous chapter of the study contributed to determining the key role of the following EPCM determinants as the sources of project risks: legal and regulatory framework, together with technical specifications and capabilities, extra-contractual measures, and resilience parameters. Furthermore, it is worth considering specific findings for each category of determinants and identifying the main sources of risk for the EPCM contracts. Among specific determinants from the group of the legal and regulatory framework, the following were considered as vital for the realisation of the EPCM project benefits: work packaging design and subcontracting; change orders, permits, and shop drawings' submission and approval; schedule of engineering, procurement and construction, and approval of completed tasks; company standard operating procedures; government auditing protocols and procedures; experience with building codes, by-laws, statutes and other government regulations definition of projects boundaries at an early stage of the project; system completion requirements. Thus, it was stated that the final success of the EPCM contracting model realisation depends on the project team's capability to understand and utilise existing legal and regulatory requirements stated by the governmental regulators. In addition, the project owner should be capable of establishing transparent and effective mechanisms of cooperation with other stakeholders to guarantee full control over key processes during the project. Failures in the

mentioned fields of activity should be considered as main sources of risk for the project in general. Moreover, specific risk mitigation strategies should be developed to address these problems.

For the category of technical specifications and capabilities, the following key determinants were considered: alignment among work breakdown structure (WBS), contracting work breakdown structure (CWBS), cost breakdown structure (CBS), and organisation breakdown structure (OBS); project cost estimate; project construction schedule, cost and quality; the experience of the project teams; the knowledge of site circumstances by the project team members; accurate work drawings and specifications; materials and labour availability and cost; geotechnical circumstances. The findings of the performed data analysis highlighted the significance of adequate knowledge concerning the internal and external environment of the project for the successful application of the EPCM contracting model. The project management team should be able to develop a detailed plan of project realisation for the successful application of this model. Mistakes in any of the earlier-presented steps of project realisation could lead to severe risks for the project in general. Moreover, specific initiatives should be suggested to guarantee effective planning of the project under the EPCM contracting model and develop effective means of knowledge collection in terms of the internal and external environment of the project.

Specific attention was also paid to the analysis of the key determinants of success in the aspect of extra-contractual measures. The following key determinants were identified as the potential sources of risk for the project management team: defining a sufficient level of the delegation of authority within the client project management team; introducing specific terms and conditions for control over purchase orders and work packages; defining appropriate expenditure limit for the

procurement phase assigned for the project director; defining an incentive scheme for the contractor for outperforming at the engineering and procurement phases; setting liquidated damages %ages for each phase of execution; outlining coordination of the design and construction works between different work package contractors; ensuring management, administration and supervision of the work packages; and delivering the project by defining certain key milestone dates. Furthermore, specific activities described in the context of extra-contractual measures could also be considered as the risk mitigation strategies that could be applied in modern companies to succeed in the application of the EPCM contracting model. However, it is possible to compare the activities mentioned in this segment of the discussion with the key sources of risk that were identified earlier. In the majority of cases, orientation towards either of the proposed strategies could contribute to the mitigation of specific risk sources.

To summarise the findings in the context of the stated research objective, the outcomes of data collection and analysis demonstrated that the key sources of risk for the EPCM project were related to the following fields of activity: cooperation and coordination of different stakeholders during the project; planning and control of the project; management and motivation of contractors; as well as control of the environmental conditions that are not under the direct control of the project team. Furthermore, specific risk mitigation strategies should be proposed for the specified groups of risks. Thus, it is reasonable to perform further studies to address each specific risk category in detail. As for the general recommendations concerning the choice of risk mitigation practices, it is important to perform further study to identify specific means and techniques that could allow organisations in the oil and gas sector of Abu Dhabi to address the stated aspects of project management in the most efficient manner.

6.1.5. Objective 5: Key success factors for the application of the EPCM model

The fifth objective of this thesis was associated with the definition of the key success factors relevant in the context of EPCM contracting model application. However, it should be noted that the results of data collection and analysis presented in the previous chapter of the thesis contributed to the definition of the optimal means that could contribute to the maximisation of benefits for organisations in the oil and gas sector of Abu Dhabi that would like to utilise the EPCM contracting model for their projects. In addition to the outcomes of quantitative data analysis, literature review outcomes were applied in the context of this study objective's realisation. The highest contribution to the study of the key success factors in the context of the EPCM contract application was delivered by Wai *et al.* (2012). According to the positions of the research group of Wai *et al.* (2012), the following factors could be considered as key to success for the project in general: factors related to the project, factors related to the project manager and team members, factors related to the organisation, and factors related to the external environment (Wai *et al.* 2012). Thus, it is imperative to consider specific parameters that could guarantee the success of the project in each of the stated groups. The findings of quantitative data analysis should be utilised in this aspect.

For the group of factors related to the project, the results of quantitative data analysis demonstrated that the proper planning and control of the project, in general, should be considered as a key to success. Moreover, the outcomes of analysis for previous objectives of the study should be considered as a reliable basis for the development of conclusions in terms of this specific objective. The type of contracting strategy selected was found to be the most significant determinant of the EPCM contracts among bid and contracting determinants groups. Work packaging design and subcontracting, change orders, permits, and shop drawing submission and approval, together with

clear system completion requirements, were also considered as the important determinants of success in the aspect of EPCM contracting model application. Nevertheless, it should be noted that, without a clear understanding of the potential outcomes of the construction project, management of the oil and gas sector in Abu Dhabi is not likely to achieve success in the application of the EPCM contracting model.

The following group of success factors included those related to the project manager and team members. Furthermore, the outcomes of previous analysis contributed to the definition of a wide range of parameters relevant to this aspect of the problem. However, it should be noted that key determinants of success in operations of the project team included the following: negotiation and communication and coordination among relevant parties involved in the project; decision-making; trust among different project parties; overall experience of engaged parties in different aspects of project management process; and a sufficient level of delegation of authority within the client project management team. Therefore, it is evident that effective organisation of teamwork within the EPCM contracting model is dependent on the capability of parties to develop a reliable communication and cooperation format. One of the main disadvantages of the EPC contracting model was found to be related to the lack of cooperation between project owners and contractors. Hence, the application of the EPCM contracting model could serve as a basis for the resolution of this problem.

Nevertheless, the effective realisation of such an outcome would depend on the capability of project management to distribute responsibilities and roles in the team. It is worth indicating that improper distribution of powers within the team could lead to worse outcomes, removing opportunities for

mutual trust and cooperation. The worst case that could take place is if project team members lose a clear understanding of their role and functions within the project. In this case, it is possible that specific tasks within the project would not be completed properly, since no single actor would consider these tasks as part of his/her responsibility. In such conditions, project owners and management teams should guarantee that all the engaged parties clearly understand their roles within a project.

The discussion of factors related to the organisation also led the researcher to the definition of useful insights into the aspect of key success factors of the EPCM project. The effective organisation of project management in the context of EPCM contracting model application was found to be dependent on a set of determinants. Among them, the following were highlighted by the study respondents: decision-making; information dissemination; reporting structure and responsibilities; schedule of engineering, procurement and construction, and approval of completed tasks; alignment among work breakdown structure (WBS), contracting work breakdown structure (CWBS), cost breakdown structure (CBS), and organisation breakdown structure (OBS); setting a steering committee for decision-making at the procurement phase; defining an incentive scheme for the contractor for outperforming at the engineering and procurement phases. Furthermore, the organisation of the project management process in the context of the EPCM contracting model application was found to be dependent on the effective distribution of roles and incentives among team members.

A specific format of power distribution in the process of project organisation was established to depend on the level of the project owner's capabilities and experience in the field of project

management. When compared to the EPC contracting model, where full responsibility was given to the senior contractor, the EPCM model allows the project owners to take a specific level of responsibility for themselves, depending on their capabilities and experience. In this context, it is of great importance to focus on the level of responsibility correlating with the actual capabilities and experience of the project owners. Otherwise, the desire to concentrate full power in a single pair of hands could lead to failures in the process of the project's realisation.

The final aspect in the assessment of the key success factors included a discussion of the factors related to the external environment. In the process of a quantitative study of the key determinants of the EPCM contracting model application, it was found that the knowledge of the project's environment is important for the successful realisation of the specific project goals. Moreover, high attention should be paid to the following determinants of the EPCM contracting model: government auditing protocols and procedures; experience in local laws and other government regulations, as well as modification in laws and regulations; experience with building codes, by-laws, statutes and other government regulations; definition of projects boundaries at an early stage of the project; knowledge of new technological techniques and materials; environmental circumstances, climate and local weather conditions; knowledge about site circumstances by the project team members; as well as materials and labour availability and cost. Hence, the factors of success related to the project's environment could be divided into two specific categories – the ones that could be controlled by the project team, and the ones that require adaptation of the project plan to specific conditions in the environment.

Taken together, the success in the application of the EPCM contracting model is dependent on a list of factors and determinants. To guarantee the realisation of the planned benefits from the application of the EPCM contracting instruments, the project management team should guarantee compliance with the stated conditions. On the one hand, the EPCM contracting model provides significant opportunities for the development of flexible and adaptive project management strategies, which could allow the project team to reach all the desired project outcomes. On the other hand, if compared to the EPC model, where full power is concentrated in the hands of senior contractors, the EPCM model places a higher level of responsibility on the project owner. The success of the project, in general, could be dependent on the project owner's capability to select the optimal project team structure and the model of responsibilities distribution.

6.1.6. Objective 6: Guidelines for the adoption of EPCM model

The final objective of the study was related to the development of the specific guidelines that should be followed by the senior management of the Abu Dhabi oil and gas sector to guarantee effective application of the EPCM contracting model for large construction projects. Similar to the approach applied to the realisation of the previous study objective, a combination of literature review and quantitative data analysis methods was utilised. The most detailed reply to the stated research objective was provided in the study by Oosterhof (2018). The following types of challenges should be addressed to reach success in the application of the EPCM contracting model: control over contractor; reactive construction management; and accountability in relations between the project owner and the contractor. For each of the specified categories of challenges, detailed guidelines were identified in the context of the study.

The first aspect of effective organisation of project management using the EPCM contracting model was related to control over contractors. To reach success in this field, guidelines for the project management team have to address the following questions: methods of contractor selection, methods of contractor motivation, and control. In the aspect of the selection of contractors, the final decision should be made based on the detailed planning of the project and understanding of the environmental conditions. In case the project owner team has sufficient experience in this aspect of the project management process, it is possible to select a group of subcontractors responsible for the realisation of the specific elements of the final project. In case the project owner lacks the required competencies and skills, it is imperative to select a senior contractor, delivering the required level of responsibility and power to him/her.

In terms of contractors' motivation and control, all procedures should be based on the pre-defined schedule of work breakdown structure (WBS), contracting work breakdown structure (CWBS), cost breakdown structure (CBS), and organisation breakdown structure (OBS). Moreover, it is important to define clear and transparent requirements for each element of the project plan, including quality and cost, as well as schedule requirements for each stage's completion. Consequently, based on the prescribed plan and requirements, the performance of each contractor should be assessed. In case the contractor perfectly complies with the requirements of the project plan or achieves even better outcomes than expected, a system of incentives and additional compensations should be utilised. Similar to this, if the contractor fails to comply with specific elements of plan requirements, a system of penalties and punishments should be applied. However, it should be noted that one of the main advantages of the EPCM contracting model is that it allows the project owner to develop and utilise a system of objective criteria and incentives that could

encourage contractors to be more productive. Such an advantage is absent in the context of the EPC contracting model, which was also considered in this thesis.

The following set of guidelines was developed to address the challenge of reactive construction management. As stated earlier in this chapter of the study, the success of the EPCM contracting model is highly dependent on the ability of the project management team to comply with the changes in the project's requirements. The initial project plan could include a detailed scheme of works distribution, but it cannot guarantee high sustainability of all project stages in the conditions of a changing environment. Thus, in order to succeed in the application of the EPCM contracting model, the management should obtain sufficient knowledge of the environment of the project, and experience in the field of project plan adaptation. Specific aspects of the environment that were found to be vital in the context of the study included information about the materials and their costs, state regulations applied to the project, as well as site conditions and climate changes in the zone of the project's realisation. Furthermore, specific focus was placed on the factor of the availability of information about technological innovations that could be applied in the context of the project's realisation.

The success of the EPCM contracting model is dependent on the capability of the project team to manage all the earlier-presented types of information about the project's environment. In the early stage of the project's realisation, it is important to develop a system of knowledge management about the environmental conditions and challenges. Such a system should serve as a basis for the early definition of potential sources of challenges and risks, prevention, and mitigation strategy development. In case such a system is not developed initially, there is a risk that unfavourable

environmental conditions would lead to the accumulation of failures and mistakes in the separate stages of the project's realisation, leading to the failure of the project in general. The final category of challenges addressed in the context of the stated objective of the thesis included the factor of accountability in relations between the project owner and the contractor. As earlier stated, the success of the EPCM project depends on the ability of project team members to develop a model of effective cooperation and communication. This argument is especially relevant in the context of the relationship between contractors and project owners. Primary attention should be paid to the question about the initial distribution of responsibilities and functions in the project team. The project owners are capable of delivering any specific level of power and responsibility to contractors, depending on their capability to take on a specific part of the functions during the project.

However, to address the problem of accountability in the relationship between contractors and project owner, it is important to develop a system of reporting and communication between parties in the initial phase of the EPCM project. In the context of the project schedule, it is reasonable to define specific milestones that have to be met by each specific contractor and provide requirements for the organisation of the reporting process in each step of the contractor's performance. The main objective of the project owner should be related to the organisation of a stable flow of information from the project contractors, adequate estimation of the current state of the project, existing opportunities, and risks. Specific elements of the contractors' reports should be initially clarified for the parties to optimise the process of communications. Taken together, the application of the EPCM contracting model in the oil and gas sector of Abu Dhabi was found to be associated with a wide list of challenges and requirements. It is imperative to mention that success in the application

of the EPCM contracting model would require the project owner to implement a wide set of guidelines addressing each of the earlier-identified categories of potential challenges. The most significant sources of risk for the EPCM project could potentially include questions of coordination and communication between the project owner and contractors, and the problems of the adaptation of the project plan to the existing environmental conditions. Nevertheless, specific recommendations provided in this chapter of the thesis should contribute to the successful implementation of project objectives with the EPCM contracting model.

6.2. Chapter summary

This chapter has discussed the key findings of data analysis in the context of the stated study objectives. The first question addressed was related to the discussion of the key theoretical and practical differences between the EPCM and EPC contracting models. It was established that the EPC contracting model could be considered as an effective alternative solution for project owners who lack experience and competencies in the field of complex project management. Nevertheless, the EPCM contracting model could be considered as a more flexible and effective contracting approach if project owners were capable of effectively distributing responsibility within the project team and guaranteeing control of the contractor's performance.

Key categories of benefits from the application of the EPCM contracting model that could be applied in the context of the oil and gas industry of Abu Dhabi could be achieved through improved cooperation between project owners and contractors, detailed planning, and control of each phase of the project, and a clear understanding of the existing conditions in the project's environment. Moreover, cost-effectiveness benefits of the EPCM contracting model could be achieved by careful

planning and control of the materials procurement processes, effective monitoring, the motivation of contractors, and the assessment of the risks of increases in material prices in the market. In the context of the EPCM contracting model application, it is important to define strict limits for the project budget, encouraging contractors to comply with the budgetary requirements. The role of the project owner should be associated with strict control of budget regulation, preventing unnecessary losses on the part of contractors.

Key risks and success factors in the context of the EPCM contracting model application were also identified in the context of the study. Based on the study outcomes, specific recommendations and guidelines were developed for the management to follow in the aspect of effective utilisation of the EPCM contracting model. It was stated that project owners should pay specific attention to the aspects of contractors' relationship management, planning and control of all stages of the project, as well as control of the environmental conditions for the project in general. Without adequate attention to all the stated aspects of project realisation, the EPCM contracting model could not guarantee the realisation of the desired result and satisfaction of all the needs of engaged stakeholders.

CHAPTER SEVEN: MODEL DEVELOPMENT, VALIDATION AND VERIFICATION

7.0. Introduction

This chapter of the research addresses the problem of the development of the end study model, its validation and verification. In the context of Chapter three, a conceptual framework was developed to clarify the theoretical model of the relationship between the characteristics of the EPCM contracting solution and the end outcomes for the management of large construction projects in the oil and gas sector of the UAE. The objective of the research was to assess the reliability and validity of the proposed conceptual framework model based on the findings of primary data analysis as a result of the survey questionnaire method application. This chapter provides a grounded discussion of the key study findings in the context of the proposed conceptual framework of the study. Moreover, it was important to show whether the proposed structure of the independent variables is relevant and valid for the description of the impacts of the EPCM contracting model on the outcomes of project management in the oil and gas sector of the UAE.

The resolution of the stated objectives of the chapter was performed based on the summarisation of the findings of the previous study and application of the specific validation and verification methods to guarantee the definition of the narrow list of parameters that should be considered in the context of the EPCM contracting model application in the UAE oil and gas sector. The results of this chapter include the definition of the final vision of the conceptual model for the description of the relationship between the EPCM contracting model features and the character of the outcomes

for the UAE oil and gas sector. Furthermore, specific implications of the model are identified in the format of practical recommendations for the management of large construction projects in the oil and gas sector of Abu Dhabi and the UAE.

7.1. Aim of the chapter

Previous chapters of the thesis addressed all the key aspects of the performed research. It was important to understand the role of the EPCM contracting model in the realisation of large construction projects in the oil and gas sector of Abu Dhabi and the UAE. It was demonstrated that the target industry was highly dependent on the successful realisation of large construction projects, and the project management teams required reliable instruments of management and control that would allow them to reach the desired goals of construction projects without excessive costs and risks for the project outcomes. The previous chapters of the study discussed the specific opportunities and challenges related to the application of the EPCM contracting model to the selected field of practice. The analysis of the study problems included the literature reviewed and the collection of primary data from the practitioners operating in the target field of project management. Results of primary and secondary data collection and analysis contributed to the resolution of the stated research questions and the definition of the main theoretical and practical implications of the research. All the findings of the study were grouped following the conceptual framework model identified in the previous sections of the study.

This chapter of the final thesis provides the verification and validation of the end conceptual model that could describe the relationship between the EPCM contracting model characteristics and the outcomes of project management based on this model for companies in the Abu Dhabi oil and gas

sector. However, it was important to apply the outcomes of primary and secondary data analysis to the initial conceptual framework to define the contents of the final model. Outcomes of data collection and analysis could contribute to the verification of the initial model or concluding the need for exclusion of part of the parameters from the final scheme. The results of this chapter had to form the basis for practical implications that would generate high use for the end practitioners – project management teams operating in the oil and gas sector of Abu Dhabi and the UAE.

To address the aims of this chapter, a specific structure was followed. First, this chapter considers the question about the relevance of the model presented. It was essential to provide strong arguments that would persuade theorists and end practitioners about the relevance of focusing on the end conceptual model. Following the clarification of the model's importance to the target audience, the researcher presents the details of the model's verification and validation process. In this context, it was important to describe the key objectives, process and results of the model's verification and validation. From the researcher's viewpoint, the provision of sufficient details about this aspect of the performed work had to form the basis for the development of a position about the high relevance and reliability of the proposed theoretical and practical implications. The absence of sufficient verification and validation procedures for the outcomes of the study could create reasons for concerns about the usefulness of the end study recommendations among the target audience.

Following the verification and validation process, the procedures of model development and presentation of model implications were performed. The procedure of verification and validation of the model contributed to the definition of the full list of characteristics of the EPCM contracting

model that should be included in the end model. Therefore, based on the summary of end characteristics of the model, specific practical implications for the target audience of professionals were identified. It was possible to define specific parameters of the EPCM contracting model that should be effectively managed by the project management teams to reach optimal outcomes of project realisation in the oil and gas sector of the UAE. Altogether, this chapter of the research serves as the definition of the end implications of the study and recommendations for practitioners in the field of the EPCM contracting model application.

7.2. The need for the model

The first question addressed in this chapter is related to the discussion of the importance and relevance of the model that would be delivered in this part of the final thesis. It was important to demonstrate the significance of the proposed solution and the presence of the target population ready to apply effective innovations in the target field of operations. For the situation in the UAE oil and gas sector, it was demonstrated in the previous chapter of the thesis that the industry is occupied by a high number of local and multinational companies interested in the realisation of large construction projects. This sector plays an important role in the national economy of the UAE and the regional economy of the Abu Dhabi Emirate. Furthermore, the findings of previous analysis demonstrated that the oil and gas sector is currently focusing on a search for efficient project management solutions that would allow the industry to manage future large construction projects. In this context, the requirements of the Abu Dhabi Economic Vision 2030 programme should be mentioned. This programme defines the need to reform the oil and gas sector in the Emirate through the creation of a new infrastructure and business capabilities for players. Such a policy shift means that the organisations would achieve new development opportunities, and the competitive powers

of specific companies would depend on their capability to utilise the available opportunities during large construction and expansion projects. The need for a reliable practical solution for the organisation of large construction projects in the Abu Dhabi oil and gas sector is also explained by the character of competition existing in the market. Currently, equal shares of domestic and multinational companies are present in the target market. This fact means that local players with headquarters in the UAE would have to compete with considerably larger and stronger global players, which differ from the UAE-based businesses in terms of managerial efficiency and resource security. Therefore, to form strong competition to the foreign players, domestic businesses should be provided with practical recommendations for effective organisation of strategic development projects. Moreover, it was important to define project contracting solutions that would minimise risks and expenses for the domestic players.

Altogether, the need for the study model that will be presented further in this chapter was explained with the presence of a strong potential demand for the proposed solution. Domestic business in the UAE oil and gas sector is supposed to be interested in recommendations that would allow them to form an asymmetric strategy of competition against multinational organisations in the local energy market. Thus, the definition of the key parameters of the EPCM contracting method performed based on the model implications could give practitioners a better understanding of the principles of project contract management. This conclusion creates the basis for the identification of the high relevance and utility of the end research model discussed in this chapter of the study.

7.3. Verification and validation objectives

The key element of the research model assessment included the procedure of the study process and verification and validation of outcomes. Before the discussion of the specific elements of the verification and validation procedure applied in this study, it is reasonable to present the general nature of the phenomenon of validation and verification. Anderson *et al.* (2007) identified the procedure of verification and validation as a process of the application of a set of approaches and methods focused on the assessment of the accuracy and reliability of the specific model in reference to the identified research problem. Verification could be defined as the process of determining the accuracy of the conceptual description of the studied phenomenon with the proposed theoretical model. In the aspect of validation, this process is oriented towards the comparison of computational predictions with experimental data to assess the modelling error. In the context of the proposed definition of the validation and verification process, it was possible to identify the key objectives of the verification and validation procedure about the stated study problem. In the context of the study, the researcher aimed to analyse different aspects of the EPCM contracting model application to reach a valid understanding of this contracting model's parameters that mainly contribute to the realisation of the desired outcomes in the field of project management. It was important to guarantee that the proposed structure of the EPCM contracting model parameters is relevant to the description of the role of this contracting method in application to the field of the Abu Dhabi oil and gas sector operations.

Due to the specifics of the functions stated for the procedures of verification and validation, it was important to divide the specific objectives relevant for both elements of results analysis. In the context of verification of the study processes and outcomes, it was stated that the procedure mainly

orients on the definition of applicability of the proposed methods of study results definition (Song and Fu, 2018). From this perspective, the objectives of the verification procedure had to include the assessment of the reliability of the selected data collection and analysis methods in the context of the stated research objectives' realisation. Therefore, the following objectives were identified for the verification element of the study analysis:

- Define the applicable data collection and analysis methods for the realisation of the study objectives;
- Estimate the key sample characteristics from the point of their impact on the prospective study outcomes;
- Assess the quality of data collection outcomes and development of a reliable database for the aims of analysis;
- Assess the effectiveness of data analysis methods and the estimation of the quality of the end study findings.

The procedure of study outcomes validation was defined as a set of activities aimed at demonstrating whether the results of the study adequately describe the existing reality (Song and Fu, 2018). In this way, the researcher aimed to clarify whether the findings and implications of the study could be considered as a reliable basis for the description of the existing reality and the development of practical recommendations. Thus, the following objectives of the validation procedure were identified:

- Assess the reliability of research findings in the aspect of the description of the existing reality in the selected field of study;
- Critically estimate the applicability of the study findings in the context of the development of practical recommendations for the target population.

Therefore, the outcomes of the verification and validation procedure during the study had to contribute to the development of a realistic and reliable research model. This model was supposed to describe the realistic relationship between separate parameters of the EPCM contracting model and the dependent variable – the outcomes of the EPCM contracting model application in the UAE oil and gas sector. At the end of the verification and validation procedure, specific elements of the study model were defined.

7.4. Verification and validation process

The previous section of the chapter introduced key objectives and motives of the researcher during the verification and validation procedure. The realisation of the stated objectives was grounded on the application of the set of methods. A set of verification strategies applied during the study followed general principles mentioned in previous studies. For instance, Morse *et al.* (2002) identified the following methods of study verification: methodological coherence realisation; appropriate development of the sample; appropriate selection of data collection and analysis methods; and theoretical thinking and development of the theory template for assessment during the study. Each of these elements of the verification process should be considered together with the specific steps taken during the study. In the aspect of methodological coherence realisation, it was important to guarantee a correlation between the research methods and the stated research questions. Key research questions were summarised in the introduction to the study. Based on the comparison and analysis of specific methods of data collection and analysis that could be applied in reference to the stated questions, it was found that the survey questionnaire methodology would perfectly fit the required objectives. The following criteria were applied for verification of the

research method: opportunities for the generalisation of the study outcomes; high reliability of the study outcomes grounded on the collection of data from the target population. Compared to other research methods that could be applied, it was found that survey questionnaire analysis was the most promising.

The procedure of appropriate development of the study sample was based on the selection of the appropriate sample size and characteristics of the study participants. In the process of defining the sample characteristics, the researcher grounded his decision on the study of the sampling technique applied in previous studies for a similar problem. Consequently, a purposive non-probability sampling technique was applied to guarantee the inclusion of participants who could deliver the most useful information in the context of the research questions. A set of participation criteria, including age, gender, work experience, and other parameters, was applied to guarantee the equal representation of target population groups in the sample. The process of appropriate selection of data collection and analysis methods included the development of a reliable survey form that would allow the researcher to gain access to useful knowledge that was not present in previous studies. The basis for the development of the survey form included an analysis of relevant academic and non-academic literature discussing the research problem. In this way, the researcher gained a deeper understanding of the research problem and existing knowledge in this field. Based on the knowledge gaps identified during the literature review, the researcher developed a survey form addressing these gaps.

The criterion of theoretical thinking during the development of the research methodology was performed via a specific focus on a high number of relevant theories that described the field of

study. Previous chapters of the thesis provided a discussion of the research problem in the context of the following theories: complex system theory (CST), agency theory and transaction costs economy (TCE) theory. All of the stated theories formed the basis for the definition of the main parameters that should be included in the conceptual framework of the study.

In this way, the procedure of the theory template's development for assessment during the study included the formation of a list of parameters for the EPCM model that could impact the outcomes of this contracting method's application in the target industry. The list of parameters was identified based on the outcomes of the literature review and analysis of the mentioned theories. The objective of the study was to assess the relevance of the application of each of the proposed parameters in the end study model.

Together with the process of research verification, a set of activities was performed to guarantee the validity of the study outcomes. The following aspects of research validity were assessed: internal validity, external validity and statistical conclusion validity. Each of the stated criteria served for the assessment of the quality of the study outcomes for the concrete dimension. Internal validity served for the assessment of the actual level of impact for the dependent variable caused by the independent variable (Hawkins *et al.* 2019). Furthermore, the following methods of internal validity assessment were applied: triangulation and reflexivity. The nature of the triangulation method is to assess the validity of the study outcomes based on a discussion of similar questions using several research methods. For the present study, the researcher utilised methods of survey questionnaire and literature analysis as separate methods addressing similar questions. The method of reflexivity included subjective assessment of the reliability of the study outcomes based on the subjective opinion of the researcher.

However, external validity criteria are applied to assess the quality of the study outcomes from the point of their generalisation. In the context of the study, external validity was assessed to define whether the outcomes of the study could be applied to explain the research problem for a larger sample (Im *et al.* 2019). Methods of external validity assessment included a thick description of the phenomena under study and variation in the selection of participants. The earlier discussion of the verification process demonstrated that the researcher aimed to collect reliable and relevant data from a large scope of participants, who also differed in their personal and professional characteristics. The instrument of thick description was applied through the development of a detailed survey form, which included a sufficient number of questions for a description of the key study parameters. The final element of the validation process included statistical conclusion validity assessment. To guarantee statistical conclusion validity, the researcher applied instruments of correlation and regression analysis, together with general descriptive statistics. The researcher also assessed primary data from the viewpoint of actual connection existing between the independent and dependent variables identified in the conceptual framework of the study. Altogether, the applied verification and validation methods had to contribute to the development of reliable and relevant study outcomes.

7.5. Verification and validation results

The final element of the verification and validation process included the presentation of the results gained from the application of the identified methods. First, the results of the verification procedures realisation should be summarised. The methodological coherence of data during the study was guaranteed with the reliance on the theoretical constructs describing the relationship

between the dependent and independent parameters of the study. In this context, the outcomes of the application of the defined theories contributed to the development of a reliable conceptual framework describing key parameters of the EPCM contracting model from the viewpoint of impact on the outcomes of project management in the UAE oil and gas sector. The results of the development of an appropriate data sample were demonstrated in Chapter five of the study. The researcher managed to form a reliable and representative sample that included participants with a high variety in aspects of work location, nationality, age, years of work experience, education, job position and level, skills, and competencies. The characteristics of the sample population demonstrated that specialists with different levels of personal and professional traits were included in a single study. Such an outcome also contributed to the external validity of the study since the researcher was capable of forming a general understanding of the research questions among the varied categories of the target population.

The verification of the applicability of the data collection and analysis methods led to the formation of a wide list of survey questions, which were grounded both on the findings of previous studies and the identified knowledge gaps. Theoretical grounding of the conceptual framework formed a reliable basis for the creation of a theoretical model that would describe the impacts of the specific parameters on the dependent variable. The findings of the study led to the formation of a reliable model that identified practical implications of the study from the target population. In the aspect of validation of the study outcomes, a comparison of the literature review and survey questionnaire analysis demonstrated a moderate level of internal validity of the study results. These findings led to the exclusion of some parameters from the final model and optimisation of the study implications. Statistical conclusion validity assessment demonstrated a high level of correlation

between the independent and dependent variables of the study, while the outcomes of regression analysis identified high reliability of the key regression models for the resolution of the study questions. Based on the outcomes of the verification and validation process and its outcomes, the final study model was developed.

7.6. Model development

The results of the application of the specific verification and validation methods included the development of a more concrete image of the study model, which would serve as a basis for the definition of the specific practical and theoretical implications of the study. It was important to summarise the findings of data collection and analysis in the form of an end theoretical model describing the relationship between the parameters of the EPCM contracting model and the outcomes of project management in the Abu Dhabi oil and gas sector. The proposed study model differed from the conceptual framework model that was discussed earlier in this study. The main difference was related to the exclusion of some independent parameters that did not demonstrate significance for the dependent variable based on a statistical analysis of the survey outcomes. The first step taken in the context of the development of a theoretical model that could be applied for the aim of identification of practical implications for project management teams in the context of the UAE oil and gas sector included the justification of the conceptual framework presented in the previous chapters of the study. The conceptual framework was a basis for the development of the regression analysis procedure, which demonstrated the significance of each of the independent variables for an explanation of the key characteristics of the dependent variable. The process of the assessment of the reliability of inclusion of each parameter of the EPCM contracting method into

the final study model was performed based on correlation and regression analysis, used for the earlier-stated questions of the study.

The findings of the correlation and regression analysis presented in chapters five and six of the thesis contributed to the definition of the final image of the study model. Compared to the initial conceptual framework presented in Figure 5, the final model of the study applied to the aim of developing practical implications lacked the following independent variables: project bidding and contracting; as well as project information and management process. These variables were excluded from the final model of the study because the findings of the data analysis in chapters five and six demonstrated the low significance of these variables for the resolution of the specific study questions. In this way, it was possible to indicate that the integration of these specific parameters in the process of developing practical implications would not contribute to the creation of effective recommendations with a high positive effect for the target population. These parameters are related to the positive outcomes of the EPCM contracting model's application in the target field. Nevertheless, the findings of the correlation and regression analysis demonstrated that the benefits from their integration into final practical recommendations are limited; thus, they were excluded from the final model. The image of the end study model is presented in Figure 6.

The presented model of the dependent and independent variables also differs from the conceptual framework of the study through the inclusion of a set of mediation variables, which served for the summarisation of success factors of the EPCM contracting model's application in the target industry. The results of the study presented in chapters five and six contributed to the identification of the specific categories of key success factors that are supposed to contribute to the effective application of the EPCM contracting model in the oil and gas sector of the UAE and Abu Dhabi

Emirate. It was found to be essential to add these parameters to the final study model to guarantee a full understanding of the conditions of EPCM contracting method application among the target population. In the context of statistical analysis of the primary data collected during the survey, it was established that the parameters of legal and regulatory guidelines, technical specifications, extra-contractual measures, and resilience parameters played a key role in the successful application of the EPCM contracting model in the target industry. Nevertheless, the presentation of the mediation variables was important to the target population to understand specific practices that are required to deliver the desired outcomes of construction projects through the EPCM contracting model. The findings of the study, including the practical guidelines, will be delivered in the following parts of this chapter.

The role of the mediator variables presented in Figure 6. was associated with the highlight of the factors that could impact the level of independent variables' impact on the specific contracting outcomes – the effectiveness of the EPCM contracting model. While the independent variables were found to be of highest importance for the effective utilization of the EPCM contracting model in the oil and gas industry projects, the mediating variables demonstrated their significance for the maximization of positive impacts of independent parameters on the dependent ones. Effective stakeholder communication was important for optimization of the EPCM contracting terms, allowing parties to consider interests of each stakeholder group in the end contracting model. Reliable method of contractor's selection was important as a factor that determined the end utility of the EPCM contracting model for the specific project. In case if poor selection of contractors was performed, the EPCM contracting model would not have contributed to the successful realization of the project objectives. The role of risks and responsibility distribution model was associated

with the need for early and careful assignment of responsibility to the specific project stakeholders to avoid risks and losses for the project. Finally, engagement of the project owner in the process of the EPCM contracting model development was found to be valuable for integration of the project owner's interests into the end contracting approach. Altogether, while the mediator variables were not considered as significant factors of dependent variables' change, they were integrated for the aims of end EPCM guidelines development in future construction projects.

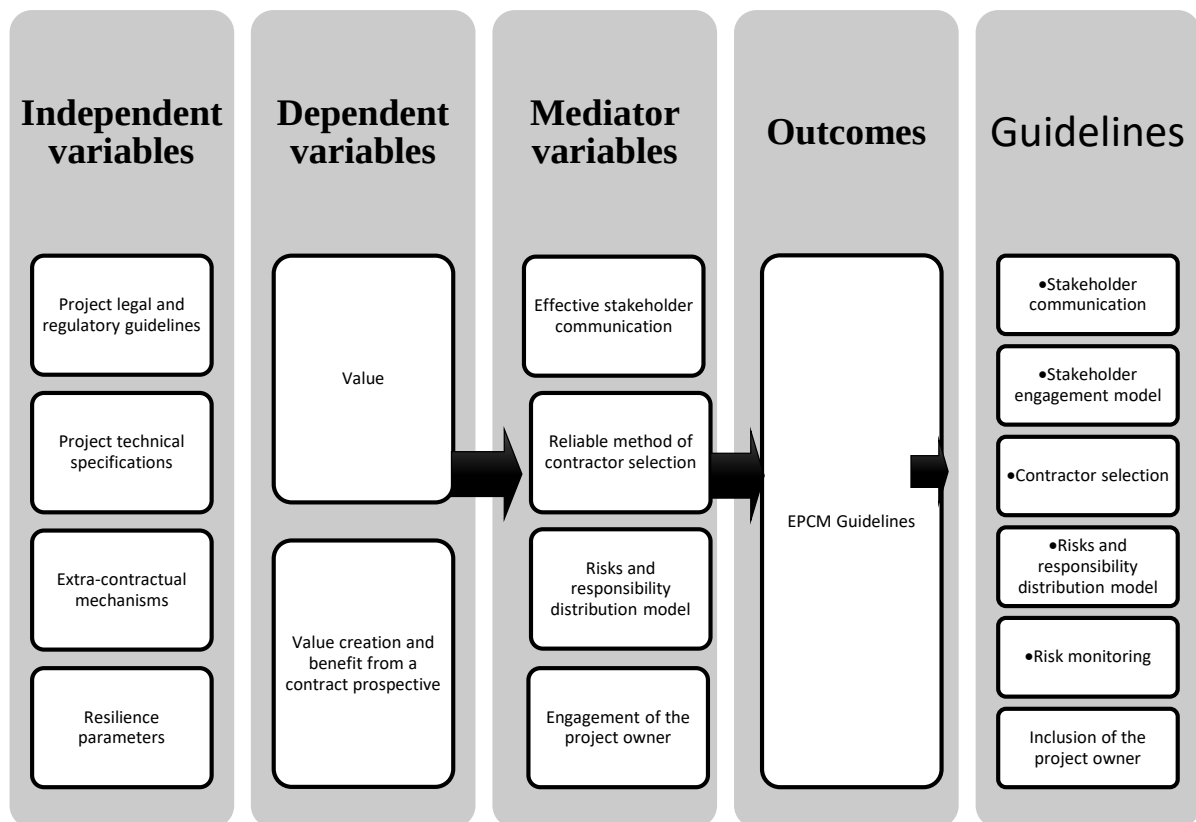


Figure 6 : Proposed model

Source: Author

An important element of the model development process included the presentation of the contents for each independent variable identified in the end study model. As evident from Figure 6, four key categories of the independent variables were included in the study. The results of the data collection and analysis in chapters five and six led the researcher to the conclusion that successful application of the EPCM contracting model in the UAE oil and gas sector requires a specific focus on the full list of parameters identified for each of the presented categories of independent variables. From this perspective, it was important to indicate the fact that all the parameters for each of the independent variables presented in the end study model are also included in this model. In the process of the development of practical implications of the model, these parameters should be included. A graphic presentation of the key parameters is delivered in Figure 7.

Project Legal and Regulatory Guidelines	Work packaging design and subcontracting
	Schedule of engineering, procurement and construction, and approval of completed tasks
	Company standard operating procedures
	System completion requirements
Project Technical Specifications	Alignment among work breakdown structure (WBS), contracting work breakdown structure (CWBS), cost breakdown structure (CBS), and organisation breakdown structure (OBS)
	Knowledge on new technological techniques and materials
	Knowledge about site circumstances by the project team members
Extra-Contractual Mechanisms	Defining sufficient level of delegation of authority within the client project management team
	Setting a steering committee for decision taking at the procurement phase
	Defining an incentive scheme to the contractor for outperforming at engineering & procurement phases
	Setting liquidated damages percentages for each phase of execution
	Introducing terms & conditions discouraging unnecessary claim submissions by contractors
Resilience Parameters	Identifying the EPCM strategy for the right scope of work provides resilience in project execution
	Flexibility in all phases of the project
	Agility in introduction of new mitigation for introduced risks

Figure 7: Independent variables of the study

Source: Author

7.7. Model implications

The implications of the study model included specific recommendations and solutions proposed for the target population. The target population of the study included project management of large construction projects in the Abu Dhabi oil and gas sector. It was important to provide them with reliable guidelines for the development of the EPCM contracting solutions applicable in the specific conditions of their projects. From the point of the key objectives of the study, the end model implications had to meet certain criteria. First, it is important to deliver guidelines that would be characterised by a high level of generalisation. It is important to deliver EPCM contracting guidelines that would be applicable in any type of organisation operating in the Abu Dhabi oil and gas sector, without dependency on the scale of its operations, the scope of the construction project, or other terms. Moreover, the expected EPCM contracting guidelines should be oriented towards the realisation of contracting solutions with minimal costs and risks for the target population. Therefore, based on the realisation of the proposed guidelines, the project management team should be capable of minimising the negative impacts of project-related risks and optimising the costs of the end project.

Specific implications of the study should be divided into two categories: the implications related to the independent variables of the study and the implications related to the mediation variables. The implications related to the impact of the mediation variables of the model aim to present the impact of the key success factors in the application of the EPCM contracting model. Specific solutions and guidelines that should be proposed based on a discussion of the mediation variables of the study include the following:

- Development of an effective stakeholders' communication framework;
- Orientation on the development of a stakeholders' engagement model that would allow management of the project to integrate stakeholders' interests into the decision-making process;
- Application of a reliable method of contractor selection for the EPCM contracting model;
- Specific criteria for contractor selection should be developed for the EPCM contracting model to achieve success. Management should apply concrete criteria based on project conditions;
- Delivery of a transparent and effective risks and responsibility distribution model in the EPCM contract;
- Development of an effective system of risk monitoring for the EPCM contracting model.
Success of the contracting model depends on efficiency of current progress monitoring by project owner;
- High level of inclusion of the project owner as an active stakeholder in the EPCM contract;
- Increase of contract terms and structure flexibility to guarantee adaptability of the project to the changing environment conditions;
- Clear definition of the assigned scope of works and desired result in the EPCM contract;
- Application of a transparent incentive scheme for the contractors in the EPCM contract;
- Clarification of technologies that should be integrated into the project in the contract terms;
- Development of a standardised legal scheme of project management in the EPCM contract.

The first implication of the mediation variables' analysis included the definition of the importance of the inclusion of an effective communication scheme for stakeholders in the contract. To achieve success in the field of the practical application of the EPCM contracting model for the realisation

of UAE oil and gas sector projects, the project management team should integrate terms of the contract that would define the obligations of parties for transparent and effective communications during the project. One of the main sources of failure for the EPCM contracting model in its application to construction projects is the lack of communication among stakeholders. Thus, it is important to utilise the mechanism of contracting terms to guarantee that the project management team and the project owner would be capable of collecting and delivering all the required information to external stakeholders.

The second important implication of the study was related to the definition of the role of the proper selection of contractors for the success of the EPCM contracting model. The earlier-identified independent variables of the study model contribute to the successful realisation of the project management objectives depending on the quality of contractor selection. From the viewpoint of this finding, it is recommended that the management of large construction projects in the UAE oil and gas sector should rely on efficient methods of contractor selection. The presented study did not deliver specific methods of contractor selection, since this theme is highly specialised, and specific companies could rely on their own methods and criteria of contractor selection. Further study could be oriented towards a discussion of the specific methods that could be applied in the process of contractor selection for the target industry. The third important implication of the study model included the importance of delivery of a transparent and effective risks and responsibility distribution scheme for users of the EPCM contract. A scrupulous study of academic literature sources demonstrated that one of the most relevant sources of failures in the realisation of construction projects using the EPCM contracting model was a poor understanding of the expected responsibilities among the stakeholders engaged in the project. Specific contractors might not

figure out that the concrete task is in their field of responsibility, which would lead to a lack of task realisation and delays in the whole project. Thus, in addition to the distribution of roles, responsibilities for failures and delays should be clarified.

The final implication of the study model included a definition of the importance of project owner inclusion in the EPCM contract as an active stakeholder of the project. Compared to the EPC contracting model, which was also discussed in the study, it was found that the success of the EPCM contracting model application is highly dependent on the proper definition of the role and functions of the project owner as a member of the project management team. Therefore, practitioners in the UAE oil and gas sector should rely on the proper definition of the responsibilities and role of the project owner, clarifying these aspects in the contract. Altogether, the results of the proposed study model application contributed to the definition of a large number of practical implications that would serve as a reliable basis for future decision-making and application of the EPCM contracting model. The management of the oil and gas companies in the UAE should rely on the proposed implications as a source of the EPCM contracting model guidelines. Key results of the study together with practical recommendations are presented in the following chapter of the research.

The current study also led to the definition of global implications and recommendations applicable for contractual management of megaprojects in other industries and regions. The similar principles of the EPCM contracting guidelines development could be tested from the point of their applicability in other practical conditions. The most important implications of the study from the point of global business projects' objectives included the recognition of the early stakeholders

engagement' significance (especially the project owner); the importance of contractors' selection mechanism development based on the end needs of the project owner and other stakeholders; application of the reliable risks and responsibility distribution scheme in the process of project management; standardization of legal scheme and technologies applied for the needs of project management; transparent distribution of tasks among contractors and promotion of the adaptive incentives scheme for the contractors.

All these principles should form the basis of the contractual management model creation in modern construction business. Ignorance of either of the proposed insights could lead to the significant negative outcomes for the project owner and other engaged stakeholders. Future project management teams should orient on the search of optimal balance between standardization of legal and technical requirements and the flexible adoption of contracting terms related to distribution of work and incentives scheme. The EPCM contracting model's advantage includes opportunities for combination of standardized and flexible solutions in the process of the contracting approach development. Future generations of project owners and managers should learn to apply this advantage for the benefit of project outcomes.

7.8. Chapter summary

This chapter of the study has summarised the findings of data collection and analysis, which were presented in chapters five and six, to develop the final study model, applicable to the delivery of the specific EPCM contracting guidelines to the target population. The importance and relevance of the proposed model for the target population were identified. This chapter also summarised the information about the verification and validation procedure applied in the context of the study.

Specific verification and validation instruments applied during the research demonstrated the general applicability of the selected data collection and analysis methods, together with the high validity of the study outcomes in the aspect of the explanation of the study field. Based on the identified model of the study, specific implications of the research were identified. The final research model was different from the conceptual framework presented in the previous sections of the study, mainly in the aspects of the exclusion of project bidding and contracting; project information; and management process parameters from the list of independent variables. They were excluded from the end model mainly due to the findings of data analysis. It was established that, though they play a specific role in the realisation of benefits from the application of the EPCM contracting model in the target industry, the scope of benefits generated is considerably lower compared to other independent variables of the study. Therefore, the researcher decided to integrate the most valuable independent variables in the model for the development of the practical implications. Together with the definition of key independent variables in the study, the research model included a list of mediator variables. These parameters played the role of key success factors contributing to the realisation of the expected benefits from the impact of the independent variables on the dependent parameters of the study. It was found during the study that these parameters should also be included in the final model since, without their realisation, the expected benefits from the independent variables of the study could be reduced.

CHAPTER EIGHT: CONCLUSIONS AND RECOMMENDATIONS

8.0. Introduction

Previous chapters of the study formed the basis of the research, presenting the key elements of the research process, literature review outcomes, methodology of the study, as well as the results and implications of the study. This chapter summarises the key implications and findings of the study as the basis for the definition of the practical recommendations for different stakeholders of the research project. The primary objective of this chapter was to identify the overall contribution of the presented study in the context of the stated research objectives. In following the definition of the main contribution of the research process and its outcomes, specific recommendations were developed for the stakeholders of the study. Primary stakeholders of the research project included senior project practitioners. This study addressed the specific challenges of organisations operating in the oil and gas sector of Abu Dhabi and the UAE. Furthermore, it was important to understand what specific challenges are experienced by this type of organisation in the context of large heavy engineering project management and propose effective solutions aimed at improving the current situation. The implications and recommendations of the study were based on the findings of the literature review and analysis of primary quantitative data collected using a survey questionnaire. The study participants included policymakers – actors specialised in the development of legal regulations in the field of large construction project development for the UAE oil and gas sector. In the context of the needs of this type of participant, it was important to define the specific steps that would allow policymakers to support organisations facing the need for large heavy engineering construction project realisation. As established in this study, policymakers are mainly interested in

the improvement of the business climate in the local region and the generation of benefits for the largest number of stakeholders engaged in such a project.

The next aspect of the research addressed in this chapter includes recommendations for further research. In this context, it was important to identify specific steps that could be taken in the future to generate a higher scope of useful knowledge in the context of the research field. The final element of the chapter includes a discussion of the research limitations. The analysis of the specific limitations of the study also had to contribute to a better understanding of the potential issues concerning the study implications and opportunities for further study.

8.1. Contribution of the research

The primary question addressed in this chapter of the study includes the definition of the research contribution. The specific contribution of the study could be clarified based on the range of questions addressed during the study and the main findings defined in this context. The primary question addressed during the study comprised the definition of the significance of the project management theme for the target industry. It was established that the oil and gas sector plays a significant role in the economic development of Abu Dhabi and the UAE in general and that the future development of the industry is related to the successful realisation of large construction projects in different fields. Based on the presented findings, the relevance of the study problem was identified.

8.1.1. Objective 1: Establish theoretical and practical differences that exist between EPCM and EPC contracting models.

Another important contribution of the study included the identification of the main differences between the EPC and EPCM contracting models. While the presented research aimed to consider key characteristics of the EPCM contracting model in the application to the needs of project management for the UAE oil and gas sector, it was also important to define specific differences between this and the other most popular contracting model applied in modern business. It was established that the EPCM contracting model could provide more flexible conditions for the participation of the project owner in the process of the project's management and realisation. Nevertheless, the application of these advantages is highly dependent on the capability of the project owner to arrange effective cooperation and communication with contractors and other project stakeholders using the EPCM contracting mechanism. In this way, the research formed the basis for understanding opportunities for the application of the EPCM contracting model in the target industry.

8.1.2. Objective 2: Ascertain how key benefits that are aligned to the EPCM project contracting model can be adopted by senior project practitioners delivering oil and gas projects in Abu Dhabi; and

8.1.3. Objective 3: Determine how senior project practitioners delivering oil and gas project in Abu Dhabi can achieve cost effectiveness through the adoption of the EPCM model.

In following the definition of the key perspectives of the EPCM contracting model application in the target industry, it was important to identify specific parameters of this contracting mechanism that should be estimated during the process of contract management. The results of the literature

review and primary quantitative data analysis led to the definition of the main characteristics of the EPCM contracting model that should serve as a basis for the effective realisation of the objectives of heavy engineering project delivery. It was found that the success of the EPCM contracting model utilisation for the needs of the UAE oil and gas sector depends on the application of the following determinants of the EPCM contracts: project legal and regulatory guidelines; project technical specifications; extra-contractual mechanisms; and resilience parameters. In the context of the study findings, it was stated that the parameters of extra-contractual mechanisms and resilience parameters are the most important and valuable parameters of EPCM contracting model application for the target population. Thus, the contribution of the study was the definition of the main dimensions of the EPCM contracting model that should be targeted by practitioners to reach the desired objectives of project management.

8.1.4. Objective 4: Identify key risks that are associated with the EPCM model and propose mitigation strategies that can be adopted by senior project practitioners in Abu Dhabi; and

8.1.5. Objective 5: Identify key success factors for EPCM model in the oil and gas sector.

The final contribution of the study included the definition of the mediator variables that contributed to the successful realisation of the project management aims using the EPCM contracting model. It was established that the success of the EPCM contracting model application, including the earlier-mentioned dimensions of this instrument, was related to the implementation of the set of regulatory guidelines. The following factors were identified as the sources of success for the EPCM contracting model application in the target industry: effective stakeholder communication; reliable method of contractor selection; risks and responsibility distribution model; and engagement of the

project owner. Based on the study findings, it was possible to develop a set of practical guidelines that could be applied by practitioners operating in the Abu Dhabi oil and gas sector.

8.2. Recommendations to the industry

The most important part of the study findings was related to the development of practical recommendations for the project management teams that will apply the EPCM contracting model in the Abu Dhabi oil and gas sector. For the needs of the target population, it was found to be reasonable to focus on the main parameters identified in the study model. Using the information about specific variables defined in this model, practitioners should be able to identify key guidelines that should be followed in the process of the EPCM contracting model application. The first segment of practical recommendations was related to the discussion of the independent variables of the model. In this context, key recommendations for practitioners are related to the need for orientation towards the main parameters of the EPCM contracting model fixed in the structure of the independent variables of the study. As demonstrated earlier in the study, each of the independent variables is characterised by a specific set of parameters that affect the format of their realisation in the context of the process of project management using the EPCM contracting model. Therefore, the management of the UAE oil and gas sector specialising in the process of project management should consider the stated parameters and develop an EPCM contracting model based on the integration of the specific solutions corresponding to the project objectives of their company.

From the viewpoint of management of the independent variables of the study model, it is impossible to give more detailed recommendations that would still be characterised by a sufficient

level of opportunities for generalisation. The problem is that each specific company will have its certain objectives for the project management process and specific criteria of project success. In such conditions, it is imperative to give a general description of the key independent variables that could characterise the effectiveness of the EPCM contracting model application and allow the management to adapt the EPCM contracting solution to the specific needs of the concrete project.

The second category of study recommendations that could be considered as generalised for the needs of a wide range of target companies is related to the role of the mediator variables of the study model. While the description of the independent variables of the study was found to be personalised to the needs of the concrete company, mediator variables included the implications that could be applied to any type of organisation without dependency on the objectives of project management for business. Four main recommendations could be defined based on the study findings. First, the management of the project inside the oil and gas company should rely on the development of an effective communication mechanism for the project owners and all the project stakeholders. Such a mechanism should be defined and fixed in the EPCM contract so that the stakeholders could follow the identified communication model and avoid disputes and conflicts during the project.

The second recommendation of the study based on the mediator variables included the importance of the application of the effective methods of contractor selection for the organisation. This recommendation was based on the findings of the literature review and might lack practical utility from the viewpoint of the definition of the concrete steps that should be taken by the specific organisation. To define a set of criteria that might be used to select promising contractors for

business using the EPCM contracting model, an additional study might be required. Other recommendations based on the findings of the study comprised the relevance of effective distribution of risks and responsibility among stakeholders and the active engagement of the project owners. Therefore, the findings of the study formed the basis for the development of a personalised set of guidelines for the application of the EPCM contracting model in the modern oil and gas sector of Abu Dhabi.

8.3. Recommendations to policymakers

The previous section of the chapter presented recommendations of the study for the oil and gas industry in the UAE and Abu Dhabi. In addition, the implications of the study could support the performance of policymakers, whose main objectives include the creation of an attractive working environment for business and other stakeholders of the industry. Compared to the strategic objectives of the business organisations that apply the EPCM contracting model, policymakers have to seek effective strategies that would guarantee an improved balance of interests for all key actors. In the context of the theme of the EPCM contracting model application, policymakers should consider the interests of the following parties: business, employees, clients, contractors, and the community in general. Compared to the interests of business owners and management, the main interest of the policymakers should be focused on the maximisation of benefits and reduction of risks and losses related to the application of the EPCM contracting model.

As earlier stated, the application of the EPCM contracting model supposes a higher level of cooperation between project owners and contractors in the process of construction project management. For policymakers, it is important to develop a regulatory mechanism that would

allow them to control both parties of the project management process in order to avoid decisions or actions that would generate risks for all the earlier-stated stakeholders. Moreover, it is essential to develop a transparent format of regulation of the relationship between project owners and contractors. It was found based on the study model that the utility of the EPCM contracting model application would depend on the capability of the parties to build constructive cooperation, distribute roles and responsibilities, and apply legal mechanisms of mutual influence. Thus, policymakers should provide both parties of the project management process with the required resources for the realisation of these objectives.

Therefore, the main recommendation for the policymakers in the context of the study findings is related to the need for the optimisation of the existing legal mechanisms of relationship regulation between the project owners and contractors. In case the policymakers want to motivate businesses to apply the EPCM contracting model, it is important to show that businesses will be provided with reliable mechanisms of potential dispute resolution and protection of their interests in relationship with contractors. Such a legal mechanism could optimise time losses for disputes inside the project teams that would apply the EPCM contracting model. Such a legal framework would also help project owners with limited knowledge and experience in the field of the EPCM contracting model application to understand the optimal format of cooperation with contractors.

8.4. Recommendations for further research

The findings and implications of the study led the researcher to the definition of a set of additional questions that could be raised in further study. It is important to consider the implications of the study from the viewpoint of opportunities for further research. One of the main implications of the

study that could require additional research is related to the second mediator variable of the study model. It was stated that project owners in the Abu Dhabi oil and gas sector should develop a reliable methodology of contractor selection to guarantee the effective application of the EPCM contracting model (Khoso and Yusof, 2019). While this implication is a logical sequence of the performed literature review and analysis of primary data, it is difficult to identify specific solutions that should be applied by practitioners to reach this goal.

In the context of the identified success factor of the EPCM contracting model application, it is of great significance to address several questions in a further study. First, it is necessary to identify specific criteria that should be utilised in the process of contractor assessment and selection. Second, it is reasonable to define whether a set of criteria and selection procedures followed in the target companies should be universal, or if each company should rely on its individual procedures and methods of selection and assessment. The third recommendation is that further study should include a presentation of the significance of the adequate selection of contractors for large construction projects in the target industry. While the development of the specific recommendations in the field of contractor selection could be a valuable outcome of the study, it is also important to persuade the target audience of the importance of the proposed solutions' application. Since any type of activity in business is associated with costs, the management of the company should be able to compare profits and losses from the application or non-application of the proposed methodology of contractor selection.

The format of a further study for analysis of the contractor selection methodology could include analysis of a larger sample size using quantitative and qualitative methods of data collection and

analysis. It is important to apply both methodologies to guarantee a balance between opportunities for generalisation and a deep understanding of the research questions in the context of the study outcomes (Ahmad *et al.* 2019). The results of the study should be applicable for generalisation on the overall target population. At the same time, the study should provide opportunities for deeper knowledge collection, which was a limitation of the present study. Another implication of the study that could form the basis for further study is related to the final mediator variable, which identified the role of project owner engagement in the process of project realisation. It was established that the effectiveness of the EPCM contracting model's realisation depends on the capability of the project owner to be engaged in all the phases of the project's realisation, which is an important advantage compared to the EPC model. Nevertheless, this implication also raised a set of study questions. First, it is reasonable to consider whether the engagement of the project owner at a certain level could cause a reduction in the effectiveness of the contractors' performance. While the overall result in the form of project owner engagement during the project could improve project outcomes, there is a logical hypothesis that the excessive engagement of the project owner could increase time and financial expenses for the realisation of specific tasks and the project in general. Moreover, a further study should define the level of project owner engagement that could be considered as optimal from the viewpoint of project objectives' realisation and the performance of contractors. The key findings of the study formed a reliable basis not solely for the practical recommendations developed for policymakers and practitioners in the UAE oil and gas sector; the implications of the study also raised a set of questions that could be addressed in a further study. The development of the study in the selected fields of interest could lead to deeper knowledge about the problem of the EPCM contracting model application for the needs of the target industry. Thus, it is imperative to arrange a further study to include the specific factors common to the oil

and gas sector in the UAE and other countries. Therefore, a further study should consider opportunities for the generalisation of the study findings for the needs of other industries and companies.

8.5. Limitations of the research study

The final aspect that had to be considered in this chapter of the study was the definition of the main research limitations. From this perspective, it was important to critically analyse the main sources of risks and limitations identified during the study. The outcomes of analysis of the key study limitations have to contribute to a better understanding of the opportunities and requirements for further study.

One of the main limitations of the present study is related to the sample bias. The key findings of the study were based on the results of the primary data collection and analysis. To fulfil this part of the research, the researcher oriented towards the method of a survey questionnaire forming a sample using a purposive sampling approach. From this perspective, the end characteristics of the sample were identified by the researcher based on his understanding of the main characteristics of the target population. From this perspective, there is the risk of a mistake in the process of definition of the main characteristics of the sample that should have been targeted during the study (Barboza *et al.*, 2016). In addition, the size of the sample could be unreliable from the viewpoint of the assessment of the overall quality of the study outcomes (Keserlioglu *et al.*, 2019). The researcher selected the final sample size based on his capability to collect and analyse the defined number of study participants. A further study might require the organisation of the data collection procedure for a larger sample of the target population. The resolution of the problem of sample bias was

achieved through the diversification of the study participants' pool based on the key personal and professional characteristics of the respondents. A further study might require more careful specialisation of the target population's characteristics, which would allow the researcher to collect reliable and relevant data contributing to the realisation of useful study outcomes and implications. At the same time, in the context of similar project objectives, non-purposive and random sampling techniques could not be considered as a promising sampling approach. Thus, in order to collect relevant and reliable data about the narrow field of interest, it is important to focus on the narrow list of specialists with appropriate personal and professional characteristics.

Another potential limitation of the study is subjectivity bias, mainly taking place in the field of the survey form development. For the aims of the study, the researcher oriented towards the independent development of the sample form, avoiding the application of the existing survey forms from previous studies, for which a certain level of reliability and validity was proven earlier. In this way, there is a risk that the researcher could form an improper list of research questions, which would not allow the research to reach optimal implications and form practically useful findings (Ross and Zaidi, 2019). The researcher performed specific verification procedures to guarantee a high level of survey form reliability. Nevertheless, in a further study, it might be possible to define even more optimal methods of data collection in the context of the stated research objectives.

Thirdly, the study lacked access to reliable data about the field of interest. The researcher had to focus mainly on academic literature sources that discussed theoretical concepts or specific cases in the field of EPCM contracting model application and arrange data collection procedures among specialists operating in the target industry (Olufowote, 2017). Nevertheless, during the study, it

was impossible to find a sufficient number of sources that would provide insights into the application of the EPCM contracting model specifically in the UAE oil and gas sector. At the same time, it was difficult to arrange the collection of the detailed data about the object of interest among the study respondents.

From the viewpoint of the stated study limitations, a further study could be arranged in a format oriented towards the collection of a higher scope of specialised information that is not dependent on the character of the survey questions. Moreover, it is reasonable to develop a research design applying a semi-structured interview format so that the researcher could collect reliable and relevant data about narrow aspects of the study problem from the selected participants. The format of the purposive sampling model should be preserved, while the character of questions asked to the participants of the study should be more flexible and adaptable to the specific needs of the researcher. Such a shift in the research methodology should allow the researcher to address the identified limitations of the study and develop improved study outcomes.

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APPENDIX 1: CONSENT LETTER

Determinants of Value Benefits in adopting EPCM Contracting Model

I am currently undertaking a PhD in Project Management entitled “Determinants of Value Benefits in Adopting an EPCM Contracting Model”. This study is oriented on the discussion and assessment of the effectiveness of different project management contracting models for the aims of construction project realisation in the UAE oil & gas sector. In the context of the study, I aim to compare the efficiency of the engineering, procurement and construction (EPC) model with the potential usefulness of the application of the engineering, procurement and construction management (EPCM) model. The criteria of model comparison and assessment include the efficiency of construction project objectives’ realisation and cost-effectiveness of project management. I believe that the realisation of the presented study can provide specialists in the sphere of project management in the UAE organisations with valuable science-based knowledge about the requirements for the efficient organisation of project management. It is important to determine how value benefit realisation in oil and gas projects can be achieved and sustained through the adoption of an EPCM contracting model. As such, we aim to propose practical EPCM guidelines/determinants that can be adopted by senior project practitioners delivering large oil and gas projects in Abu Dhabi.

I decided to invite you for participation in the study due to your excellent background and wide experience in the field of project management. I would be grateful if you could share your

experience and knowledge of the chosen field during the study. For this aim, I ask you to take part in the data collection procedure that would include filling in the questionnaire form. This should take no more than 15 minutes and will be a valuable source of information for the development of important results of the study. I assure you of the confidentiality and security of your private data during the study. All personal data will be destroyed at the data processing stage and will never be published.

I hope that the outcomes of the study will provide valuable recommendations for the improvement of project management efficiency in the UAE oil & gas sector.

APPENDIX 2: QUESTIONNAIRE

Individual Info:

Name	
Company / Organisation	
Value of Recently Handled Project	

Demographics:

1	Work Location	☐ Al Dhafra	☐ Al Ain	☐ Abu Dhabi	☐ Dubai	☐ Sharjah	☐ Ras Al Khaimah	☐ Fujairah
2	Region/Nationality	☐ Middle East	☐ Africa	☐ Europe	☐ Asia	☐ North America	☐ Latin America	☐ Pacific
3	Gender	☐ Male				☐ Female		
4	Age	☐ 30 or less	☐ 31-39	☐ 40-49	☐ 50-59	☐ 60 or more		
5	Years of Work Experience	☐ 1 or less	☐ from 2-4	☐ from 5-7		☐ from 8-10	☐ 11 or more	
6	Education Level	☐ PhD	☐ Master	☐ Bachelor	☐ Diploma	☐ High School	☐ Other	
7	Job Position and Level	☐ Project Manager				☐ Technical Manager		
		☐ Procurement Manager		☐ Contract Manager		☐ Project Engineer		
8	Skills and Competencies	☐ Technical Skills				☐ Human Relation Skills		
9	Marital Status	☐ Single		☐ Married		☐ Divorced		☐ Widowed

Assessment is based on six key components derived as broad areas for EPCM guidelines/determinants development as independent factors

- Project bid and contracting
- Project information and process management
- Legal and regulatory guidelines
- Technical specifications
- Extra-contractual mechanism
- Resilience parameters

✓ **Part 1: Determinants for the EPCM Contracting Model**

• **Project Bid and Contracting**

Please rate the importance of the following determinants to achieve value benefit in the EPCM contracting model.

Bid and Contracting		Very Important	Important	Somewhat Important	Neutral	Unimportant	Very unimportant	Extremely unimportant
a.	Contract details and written contract	☐	☐	☐	☐	☐	☐	☐
b.	Type of the contract to match the nature of the project	☐	☐	☐	☐	☐	☐	☐
c.	Contracting strategy vision at early stage of the project	☐	☐	☐	☐	☐	☐	☐
d.	Type of contracting strategy	☐	☐	☐	☐	☐	☐	☐
e.	Complete appraisal of bids	☐	☐	☐	☐	☐	☐	☐

• **Project Information and Process Management**

Please rate the importance of the following determinants to achieve value benefit in the EPCM contracting model.

Project Information and Process Management	Very Important	Important	Somewhat Important	Neutral	Unimportant	Very unimportant	Extremely unimportant
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a.	Negotiation and communication and coordination among relevant parties involved in the project	☐	☐	☐	☐	☐	☐	☐
b.	Financial processes	☐	☐	☐	☐	☐	☐	☐
c.	Decision-making	☐	☐	☐	☐	☐	☐	☐
d.	Skills for labour and engineering	☐	☐	☐	☐	☐	☐	☐
e.	Materials procurement	☐	☐	☐	☐	☐	☐	☐
f.	Construction processes and methods	☐	☐	☐	☐	☐	☐	☐
g.	Project site issues	☐	☐	☐	☐	☐	☐	☐
h.	Information dissemination	☐	☐	☐	☐	☐	☐	☐
i.	Project management structure	☐	☐	☐	☐	☐	☐	☐
j.	Interface management system	☐	☐	☐	☐	☐	☐	☐
k.	Planning and scheduling	☐	☐	☐	☐	☐	☐	☐
l.	Organisation structure	☐	☐	☐	☐	☐	☐	☐
m.	Interfaces with other interdependent projects	☐	☐	☐	☐	☐	☐	☐
n.	Reporting structure and responsibilities	☐	☐	☐	☐	☐	☐	☐
o.	Trust among different project parties	☐	☐	☐	☐	☐	☐	☐

- **Legal and Regulatory Guidelines**

Please rate the importance of the following determinants to achieve value benefit in the EPCM contracting model.

Legal and Regulatory Guidelines		Very Important	Important	Somewhat Important	Neutral	Unimportant	Very unimportant	Extremely unimportant
a.	Work packaging design and subcontracting	☐	☐	☐	☐	☐	☐	☐
b.	Change orders, permits and shop drawing submission and approval	☐	☐	☐	☐	☐	☐	☐
c.	Schedule of engineering, procurement and construction, and approval of completed tasks	☐	☐	☐	☐	☐	☐	☐
d.	Company standard operating procedures	☐	☐	☐	☐	☐	☐	☐
e.	Government auditing protocols and procedures	☐	☐	☐	☐	☐	☐	☐
f.	Experience with local laws and other government regulations and modification in laws and regulations	☐	☐	☐	☐	☐	☐	☐
g.	Experience with building codes, by-laws, statutes and other government regulations, definition of project	☐	☐	☐	☐	☐	☐	☐

	boundaries at early stage of the project							
h.	System completion requirements	☐	☐	☐	☐	☐	☐	☐

- Technical Specifications

Please rate the importance of the following determinants to achieve value benefit in the EPCM contracting model.

Technical Specifications		Very Important	Important	Somewhat Important	Neutral	Unimportant	Very unimportant	Extremely unimportant
a.	Alignment among work breakdown structure (WBS), contracting work breakdown structure (CWBS), cost breakdown structure (CBS), and organisation breakdown structure (OBS)	☐	☐	☐	☐	☐	☐	☐
b.	Project cost estimate	☐	☐	☐	☐	☐	☐	☐
c.	Project construction schedule, cost and quality	☐	☐	☐	☐	☐	☐	☐
d.	Experience of the project teams	☐	☐	☐	☐	☐	☐	☐
e.	Knowledge on new technological techniques and materials	☐	☐	☐	☐	☐	☐	☐

f.	Environmental circumstances, climate and local weather conditions	☐	☐	☐	☐	☐	☐	☐
g.	Knowledge about site circumstances by the project team members	☐	☐	☐	☐	☐	☐	☐
h.	Accurate work drawings and specifications	☐	☐	☐	☐	☐	☐	☐
i.	Materials and labour availability and cost	☐	☐	☐	☐	☐	☐	☐
j.	Geotechnical circumstances	☐	☐	☐	☐	☐	☐	☐

• Extra-Contractual Mechanisms

Please rate the importance of the following determinants to achieve value benefit in the EPCM contracting model.

Extra-Contractual Mechanisms		Very Important	Important	Somewhat Important	Neutral	Unimportant	Very unimportant	Extremely unimportant
a.	Defining sufficient level of delegation of authority within the client project management team	☐	☐	☐	☐	☐	☐	☐
b.	Setting a steering committee for decision taking at the procurement phase	☐	☐	☐	☐	☐	☐	☐
c.	Introduction of specific terms & conditions for control over	☐	☐	☐	☐	☐	☐	☐

	purchase orders and work packages							
d.	Defining appropriate expenditure limit for the procurement phase assigned for the project director	☐	☐	☐	☐	☐	☐	☐
e.	Defining incentive scheme to contractor for outperforming at engineering & procurement phases	☐	☐	☐	☐	☐	☐	☐
f.	Setting liquidated damages %ages for each phase of execution	☐	☐	☐	☐	☐	☐	☐
g.	Introduction of child contract strategy under the EPCM contract	☐	☐	☐	☐	☐	☐	☐
h.	Outlining coordination of the design and construction works between different work package contractors	☐	☐	☐	☐	☐	☐	☐
i.	Ensuring management, administration and supervision of the work packages	☐	☐	☐	☐	☐	☐	☐
j.	Delivery of the project by defining certain key milestone dates	☐	☐	☐	☐	☐	☐	☐
k.	Introducing terms & conditions discouraging	☐	☐	☐	☐	☐	☐	☐

	unnecessary claim submissions by contractors							
l.	Limiting role of company in insurance claims of contractors	☐	☐	☐	☐	☐	☐	☐

- Resilience Parameters

Please rate the importance of the following determinants to achieve value benefit in the EPCM contracting model.

Bid and Contracting		Very Important	Important	Somewhat Important	Neutral	Unimportant	Very unimportant	Extremely unimportant
a.	Identifying the EPCM strategy for the right scope of work provides resilience in project execution	☐	☐	☐	☐	☐	☐	☐
b.	Flexibility in detailed design changes	☐	☐	☐	☐	☐	☐	☐
c.	Agility in introduction of new mitigation for introduced risks	☐	☐	☐	☐	☐	☐	☐
d.	Flexibility in assignment of work packages to the benefit of project need	☐	☐	☐	☐	☐	☐	☐
e.	Flexibility in defining construction sequences based on project need	☐	☐	☐	☐	☐	☐	☐

f.	Flexibility in defining procurement strategy based on project need	☐	☐	☐	☐	☐	☐	☐
g.	Flexibility in introducing additional work package contractors based on project need	☐	☐	☐	☐	☐	☐	☐
h.	Flexibility for exist strategy within a phase of execution	☐	☐	☐	☐	☐	☐	☐

Part 2: Value Creation and Benefit (Contract prospective)

• Value Creation and Benefit Realisation in the EPCM Contract

Please rate the agreement of the following contract elements that can achieve value benefit in the EPCM contracting model:

Bid and Contracting		Very Important	Important	Somewhat Important	Neutral	Unimportant	Very unimportant	Extremely unimportant
a.	Shorter bidding time	☐	☐	☐	☐	☐	☐	☐
b.	Standardised work packages	☐	☐	☐	☐	☐	☐	☐
c.	Fast track schedule through alignment of procurement and work packages	☐	☐	☐	☐	☐	☐	☐
d.	Optimised material procurement cost	☐	☐	☐	☐	☐	☐	☐
e.	Controlled project cost	☐	☐	☐	☐	☐	☐	☐
f.	Adoption of new technologies	☐	☐	☐	☐	☐	☐	☐
g.	Mark-up cost on material and execution are almost removed	☐	☐	☐	☐	☐	☐	☐
h.	Controlled change orders	☐	☐	☐	☐	☐	☐	☐
i.	Trust among different project parties	☐	☐	☐	☐	☐	☐	☐
j.	Faster system completion achievement with client involvement	☐	☐	☐	☐	☐	☐	☐

k.	Minimising claims from contractor	☐	☐	☐	☐	☐	☐	☐
l.	Minimising conflicts on payment to subcontractors	☐	☐	☐	☐	☐	☐	☐