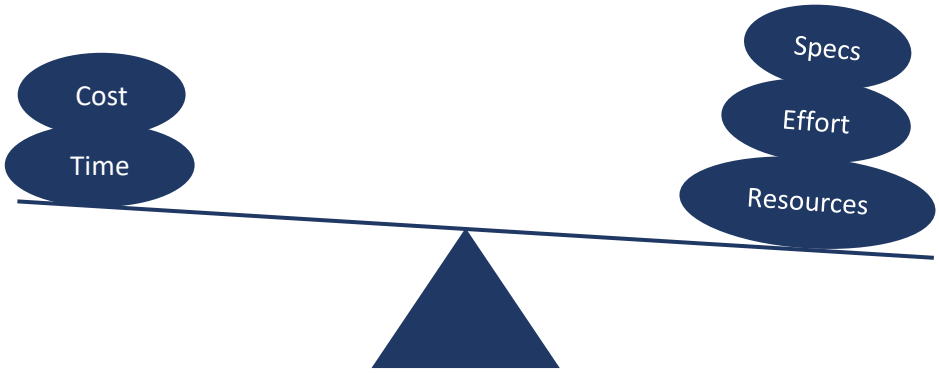
Scope Creep in Onshore Wind Farm Projects

A study on scope creep in onshore wind farm projects governed by FIDIC yellow book



MSc Graduation Thesis

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Construction Management & Engineering

TU Delft

Scope Creep in Onshore Wind Farm Projects

A study on scope creep in on onshore wind farm projects governed by FIDIC yellow book

By

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In partial fulfilment of the requirements for the degree of

Master of Science in Construction Management & Engineering

Delft University of Technology

2020

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Project Duration	February 2020 – August 2020	
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DURA VERMEER

Preface

In the context of my studies for the Master of Science in Construction Management & Engineering at TU Delft. I have performed this research as my final graduation project, Which I hereby submit in partial fulfilment of my MSc program. For the past 10 months (November 2019 – August 2020) I have been exploring the impact of scope creep in various sectors in the construction industry. Dura Vermeer Infra Landelijke Projecten B.V provided me with the opportunity to carry out this research by providing me access to their project data and their invaluable assets. During my research, I focussed on scope creep in onshore wind farm projects that are governed by FIDIC yellow book. My investigation has revealed that scope creep is difficult to identify when it is happening and by the time the issue is identified the damage would already have occurred. Scope creep is a slippery slope and is difficult to recover from, therefore prevention is the only cure. During my research, it was also observed that scope creep was a less familiar subject to many, and it barely receives any attention. Therefore, I am elated to present my findings which identifies the causes, consequences and provides recommendations to counter scope creep, which I believe will contribute to enhanced awareness concerning the issue and will improve the project management approaches in the construction industry. The research will be a valuable knowledge addition to professionals, who are/will play their part in the management of projects.

During the journey of my research, my graduation committee provided me with invaluable inputs, which guided me in the right path and therefore to complete my thesis successfully in the expected time. I would like to wholeheartedly thank my first supervisor, Yan Liu, who has always been available to guide me in the right direction. His knowledge in project management gave me insights and ideas on my approach towards the research, My second supervisor, Bauke Steenhuisen, who has agreed to join my committee at a crucial juncture, My company supervisor, Maureen de Munck, has been extremely conducive, critical and supporting throughout the journey and has provided me details with great patience and my third supervisor, Yvo de Mul, his expertise in the field of contracts was valuable and has guided me in researching on the subject of FIDIC yellow book. Furthermore, I would like to give special thanks to my chair, Professor Hans Bakker for providing me with the guidance in performing this research, for criticising my work, for bringing out the best quality, for being extremely patient in clearing my doubts during the last 10 months and for being part of my graduation committee.

The constructive feedbacks my committee members have provided on and off the meetings provided me with a clear overview of the essentials to achieve quality work. Furthermore, I would like to thank all the professionals who took time out of their busy schedules to answer my questions without whose cooperation the research would not be possible. I would also like to thank Paul Bleijenberg from Dura Vermeer, who has welcomed me into the company and given me the opportunity.

Finally, I would like to thank my family, friends and peers for their invaluable support and guidance!!!

Sankeerth Gangapatnam

Executive Summary

Introduction

The process of execution of construction projects is subjected to multiple complexities which are highly dynamic in nature. Among several complex dynamic elements present in a project, the scope is one of the elements which is extremely important. Scope is the work that needs to be achieved to develop or produce a product/infrastructure with the desired features and functions. The scope of a project is developed during the scope definition phase and is controlled during the execution phase.

The scope is adjusted multiple times during the definition and execution phases to add or remove a feature which is known as scope change. Whereas, there exists a situation where the scope of the project grows organically, uncontrollably and unexpectedly out of the desired scope during the conception, definition and execution phases which is known as scope creep. Based on several definitions identified from the literature the author defines scope creep as Informal and unauthorized works/changes in the scope that extends the project boundaries as the project progresses. The scope creep activities find sources from multiple factors such as flaws in contract, poor scope management process, poor communication and so on. The literature has not identified a tool firmly to prevent the occurrence of scope creep, hence a research question is formulated to recommend solutions to address the problem.

"What are the suitable strategies to overcome scope creep in onshore wind farm projects, governed by FIDIC contracts, and thereby improve project delivery"

To answer the main research question a few sub-questions are formulated to deeply study the sources of scope creep. The sub-questions are formulated to identify the factors that could lead to scope creep from literature, and the gaps present in scope management model of Dura Vermeer and to identify how flaws present in contract conditions such as FIDIC yellow book, UAV-GC etc. contribute to scope creep. By identifying all the sources of scope creep a suitable solution is recommended to address the problem and thereby improve the project delivery. Therefore, the objective of this research is to recommend a suitable strategy to the contractor organization, Dura Vermeer to prevent scope creep from occurrence.

Research methodology

Qualitative research was carried out to answer the research question, which included both desk research and empirical research. During the literature study a clear distinction between scope change and scope creep, the factors that could lead to scope change and scope creep and their impacts were identified and are presented followed by the identification of the flaws in FIDIC yellow book and study on the scope management and change management model recommended by literature. The empirical research was carried out with two rounds of interviews with 6 managers who were part of 3 onshore wind farm projects i.e. two from each case. The interviewees included a project manager and contract manager from each case to study the problem from different perspectives. The first round of interviews was focussed on

scope change, scope creep, FIDIC yellow book and understanding the scope management model of the contractor. From the findings from both the desk research and first round of empirical research the second round was initiated. The second round was targeted to analyse the cases by identifying the sources of scope creep in the cases and to identify the gaps present in the scope management model of the contractor by critical thinking. Based on the identified issues solutions are proposed, that are identified in the literature. The best solution which align with the interests of the organisation is recommended. The recommended solution is validated with two experts from Dura Vermeer, who were not involved in the previous meetings. Finally, the suggestions are incorporated, and the research question is answered. The methodology followed is presented in the figure 4 in the report.

Findings

The initial literature study was focussed on identification of the factors that could lead to scope change and scope creep and their effects on projects. The research included empirical based literature from diverse construction sectors such as transportation (rail and road), housing, mining, offshore and airport projects from around the world. The research papers have not clearly highlighted the occurrence of the scope issue just by the mere presence of the factors that are identified in literature therefore the certainty and intensity are specific to project and other conditions. The literature has identified most of the factors occurring in the definition and execution phases of the project life cycle. Cost overruns and delays were identified as the immediate effects of both scope change and scope creep. The scope creep factors 1) improper scope assessment 2) poor communication 3) conflicting requirements of stakeholders 4) complexity 5) experience of team 6) change in team and 7) Improper management of scope changes could be concluded as the most important factors that could lead to scope creep. The factors, flaws in contract conditions and poor scope management, which could also lead to scope creep, are further studied deeply as they are inherently present in any project and hence it is important for this research to identify how they could contribute to scope creep.

The scope management model recommended by literature was compared with the scope management model of the company and it was identified that the contractor does not have a strict adherence to the model suggested by the literature. The contractor has skipped the crucial step of planning the scope and has not thrown attention in stakeholder analysis. Similarly, it was identified that the contractor does not review the executed changes which can turn out to be disastrous to a project. Along with the above a few more practices such as informal execution of changes, team shuffling etc. in the organization have been identified which could lead to scope creep.

The FIDIC yellow book (1999) is the concerned contract condition in this research. The FIDIC yellow book was extensively analyzed and compared with the UAV-GC (2005). The analysis of the FIDIC yellow book has revealed flaws in the contract conditions that could lead to scope creep. Especially the position and powers of the engineer was identified as a major flaw that could lead to scope creep. The flaws could in turn lead to other scope creep factors identified with the literature and therefore could lead to scope creep in the projects.

Post the identification of the flaws the cases were analyzed and several flaws identified in the previous stages of the research were present in the 3 chosen wind farm projects. 11 of the 19 scope creep factors and 5 of the 9 FIDIC flaws were present in the cases studied. Along with them two new factors Project team unfamiliarity on tasks and appeasing the employer were identified. Most of the factors were identified in the definition and execution stages. The literature factors identified to be common in all three cases are informal decision making, poor communication between stakeholders, time pressure, ignorance of small changes, Project team unfamiliarity on tasks and improper assessment of scope. Vagueness of terms and clause 3.3 were identified as common FIDIC yellow book causes in the cases 1 and 2.

Based on the observations a few solutions are recommended and two of the most feasible solutions were identified, which have a proactive approach towards changes during the scope development phase and provides guidance during the execution phase. The solutions were developed taking into consideration the root causes of scope creep i.e. lack of proper communication, unclear responsibility and lack of stakeholder involvement. However, the solutions identified were expensive to implement and such solutions do not work out for small budget projects. Therefore, cost-conscious recommendations have been suggested to the contractor to implement to prevent scope creep. Further, the recommendations were taken to the attention of two experts from the contractor organization for validation.

The recommended solutions include an agile Scrumban integrated with BIM 3D or 5D, which are highly complex and expensive. Therefore, the author provides the following cost-conscious recommendations which are to assign a case manager who shall pass by the project and review it after every milestone, alter the flaws that could lead to scope creep in FIDIC yellow book, facilitate proper communication, prevent gold plating, prevent appeasing the employer etc. which are presented in the report as recommendations.

Conclusion

To conclude, to prevent scope creep awareness among people who are executing work packages is extremely important, the setbacks should be identified and eliminated at an early stage by employing a proactive approach. The suggestions provided by the author as presented in this thesis research will help the contractor organisation in preventing the occurrence of scope creep and will inspire the organisation to make changes towards their approach in executing projects especially during the execution stage concerning scope management.

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INTRODUCTION

1.1 Background

Historically, the construction industry is perceived as a notorious sector to have had several construction projects experience cost overruns and delays even with a lot of experts involved in the project (Hussain 2012). Cost overrun is the amount of money essential to finish a project beyond its initial estimated budget, which is equivalent to the difference between the contract amount and the actual amount spent on the project (Alinaitwe et. al 2013). Similarly, a delay occurs when the project is not finished before the planned completion date (Anastasopoulos et. al 2012). Various techniques have been developed by research and by industry experts to control and execute a project in the desired manner (Madhuri et al. 2014). Despite several advancements in project management tools and techniques, the success of a project is a challenge. Project success can be measured by delivering the required product within the estimated time, budget and at the employer's expectation, which can be achieved only when project management techniques are followed scrupulously.

In construction projects, the goal of project management is to make certain that project activities meet the desired goals and objectives, finishes as per schedule, within budget, and achieves the desired quality i.e. in a nutshell to satisfy the demands of the iron triangle. Organizations predominantly use project management practices to accomplish their goals and strive to deliver projects successfully (Grant., & Pennypacker 2006). Unfortunately, in the real world, results show that a lot of these practices are not executed as they are meant. Therefore, projects experience delays, cost overruns and delivery of different objectives than what was initially planned due to the dynamics in the project environment, which is continuously transformed by the interactions between internal and external environments. In addition to this dynamic nature, projects are encountered with complexities which are burdening the established practices even more. These negative effects are making the success rate of projects very meek compared to the efforts and expertise of experts(Adam 2016).

The scope of a project is likely to undergo several changes during the execution phase of the project, due to various reasons such as incorrect identification of needs, the discovery of anomalies, economic developments, technological advancements, change in Employer interests, a better understanding of conditions etc., these changes will show an effect on the delivery, cost, and quality of the project (Ertel & Rudner 2000). Frequent changes in scope may result in scope creeps (due to improper change management), delays (resulting in heavy penalties & damage to reputation), fee write-offs (reduce the net income of firms), stress on staff to reduce overruns, increases the risk of damaging relation with Employer, etc. (Ertel & Rudner 2000). Hence managing scope of a project should be given high priority, given the fact that it also has a central role to play in the field of project management. This is explained with

a degree of complexity and interconnectedness with other critical elements in project management (Figure 1). A disturbance in any of the elements shown in Figure 1 is likely to also show an impact on the element of stakeholder management.

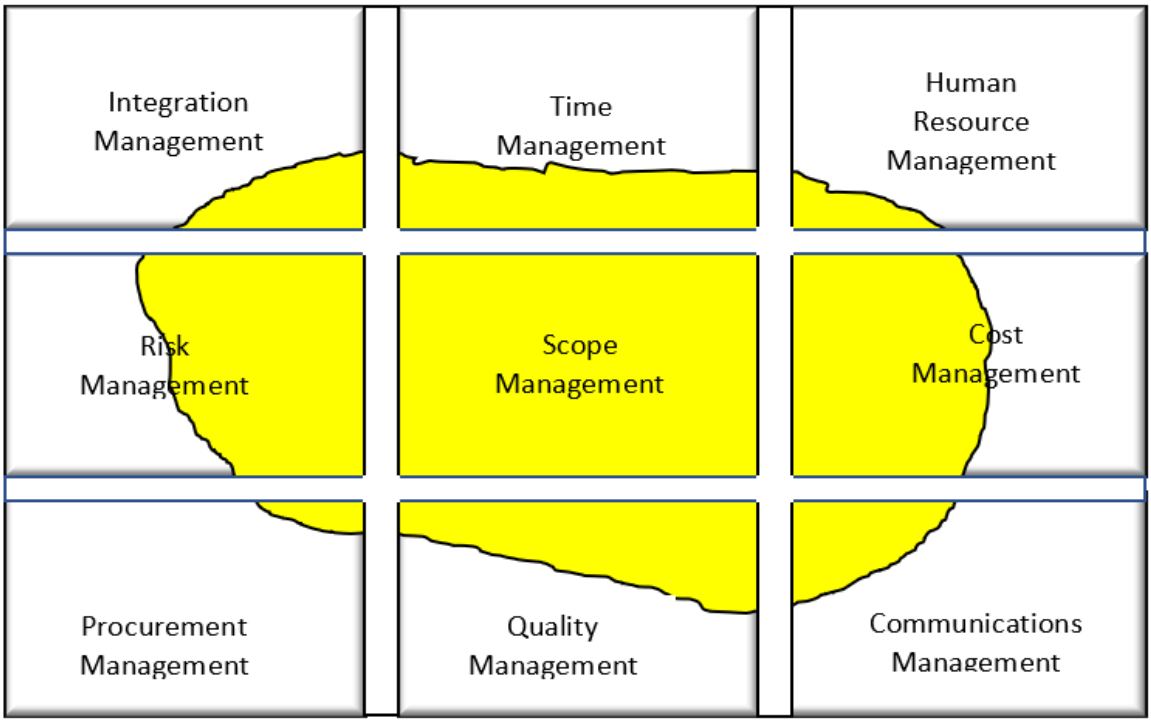

Figure 1 Effect of scope on other elements of project management (Ertel & Rudner 2000)

Apart from the scope, successful project execution also requires a solid contractual foundation especially when multiple parties are involved in a project to avoid conflicts and disputes which have considerable time and cost effects. Therefore, parties need to be bound by a good contractual agreement.

The recent uproar on the changing climatic conditions across the world has put countries under severe pressure to meet their energy demands from sustainable sources of energy. This has brought renewable sources of energy into the limelight and among all sources of renewable energy, Wind energy looks promising especially for the Netherlands. The Netherlands is geographically placed in an advantageous position to tap the abundant supply of the wind source. The demand for clean energy, push from the government and the availability of sources has opened the market for the development of wind farm projects in the Netherlands.

With investment opportunities in plenty, international parties are coming forward to invest in the green energy business. Therefore, when international parties are joining hands to realise a project due to lack of knowledge about the local laws, they prefer to have an international contract template i.e. FIDIC so that all the parties are on common ground. Contractors are generally powerless when it comes to influencing the conditions and clauses of the template. Whereas, Employers usually are more powerful in the game as they are the business providers and they have all the power to alter the clauses in the contract to their favour. Therefore the key focus in this research is Scope, which is the desired objective, FIDIC, which can influence the scope if not well defined and onshore wind farms.

1.2 Problem analysis

As organizations strive to make their process more efficient it tends to press its people to work faster and smarter. During this process, there is a risk of deviating from the path of actual scope and ending up executing, which is not necessary, which is scope creep. Research shows that scope changes and scope creep are one of the critical causes that are the most influencing parameters and must be managed efficiently to improve a project's success (Hussain 2012; Amoatey and Anson 2017; Habibi et al. 2019). Nelson (2007) has also highlighted that scope creep is one of the causes that have detrimental effects on a project by consuming resources, time and budget and eventually leading to project failure.

Among several challenges faced in a project, scope changes and scope creep are major concerns that contribute to project failure. (Suma and Madhuri, 2014 & Madhuri et al. 2014; Kermanshah 2019). A lot of projects suffer from scope changes during the execution phase of the project. These changes ultimately lead to cost overruns and delays, leading to claims and disputes between the parties involved. Practitioners across the world are finding it difficult to obliterate scope issues with suitable strategies (Kermanshah, S. 2019).

Change can be extremely challenging to organizations, it is estimated that half of all change efforts fail (Beer & Norhia, 2000). The more changes the more likely a project fails to reap the benefits that were originally promised as initial plans of projects are almost always altered before the project gets completed(Farok & Garcia 2016; Nelson 2011).

Scope change and scope creep augments work and reduces the degree of satisfaction of parties. The issue is even more severe in projects with vast numbers of people involved and where continuous organizational shuffling is done. Scope creep is a slippery slope and difficult to recover from and hence prevention is the cure. On numerous occasions, firms see their projects to be too unique and fail to pay attention to what happened in the history (Farok & Garcia 2016) and much less attention is given in the identification of scope creep.

On one hand, scope creep puts the affected project in jeopardy on the other hand scope creep in one project consumes a lot of resources and therefore demands resource commitments. Placing the entire portfolio of projects under risk when projects share the same scarce resources (Teller et al 2012).

Effective project scope management demands an understanding of the requirements of the Employer and the factors that are influencing the process. The identification of the impact of scope changes and scope creep on project influencing parameters and further on the success of the project will facilitate project managers to contrive effective management strategies to overcome scope issues. This can be achieved by doing a comprehensive analysis of the factors that could lead to scope changes and scope creep and the influence it has on the success of a project.

Research made in the past also clearly indicates that the assurance of project success can be achieved through taming project influencing drivers efficiently. Further, effective management of scope is found to be one of the most productive parameters which can bring in the expected level of project success. Therefore, emphasis must be given to scope management to achieve first-rate project performance. (Olawale & Sun 2013; Kermanshah 2019).

Sovacool, et. al (2014) have researched on 35 wind farms worth USD 20.1 billion in investment. They identified that the cost overruns in these projects was USD 1.1 billion in total and had a mean cost escalation of 7.7%. It was identified that around 20 of the studied projects were afflicted by cost overruns. Lack of proper management system in place was a prime reason for the failure of those projects. More than half of the wind farm projects have experienced cost overruns, the mean escalation in cost stood at 8% in 35 samples and an average time overrun by 10%. This increase in cost will increase the overall cost per KW of electricity produced. Sovacool, et al (2016) has also mentioned in their research that out of 51 wind farm projects the mean cost escalation was 6.5% or USD 63 million per windfarm

A preliminary literature study regarding scope creep has revealed that flaws in contracts conditions and failure to effectively manage scope changes are some of the prime reasons for projects to experience scope creep.

The firm Dura Vermeer had issues in successfully managing scope in the execution of wind farm projects. Two out of three wind farm projects Dura Vermeer has developed were governed by FIDIC yellow book contract. Interestingly, those two projects experienced a lot of scope creeps than the third, which is governed by UAV-GC. The scope management issues encountered led to destabilization in the areas of planning, execution and operations of projects. The disruptions have burdened all the parties in complying to the initial plan, which has resulted in cost overruns (figure 2), benefit shortfalls, wastage, delays and loss of reputation of the firm. The problem of scope creep is difficult to identify as it occurs uncontrollably from multiple sources. Some of the sources being improper scope definition, flaws in contractual conditions (such as FIDIC yellow book, UAV-GC etc.) and so on. A tool to overcome the problem concretely couldn't be identified in the literature at the same time much research hasn't been performed in this direction. Hence the research question " To identify a strategy to improve scope management in onshore wind farms governed by FIDIC yellow book" is formulated, which is further explained in chapter 2.

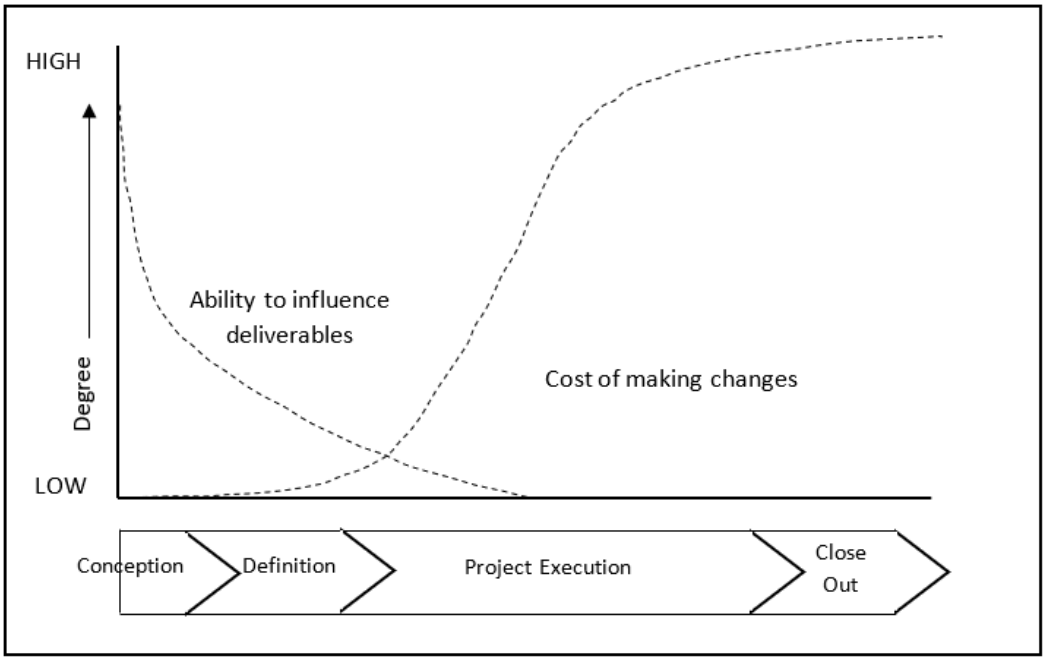

Figure 2 Increase in costs with changes as project progresses in different phases of project life cycle (Nicolas & Steyn 2017).

1.3 Scope

Project scope is the work that needs to be achieved to develop or produce a product/infrastructure with the desired features and functions. Scope helps in defining the objectives, which guides the project and the project managers in the appropriate direction. Maintaining the main thread of project scope is one of the prime determining factors of the success or failure of the project (Kerzner 2013). It is important to have clear objectives to develop a well-defined scope without which people may lose the track of what they intend to develop and eventually deliver an unsuccessful project leading to cost overruns, cost escalations and delays (PMBOK 2016). The scope of a project consists of the following aspects:

- Statutory requirements: Infrastructure development projects require a statutory permit before the commencement of construction to make sure the project is within the permissible limits of causing disturbance to the environment and living things, for example, Environmental Impact Assessment (EIA), Social impact assessment (SIA) etc.
- Stakeholder requirements: The requirements of stakeholders should be recognized and studied to develop the right scope and to ensure the demands are addressed.
- Design specifications and drawings: This document should contain all the details of the scope of work, the quality level, tolerances etc.(PMBOK 2016).

As mentioned earlier the scope of a project experiences multiple official changes during the life cycle of a project and it can lead to either positive or negative consequences. Whereas, there is also a different type of change that occurs in projects known as scope creep both the terms have been defined in the below subsections.

1.3.1 Scope Change

Scope change is an officially made decision to change or alter the scope of the project made by the project contractor and the Employer for example to add or remove a feature or to expand or reduce the functionality etc. Scope change involves a thorough procedure which is completely documented and a revision of the cost, budget, schedules, and other features. An official change request is made by either of the parties before making any changes and the parties must agree on the new terms for every change made.

1.3.2 Scope Creep

Scope creep is a different concern in infrastructure projects, several authors who have researched on scope creep in the past have defined it differently, the definitions are provided in table 1.

Table 1 Scope creep definitions

Author (Year)	Definition	Journal
Shane et al (2009)	scope creep is the tendency for the accumulation of many minor scope changes to increase project cost and size. Where the project grows naturally as the project progresses from conception through development to construction	*Journal of Management in Engineering*,
Moneke & Echeme, (2016)	The tendency of a project to grow bigger and bigger or extending beyond its boundaries	*International journal of engineering and technical research*
Coman, A., & Ronen, B. (2010)	Excessive addition of scope resulting in mind-boggling projects	*International Journal of Project Management*
Abrantes (2015)	The project scope changing throughout the whole development cycle from the front end until the design is completed. Example changing or adding features, modifying design etc.	*International Journal of Project Management*
Usher (2017)	Incremental expansion in project scope	*International Journal of Project Management*
Shmueli, O., & Ronen, B (2017).	A practice of expanding a project to include excessive functionality and capabilities during the development phase of a project	*International Journal of Project Management*,
Wulf (2020)	Scope creep is when a project gets larger and complex than initially intended. Poor document control and lack of proper communication are the major causes of scope creep.	*IEEE Engineering Management Review*,
The Project management institute	scope creep is the incremental expansion of the scope of the project	
Farok & Garcia (2016)	Scope creep is a process in which a project grows beyond its initially anticipated size and eventually ends up with a significant negative impact.	*Journal of the International Association of Advanced Technology and Science*
Nicholas & Steyn (2017)	scope creep means a project continues to grow due to changes made in the number or the size of deliverables. Scope creep, if not controlled, can lead to outgrowth in project budgets and schedules which result in several benefit shortfalls.	Project management for engineering, business and Technology

Hussain (2012)	scope creep is the phenomenon where the original project scope to build a product with feature X, Y and Z slowly grows outside the scope originally defined in the statement of work. A change which happens slowly and unofficially without changing due dates or adjusting the budget. The tendency of a project to extend beyond its initial boundaries	*Global Journal of Management and Business Research*
Neimat (2005)	scope creep is uncontrolled and unexpected changes in Employer contemplations and needs as project progress.	*Journal of Facilities Management*

Scope creep is not officially executed therefore revision of budgets, schedules and other features may not be performed. Scope creep occurs very subtly and is difficult to identify, the later it is detected more the damage occurs. It is important to note that scope change and scope creep are not similar. Scope change is part and parcel of every project and is done expecting a positive outcome. Whereas scope creep is not, Scope creep can occur out of ignorance without any recognition and it may arise from any party connected to the project. A distinction between scope changes and scope creep is further explored in chapter 3.

1.4 Wind Energy

Wind energy is the fastest growing renewable source of energy on the global market and is an industry with a significant presence worldwide. In many regions wind farms generate electricity more cheaply than non-renewable resources and In the coming years, onshore wind energy will become one of the cheapest among the renewable sources of energy(WWEA, & ogg, F, 2018). With a restricted amount of fossil fuels available and growing concerns for pollution & global warming, governments across the world are pushing themselves to produce energy from renewable sources and Onshore wind farms as a carbon-free source of energy is a promising contributor in the reduction of greenhouse gas emissions.

With the Paris agreement, all major players in the world came together intending to combat climate change, this explains how determined countries across the world are, to move towards a pollution-free world. The Paris agreement charted a new course in the effort of global climate change with an ambitious target to restrict the global temperature rise to below 2 degrees Celsius (European Comission,2019).In concordance, the countries in the European Union have pledged to meet 20% of their energy demands from renewable sources of energy. The Dutch government, following the above agreements, has developed its ambitious climate plan also known as the National Energy and Climate Plan (NECP), which is bound by the climate act 2019 (Ministerie van Economische Zaken,2020). The Dutch government intends to reduce the greenhouse gas emissions by 49% by 2030, compared with the 1990 level of emissions and a 95% reduction by 2050(MEA, the Netherlands,2016; Ministerie van Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer. 2020).

The current energy production capacity of The Netherlands from sustainable sources can meet only 6% of the required demand and remaining is received from sources such as natural gas, oil and coal, which have adverse effects on the environment such as global warming, the release of greenhouse gas into the atmosphere and so on. In The Netherlands, wind energy

is abundant and is one of the key sources of renewable energy. It has a geographical advantage of being placed in a zone with constant strong winds, which is a clean source of energy and makes the country less dependent on fossil fuels. (Veldman 2019).

Apart from the development of new wind farm projects several companies like Vattenfall are extensively looking to replace old wind turbines with larger and more powerful turbines to produce more power to make a fossil-free living possible within one generation (Vattenfall, 2019) (Gordon, P. 2019). There is a strong push from the central government of the Netherlands to capitalise on the available resource and they are encouraging the development of onshore and offshore wind farms. To meet the targets the government has taken measures such as fast track procedures for installing new wind farms, better information and communication to overcome residents' resistance (Ministerie van Algemene Zaken, 2017).

The Dutch government post the Paris agreement has expressed that it is ambitious in developing wind farm projects and expressed that the country wants 40% of its total electricity demand to be fulfilled from wind farms. All these factors highlight the fact that there is a high potential for an increase in the development of wind farm projects in the Netherlands. In conclusion, the key driver for wind energy development in the Netherlands is the political will of the government to develop green energy infrastructure. And onshore wind farm projects are promising contributors to the ambitious plan which proves that the demand for wind energy will keep growing on the global market and will likely be a winner among the renewable sources.

1.5 FIDIC

International Federation of Consulting Engineers also known as FIDIC is an international organisation which develops contract templates i.e. defining conditions of the contract to consult and construction in the construction industry. FIDIC contracts are developed to protect the interests of Firms, Contractors and Consultants in the process of supplying services for the built and natural environment and are recognised and used globally in many jurisdictions, on all types of projects. The standard forms of contracts developed by FIDIC are mostly used between Employers, contractors and consultants in international projects. The FIDIC clearly defines the roles, boundaries & responsibility of all the main stakeholders involved in the project and the priority of documents in case of conflicting clauses, thereby reducing conflicts, delays and cost escalations etc. (FIDIC.org). The FIDIC has defined contracts for different purposes and these are identified based on their colour:

1. Red: Civil Engineering Construction (Design by employer)
2. Yellow: Plant and Design-Build (Design responsibility with Contractor)
3. Silver: EPC/Turnkey contract (Contractor does the major part of the design)
4. Green: Short Form of Contract
5. Gold: DBO contract
6. Blue-Green: Dredging and reclamation works
7. White: Employer/ Consultant model services agreement

Figure 3 gives a clear picture of the type of book to choose for a project. The distinct forms of contract in the FIDIC suite are arranged around the boundaries of design and responsibilities expected or assumed by the Employer and the contractor The FIDIC contracts can be applied

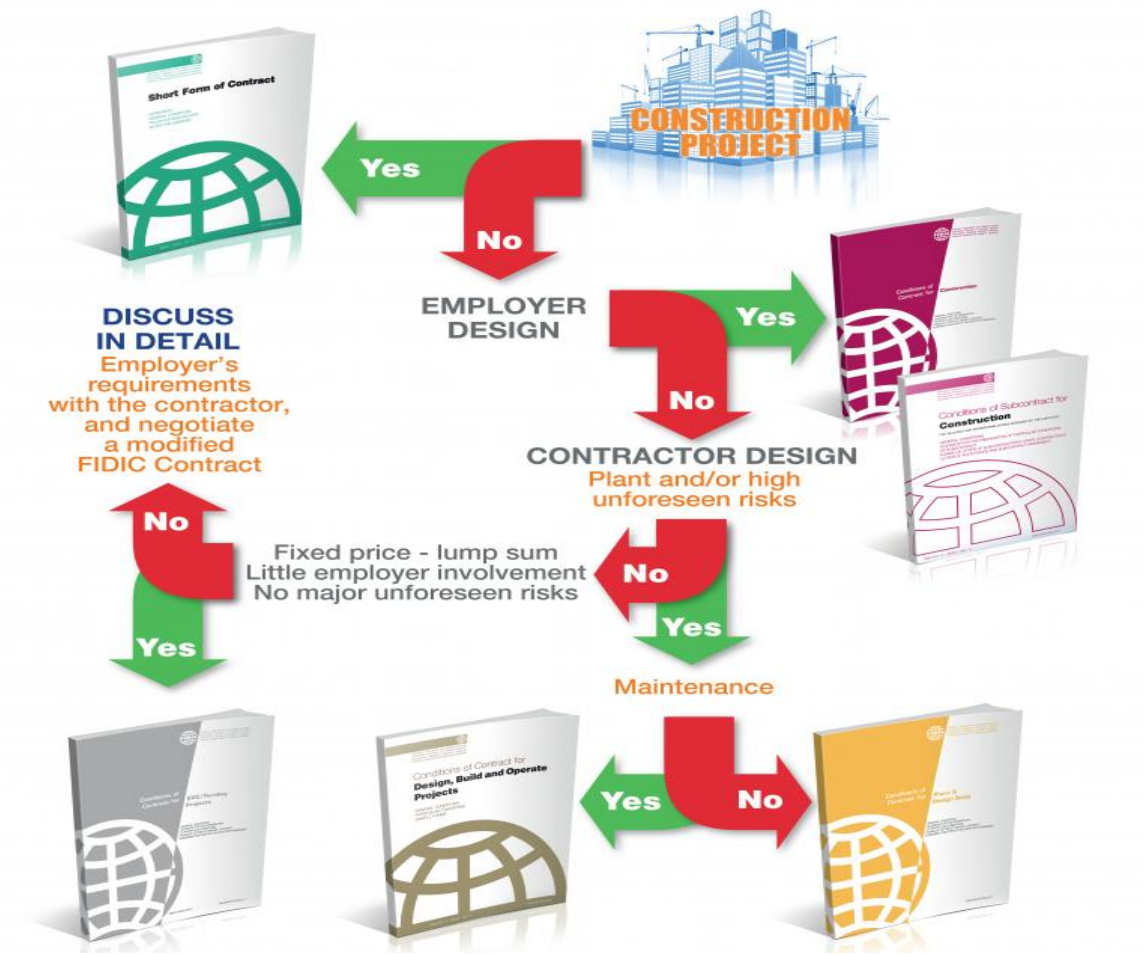

Figure 3 FIDIC series (yellow book in bottom right corner)

to a wide range of engineering and construction projects i.e. from conventional civil engineering projects to wind farm projects and large oil & gas process plants(Turner & Townsend)

The main concern in this research is linked with the usage of FIDIC yellow book as the contract template, hence it was decided to limit the research within the boundaries of the FIDIC yellow book. The FIDIC yellow book was launched in the year 1999, it has the conditions of contract template of the plant and Design-Build for Electrical and mechanical plant, and for building works. The design responsibility in this contract lies with the contractor.
The main contents of the book include :

1. General conditions of the contract
2. Guidance for the preparation of specific conditions
3. Forms of tender and contract agreements
4. Dispute adjudication agreement

The plant design-build also is known as the yellow book contains conditions of contract where the contractor is obliged to carry out the design works. The yellow book applies to the provision of electrical or mechanical plants and for the design and implementation of building or engineering works. Under this type of contract, the contractor designs the works as per the requirements of the employer which include civil, electrical, mechanical and other construction works or a combination of all of them. The book also guides the preparation of specific conditions when it is necessary to modify the general terms and conditions. (Turner & Townsend).

1.6 Dura Vermeer

This research is facilitated and supported by Dura Vermeer, a Dutch EPC Contracting company; The 165-year-old company provides versatile services in the areas of residential, non-residential, infrastructure and industries. The company has recently forayed into the business of onshore wind farm projects. To improve its scope management in wind farm projects the company is conducting this research. The research aims to recommend suitable strategies to overcome scope issues that could improve the delivery of a project.

2

RESEARCH DESIGN

This chapter will present the design of the research work of this report. This chapter will present the research goals, questions and method employed to answer the research questions.

2.1 Introduction

In defining the scope of this study, it was decided to limit the research to onshore windfarm projects governed by FIDIC yellow book. The objective of this research is to develop and recommend solutions to EPC contracting companies i.e. Dura Vermeer to improve its scope management and thereby enhance adaptability to scope changes and reduce scope creep.

This will be achieved by analyzing the factors that are affecting scope management, by analyzing the FIDIC yellow book, by studying the scope management and change management models of the company and by making a case study analysis of wind farm projects executed by Dura Vermeer.

The main goal of this research is to contribute to improved scope management by identifying or developing the best suitable practices to control scope creep in onshore windfarm projects developed by Dura Vermeer by comparing literature findings with practical experience.

2.2 Research Question

The main research question is stated as follows: What are the suitable strategies to improve scope management for Dura Vermeer in onshore wind farm projects, governed by FIDIC yellow book, and thereby improve project delivery

To answer the main research question, the following sub-questions have been formulated:

1. What are the factors that are leading to scope creep and scope changes in construction projects according to literature?
2. How does the FIDIC yellow book contribute to scope creep in the projects?
3. What are the gaps present for improvement in the scope management model practised by Dura Vermeer in onshore wind farm projects?
4. What are the appropriate strategies to follow to overcome the challenges of scope creep?

2.3 Method

The research is conducted to determine the factors that could lead to scope change, scope creeps, to study the FIDIC Yellow Book's role in contributing towards the occurrence of scope creep and to study scope management in construction projects by performing a literature study and then by performing a Qualitative comparative case analysis of projects completed by Dura Vermeer to better understand the nature of the scope issue. Finally, propose suitable recommendations for the organization to manage scope creep in onshore windfarm projects.

The research will be carried out by doing a literature study and case study analysis of three onshore windfarm projects executed by Dura Vermeer. The investigation is divided into three different steps, where necessary information is collected in each step to answer the sub research questions and finally the main research question is answered.

A literature study is an essential start to identify the factors causing scope change and scope creep, clearly understand the distinction between the terms, identify the gaps in FIDIC yellow book and the scope management model. To carry out the literature study, Google scholar is primarily employed along with the TU library services. From the identified research papers the papers related to civil engineering and management from international journals are selected. Based on the relevance to the research the papers are studied more closely. In the first step, the focus is more on the terms scope, scope change and scope creep.

The theoretical approach consisted of reviewing of existing research articles on scope change and scope creep using keywords such as scope, scope change, scope creep and further the search is extended using keywords such as schedule delay, cost overrun, scope mismanagement, creep, contractor reputation, scope in onshore wind farms, wind farm failures, reworks etc. The search for research articles on scope creep also included synonym terms of scope creep which are identified from the articles studied initially. The terms such as feature creep, project creep, uncontrolled growth, diminishing scope and dynamic scope creep are the identified synonyms to scope creep. The results from this step answers the first sub-question.

After analysing the terms, The scope management model and change management model are searched along to develop a deeper understanding of the scope management model. Finally, the focus is shifted to contracts, FIDIC, FIDIC yellow book and international agreements in construction.

The first phase of the research is a combination of theoretical and empirical approaches. Therefore, followed by the theoretical approach an empirical research is carried out which involves exploratory interviews with 2 managers each from 3 cases. The interviews are held over skype with employees from Dura Vermeer, after the initiation of the literature review. During the interview a structured set of questions are asked on scope changes, scope creeps, the FIDIC Yellow book, scope management and change management.

The findings of the literature review give an overview of the status of research on the interested research area and help to identify the knowledge gaps. More specifically on terms scope change & scope creep, their factors and impacts, FIDIC yellow book, scope management and change management procedures. The interviews with managers are used to conform with the scope creep factors identified and to partially answer the second sub-question.

Followed by the literature review the FIDIC yellow book is studied closely and analysed by taking leads from the literature review, past thesis research reports and the interviews with managers. The results answer the second sub-question. After the information gathered from the literature study and FIDIC analysis the research proceeded to study the scope management model of the company by analysing the documents of Dura Vermeer and from the inputs of project managers.

In the empirical approach semi-structured interviews are carried out with the same group of managers. The open-ended setting provides an opportunity to explore the subject of interest from multiple directions. The second interview focusses on scope creep particularly in the 3 onshore windfarm projects executed by Dura Vermeer and the scope management model employed by the company. The idea behind the interview structure is that it provides flexibility to explore multiple aspects within a boundary.

To determine the examples of scope creep the managers are asked to review their project documents and reports (ex: Kwalitaat rappotage). Followed by the reviewing of project reports, discussions and critical thinking in terms of cost over runs, delays, disputes etc in the projects are held which enables the identification of the scope creep activities in the projects.

The results from the first round of interview gives a practical perspective on the terms mentioned earlier whereas the second round gives issues encountered during the scope development process and in the execution of 3 onshore wind farm projects. By the end of the second round of interview majority of the issues i.e. scope creep factors, flaws in FDIC yellow book and the gaps in scope management model of the company are identified along with a few examples of scope creep from each case. Therefore the third sub-question is answered.

The results from the interviews are both qualitative and quantitative that speaks about the understanding of the practitioners on the subject scope creep and provide elements of actual and desirable practice.

Based on the identified issues solutions are proposed, that are identified in the literature and the best solution as per the interests of the organisation and from the discussion with managers is developed. The solution is validated with two experts from Dura Vermeer, who are not involved in the previous meetings. The qualitative validation aims to assess the feasibility and the fitness of the solution in the organisation and finally the main research question is answered. The framework of the research method is further presented in figure 4 below.

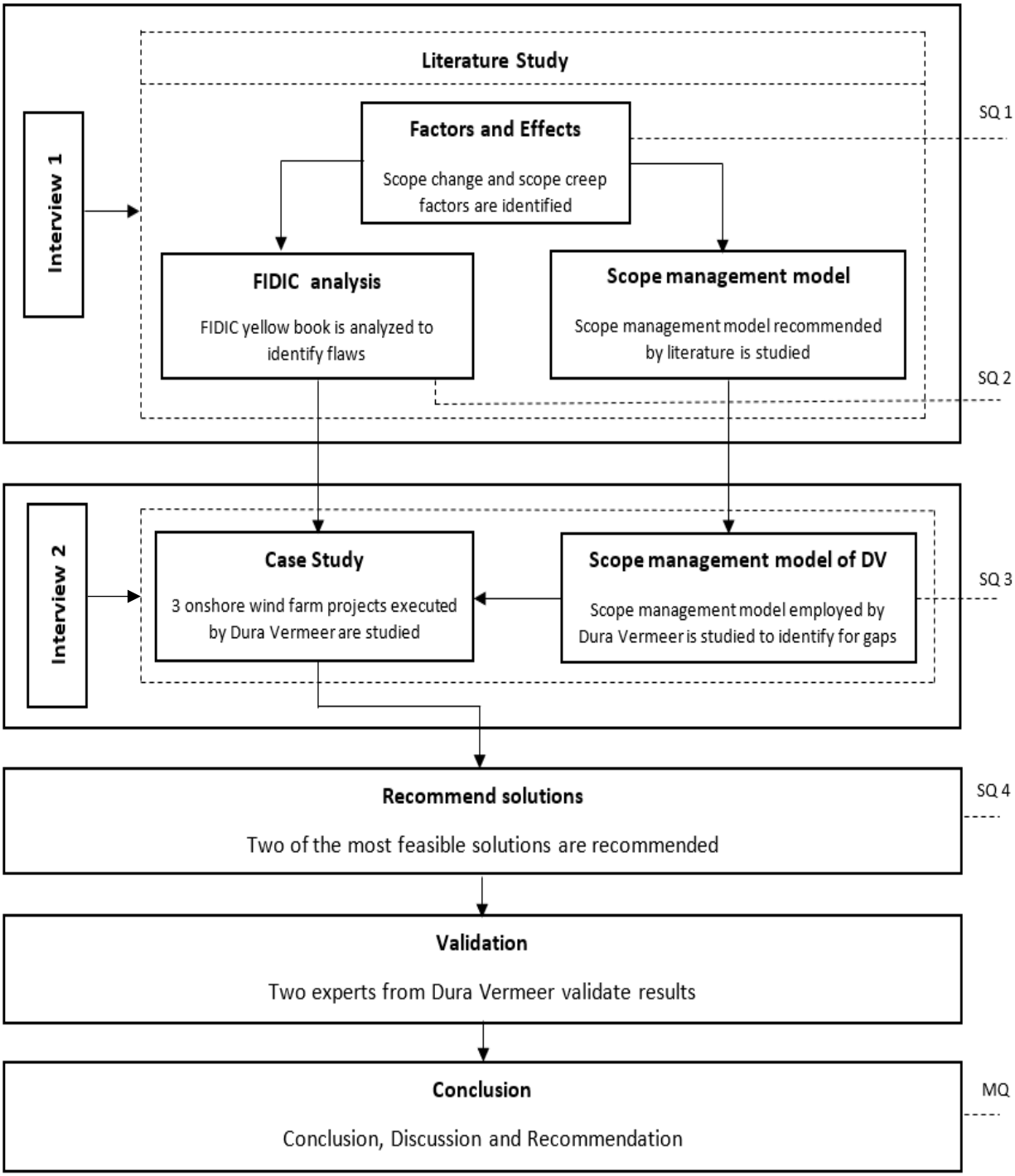

Figure 4 Research method framework

3

FACTORS & EFFECTS

An extensive literature study will be performed in this chapter on the terms scope change and scope creep. Further, the factors and effects of scope change and scope creep will be identified along with a clear distinction between scope change and scope creep.

3.1 Introduction

The research focuses mainly on the concept of scope creep however it is important to understand the difference between scope change and scope creep in projects and especially in onshore wind farm projects in this research. A study investigating the differences between scope change and scope creep is a necessary start in identifying or developing a solution that fits the problem. Hence this section will define the concepts of scope change, scope creeps and will also address the factors that could lead to the respective issues in projects. Additionally, after identifying the factors leading to scope change and scope creep the effects of the terms on projects when they occur will also be presented.

3.2 Scope change

During the development of any type of project; change orders are unavoidable, and most parties are open to embracing changes, however, the magnitude of changes are a concern as they can have a detrimental effect on the project leading to several negative effects. Therefore, it is important to understand the cause and effects of scope changes to understand scope creep better. Table 2 consists of a list of factors that were identified in the literature that could potentially lead to scope changes in projects. The factors are followed by a list of effects of scope changes presented in table 3.

3.2.1 Scope change factors

Table 2 Factors causing scope changes

Factors causing scope change	**References**	
Change in Employer requirement *(Employer has fresh ideas and intends to add or remove features)*	Hsieh et al (2004)	Sun & Meng (2009)
	Serag (2010)	Shrestha (2019)
	Kim et. al (2020)	Abad et. al (2019)
	Kostka et al. (2016)	Alnuaimi et. al (2010)

Change in specifications *(Characteristics of works that the employer intends to purchase such as technical aspects, environmental performance, design, safety, quality etc. are modified)*	Hsieh et al (2004)	Sun & Meng (2009)
	Shrestha (2019)	Kostka et al. (2016)
	Kim et. al (2020)	Shalaby et. al (2019)
	Staiti et. al (2016)	
Design change *(Change in design due to new developments during execution)*	Hsieh et al (2004)	Sun & Meng (2009)
	Shrestha (2019)	Alnuaimi et. al (2010)
	Staiti et. al (2016)	Kostka et al. (2016)
	Olawale & Sun (2013)	
Lack of funds *(Shortage of money, market fluctuations)*	Staiti et. al (2016)	Shalaby et. al (2019)
	Shrestha (2019)	Abad et. al (2019)
	Goodrum et. al (2005)	
Slow/poor decision making *(Taking too much time or wrongful decisions results in undesirable effects such as cost increase, delays leading to changes in scope)*	Sun & Meng (2009)	Staiti et. al (2016)
	Kostka et al. (2016)	
Poor planning *(Mistakes in planning, lack of enough pre-project planning, lack of strategic planning)*	Hsieh et al (2004)	Sun & Meng (2009)
	Shrestha (2019)	Goodrum et. al (2005)
	Kim et. al (2020)	Shalaby et. al (2019)
	Kostka et al. (2016)	Alnuaimi et. al (2010)
Inexperienced project team *(Inexperienced team may take unsound decisions leading to errors, delays, cost over runs and therefore lead to scope change)*	Sun & Meng (2009)	Kostka et al. (2016)
	Abad et. al (2019)	Shrestha (2019)
	Alnuaimi et. al (2010)	Shalaby et. al (2019)
Change in stakeholders *(Addition or removal of stakeholders changes the dynamics of the project ex: financially, new demands)*	Hsieh et al (2004)	Kostka et al. (2016)

Complexity *(Complicated tasks involving large number of interacting parts that makes projects complex to manage ex: technological, organisational etc.)*	Sun & Meng (2009)	Serag (2010)
	Shrestha (2019)	
Unexpected site conditions *(Different conditions encountered during execution than when planning ex: poor soil)*	Hsieh et al (2004)	Sun & Meng (2009).
	Shrestha (2019)	Olawale & Sun 2013
	Abad et. al (2019)	Serag (2010)
	Alnuaimi et. al (2010)	Kim et. al (2020)
	Kostka et al. (2016)	Shane et al (2009)
Design errors/omissions *(Changes in design to correct errors and omissions)*	Hsieh et al (2004)	Sun & Meng (2009)
	Shrestha (2019)	Shalaby et. al (2019)
	Abad et. al (2019)	Serag (2010)
	Alnuaimi et. al (2010)	
Ambiguous design details *(Design details that are difficult to understand)*	Hsieh et al (2004)	Sun & Meng (2009)
	Kostka et al. (2016)	Alnuaimi et. al (2010)
External causes *(Political, economic, environmental etc.)*	Hsieh et al (2004)	Sun & Meng (2009)
	Abad et. al (2019)	Olawale & Sun (2013)
	Kostka et al. (2016)	
Lack of proper understanding of scope *(Poor understanding of project scope due to poor definition, poor requirements collection etc.)*	Staiti et. al (2016)	Sun & Meng (2009)
	Goodrum et. al (2005)	Shrestha (2019)
	Alnuaimi et. al (2010)	Shalaby et. al (2019)
	Hsieh et al (2004)	Kostka et al. (2016)
Lack of enough data *(Insufficient data results in an unsound design. During execution the designs could be incompatible)*	Hsieh et al (2004)	Staiti et. al (2016)
	Kostka et al. (2016)	Abad et. al (2019)

Poor communication between parties *(Poor communication will result in poor information transfer leading to errors ex: wrong interpretation)*	Sun & Meng (2009).	Staiti et. al (2016)
	Serag (2010)	Shrestha (2019)
	Kostka et al. (2016)	Alnuaimi et. al (2010)
Risks and uncertainties *(When unpredictable scenarios are encountered changes in design may get inevitable)*	Hsieh et al (2004)	Kostka et al. (2016)
	Peña-Mora et. al (2005)	Serag (2010)
	Olawale & Sun 2013	Sun & Meng (2009).
Increase in project cost or budget *(Project budget may increase during the execution stage due to several reasons ex: anomalies, in order to complete with the desired result changes, are brought into effect)*	Kostka et al. (2016)	Abad et. al (2019)
Alteration in design by Engineer *(Alteration in the design suggested by the engineer/ consulted to make improvements or to add/remove features)*	Sun & Meng (2009).	Hsieh et al (2004)
	Shrestha (2019)	Shane et al (2009)
Disagreement among contract documents *(Conflict among the project documents i.e. multiple documents with different requirements)*	Hsieh et al (2004)	Staiti et. al (2016)
	Abad et. al (2019)	
Poor workmanship *(Poorly executed work such as bad quality)*	Sun & Meng (2009).	Staiti et. al (2016)
	Olawale & Sun 2013	Alnuaimi et. al (2010)
Optimism bias(delusion) *(Too optimistic estimation, underestimating the amount of works, risks etc resulting in budget shortfalls)*	Flyvbjerg, B. (2002).	Olawale & Sun 2013
	Shrestha (2019)	Shane et al (2009)
Strategic misrepresentation (deception) *(Deliberately misrepresenting the estimation of a bid to win the contract and eventually falling short of budget)*	Flyvbjerg, B. (2002).	Shrestha (2019)
Outdated design *(The design construction criteria does not suit present construction technology)*	Alnuaimi et. al (2010)	Shrestha (2019)
Value engineering *(A change that brings an additional value to the project such as reducing cost, improving efficiency etc.)*	Kim et. al (2020)	
Unavailability of adequate resources *(Lack of sufficient resources may require the scope to be changed so that an alternative can be used to achieve the objectives)*	Staiti et. al (2016)	Olawale & Sun 2013
	Shrestha (2019)	Abad et. al (2019)
	Alnuaimi et. al (2010)	

Lack of clear understanding of government policies *(Unclear understanding of the government policies results in a design which is not acceptable leading to inevitable changes)*	Hsieh et al (2004)	Staiti et. al (2016)
	Abad et. al (2019)	Alnuaimi et. al (2010)
Challenges in technology, supply chain, finance**.** *(Challenges leads to roadblocks which hamper the smooth progress of the project therefore changes are brought into effect to make progress)*	Sun & Meng (2009).	Staiti et. al (2016)
	Alnuaimi et. al (2010)	

3.2.2 Effects of scope change

The previous sub-section 3.2.1 gives an overview of potential causes of scope changes in a project. Scope changes are usually done to add value to a project however the degree of value addition depends/varies according to the phase of the project. Therefore, it is important to take the pertinent effects of scope changes into account when making changes to the scope. The table 3 lists a set of effects from the perspective of a contractor.

Table 3 Effects of scope changes

Effects of scope changes	**References**	
Cost overruns (direct & indirect) *(Increase in project budget due to the changes)*	Sun & Meng (2009)	Kermanshachi (2019)
	Alnuaimi et. al (2010)	Shalaby et. al (2019)
	Robinson , & Knight (2002)	Chang (2002)
Delays *(Delay in the completion of project as per the initial schedule)*	Sun & Meng (2009)	Kermanshachi (2019)
	Alnuaimi et. al (2010)	Shalaby et. al (2019)
	Robinson , & Knight (2002)	Chang (2002)
Disputes *(Confusion and disruption of work due to changes can result in disputes between stakeholders)*	Robinson , & Knight (2002)	Sun & Meng (2009)
	Alnuaimi et. al (2010)	Shalaby et. al (2019)
Difficult to maintain quality *(Disruptions in work flow and delays can lead to work being carried out in a hasty manner resulting in poor quality of work)*	Sun & Meng (2009).	Kermanshachi (2019)
	Alnuaimi et. al (2010)	
Loss of reputation *(The contractor could lose its reputation with the employer, which may affect its future projects with the same employer)*	Sun & Meng (2009)	Alnuaimi et. al (2010)

Loss of motivation of team *(Constant changes in the work and disruptions in work will impact the motivation of the team)*	Sun & Meng (2009)	Robinson , & Knight (2002)
Reworks *(Such as revision of plans, addition of works, re-sourcing etc.)*	Robinson , & Knight (2002)	Sun & Meng (2009)
	Chang (2002)	Serag (2010)
	Alnuaimi et. al (2010)	Hao et. al (2008)
	Kermanshachi (2019)	
Employer dissatisfaction *(Employer may be unhappy with the outcome, which may impact the prospects of dealing with the contractor)*	Hao et. al (2008)	Sun & Meng (2009)
Penalties *(Changes can lead to wrongful execution, defects or delays, which in turn attract penalties)*	Hao et. al (2008)	
Disruption of workflow *(Changes requires time to re-plan which will disrupt the flow of the work)*	Awad et. al (2004)	Sun & Meng (2009).
	Serag (2010)	Robinson & Knight (2002)
	Shalaby et. al (2019)	Abad et. al (2019)
	Kermanshachi (2019)	
Scope creep *(Improper management of scope changes results in scope creeps)*	Kostka et al. (2016)	Amoatey et al. (2017)
	Olawale & Sun (2013)	Kapsali (2011)
	Hussain (2012)	Kermanshachi (2017)
	Kermanshachi (2019)	

3.3 Scope creep

According to (Kermanshachi 2019) scope creep in a construction project is one of the prime causes that lead to the poor performance of the project to develop a strategy. To mitigate the issue of scope creep various factors that cause scope creep must be identified. A better understanding of all the causes will guide the development of a rational solution to overcome the issue of scope creep. Table 4 consists of factors that could lead to scope creep that were highlighted by several researchers in literature and are in line with the definitions of scope creep provided in section 1.3.2. Further, the factors are classified based on four parameters namely Organisation, Human, technical and external which are presented in Appendix E.

1.3.1 Scope creep factors

Table 4 Factors of scope creep

Factors Causing Scope Creep	References	
Poor communication (no coordination) between stakeholders *(Improper communication between stakeholders results in wrong interpretation or poor information transfer leading to erroneous outcomes)*	Shane et al (2009)	Farok et al. (2016)
	Kermanshachi (2019)	Wulf (2020)
	Yousefi et. al (2017)	Fuentes(2019)
	Olawale & Sun (2013)	Kostka et al. (2016)
	Hussain (2012)	Moneke & Echeme (2016)
	Chan et al (2001)	Komal (2020)
Lack of a comprehensive project organization *(An organisation which deals with all the aspects of a project)*	Kostka et al. 2016	Farok et al. (2016)
	Olawale & Sun (2013)	Amoatey et al. (2017)
	Kermanshachi (2019)	
Ignoring stakeholders *(Not consulting stakeholders during decision making)*	Moneke & Echeme (2016)	Farok et al. (2016)
	Hussain (2012)	Komal (2020)
	Yousefi et. al (2017)	
Improper management of scope changes *(Poorly executed scope changes due to reasons such as no change system, unclear procedures, not involving project team and not reviewing changes leads to undesirable scope)*	Kostka et al. (2016)	Amoatey et al. (2017)
	Olawale & Sun (2013)	Kapsali (2011)
	Hussain (2012)	Komal (2020)
	Kermanshachi (2019)	Shirazi et. al (2017)
Informal decision to make changes *(Decisions made informally between people and not putting the decisions formally through the scope change process)*	Moneke & Echeme (2016)	Shirazi et. al (2017)
	Steyn (2019)	
Conflicting requirements of stakeholders *(Multiple stakeholders with conflicting requirements will lead to confusion, weak design, planning etc and therefore lead to scope creep)*	Moneke & Echeme (2016)	Chan et al (2001)
	Shane et al (2009)	Yousefi et. al (2017)
	Kostka et al. (2016)	Hussain (2012)
	Olawale & Sun (2013)	Komal (2020)
	Farok et al. (2016)	Amoatey et al. (2017)
	Giezen (2012)	

Project management decisions *(Poor decision making by the project management team without foreseeing the consequences)*	Moneke & Echeme (2016)	Kermanshachi (2019)
	Hsieh et al (2004)	Amoatey et al. (2017)
	Badewi (2016)	
Experience of team *(Inexperienced team may take unsound decisions leading to errors, delays, cost over runs and therefore lead to scope creep)*	Moneke & Echeme (2016)	Chan et al (2001)
	Assaf et al. (2006)	Turbit (2005)
	Kostka et al. (2016)	Komal (2020)
	Olawale & Sun (2013)	Nabet et,al (2016)
	Badewi (2016)	Kermanshachi (2019)
Complexity *(Complicated tasks involving large number of interacting parts that makes projects complex to manage ex: technological, organisational etc.)*	Moneke & Echeme (2016)	Farok et al. (2016)
	Yousefi et. al (2017)	Komal (2020)
	Olawale & Sun (2013)	Hussain (2012)
	Kostka et al. (2016)	Sovacool et al (2017)
Time pressure *(Unrealistically expecting or delivering too much in less time)*	Nabet et,al (2016)	Turbit 2005
	Kostka et al. (2016)	Komal (2020)
Delay in project execution *(Project delayed for too much time after scope definition. A lot of things can change during this period and executing the same without updates results in scope creep)*	Moneke & Echeme (2016)	Kermanshachi (2017)
	Kermanshachi (2019)	Farok et al. (2016)
	Kostka et al. (2016)	Hussain (2012)
	Moneke & Echeme (2016)	Shane et al (2009)
Erroneous Scope definition *(Scope definition done by people less familiar about the project, the conditions, the contract or less qualified)*	Moneke & Echeme (2016)	Shirazi et. al (2017)
Ignoring small changes *(Ignoring and executing small changes beyond the project scope without considering and foreseeing the effect of those changes on resources, cost, time etc.)*	Hussain (2012)	Moneke & Echeme (2016)
	Steyn (2019)	Shane et al (2009)
Improper assessment of scope *(Poor understanding of project scope due to poor definition, poor requirements collection etc.)*	Moneke & Echeme (2016)	Winch, G. M. (2013)
	Assaf et al. (2006)	Hsieh et al (2004)
	Amoatey et al. 2017	Hussain (2012)

	Olawale & Sun (2013)	Farok et al. (2016)
	Kermanshachi (2017)	Kermanshachi (2019)
	Chan et al (2001)	Steyn (2019)
	Nabet et,al (2016)	Komal (2020)
Discrepancy/ Ambiguity in contract documents *(Conflict or ambiguity in the contract documents or conditions such as the FIDIC yellow book & UAV-GC with diluted responsibility, creating misunderstanding between parties, unclear procedures etc can cause confusion, disputes, volatility etc, leading to scope creep)*	Nabet et,al (2016)	Farok et al. (2016)
	Shane et al (2009)	Shirazi et. al (2017)
	Chan et al (2001)	Hsieh et al (2004)
	Olawale & Sun (2013)	
Lack of proper document control *(Poor practices in reviewing, modification, distribution and accessibility of the project documents)*	Moneke & Echeme (2016)	Farok et al. (2016)
	Hussain (2012)	Olawale & Sun (2013)
	Nabet et,al (2016)	Shirazi et. al (2017)
	Wulf (2020)	
Change in Project team *(Changes made in a project team due to various reasons can lead to loss of information which is discussed in the different stages of the project)*	Moneke & Echeme (2016)	Hussain (2012)
	Kostka et al. (2016)	Amoatey et al. (2017)
	Nabet et al (2016)	Hsieh et al (2004)
	Shane et al (2009)	
Political volatility *(During the development process of the project, influential politicians will have shifting demands leading to a substantial change of plans, ideas etc.)*	Giezen (2012)	Shane et al (2009)
	Hussain (2012)	
Gold plating *(Exceeding the scope of the project with the impression that value is being added)*	Moneke & Echeme (2016)	Shane et al (2009)

3.3.2 Effects of scope creep

The factors that cause scope creep have been identified and explained in the above section, The effects of scope creep are listed below in table 5:

Table 5 Effects of scope changes

Effects of Scope Creep	**References**	
Increase in cost *(Increase in project budget due to the execution of undesirable scope)*	Shane et al (2009	Amoatey et al. (2017)
	Hussain (2012)	Farok et al. (2016)
	Kermanshachi (2019)	Madhuri et. al (2018)
	Madhuri et. al (2014)	Kim et al (2011).
	Moneke & Echeme (2016)	
Delays *(Delay in the completion of the project as per the initial schedule due to the execution of unwanted scope)*	Shane et al (2009	Nabet et,al (2016)
	Amoatey et al. (2017)	Farok et al. (2016)
	Madhuri et. al (2014)	Moneke & Echeme (2016)
	Kermanshachi (2019)	Madhuri et. al (2018)
Quality loss *(Quality of the project will be compromised in order to compensate for scope creep and complete the project within the estimates)*	Moneke & Echeme (2016)	Amoatey et al. (2017)
	Kermanshachi (2019)	Madhuri et. al (2014)
Increase in project size *(The size of the project increases as the project boundaries are pushed by the execution of undesirable scope)*	Amoatey et al. (2017)	Shane et al (2009
Customer dissatisfaction *(Scope creep consumes time, money and resources and results in delivery of the wrong objective. This shall leave the customer dissatisfied for purchase of an unworthy product)*	George et. al (2008)	Madhuri et. al (2018)
	Moneke & Echeme (2016)	
Legal dispute *(Execution of unwanted tasks consumes resources, time and money, which results in disputes between stakeholders)*	Nabet et,al (2016)	Amoatey et al. (2017)
Damage to reputation *(The executing party may risk damaging its reputation for poorly understanding the requirements and delivering the unwanted objective)*	Moneke & Echeme (2016)	Amoatey et al. (2017)
Increase in project management effort *(Increasing work demands extra effort and supervision which eventually ends up being worthless due to undesirable outcome)*	Moneke & Echeme (2016)	Madhuri et. al (2014)
Loss of efficiency *(Correcting scope creep disrupts the flow of the works and therefore affects the efficiency of the process)*	George et. al (2008)	Amoatey et al. (2017)
	Kermanshachi (2019)	Madhuri et. al (2018)
	Moneke & Echeme (2016)	Toivonen (2014)

Difficulty in determining compensation for the parties involved *(Difficult to determine which party must bear the responsibility and by how much when the wrong scope is executed)*	Moneke & Echeme (2016)	
Wastage of efforts and resources (Scope creep consumes resources and efforts without knowledge. The consumes resources and efforts cannot be recovered)	George et. al (2008)	Amoatey et al. (2017)
	Moneke & Echeme (2016)	Abrantes (2015)
Rework *(Revision of plans, addition of works, re-sourcing etc to compensate for the loss due to scope creep.)*	Shane et al (2009)	Hao et. al (2008)
	Moneke & Echeme (2016)	
Project cancellation *(The project may get cancelled due to less earned value and unreasonable delays, expenditure etc.)*	Amoatey et al. (2017)	Shirazi et. al (2017)

3.4 Conclusion

This chapter concludes the identification of the factors that lead to scope change and scope creep and their effects on the project. The literature identified and studied in this chapter was diversified in the construction sector, which includes rail and road transportation, bridges, tunnels, subways, housing, mining, offshore wind farms, hotels, culverts, real estate and airport projects. The study was also extended to scope creep from the software industry to identify the factors and effects of scope creep.

The scope change and scope creep factors presented in tables 2 and table 4 were identified by literature through empirical evidence utilizing case studies and interviews of experienced project managers. A few researchers also included the perspectives of managers from Contractor, Employer and Consultant organizations. The case studies include both public and private projects and involved projects such as the Holland tunnel project (USA), mining projects (Namibia), offshore wind farm and airports projects (Germany), Highway projects (Nigeria), metro project (Rotterdam) and so on.

The research papers have identified factors in the projects which have experienced scope changes and scope creep. However, none of the research shows the presence of any of the identified factor certainly leads to scope change or scope creep. Therefore, the occurrence of scope change and scope creep cannot be certain just by the mere identification of the factors in the projects. The certainty of the occurrence of the scope creep or scope change also depends on the factor for example: change in a project team or time pressure not necessarily means scope creep occurs for certain. Whereas factors such as complexity, improper assessment of scope increases the chances of scope creep or scope change. Therefore, the probability of occurrence of scope change and scope creep is specific to a project and the conditions.

All the scope creep factors were identified by literature in the definition and execution phase of the projects and few factors such as time pressure and poor communication were also identified during the inception phase of the project. Most of the researchers identified most of the scope creep factors, occurring in the execution phase of the projects. Almost all the researchers have identified scope creep leading to cost overruns and schedule delays, from which it can be concluded that money and time are the immediate and inherent effects of

scope creep. Whereas few researchers also focused on effects such as inefficiency, reworks, customer dissatisfaction, disputes etc. due to scope creep in projects.

During the study it was also identified that scope creep was also called as feature creep, project creep, uncontrolled growth, diminishing scope and dynamic scope creep by various researchers.

From table 2 and table 4 it can be observed that there is an overlap of factors that could lead to scope change and scope creep. For example, Complexity can lead to both scope changes as well as scope creep. Complexity in projects means more uncertainties and risks are involved, as the project progresses, and as new revelations are identified changes are performed for desirable project progress. Similarly, complexity results in complicated tasks, which could lead to confusion, volatility, difficulty in controlling and poor decision making resulting in scope creep. Therefore, an overlap in the factors causing scope changes and scope creep is very much a possibility. A link between both the terms could be that scope change could be a factor that causes scope creep or scope creep could be an effect of scope change, if not properly handled.

On other hand the effects of scope change and scope creep are also majorly similar with cost, time, disputes, reworks, quality loss and employer dissatisfaction being the common effects of both scope creep and scope change. It can also be inferred from the literature that the effect of scope creep or scope change on a party varies depending on the type of reimbursement scheme, delivery method, number of parties involved, employer experience & flexibility and the type of contract conditions employed. For example: In a fixed-price contract with design-build delivery and UAV-GC as the governing contract, the effect of scope creep is majorly on the contractor (As long as the employer is not involved in decision making). Therefore, different factors have varied effects on specific projects and each factor should be examined on each project individually.

Komal (2020) has identified 1) time pressure 2) poor scope assessment 3) inexperienced team 4) conflicting requirement of stakeholders 5) ignoring stakeholders 6) complexity and 7) poor communication as the most important factors that lead to scope creep. However, the factors are more pertinent to the software industry. Whereas, literature relevant to the construction industry has not highlighted the most important factors that could lead to scope creep, however, going by the highest identified mentions from literature 1) improper scope assessment 2) poor communication 3) conflicting requirements of stakeholders 4) complexity 5) experience of team 6) change in team and 7) Improper management of scope changes could be concluded as the most important factors that could lead to scope creep. Further, the emanation of scope creep from contract conditions (FIDIC yellow book) and due to poor scope management process are explored in the succeeding chapters.

From the literature study, multiple definitions of scope creep were identified and are presented in table 1 in sub-section 1.3.2. The definitions identified converge at the same point. Therefore, for this research purpose the author, based on the definitions identified, defines scope creep as informal and unauthorised changes/works which results in expansion in the scope of a project increasing project cost and size. Where project boundaries are extended naturally as the project progresses from conception through development to construction phases.

Finally, the primary purpose of this chapter is to identify the factors and effects of scope change and scope creep and hence answer the first sub-research question i.e. "*What are the*

factors that are leading to scope creep and scope changes in construction projects according to literature and project managers?" which is answered in table 2 and table 4.

Further, the purpose of this chapter is also extended to show the distinction between the terms scope change and scope creep. Which is presented in table 6.

Table 6 Scope change vs Scope creep

	Scope Change	**Scope creep**
Definition	Officially made change in the scope of the project	Unauthorized and informal works, which extend the project scope
Planning & Scheduling	Yes	No
Resource allocation	Yes	Consumes without knowledge
Can be controlled	Yes	Occurs without knowledge
Stakeholder satisfaction	Attempted	Unlikely

4

SCOPE MANAGEMENT MODEL

In this chapter the scope management model recommended by theory will be studied, which will be later compared with the scope management model of the contractor organisation, Dura Vermeer

4.1 Introduction

The literature on scope management available in theory will be studied in this section. The literature findings on scope management will provide inputs for the empirical research. This study helps in understanding the various aspects of scope management practices suggested by the project management guide and in answering the third sub-question presented in section 2.2.

As explained in the introduction, the scope is the work that needs to be achieved to develop a project with the desired features. In order to realize a project, the starting step is to identify the appropriate scope and define it and the intermediate is to control the scope, which during the development stage undergoes several changes as new opportunities, threats and risks are identified (Nicholas & Steyn 2017).

It is not only the initial scope but also bringing the changes into effect that should be managed efficiently as projects experience innumerable variation orders, it increases the probability of occurring of risks. When the changes are not efficiently managed by feeding them into a change management process it can lead to mismanagement of the change executions and can in turn lead to project failures, scope creep and other negative impacts on projects (Hao et al., 2008). El-Gohary (2010) has also highlighted that scope management process is extremely important when it comes to preventing scope creep, it consists of the processes which are essential to ensure the scope of the project is defined properly and therefore reduce the possibility of scope creep occurrence. Hence this section will study the scope management and change management suggested by the literature.

4.2 Comparison of scope management models

Scope management is described differently in different project management guides, which are the PMBOK 6th edition, ISO 21500 and PRINCE2.

The Project Management Book Of Knowledge (PMBOK) is developed by the project management institute (PMI) scope management is described in 5 phases : Initiation, Planning, Executing, Monitoring & Controlling and Closing, during monitoring and control the scope is tracked, reviewed and adjusted as required. According to the PMBOK firstly the requirements are collected based on which the scope is broken down in (Work Breakdown Structure) WBS and further into work packages and activities (Skogmar 2015).

Projects in Controlled environments (PRINCE2) is developed by the office of government commerce in UK. The PRINCE2 method is based on 7 themes, 7 processes and 7 principles. The 7 stages of the process are starting up, directing, initiating, planning, controlling a stage, managing product delivery, directing and closing. The themes of the PRINCE2 guide are business case, organisation, quality, plans, risk, change and progress. Scope is not primarily mentioned as a theme as done in the PMBOK, but scope management is included in the theme of plans along with time and cost management(Skogmar 2015).

PRINCE2 includes developing a product breakdown structure (PBS). PMBOK guide focusses more on customer requirements and is oriented towards processes used in developing the project whereas PRINCE2 guide focusses more on business cases and end product thereby focussing on the quality and delivery (Matos 2013;Singh 2014). Initially an overview of the product is described along with customer's quality expectations, which form the basis of PBS. Based on the relation between the components a product flow diagram is created with activities to reach deliverables. In addition Matos (2013) highlights the distinction in the methodology employed by the guides. PMBOK is a descriptive methodology where the techniques for project management are explained in detail whereas PRINCE2 is perspective and details how the techniques should be structured and implemented.

The (international Organisation for Standardization) ISO 21500 is an internationally agreed standard focussing on the processes important for project performance. The scope management process suggested by ISO 21500 is similar to the PMBOK. The 5 phases in this guide are initiative, planning, implementing, controlling and closing. Fereshtheh (2016) mentions that apart from the titles of the tertiary and fourth processes there is no difference in the concepts

PMBOK explanation includes tools and techniques and is recognised as an international IEEE standard provides fundamentals of project management and its content is suitable to most of the projects. PRINCE2 is based on the principles of PMBOK and does not contain scope management as one its prime themes, which shows that scope management is given more attention in PMBOK. ISO 21500 provides similar procedure to PMBOK and describes scope as one of the several aspects important within its processes. Therefore, PMBOK best suited to describe scope management. Further by observation all the three guides are almost similar, the difference is noticed in the scope definition. PMBOK and ISO 21500 define scope of work in WBS while in PRINCE2 scope of work is defined in terms of products using product breakdown structure (PBS) and later by WBS. (Matos 2013)

4.3 Scope management model (PMBOK)

According to PMBOK 6th edition scope management is the process of developing plans on how to execute the project. Which includes identifying the work required i.e. defining and controlling the works required in realising the project.

The scope management processes are:

1. Plan scope management: Creating a plan that documents how the project scope will be defined, validated and controlled. The key purpose of this step is to provide guidance on how to manage the scope throughout the project life cycle. This step is performed once during the initial stage or also during a few predetermined points

during the project progress. The inputs during this step are Project charter, PMP (quality, approach etc.), Enterprise environmental assets, Organisational process assets and the outputs are scope management plan and requirements plan. The outputs are achieved through data analysis, discussions and judgements. The scope management plan will describe how the scope must be defined, developed, monitored, controlled and validated.

2. Requirements Collections: This stage involves determining the needs and requirements of the Employer to meet the project objectives. This stage also provides the basis for scope definition of the project along with several feasibility studies such as technical, economical and practical matters. The requirements collection process also includes the conditions or capabilities, or result required to achieve the objectives. This stage becomes the foundation for the WBS and is extremely important for the executors to have a clear picture on the work to be performed. The estimations, schedules, planning, procurement etc. all rely on the developments made in this stage.

3. Defining scope: The process of developing a detailed description of the project. This process establishes the result boundaries and acceptance criteria. Taking the previous stage as base the final scope of the project is fixed in this stage, all the requirements identified in the previous stage are filtered and matched with several assumptions, constraints and major deliverables to develop the final project requirements documentation based on which a detailed description of the result to be achieved is developed. This stage is highly iterative as more information such as the risks, opportunities etc about the project are uncovered, the scope is analysed and updated as necessary.

4. Create WBS: The process of dividing the project deliverables into smaller and more manageable packages. A framework of the work packages to be delivered is developed in this stage, the framework helps the people involved to have an overall understanding of the deliverables by a simple and easy to understand, hierarchical decomposition of the scope of work to achieve the project deliverables. The WBS helps in decreasing the complexity in understanding the work and improves the understanding of interfaces.

5. Validation: The process of formalizing the complete project deliverables. The deliverables framework developed from the previous stages are brought forward to the presence of the employer and is reviewed to check if the work packages are aligning with the interests of the Employers and are satisfactory to them.

6. Control of scope: This process helps in maintaining the scope baseline throughout the project by monitoring the status of project scope and managing changes. All the variation orders and recommended corrective or preventive actions are processed in this stage. The uncontrolled increase in the scope without adjusting the time, cost and resources could lead to scope creep. The way scope changes are handled can potentially have an impact on the cost overrun and time delays (Maharjan & Shrestha 2018)

The scope control/change management process is explained by PMBOK in 3 stages i.e.

I. Tracking
II. Reviewing
III. Reporting

The overall progress to meet the performance objectives is defined in PMP. The main purpose of this step is to ensure stakeholders are made aware of the changes performed, to acknowledge the actions taken to tackle the issues and to have an overview into the future of the project status in terms of cost and schedules. The change control process is extremely crucial in preventing the occurrence of scope creep, a clear understanding of the requirements is essential to guide and implement the change successfully (Kozak-Holland et. al 2014).

Figure 5 gives an overview of the scope management suggested by PMBOK 6th edition along with the inputs, tools and outputs in each stage of the scope management process.

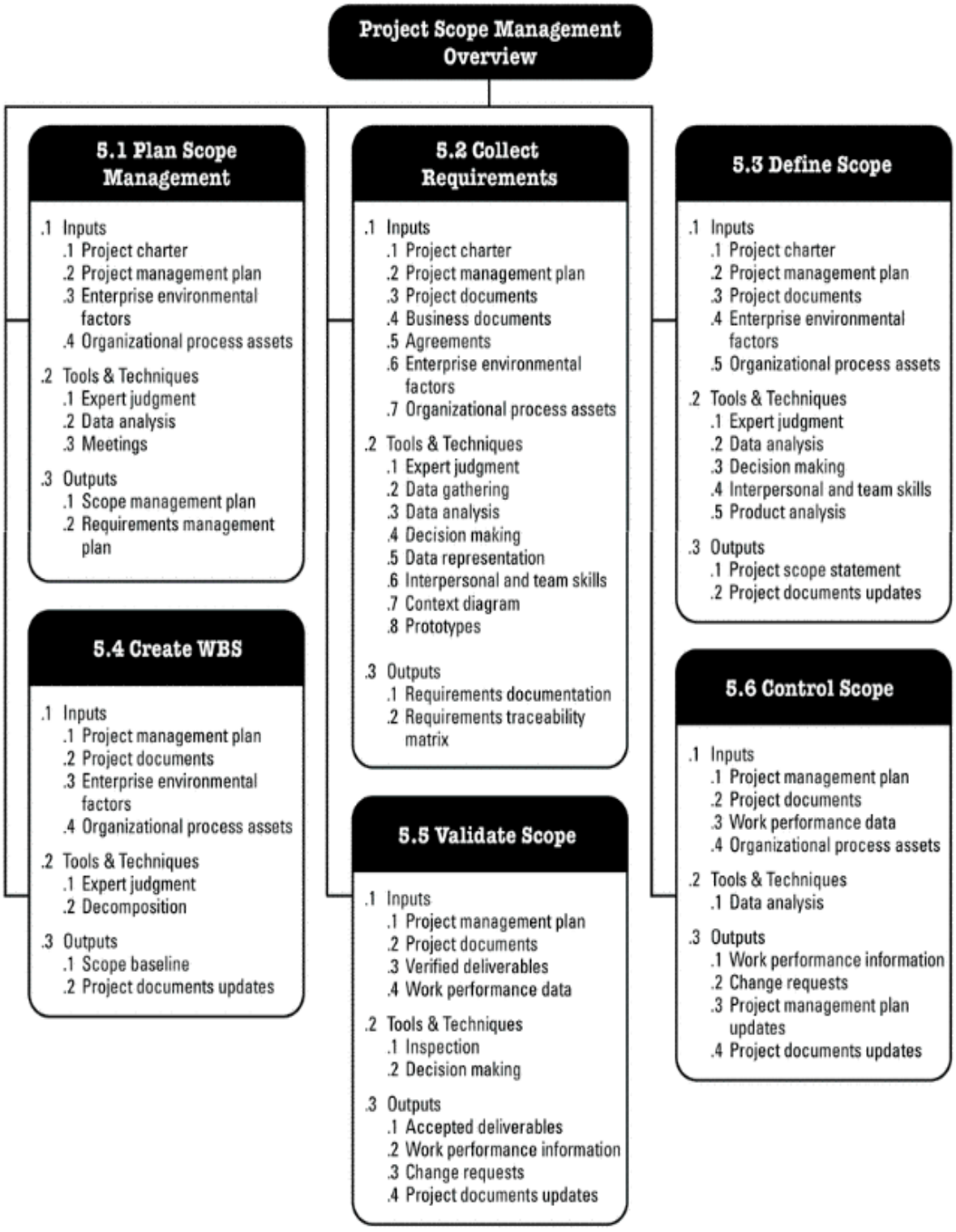

Figure 5 Project scope management overview (PMBOK 6th edition)

4.4 Change management model

Extending the study from PMBOK, Hao et al., (2008) have proposed a scope control/change process model by first classifying the changes according to phases, connected stakeholders in a phase and the impact on the project, to assist in the decision-making process. Which are shown in Table 7:

Table 7 (Hao et al., 2008) classification of changes

Phase	Stakeholder concerned	Sources of Change	Impact
Specification	• Employer • Contractor	• Changes in requirements including: • Specification • Scope • Design brief • Regulation	• Changes in design and construction processes
Designing	• Designer • Contractor • Employer	• Design error • Design change • Omission of site conditions & buildability	• Rework in designing • Rework in construction • Change orders
Construction	• Contractor	• Quality defect • Unforeseen site conditions • Value Engineering • Weather conditions	• Rework • Change orders • Change in design

Hao et al. (2008) have further identified three kinds of changes and highlighted the relationship between them. The identified kinds of changes are:

1. Change Order (CO)

Changes that occur due to unanticipated conditions, for example: technological changes, site conditions, supplier issues etc. This type of change involves negotiations between parties and requires them to reach a consensus.

2. Construction Change Directive (CCD)

A change that originates from employer or his representative requesting a change in the scope of the work when there is not agreement on cost. This type of changes emanates from change orders that are disputed and those that become change orders once the dispute between the parties is resolved.

3. Reworks

ʃThe works that must be done again due to incorrect executions, which are usually due to defects, negligence, design errors, poor management of work. The relation between the three kinds of changes identified by Hao et. al (2008) is presented in the figure 6.

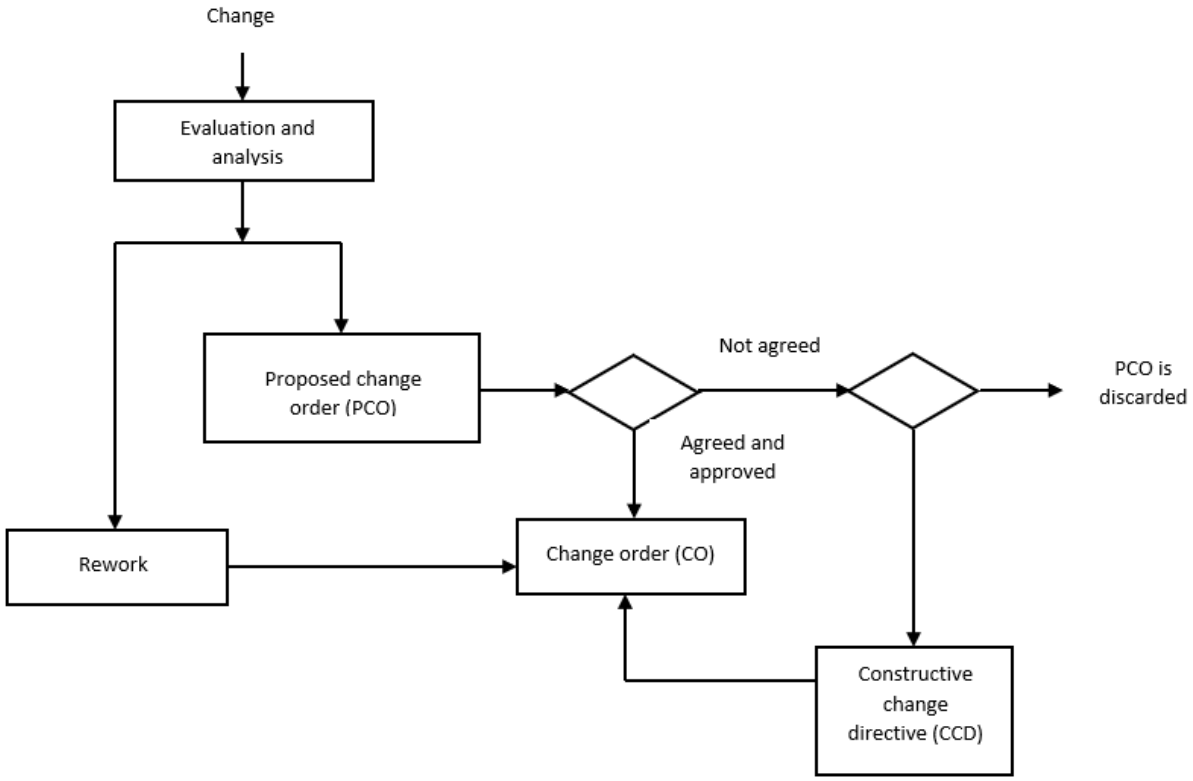

Figure 6 Relation between CO, CCD's and reworks (Hao et.al 2008)

The authors have developed a change process model, which falls in the lines of the scope control of PMBOK i.e.

a. Identify the changes that have already occurred (Track)
b. Plan preventive measures (Review)
c. Co-ordinate change to the entire project (Report)

The below stages explain the change process model (Figure 8) developed by Hao et al., (2008) in detail

- Identify

Identification of the changes using a set of defined proactive rules (sources, causes, types and change actions). Which is fed into the change management system to properly build the connections between requirements and other aspects of variations. Hao et al (2008) highlight that it is common to avoid this stage in a typical change management system however having

this stage included in the process is beneficial when unexpected deviations occur, during which the system can caution the authority.

- Evaluate and propose

In this stage, based on the identifications of the previous stage, All the potential impacts of the change on other processes and teams with respect to the budgets and schedules are evaluated. An analysis is essential for the managers to decide whether to execute the changes or to perform more examination. This stage includes weighing other options, impact estimation, and check for optimization of the changes. A thorough evaluation results in a proposal for change order, which contains details of the change and the effects if the change goes through. Based on the decision a new plan with revised budgets and schedules is prepared.

- Approve

Post the evaluation process the change is forwarded to the next stage for approval. Firstly, the changes are brought to the attention of all the internal stakeholders if approved it goes for Employer's approval else the change is rejected. The Employer shall weigh all the factors such as the contract, cost, time etc. and gives a yes or no decision, this step may also involve several discussions and negotiations, based on the Employers call if yes the process moves to next stage else the decision is rest on internal stakeholders to take a call. If not, then the change is rejected and the same is notified to the concerned team. If the internal stakeholders consider the change is essential to the project the change is forwarded to the next stage.

- Implement

After the approvals and decisions made regarding the changes, the implementation stage is initiated taking into consideration all the evaluations and its results done on the proposed change in the previous stages. The recorded information about the changes is shared with all the parties for future usage. This stage primarily refers to the management of the information, controlling the documents, updating the designs and drawings etc. An operational system must ensure that all the details are updated on records and notified to the parties.

- Review

In the event of disputes between parties, an investigation of the direct and indirect causes of the change is performed and an analysis shall be performed to identify the effects of multiple change causes and the overall system performance can be reviewed based on the data collected.

The change process model recommended by Hao et. al (2008) is presented in figure 7.

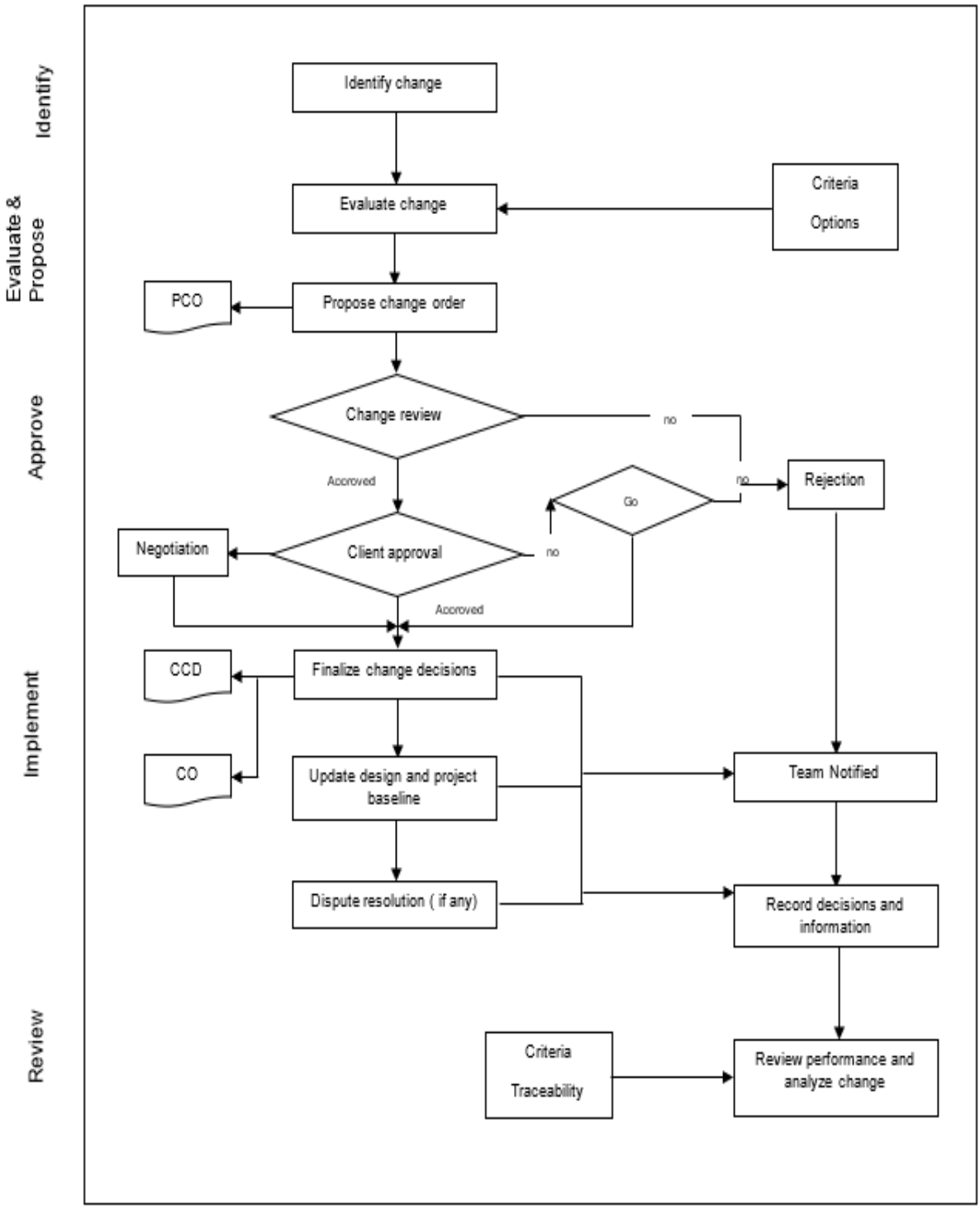

Figure 7 Scope change process model (Hao et al 2008)

4.5 Scope Management Model of Dura Vermeer

This section gives a glimpse of the scope management model and the change management model employed by Dura Vermeer, which will be studied and compared with the scope management model and change management model identified with literature in the preceding sections 5.3 and 5.4 to identify for gaps for improvement.

4.5.1 Scope management model

The Scope management process of the contractor, Dura Vermeer is discussed below:

1. Requirements collection: Once the contractor determines the needs and requirements of the employer. The contractor's team shall study and analyse all the requirement to make sure about the applicability and SMART ness of the objectives to identify the major goals of the Employer requirements. This stage forms the basis of scope definition and forms the foundation for the WBS of the project and improper collection of requirements can lead to improper assessment of the scope of the project
2. Object tree and WBS : The Employer also provides a preliminary Work breakdown structure along with an object tree. The object tree consists of a hierarchy of objectives and gives a clear indication about the interfaces in the project to the contractor.
3. Validation : It is the process of checking whether the specification captures the Employers needs and requirements. In this stage the contractor gets in touch with the Employer to ensure that they both have the same interpretation of the requirements. It helps in developing an approach to realize the project and gets it validated in this stage. During the process of development the contractor can come across much more efficient and effective approaches known as value engineering. The new approach however has to be validated with the Employer.
4. Verification : It is the process of checking that the project or product the contractor makes meets the specifications.
5. Scope definition : This stage includes the preliminary designing and detail designing and includes the feasibility studies. This stage is built upon the base formed during the requirements collection and establishes the project boundaries and acceptance criteria.
6. WBS: The contractor creates a WBS after the scope definition step or makes changes to the WBS provided by the Employer based on the discussions, negotiations and other findings during the previous steps.
7. Verification : A verification is done with the Employer and his agreement is taken into consideration to freeze the design and initiate the execution process. This step is to make ensure that the Employer and the contractor are on the same page with respect to the defined scope and are clear about the deliverables.
8. Scope control : This process helps in maintaining the scope baseline throughout the project by monitoring the status of project scope and managing changes. The scope control procedure is similar to the procedure suggested by Hao. et al (2008). The contractors scope management model is further presented in figure 8.

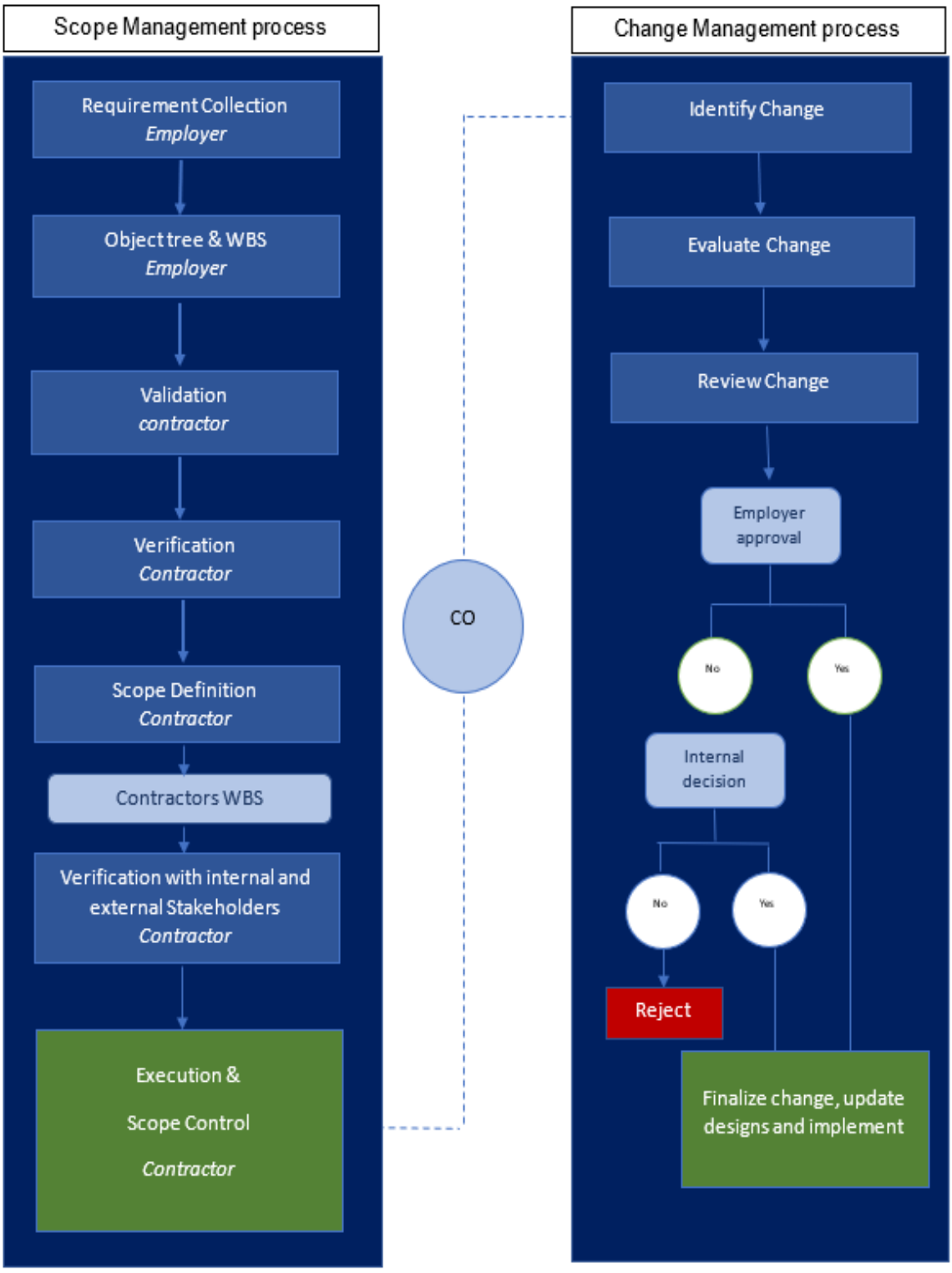

Figure 8 Scope management model of Contractor (Dura Vermeer)

4.5.2 Analysis

When a comparison was made with the scope management model and the change management model suggested by literature with the models employed by the contractor it can be observed that there exist differences in the scope management suggested by literature and scope management executed in practice. The model suggested in PMBOK 6th edition consists of 6 major stages in scope development process namely :

1. Plan scope management
2. Requirements collection
3. Define scope
4. Creation of WBS
5. Scope validation
6. Scope control

Whereas, In practice the scope management model employed by the contractor has no strict adherence to the model suggested by the PMBOK 6th edition. It was observed that the contractor firm does not consider the first step suggested by PMBOK that is “plan scope management” as an important step in the scope development process. This is the step where plans are created that documents how the project scope must be defined, validated and controlled. The key purpose of this step is to provide guidance on scope management. The project charter which is used as an input in this step works as an indispensable instrument in monitoring and controlling the costs, schedules and the deliverables. Therefore, this step is crucial in the prevention of scope creep. By skipping this step the project also misses the scope management plan and requirements plan, which are outputs of this step that are critical in making the project planning robust.

The contractor has neither emphasised on identification & analysis of stakeholders prior to writing down the requirements nor their involvement in scope definition, which is critical for proper scope development and the success of the project. The Object tree, which is derived from PRINCE2, is incorporated into the process only when provided by the employer but in case the employer fails to provide it, the contractor organisation skips including an object tree. The fusion of both the methods of PMBOK and PRINCE2 provides more compliance therefore by skipping the element of object tree the contractor is losing the advantage of providing an additional tool to the project management team.

An additional phase of verification and validation is added to the model employed by the contractor before the scope definition which is a slight variation in the procedure suggested by PMBOK. In addition to the 6 stages mentioned in PMBOK 6th edition the extra phase of verification and validation provides an edge to the contractor to ensure it is going in the right path.

The final gap was identified in the scope control step where the reviewing of the implemented scope change is not included in the model employed by the contractor. Lack of the reviewing of the scope changes can be disastrous to the project especially when the changes are improperly implemented or when any key procedure is missed. The reviewing of the changes in the scope control phase is extremely crucial in the prevention of scope creep, as mentioned in the table 4 improper management of changes is a factor that could lead to scope creep and therefore, implementing changes must be dealt with attention and have to be reviewed to ensure the implementation is proper.

Further it is identified that the contractor is usually under time pressure and must be cost conscious during the scope development process to ensure a competitive bid is developed. During the discussion with the managers more gaps were identified in the practice of the contractor during the scope management process that could lead to scope creep. The gaps identified are presented below:

1. A loss of information is possible between steps when project team members are shuffled or when the information is not well documented.
2. Not all stakeholders are considered during the scope management process, including in the validation and verification steps, which is extremely important to avoid changes or creep.
3. The responsibility was not clear during the scope management process. Both from the sides of Contractor and Employer
4. Not all members of the project were familiar about the process to achieve the deliverables.
5. The Employer does not involve the contractor if it provides the object tree and WBS, this practice could lead to a lot of errors.
6. Several changes are executed informally without feeding into the scope change management system.

4.6 Conclusion

The contractors scope management model is analysed in this chapter by comparing it with the scope management model suggested by literature. The findings of this chapter answer the third sub-research question i.e " What are the gaps present for improvement in the scope management model practiced by Dura Vermeer in onshore wind farm projects?"

It could be identified that the contractor does not perform the scope management as recommended by the PMBOK. The initial planning phase of the scope management process suggested by literature is skipped. Skipping the scope planning phase makes it difficult to the project management team during the scope development and execution phases due to lack of guidance.

The contractor has also not considered including the object tree in its process when not provided by the employer, which otherwise provides an additional tool to the project management team and guides them during the execution phase in better management of the interfaces, especially when they are complex.

Additional steps of verification and validation are included in the contractor's model which helps the contractor to ensure it is going in the right direction. A crucial phase of reviewing the scope changes is missed by the contractor, which is extremely important for preventing scope creep.

Apart from the gaps identified in the scope management process of the contractor a few more gaps were identified that occur during the process from the empirical research that could increase the chances of scope creep occurrence in the projects. The gaps identified could lead to information losses due to changes in project team, increase of scope changes due to lack of stakeholder involvement, lack of clarity due to unclear responsibility, and finally

confusion due to informal execution of changes. The identified gaps could lead to scope creep and towards the failure of project.

5

CONTRACTS

In the previous chapter, the causal factors and effects of scope creep were identified. In this chapter, the contracts like FIDIC yellow book and UAV-GC, which were used by the company in different projects, will be explored to identify how poor contract definition can contribute to scope creep in projects.

5.1 Introduction

As mentioned in sub-section 1.2, problem analysis, the contractor firm Dura Vermeer has experienced scope creep in two out of three projects and interestingly the two projects which experienced scope creep were governed by the FIDIC yellow book (1999) whereas the third project, which was extremely successful was governed by the UAV-GC (2005) (Dutch contract). Therefore, the focus in this research will be more on the flaws in FIDIC yellow book that contribute to the occurrence of scope creep and comparison shall be made with the UAV-GC to identify similar flaws with the Dutch contract.

FIDIC is an international organisation with a significant presence in the global arena for engineering and consultancy in the construction industry to encourage the business interest of parties, who supply goods and services for the built and natural environment (International federation of consulting engineers, 2017).

The FIDIC contract template is usually employed when international parties come together to realise a construction project. As per the FIDIC yellow book, the contractor is the principal designer of the project and the designs must be approved by an Engineer appointed by the employer. It should be noted that a latest version i.e. FIDIC yellow book (2017) is available with a few changes to the FIDIC yellow book (1999). However, the parties of interest in this research i.e. the contractor and employer have mutually decided not to use the newer version to avoid some additional clauses related to solving claims. Therefore, the FIDIC yellow book (1999) is considered for analysis in this research.

The Uniform Administrative Conditions for integrated contracts (UAV-GC) is a contract template mostly used in the Netherlands. The contract contains general terms and conditions where the design and execution are in the hands of a single party concerning the employer, in general, the contractor is considered as the single party in contact with the employer (Chao-Duivis 2018, ch. 5.1).

According to this design and build contract, the contractor assumes the design responsibility after receiving all the documents (ex: preliminary design) from the employer. From the moment the contractor takes over the responsibility of the project the employer’s active involvement is restricted to change requests, verification and acceptance of the contractor’s work (Chao-Duivis 2018, ch. 5.3.1). The contractor, however, is open to enter into separate contracts with

other architects, engineers and contractors and shall choose a suitable contract such as New rules 2011, UAC 2012 and so on.

5.2 Assessment of FIDIC Yellow Book

Ambiguity in certain terms, clauses & procedures, improper responsibility distribution among parties, the authority of Engineer etc. in the contract conditions could stand as barriers to effective communication and therefore could potentially lead to scope creep.

The assessment of the FIDIC yellow book has resulted in the discovery of a few flaws mentioned below. Before proceeding with the assessment of the FIDIC yellow book it must be noted that there could be more flaws within the FIDIC yellow book but for this research purpose, only those flaws that could lead to scope creep are considered. Some of the key elements identified as flaws in FIDIC yellow book that could lead to scope creep in projects are:

5.2.1 Dual Nature of the Engineer

Under FIDIC yellow book the engineer has to act as an employer's agent for the supervision of the design, works and contract, therefore, has to safeguard the employer's interests. The engineer is a third party who is expected to act fairly and independently, where he must play the role of a certifier and decision-maker; this dual role by the engineer under FIDIC yellow book can be conflicting. On one hand, the engineer is the representative of the Employer, on the other hand, the engineer must be the certifier, wherein he must act independently, during which the engineer is required to conform with sub-clause 3.5 i.e. determinations under the contract. which states that

'the Engineer shall proceed under the sub-clause 3.5 to agree or determine any matter, the engineer shall consult with each party in an endeavour to reach an agreement. If an agreement is not achieved, the engineer shall make a fair determination under the contract, taking due regard to all relevant circumstances."

This raises a question of the independent actions of the engineer, as the engineer is paid and employed by the employer, the engineer's decision to review impartially is a conflict of interest. This dual role of the engineer will make him experience intersender and interrole conflicts and burden him to discharge different roles simultaneously while making a decision that is unbiased and just (Chao-Duivis 2006; Jones & Deckro 1993). Example: the engineer may be the cause of a problem due to design error and delay in decision making. Also, the engineer must control the carrying out of a design, that is not the engineer's design. So, if not happy with the choices made in the design, the engineer will try to alter the choices. That could be a cause for scope creep.

The dual nature of the Engineer could lead to confusion, volatility, poor communication between stakeholders, improper management of scope changes, informal and poor decision making and ignorance of impacts of the changes.

When parallels are drawn with the Dutch contract i.e. UAV-GC, unlike the FIDIC yellow book the UAV-GC does not have a role for the engineer. The employer can have a representative,

who shall verify the contractor's work before taking delivery. The UAV-GC requires the contractor to appoint a representative to overlook the contractors work as per section 2(7). The contractor shall take the approval from the employer during the appointment of the representative for the sake of providing clarity about the powers of the representative to the Employer. In case, if the contractor fails to appoint a representative the contractor can be held liable for an imputable failure and possibly attract penalties. Therefore the total responsibility of the works is with the contractor. (Chao-Duivis 2018 ch. 5.3.5).

5.2.2 Variation and adjustments

Clause 13.3

The Engineer shall, as soon as practicable after receiving a proposal, respond with approval, disapproval or comments. The contractor shall not delay any work whilst awaiting a response

The contractor shall not delay the work whilst awaiting the response from the engineer which means the value of the work will be evaluated after the change order is carried out. On one hand, the Employer approving the changes is questionable on the other hand the price determination process could lead to disputes and delays. A rejection of the executed change means the cost for the change order is not reimbursed making the contractor fall short of costs.

This clause could in turn lead to poor communication among the parties, poor decision making, delay in execution and changes in the project team. These potential issues could lead to scope creep.

When juxtaposed with UAV-GC, it does not encourage the employer ordering changes because the entire design work is performed and is the responsibility of the contractor. However, the contract is still open to accepting variations only in case 1) the employer has fresh ideas 2) employer unhappy with developments and 3)unexpected circumstances that make variation necessary. In such incidences, the contract emphasises that the employer risks transferring responsibility to itself, which also includes financial implications. According to UAV-GC section 45 (2) the contract demands the price be decided before the commencement of the variation or at a reasonably as quick as possible duration (Besaiso et.al 2016; Chao-Duivis 2018).

Clause 3.3

The Engineer may issue to the contractor instructions which may be necessary for the execution of the works and the remedying of any defects, all in accordance with the contract.

This involves a risk of the engineer suggesting changes in the design or execution procedure, which was not carried out by the engineer and which can increase the cost of the contract to a larger degree. These in turn could lead to poor decision making of the project management team and lead to disputes which could delay the execution of the project.

Whereas according to the UAV-GC the design work is carried out by the contractor and therefore in the case of changes the contractor's team is more than comfortable and familiar in executing the changes thereby ensuring the contractor stays in a better position than in the

FIDIC yellow book. As per the UAV-GC sections {4(9), 6(1), 10(4),19(1) & 28(1)} the contractor bears the entire responsibility on reasonable grounds except for the information provided by the employer. The contractor's responsibility also varies with the behaviour of the employer for example: if the works are influenced by the employer, the responsibility distribution is debatable. Therefore any increments in costs shall be borne by the contractor as long as they do not arise from the employer's side and are unexpected. This way the contractor pays more attention to the designing work and is careful in averting changes, which could dent its profits. As mentioned above, the employer is expected to stay away from interfering with the works, in case of the employer's involvement the contractor does not have to warrant the result as the employer did not abide by the nature of the contract but acted as a traditional client. In a nutshell according to UAV-GC "he who decides pays" i.e. the party that decide how something should be made is liable.

5.2.3 Design Error

Clause 5.9

If errors, omissions, ambiguities, inconsistencies, inadequacies or other defects occur, the works shall be corrected at the contractors cost and the contractor shall indemnify and hold harmless the employer from and against any damage, cost expenses, obligations or liabilities arising from or in connection with the design

According to this clause, the design errors should be corrected at the contractor's cost but if the basic design is provided by the Employer and the contractor has developed the design based on the inputs received from the basis, holding the Contractor responsible for all the errors is not just.

This could lead to a lot of confusion and disputes between parties and therefore increase the chances of scope creep occurrence.

The clause does not consider the fact that "he who decides pays" as in UAV-GC. Where it has an entirely different setting and considers several scenarios when it comes to the distribution of liability. In the UAV-GC sections { 4(7) & 4(8)} the reasonableness and fairness of the responsibility distribution are also considered when the dispute is taken forward to the presence of The Board of Arbitration.

5.2.4 Autocratic power of the Engineer

Clause 5.1

Upon receiving the notice for commencement of works, the contractor shall scrutinise the employer's requirements and give notice to the Engineer of any error, defects or faults found in the Employers requirements.

After receiving the notice, the engineer shall determine…to what extent an experienced contractor exercising due care would have discovered the error, fault or defect when examining the site and employers' requirements before submitting the tender….

If the contractor experiences delays and cost overruns as a result of an error in Employer requirements and an experienced contractor failed to discover it when scrutinising the documents as per clause 5.1 then as per clause 1.9 the contractor has to notify the engineer, who decides whether and if so to what extent was the error not discoverable and then decide to what extent the time and cost could be adjusted, making the engineer the sole decision-maker. The Engineer is given an unreasonable amount of authority where it can initially approve the design and suggest changes later, which could affect the outcome of the contractor's expectations. On one hand, there is the contractor's obligation to carry out the design and be responsible for developing the design. On the other hand, the contractor is not fully in control of the work, because of the control by the engineer, which makes it conflicting.

Similarly in clause 4.10 regarding the site data, Chao-Duivis (2006) has criticised it saying that it is neither logical nor feasible for the contractor to take note of all the details given the inherent shortage of time in preparing and submitting the tender.

The UAV-GC does not create space for an employer's representative as the design is only partially (minorly or majorly) developed by the contractor and therefore distributes the responsibility based on decisions taken by either of the parties. The UAV-GC takes into consideration of how far a detail was not detectable and the same is considered by the board of arbitration on reasonable grounds rather than an engineer like in the FIDIC yellow book.

The autocratic power of the engineer makes the FIDIC yellow book cold towards the interests of the contractor. The issues such as mentioned above shall lead to disputes and may make the contractor unable to make sound decisions and may shuffle project team to handle the situation in a better manner.

5.2.5 Conflicting clauses

Clause 4.1d
The contractor shall assist the employer to coordinate technical interfaces, with respect to the employer's requirements, with the employer and with other contractors instructed by the employer….

Clause 8.6
The contractor shall always exercise reasonable endeavours to accelerate the rate of progress of the work and avoid and/or mitigate any delay to the works and/or cost incurred as a result of the occurrence of any of the events.

The clauses 4.1d and 8.6 are conflicting with each other. The clauses make the contractor responsible for factors on which it has no control. During the conception, definition and execution stages the Contractor will have to hold a series of interface meetings, according to clause 4.1d, with multiple stakeholders, who may delay the progress of the works. The progress of the meetings is beyond the control of the contractor as multiple parties who are not controllable to the contractor are involved. The clause 8.6 prevents the contractor from making claims even when the contractor encounters adverse conditions which may delay the progress of the work. Therefore making the contractor put in extra effort, costs and work under time pressure to ensure the milestones are met.

However, according to the UAV-GC clause 8, the contract obliges the contractor to deliver reasonable assistance with respect to technical interfaces but does not force the contractor to the extent that could hamper the progress of the contractor's work. In the event of a delay occurs due to performing such an activity the contractor can claim the employer for a time extension.

5.2.6 Obligation on Contractor

Clause 8.3

The contractor shall promptly give notice to the engineer of specific probable future events or circumstances which may adversely affect the work, increase the contract price or delay the execution of works

This clause places an obligation on the shoulders of the contractor alone not making it clear about the employer's obligation. This flaw of improper risk allocation could potentially increase the risk of disputes between parties which may lead to delay in execution for a longer period and therefore increasing the chances of scope creep occurrence. The employer is not obligated to assist in resolving the problem which highlights the adversarial nature of the FIDIC, as the risks are allocated to the contractor and making it alone responsible in mitigating the risk and in bearing the repercussions. The FIDIC yellow book does not contain sound conditions for encouraging parties to discuss to solve issues jointly (Downing, N., Ramphul, M., & Healey, T. 2013).

FIDIC does not encourage bringing the parties together to round a table to have positive gains from the project. The window for the likelihood of friction between the engineer and contractor or the Employer and the contractor is wider. Hence it rarely holds for supporting the win of either of the parties.

Whereas in the UAV-GC both the parties are encouraged to solve problems jointly during the process according to section 3(1), the contractor has a duty to warn the other party as per section 4(7) and to negotiate on reasonable grounds. if a dispute is unsolvable the issue is taken to the attention of the board of arbitration, who shall provide their decision on good faith. (Chao-Duivis 2018, ch. 5.3.5)

5.2.7 Prolonged suspension

Clause 8.11

If the suspension of the works continues more than 84 days (3 months), the contractor may request the employer's permission to proceed by giving notice to the employer with a copy to the LTA (Lender Technical Advisor) and the security agent….

When compared to the UAV-GC, If the works are suspended by more six months the contractor may choose to rescind the contract under section 16(5).

In the event of such prolonged delays, the contractor may divert his resources to a different project and the new team may not be familiar with several conditions that were part of the project, which may increase the occurring of scope creep.

Prolonged suspensions could hamper the contractor from making sound decisions and could also lead to poor document control when the project is suspended for a very long duration. However such situations are uncontrollable, and the conditions FIDIC yellow book and UAV-GC propose a time period of 3 months and 6 months respectively. Therefore this effect is the same irrespective of the type of contract that is chosen, in fact, the effect is more with the UAV-GC. However, the UAV-GC provides betted clarity on the behaviour of the parties, for example, the contractor can rescind the contract in the occurrence of a delay and can claim the cost for the works completed at the time of completion along with a 5% of the remainder of the price and any other costs arising from the contractor's obligations. However, if the delay is due to an imputable failure on part of the contractor it forfeits the entitlement for an extension or reimbursement of costs.

5.2.8 Vagueness of terms

Chong et al. (2010) and Besaiso et al (2016) argue that one of the main causes for the germination of disputes is misunderstanding and misinterpretation of contract clauses. Jaeger (2010) emphasised the importance of clarity for the parties to understand their responsibilities and duties which would otherwise make things more complicated, expensive and time-consuming by directing towards a broad expression of the way authority can be exerted. The authors go on to highlight several other factors such as too long sentences, repetitive words, passive voices, complex and ambiguous noun phrases etc. in the FIDIC yellow book as sources of disputes. The language and structure of the FIDIC yellow book are complex and this complexity in the contract template hampers positive cooperation between parties.

Similarly, Subclause 4.12 in FIDIC yellow book deals with Unforeseeable Physical Conditions but remains rather abstract about the definition of these physical conditions. A discussion between contractor and engineer on what means physical conditions are possible and the outcome is unsure. In any case, friction between parties is possible which can widen the window for scope creep to occur. The vagueness of terms and clauses could lead to on one hand poor communication, conflict in the requirements of the parties and on the other hand lead to poor decision making and improper assessment of scope. The contractor in order to realise the objectives of the project might have to shuffle teams, which could lead to information loses and more uncertainties.

The UAV-GC however provides better clarity in such aspects by defining the procedures in a clearer manner. In the event of vagueness the contract encourages for a discussion between the parties or a judgement from the board of arbitration on fair and reasonable grounds or following the rules of law. Clarity in the statements and procedures, for example : clear procedures for variation orders, enables the contractor to account for the risk that is being taken and therefore develop an offer that rewards or protects the contractor from the risks during the execution. This makes either of the parties safe and in turn in the successful completion of the project.

Overall the conditions and scenarios are better defined in UAV-GC. The FIDIC yellow book leads to more discussions when it comes to procedures and decision making with respect to contract management than the UAV-GC. Lack of proper definitions could be used to convenience by parties involved to manipulate a situation to their advantage.

5.2.9 Force Majeure

The clause 19.1 in the FIDIC yellow book provides a list of events such as war, terrorism, riots, pandemic etc, under force majeure. The lack of clarity on the direct and indirect effects in this section in the FIDIC yellow book increases the risk of disputes between the employer and contractor as there exists an ambiguity in the extent of the contractors entitlement to an extension of time and reimbursable costs, as to whether it will cover the direct and indirect effects of the event. This loosely defined clause could cause disputes delaying the project and increasing the costs. The lack of clarity affects the sound decision making of the contractor's project management team and the contractor organisation will be forced to make changes in its strategy such as shuffling teams to cut costs.

Whereas the UAV-GC clause 44(1c) does agree that in the event of an unforeseen circumstance occurrence the contractor is entitled for a reimbursement of costs and/or extension. The contract also clearly draws line between unforeseen and unforeseeable circumstances (Chao-Duivis 2018 ch 5.6.5). If a circumstance occurs the contract shall be examined by all means of reasonableness and fairness if a change in the contractual terms is necessary. Therefore if the case is taken to the presence of the board of arbitration, they shall take several aspects into consideration before providing their judgement.

5.3 Conclusion

The assessment of the FIDIC yellow book has revealed several gaps that could potentially lead to scope creep. The findings thus answer the second sub-research question i.e. " How does the FIDIC yellow book contribute to scope creep?". The findings will guide the contractor's contract management team to avoid slipping onto the slope of scope creep. The main elements the author intends to exploit is that the flaws identified could stand as barriers between the parties which can lead to confusion, volatility, improper communication, poor decision making, uncertainty and disputes. When connected with section 3.2.1, the factors that could lead to scope creep, a few factors are identifiable to be emanating from the flaws identified with FIDIC yellow book. The scope creep factors identified in the FIDIC yellow book flaws and the emanating factors discussed in the above sub-section are summarised and presented in table 8.

Table 8 FIDIC yellow book flaws vs Scope creep factors

FIDIC yellow book flaws	**Scope creep factors**
Dual nature of the Engineer	• Poor communication (no coordination) between stakeholders • Improper management of scope changes • Informal decision to make changes • Poor decision making • Ignoring small changes that lead to bigger impacts • Change in project team

Flawed variation and adjustment process	• Informal decision to make changes • Conflicting requirements of stakeholders • Poor decision making • Delayed execution
Unjust distribution of responsibility	• Conflicting requirements of stakeholders
Autocratic power of engineer	• Ignoring stakeholders • Informal decision to make changes • Conflicting requirements of stakeholders • Poor decision making • Change in Project team
Conflicting clauses within FIDIC yellow book	• Improper management of scope changes • Time pressure /Unrealistic expectations • Poor decision making • Improper assessment of scope • Change in project team
Obligations on contractor	• Conflicting requirements of stakeholders • Time pressure /Unrealistic expectations i.e. too much in less time • Delay in project execution • Change in Project team
Prolonged suspension of works	• Delay in project execution years after scope definition • Time pressure /Unrealistic expectations • Poor decision making • Poor document controlling • Change in Project team
Vagueness of terms	• Poor communication (no coordination) between stakeholders • Conflicting requirements of stakeholders • Poor decision making • Improper assessment of scope • Change in Project team
Force majeure effects	• Conflicting requirements of stakeholders • Poor decision making • Change in Project team

It is interesting to note that the factors 1) improper assessment of scope 2)poor communication with stakeholders 3) poor document control 4) time pressure and 5) informal decision to make changes, which were mentioned by the managers during interviews as the most important factors that could lead to scope creep were also identified with the flaws in FIDIC yellow book. It must be noted that the FIDIC yellow book's contribution to scope creep can only be prevented by being aware of the gaps as the selection of the contract template rests with the interest of the employer and the contractor is not in a position to force the employer to choose a different contract template such as the UAV-GC or NEC3 as the employer may feel threatened to use a contract template which it is not familiar.

Alternatively, the advantage of employing the UAV-GC as the governing contract can be pitched to encourage the parties to choose the UAV-GC over the FIDIC yellow book or propose to alter the flawed clauses, especially when it comes to scope creep. However, the alteration may reduce the power of the employer the FIDIC yellow book provides, therefore, the alteration of the contract template as per the requests of the contractor is debatable.

Hence, the contractor making itself and making other parties aware about the negative effects of scope creep and its emanation from the flaws is according to the author the optimal way in preventing scope creep occurrence if FIDIC yellow book is the chosen contract. A comparison of the flaws identified in FIDIC yellow book with the UAV-GC is provided in table 9.

Table 9 FIDIC yellow book vs UAV-GC

	FIDIC yellow book	**UAV-GC**
Role of Engineer	Dual nature (representative and certifier)	No engineer but a representative only for verification
Variation process	Forces contractor to executes changes before price determination	Suggests price determination before implanting changes
Responsibility distribution	Unfairly distributed	Fairly distributed (he who decides pays)
Authority of engineer	Powerful	Limited authority
Conflicting clauses	Rigid, if a delay occurs due to performing other duties	Flexible, if a delay occurs due to performing other duties
Obligations	More on contractor	Equal responsibility on both parties
Prolonged suspension	84 days (3 months)	6 months

Vagueness of terms	Less clarity	Better clarity
Force majeure effects	Ambiguous with indirect costs	Reasonable and fairness of the effects are considered

Overall, the UAV-GC is more conducive and flexible than the FIDIC yellow book, which is more rigid. The UAV-GC encourages parties to solve issues by having discussions. A lot of differences especially with respect to time frame exist between the FIDIC yellow book and the UAV-GC for example the variation procedure, claim procedure, notification etc. In the UAV-GC the contractor must give a notification to the employer as soon as the contractor becomes aware of an issue whereas in the FIDIC yellow book the notification has to be given in a certain number of days (ex: 30 days). The time boundaries are very important to the employer and the engineer and must be meticulously followed by the contractor in the FIDIC yellow book else the contractor loses the right to claim. The UAV-GC encourages discussion and runs on the principle of fair policy whereas the FIDIC runs on a concrete set of rules which demands a party to do things in a particular manner or time if not done the affected party loses the right.

The managers during the interviews with hindsight mentioned that the FIDIC being a rigid contract can make the contractor more scope aware and perform project management duties in a much stricter manner. Whereas, as mentioned earlier the UAV-GC runs on the principle of fair policy and can work for either of the parties if the affected party can motivate their concern in a plausible manner such that the reasonable interests of the other party is taken into consideration during the contractual relationship.

6

CASE STUDY

This chapter comprises the analysis of the windfarm projects executed by Dura Vermeer. The goal of this chapter is to identify the scope creep examples encountered in the cases and therefore identify what factors or flaws led to the occurrence of scope creep.

6.1 Introduction

A document review of the three projects is performed and a discussion is held with the managers involved in the projects to identify the issues encountered. The interviews will provide an in-depth explanation of the scope creep and other issues encountered during the inception, definition and execution phases of the project from the contractor's perspective. The profile of the interviewees is provided in Appendix A. Accordingly, the cases that will be studied in this chapter include 3 onshore wind farm projects namely : Wind park Deil (Case I), Wind park Vermeer (Case II), Wind park Moerdijk (Case III). Following the individual analysis of the cases a cross-case analysis has been performed to identify the similarities of issues encountered in the cases. The locations of the three projects used as case studies are presented in figure 9.

Figure 9 Location of the cases chosen for analysis

6.2 Case I - Wind park Deil

The Wind park Deil is an ongoing project which is close to completion. The total project consists of 11 Wind Turbine Generators (WTG's). Wind park Deil B.V is the employer in this project and Dura Vermeer Infra Landelijke Projecten B.V as the contractor was awarded the contract for development of civil works for 5 WTG's on 03 December 2018. Cooperative Rabobank U.A was the financial security agent. The project was executed at Geldermalsen and Neerijnen, Gelderland, NL. This is a Build of Plants (BoP)- civil works contract, which refers to all the components and accessory systems required to support the power plant in order to generate energy, apart from the generation unit. The BoP works include roads, drainage, crane pads, turbine foundation, cable trenches and buildings for equipment. In a nutshell all the windfarm civil works and electrical works is called BoP as shown in figure 10. FIDIC yellow book (1999) was chosen as the governing contract template with modifications to the actual contract template.

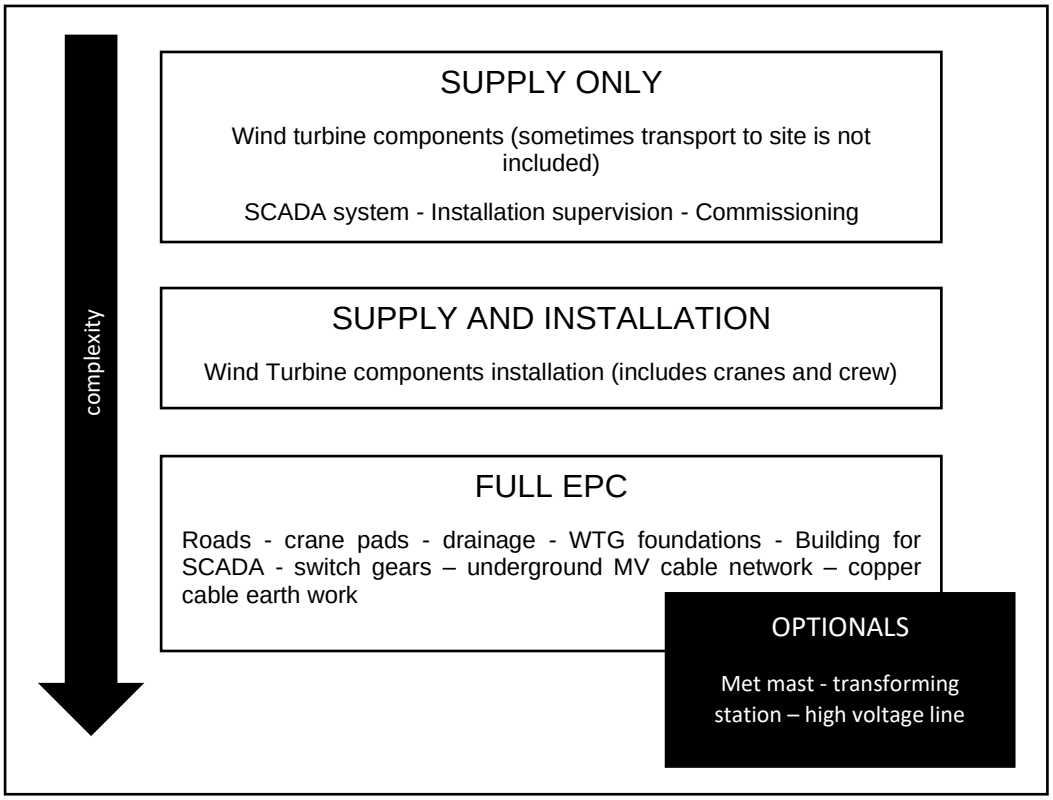

Figure 10 Built of Plant(BoP) works

Dura Vermeer was selected based on competitive bidding as the contractor to execute the balance of plant works and services, which included the civil works such as temporary hard stands for piling machines, crane pads, all necessary drainage works, temporary and permanent infrastructure necessary to realise the complete foundations and civil infrastructure (including roads and crane pads) for the 5 WTG's. The EPC contract also included traffic measures such as temporary modification of roads, change of traffic signs, permanent access/exits, dewatering, Procurement and supply as well.

Dura Vermeer undertook the project to provide its services i.e. designing and executing of the project on a Lump sum reimbursement scheme as a payment mechanism for this contract. The project was initiated by having a legal agreement between Wind park Deil B.V and Dura Vermeer Infra Landelijke Projecten B.V for a design-build contract where everything to be

delivered was brought forward explicitly in a written document (ANNEX 1 employer's requirements)

According to the contract the Initial parts of the design were made by the employer's representative, Yard Energy Development B.V., as a reference and were shared with the contractor. The contractor is responsible for the buildability of the WTG foundations, Crane pads and roads and is responsible for all further engineering (including recalculation or redesign works) and completion of design made so far together with execution design of the remaining civil infrastructure as deemed necessary for the completion of works.

A few statements in the contractual agreement of the project were loosely defined, which made it tough for both the actors to come to a common ground. The ambiguities have affected the trust formation among the parties i.e. Employer, Engineer and Contractor adversely. There were a total of 30 change order requests, initiated by the Engineer during the execution phase of the project and the majority of those changes were initiated informally.

Scope creep examples identified in this project are presented below:

1. Milling of soil layer
    a. The contractor had to remove the topsoil layer from the land of the landowners on those places where the crane pads, temporary roads, foundation are executed. The top of the soil is grass, when the soil is deposited as a heap and if the grass is not milled then it is difficult to reuse the soil. The contractor decided to mill the felt layer off the grass before making a heap, which is the scope creep. It was an initiative of the construction manager of the site without any prior discussion. The task was outside the scope of the project. The task costed the contractor an amount of 11500 euros. An approximate 100 man hours were lost in this activity. The said activity was not an obligation of the contractor but was executed to stay in the good books of the employer.
    b. Scope creep factors observed in this example include : Informal decision making, experience of project team, appeasing the employer, poor decision making, ignorance and improper assessment.
    c. Impact of the activity : Cost overrun by 11500 euros, delay of over 100 man hours and disputes between the parties.

2. Scenario planning
    a. During tender stage the employer has given the contractor a preliminary design (layout, positioning of the foundations etc.) and later informed the contractor that the design may change with waterboard's decision. However, the contractors team spent time on estimating and developing plans for two different scenarios for project management. The process required the commitment of different experts (the project manager, contract manager, project coordinator, construction manager). A lot of work had to be done to determine what was the most likely time schedule according to the issues. Later it was realized that far more work was done than what was required in preparing schedules and in making scenarios for the time schedules. The task also demanded the commitment of 10 other experts, who were associated with other projects as well and therefore affected the efficiency of 5 other projects of the contractor's project portfolio. A scope change attempt made by the contractor was declined, saying the contractor must do everything to prevent delay, which is a flaw present in the FIDIC Yellow Book. In accordance to the clause the contractor's team

developed possible scenarios for the time schedule. The job was not part of the scope and was performed to appease the employer. It was the employers responsibility to notify the contractor about the prevailing schedule and also which milestones are supposed to be followed.The spending excessive time in planning scenarios is the creep in this example.

b. Scope creep factors: FIDIC flaws, poor communication, ignoring stakeholders, appeasing the employer and poor decision making
c. Scope creep impacts : cost overruns of 13500 directly and 32750 euros indirectly, delays, inefficiency and wastage of efforts.

3. Fencing and drainage works
   a. The project manager included fencing and drainage works of the land into the scope though it was not part of its scope. This work, which is the scope creep, costed the contractor an amount of 15000 euros. A commitment of a machine and few grounds men were required for the job. The task however required to rework on the project file (drawings, standings etc.). therefore, it demanded the time of designers, who were unavailable at that moment. This put the contractor under a lot of time pressure as it was time bound to submit the document which in the case of failure would attract a penalty of 1750 euros per day per turbine. The contractor was expecting a delay of 5 days and staring at a loss of 43750 euros.
   b. Scope creep factors observed in this example include poor communication, poor decision making, appeasing the employer and ignorance
   c. Impact of the activity : cost overrun by 15000 euros, delays and disputes

4. Dual nature of the engineer
   a. The Engineer in the Deil project had two different roles to play i.e. as the employer's representative and as a certifier. However, the engineer was acting only as a representative of the employer suggesting a lot of changes in the design which was not his design. The engineer proposed his design and forced the contractor's team to just follow the design it has provided. This led to confusion in the project management team making them to execute work packages not part of their scope (such as foundation heightening, dewatering etc.) i.e. scope creep. This lead to cost overruns and delays. The fact that the design responsibility lies with the contractor was not considered by either of the parties during the decision-making process and the scope boundaries were pushed largely, resulting in scope creep. The engineer was expected to act neutral in this situation, but all his actions favored the Employer and weakened the position of the Contractor.
   b. Scope creep factors : FIDIC flaws, poor communication, poor decision making, informal decision making and ignorance.
   c. Scope creep impacts : cost overruns by 100000 euros, delays, inefficiency, disputes and damage to reputation

5. Implementing changes without feeding into system
   a. A lot of orders were executed without any formal approval from the Employer. The Engineer has suggested a lot of variations in the design, which the engineer approved initially. The contractor has agreed to execute the changes without a formal approval. The contractor has done it in order to appease the employer, but the works were not

part of the scope. When the variations were taken to the Employers attention for approval, the employer rejected it. Making the contractor execute a variation order without any reimbursement. This led to a lot of discussion with regards to scope, cost and delays. The change orders were not documented and led to confusion,delays and disputes. In several instances the variations were received implicitly by the Engineer and were negotiated after the work order was executed. The flaws in the contract as mentioned in section 5.2, the clause 13.3, made room for the issue to occur. The individual nature of the engineer is also questionable here, where it has asked the contractor to execute a job beyond the scope of work and later not pushing for reimbursement.

b. Scope creep factors : informal decision making, experience of team, time pressure and ignorance.
c. Scope creep impacts : cost overruns (inestimable), delays, reworks, inefficiency and loss of reputation

6. Poor contract definition
   a. The contract clause in employers' requirements mentions that "the contractor (Dura Vermeer) of this EPC contract is responsible to realize everything that will not be realized by the WTG supplier" This statement is vague and wide conclusions can be drawn. This loosely defined clause played a major role in creating disputes between the parties. The employer used this statement several times to reject claims made by the contractor regarding the variations. The lack of clarity in the sentence made things complicated and time consuming for the contractor and eventually to disputes between the parties, standing as a barrier to positive cooperation. This has led to poor communication among parties, conflict in their requirements and poor decision making.

Other Issues identified in this project, which could have contributed to the occurrence of scope creep are:

1. Conflicting clauses

   The contractor held several interface meetings as per the clause 4.1d, however a delay occurred due to the interface meetings and When a claim was raised to alter the milestones the Employer failed to acknowledge them. Which made the contractor to experience time pressure. The time and cost pressures have led to poor decision making and shuffling in project management team

2. Adjustment

   The flaw with clause 3.3 surfaced in the project where the engineer suggested changes in the design, which was not carried out by the engineer. This resulted in an increase in the cost of the contract works to a large degree. When taken to the attention of the employer the contractor was not compensated for the changes made in the design. This has led to poor decision making of the project management team and to disputes which delayed the execution of the project.

3. The work process was initiated without clearly knowing the project requirements

The contractor has initiated the works in order to reach the milestones as per schedule, however not everybody in the project management team was aware of the project requirements as per work package because the requirements were not specific enough. This led to the execution of the works based on the individual expertise/craftsmanship of people, which led to poor decision making during the execution phase.

4. Managers tried to appease the employer

   Project management team members acted very employer focused to achieve future projects from the employer and executed changes as per their interest instead of verifying the effects of those variations in relation to the scope, budget and time. The ignorance and informal changes dented the budget of the project.

5. Failed to scrutinize employer documents

   The employer submitted new documents after Best and Final Offer (BAFO) to the Contractor, in advance of the Contract signing. The Contractor, however, did not act, and verify/notify the effects of these documents due to shortage of man power.

6. Contract agreements were all established in the Employer's favor

   The clauses were such that if there was a delay caused even by the employer's fault, the Employer was eligible to claim additional cost due to the delay. The contract received after the BAFO was a modified FIDIC version consisting of clauses that were in Employers favor. The contractor failed to cross check as mentioned earlier.

7. Optimism bias

   The estimated bids were prepared without taking into consideration the amount of effort involved in realizing the contract making the bid value too optimistic

8. Redesigning due to cost constraints

   After making a set of variations to the existing design due to regulations the design was made more robust and the contractor was given a "go" signal from the employer to execute the work. But the contractor has provided the cost of the work only after executing it, which triggered the redesign of the existing work package and hence its costs. In order to avoid any further delay and expense, the Engineer provided a new design without any contractual obligation. Consequently, not the employer but the contractor had to bear the effects of delay from a series of events in the project.

9. Responsibility confusion

In the Deil projects the basis of the design was provided by the Employer and the contractor has developed the design based on the base. However, the contractor was held totally responsible for the design without considering the premise.

10. Time pressure

The Deil project was suspended due to a delay in permit that should have been obtained by the employer, however the contractor was not compensated for the employer's fault and the contractor was asked to meet the milestone which was planned initially. This has put a lot of time pressure on the contractor which resulted in cost overruns and scope creep.

6.2.1 Findings from Case I

Based on the interview responses and case documents the examples of scope creep and other issues which could have led to scope creep have been identified. The scope creep examples, and the issues identified are compared to the findings in the previous chapters. The findings include the scope creep factors and flaws in FIDIC yellow book identified from literature and also with the gaps identified with the scope management model of the contractor firm and are presented in table 10.The table also presents which factor showed impact in different phases of the project life cycle. The factors are ranked based on their number of mentions during the case I analysis. The following analysis considers only the barriers that were identified in the previous sections and occurred in practice in the Wind park Diel project.

Table 10 Identified scope creep factors/causes in case I

(A- CONCEPTION PHASE; B- DEFINITION PHASE; C- EXECUTION PHASE; D- OPERATION PHASE)

Rank	Factor/cause	PHASES			
		A	B	C	D
1	Appeasing the employer		✓	✓	
2	Ignorance		✓	✓	
3	Poor decision making		✓	✓	
4	Informal decision making			✓	
5	Vagueness of terms	✓		✓	
6	Improper assessment of scope		✓		
7	Time pressure	✓	✓	✓	
8	Poor communication		✓	✓	
9	Experience of project team			✓	
10	Conflicting clauses			✓	
11	Dual nature of the engineer			✓	

12	Improper scrutinising of employer documents	✓			
13	Project team unfamiliarity on tasks			✓	
14	Adjustment Clause 3.3			✓	
15	Conflicting clauses			✓	

From the case I i.e. the Wind park Diel project analysis it could be found that

1. The contractor's attitude of appeasing the employer to stay in the employers' good books has led to the major damage of the project.
2. The contractor has let the damage happen in order to gain future contracts from the employer.
3. Apart from appeasing the employer, the contractor's team lacked the foresight to assess the consequences.
4. As a matter of fact, the extra scope of works could have led to a much larger damage. It could be noted that 10 of the 19 scope creep factors identified from literature caused the scope creep to occur in this project.
5. Apart from the factors identified in literature the vagueness of the contract, conflicting clauses and dual nature of the engineer, which are flaws identified with the FIDIC yellow book that could lead to scope creep, have also led to scope creep.
6. The flaws in the FIDIC yellow book have forced the contractor to perform tasks out of its scope that added to the damage.
7. During the interviews it was also found that not all members of the project management team were familiar with the tasks, which could have also contributed to the occurrence of scope creep in the project.
8. The managers were not quick enough to realize the expansive growth in the scope as they were focused more in negotiating and resolving disputes with the employer.
9. In a way, the contractor teams' lack of familiarity of the FIDIC yellow book contract and the contractor organization being understaffed are strong reasons for the failure of the Wind park Diel project.
10. The contractor teams' too much attention on the contract, its impact and overestimation have made the contractor to perform tasks beyond its scope.
11. Most of the factors identified were present in the execution phase of the project.
12. Rather than saying that the issues were present only in one phase it can be said that the issues were prevalent in all the phases, but the vulnerability of the issue got exposed only the phase as presented in table 13.

6.3 Case II - Wind park Vermeer

The wind park Vermeer also known as wind park N33 is a similar project to wind park Deil but much bigger in size and was started during the same time period. The total project consists of 20 Wind Turbine Generators (WTG's). Wind park Vermeer B.V. is the employer in this project and Dura Vermeer Infra Landelijke Projecten B.V. as the contractor was awarded the contract to develop civil works for the WTG's on 10 April 2019 and Yard Energy B.V. was the

employer's representative. The project is executed at the municipalities of Veendam and Menterwolde, NL.

Like in the case I the case II is also a Build of plants (BoP)- civil works contract. FIDIC yellow book was chosen as the governing contract template with modifications to the actual contract template and lump sum payment mechanism was chosen as the reimbursement scheme.

According to the contract the initial parts of the design were made by the employer's representative, Yard Energy Development B.V., as a reference and were shared with the contractor. The contractor was responsible to scrutinise for the buildability of the WTG foundations, Crane pads and roads and is responsible for all further engineering (including recalculation or redesign works) and completion of design made so far together with execution design of the remaining civil infrastructure as deemed necessary for the completion of works. There were a total of 40 change order requests in the project, initiated by either of the parties during the designing and execution phase of the project.

Scope creep examples identified in this project are presented below:

1. Head reinforcement in piles
    a. The piles under the foundation need to take in the pull pressure and the moment of the foundation. The moment of the foundation was not given in the documents which is required to calculate the head reinforcement needed in the piles. This was never known during the tender phase and was thus not considered initially but was later conveyed orally. This has happened in the time when there was a lot of switching between project managers. This has resulted in extending the project boundary for the contractor resulting in scope creep.
    b. Scope creep factors identified : poor communication, improper assessment of scope, poor decision making, time pressure, scope definition done by wrong people, lack of proper document control and project team shuffling.
    c. Scope creep impacts : Cost overruns by 100.000 euros, inefficiency, customer dissatisfaction and damage to reputation.

2. Ground deposits
    a. During the offer it was considered that ground will be placed beside the crane and the same was documented. However, In one document it is stated that the ground can be placed beside the crane and in the rest of the documents there were certain places where it was recorded as the ground cannot be placed beside the crane. The lack of clarity resulted in depositing the ground beside the crane however this led to discussions and the ground had to be redeposited in a different place leading to scope creep.
    b. Scope creep factors identified : poor communication, lack of document control, discrepancy in contract documents and project team shuffling
    c. Scope creep impacts : cost overruns by 40.000 euros, rework and inefficiency

3. Temporary road
    a. During the tender stage the contractor developed a plan to build the temporary roads with asphalt topping. But during the succeeding stage discussions between the contractor and Employer resulted in a conclusion that the temporary roads shall be

built with just Gravel. However, the contractor failed to feed the information into the scope management system and the project manager executing the project went ahead and built a temporary road with asphalt topping, which is the scope creep activity. Several of such change of plans were not fed into the scope management system of the organization. During the initial stages of the project the project was under the control of a different project manager, who took several decisions, which were not recorded and later when the project manager was replaced with the current project manager those decisions were not considered during the execution.

b. Scope creep factors identified : poor communication, improper assessment of scope, informal decision to make changes, time pressure, lack of proper document control and change in project team.
c. Scope creep impacts : cost overruns of 30.000 euros, delays, wastage of resources and increase in project management effort

4. Soil deposits
   a. The area next to the temporary road as per the WTG supplier should be less than 0.5m in height from the road level but since the manager at site did not have an execution design, as the contractor was understaffed during the road excavation. The site manager has ordered to dump all the mud excavated for the formation of the temporary road and for other purposes on the area next to the road. The damage was done by the time the manager realized the mistake resulting in scope creep and additional cost was incurred to the contractor to re-excavate the soil and reduce the level of the area next to the temporary road to 0.5m less than the road level.
   b. Scope creep factors : improper assessment of scope, informal decision making, poor decision making, experience of team,
   c. Scope creep impacts : cost overrun by 30.000 euros, wastage of efforts, reworks and loss of efficiency.

5. Removing crane pads (Q2) places
   a. To install the beam of the crane, three cranes are needed. These cranes need to be placed on crane pads. In the tender phase it is assumed that the Q2's doesn't need to be removed, since it wasn't stated anywhere. In the end of the tender phase a document came which stated that the Q2's are temporary. In the overall contract it is stated that temporary crane pads need to be removed. The removal of crane pads was not included in the initial plan and therefore created some information gaps resulting in scope creep.
   b. Scope creep factors : improper assessment of scope, poor decision making, inexperienced team, time pressure and poor communication
   c. Scope creep impacts : cost overrun by 65000 euros, delays and inefficiency.

6. Autocratic power of the Engineer
   a. During the tender phase of the Vermeer project the Employer has mentioned that a few parts of the site contains soil pollution but after the execution works began the contractor identified almost all parts containing soil pollution. When the issue was raised with the Engineer, the issue was downplayed by mentioning the soil pollution could have been expected. Similarly, the engineer mentioned the Clause 4.7 to decide that to an extent the errors were discoverable. As Chao-Duivis(2006) mentioned it is neither logical nor feasible for the contractor to take note of all the

details given the inherent shortage of time in preparing and submitting the tender. The Engineer has not taken that into consideration during evaluation as it was acting as per the contract setting.

7. Vagueness of terms
   a. Similar to case I the contract clause in case II also contained the statement that “the contractor (Dura Vermeer) of this EPC contract is responsible to realize everything that will not be realized by the WTG supplier” This statement as in the previous case I is vague and was used to advantage by the employer. This led to disputes and disruptions of the work.
      Prolonged discussions were held with regards to the term steps vs staircase. The employer was demanding more than what was originally described in the requirements. As per the contract the contractor is expected to provide steps, which the contractor thought was 2 steps to the foundations of the wind turbines from ground level to the foundation level but the employer demanded a staircase which required a budget allocated for that work package from 20,000 euros to 130,000 euros for 20 foundations. The employer’s representative constantly showed the statement “ Dura Vermeer needs to do everything that WTG supplier doesn’t do”, which led to scope creep and resulted in disputes between the parties.
   b. Scope creep factors : FIDIC flaws, improper assessment of scope, poor decision making, inexperienced team, and poor communication
   c. Scope creep impacts : cost overrun by 55000 euros (After 50% reimbursed by the employer).

Other Issues identified in this project, which could have contributed to the occurrence of scope creep are:

1. The work was initiated without knowing all the Employer requirements clearly

   The design process was started with the preliminary design received from ABT (a company hired by the employer to make designs for the foundations, hardstands and crane pads) and the assumptions used for the preliminary design were not provided by ABT and the employer forced the contractor to just submit an execution design of what ABT delivered. Several assumptions such as underground measurements, bearing capacity etc. were required to work on the preliminary design and then make an execution design. This led to a difference of interpretation and the contractor did not make an execution design as it was not able to assure that the designs if executed will fit the intended purpose. It costed delays in the design process of the project. Every time new information was received the design had to be adjusted. This delay led to disruption in the process, wastage of design efforts, extra costs and a lot of rework during the designing phase.

2. Poor decision making from the Employer’s side

   Several discrepancies in the design were not answered in time by the Engineer and Employer, this made the design process hard. For example: Culverts were not in exact

place as per the design, contractor was not able to pass the culverts, therefore they must be replaced, which was not foreseen. When the Contractor asked the Employer where they want the culverts, nobody had clarity on how things should go ahead.

3. Risky document controlling

   The document control was done in 3 different systems, the fact that the employer kept sending new information, which led to scope changes at a later stage. The changes suggested in PODIO (a communication platform) sometimes went unnoticed and the work was executed a lot of times as per initial plans.

4. Time pressure

   Not everything was considered due to time pressure, Contractor was not able to comprehend the design obligation that were in the FIDIC contract during tender phase and faced a lot more design efforts after the contract was agreed. With tight budget, design changes and time pressure led to a design failure and increased risk of committing mistakes.

5. Contractual agreements favoring the Employer

   FIDIC yellow book was written in the Employer's favor, the design responsibility appointed to the contractor was very large. The contractor didn't know FIDIC yellow was altered as the contractor was not very familiar with FIDIC yellow book and didn't know how much was altered. A lot of shuffling in the project team was also a reason for not scrutinizing the contract.

6. The bid for the contract was underestimated

   The contract was not comprehended enough, due to lack of proper understanding of the contract requirements due to vagueness in addition the discussions were not properly recorded. This made the contractor's team underestimate the efforts involved in realizing the project. Compared to the design responsibilities of the contractor as per the conditions the risk vs benefits were not balanced.

7. Lack of proper collaboration between teams

   The collaboration between engineering (DV design team) and execution wasn't good. This led to reworks and cost overruns. The project manager felt the design team didn't do their job and the execution team didn't check the designs as the execution team was understaffed.

8. Project delayed

   The execution of the Vermeer project was delayed by more than a year and the project management team that was initially part of the project was diverted to some other project and a new team was assigned to the Vermeer project. Several project decisions

which were discussed during the initial stages were not incorporated into the project as they were not recorded.

6.3.1 Findings from Case II

Based on the interview responses and case documents the examples of scope creep and other issues which could have led to scope creep have been identified. The scope creep examples and the issues identified are compared to the scope creep factors and flaws in FIDIC yellow book identified from literature and also with the gaps identified with the scope management model of the contractor firm and are presented in table 11.The table also presents which factor/cause showed impact in which phase during the project life cycle. The factors/causes are ranked based on their number of mentions during the case II analysis. The following analysis considers only the barriers that were identified in the previous sections and occurred in practice in the Wind park Vermeer project.

Table 11 Identified Scope creep factors/causes in case II

(A- CONCEPTION PHASE; B- DEFINITION PHASE; C- EXECUTION PHASE; D- OPERATION PHASE)

Rank	Factor/cause	PHASES			
		A	B	C	D
1	Poor communication	✓	✓	✓	
2	Ignorance	✓	✓	✓	
3	Improper assessment of scope		✓	✓	
4	Poor decision making		✓	✓	
5	Time pressure	✓	✓		
6	Lack of proper document control	✓	✓		
7	Change in project team		✓	✓	
8	Informal decision making		✓	✓	
9	Experience of project team		✓	✓	
10	Discrepancy in contract documents			✓	
11	Scope definition done by wrong people			✓	
12	Vagueness of terms			✓	
13	Autocratic power of engineer			✓	
14	Project team unfamiliarity on tasks			✓	
15	Unclear responsibility allocation	✓	✓	✓	
16	Improper scrutinising of employer documents	✓			
17	Information loss		✓		

18	Adjustment clause 3.3			✓	

From this case study analysis it was found that

1. Poor communication both externally and internally, ignorance and improper assessment of scope were the major reasons for the occurrence of scope creep in the Wind park Vermeer project.
2. Poor decision making, time pressure, lack of proper document control and changes in the project team were also equal contributors of the scope creep in this project.
3. During the interviews it was revealed that the impact of the issues in the wind park Diel project was present on this project to an extent as both the projects were carried out in parallel.
4. The interviewees have agreed that due to time pressure during the tendering stage the document controlling was not properly handled to add to the issue the contractor firm, as mentioned earlier, was understaffed.
5. After the contract was awarded to the contractor the project was delayed by almost a year which forced the contractor to replace the project manager, who oversaw the Vermeer project until that moment.
6. When the team was shuffled there was a loss of information as some decisions were not recorded in the documents.
7. The interviewees agreed that time pressure during the tendering stage did not permit them to review all the employer documents which led to issue during the execution stages.
8. The project team was not well experienced which resulted in making hasty decisions without foreseeing the consequences of an activity which in turn led to too many reworks.
9. The reworks hampered the efficiency of the progress and also towards cost overruns. Delays was not cited as a major impact by the interviewees as the employer was flexible with the schedules.
10. The other major cause for scope creep is the flaws present in the FIDIC yellow book.
11. The flaws, vagueness in contract and autocratic power of the engineer led to too many discussions and confused the project team in executing the activities.
12. Out of the 19 scope creep factors identified with literature 10 of the factors were identified to be causes of the scope creep occurrence in this project.
13. The interviewees also opined that poor collaboration internally and lack of clarity to the project team about the tasks were also factors that could have added mileage to the occurrence of scope creep.
14. Most of the factors/causes identified in this project were present in the definition and execution phases.

6.4 Case III - Wind park Moerdijk

The Moerdijk project is also a BoP contract, which was closed between Nuon Wind park Moerdijk B.V. a subsidiary of N.V.Nuon Energy (part of Vattenfall), the Employer and Dura Vermeer Infra Landelijke Projecten B.V., the Contractor on 21 December 2018 and the contract is governed by the UAV-GC (2005) contract template. The contractor was selected by the Employer by employing the restricted procurement process, where the contract was advertised to invite potential tenders to express an interest and a limited number of economic operators were invited to submit a tender (Chao-Duivis et al. 2018). The project consists of developments works for 7 WTG's and was executed in the area of port of Moerdijk, situated in the waterway of Holland Diep, Noord-Brabant, NL(figure 11). The port of Moerdijk is an

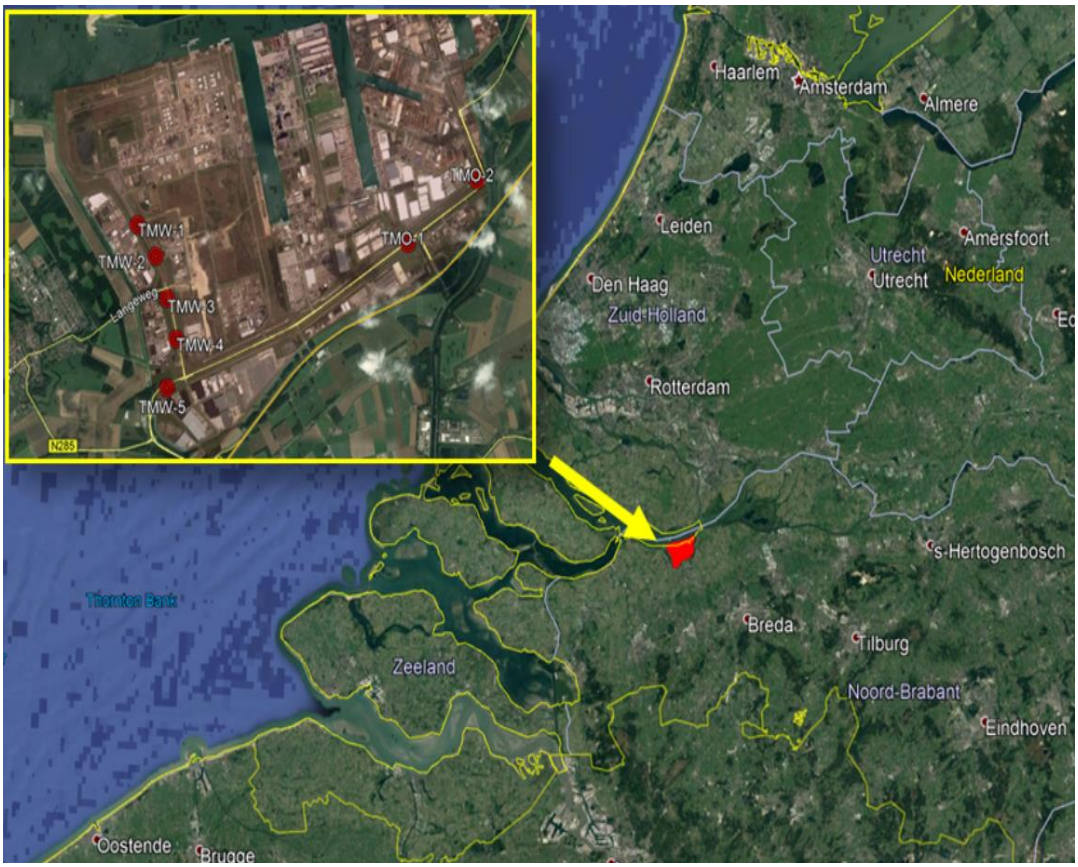

Figure 11 Location and position of WTG's (Moerdijk)

industrial site, situated between the townships of Klundert and Moerdijk. The industrial area is filled with business related to chemicals, logistics, manufacturing etc. The site surroundings were occupied by vulnerable assets such as office buildings, public roads, railways, underground cables and pipelines, dike (primary flood defense structure) etc. The contract includes design and construction of the roads, foundations, outside WTG cabling, switch gear and crane hardstands etc. in the realization of the wind park construction of a meteorological measurement tower was also included in the scope of work.

The employer has clearly Identified all the external stakeholders, who will be affected by the project and shared their information with the contractor. The employer has also developed a systems engineering structure, which also included out of scope works and obliged the contractor to use it for a structured verification during the design and construction process. By sharing the system structure, the contractor could clearly define the interfaces between objects (figure 12). Along with clear functional requirements, verification procedure during design, construction and operation phases.

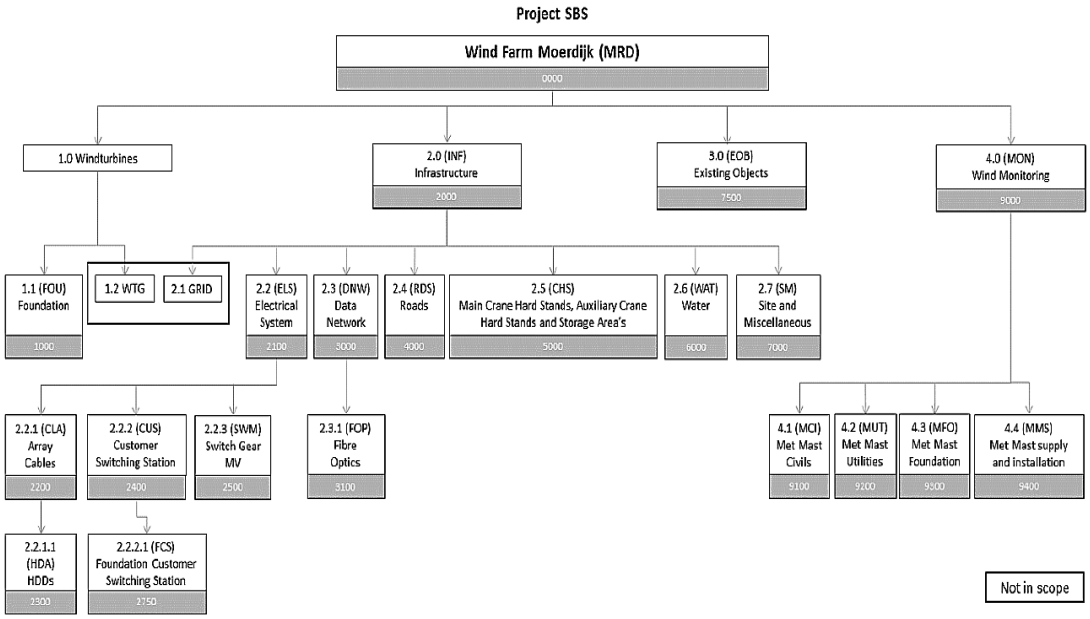

Figure 12 System Breakdown Structure of Moerdijk project

The employer showed extreme proficiency in explaining its requirements, which could be inferred from the documents presented by the employer, every information to detail was provided, which made it easy for the contractor to understand what exactly the employer requires. The employer also provided clear and clarified instructions on how it wants things to be executed.

Issues surfaced in this project, which were identified during interviews were:

1. Contract agreement/requirements were altered during almost the end phase

   The contract requirements were changed during different phases. Initially the Employer mentioned it does not need any SCADA *(Supervisory control and data acquisition)* in the contract with the contractor but during the BAFO phase the Employer wanted preparation to be made for SCADA, but the level of preparation necessary for the installation of SCADA compatible components was not clear and 1.5 years later the Employer wanted the total package of SCADA back into the project contract. This has disrupted the work process, design and led to lot of discussions. The customer switch building entrance is too small for SCADA equipment and therefore the entire part of it had to be redone.

2. Unclear expectations from Employer

   The requirements of the Employer mentioned that Contractor must discuss with the stakeholders. But the clause was not very clear i.e. if it was to get a formal acceptance from parties or hold interface meetings etc. this was not clear for the contractor, this led to commotion between parties.
   Employer expressed it wanted a formal agreement with regards to the design, but Contractor thought it was only to do with general interface meeting, information deliverance and not more than that. There existed some differences in the insights about the expectations of the Employer.

3. Scope changes made with knowledge possessed at that moment without foreseeing the effects of the changes.

   The change of the cable track/routing in the Moerdijk project, the Employer could not design the cable track as per the regulations and acceptance of the authorities in time. This led to delays in design, which had put realization phase in the high-water season. The primary water defences had to be influenced and the water board doesn't allow that to happen during November - March period, unless an entirely different application method was used for the cable. This led to increase in the realization costs significantly and delayed the project by more than 3 months.

4. Not everybody was informed about changes and delay in decision making by Employer

   The whole of Employers team was not informed about changes made during the execution phase. The Employer management team had several layers and was situated in Sweden, Germany, England, The Netherlands. A site manager was on site, a part time local project manager in Amsterdam, the overall project manager was in Ireland, a commercial manager in Munich. The management must approve the changes through a software controller system but sometimes someone would forget to give their approval after they review the changes and the project i.e. to check the contract and budget issues.

   The delays in decision making of the management took more time than required for the scope changes, design approvals. and has affected the delivery of components by suppliers, which delayed the overall project. Due to this delays the contractor shifted the project manager of the project to another project and the finishing is expected to be handled by a project coordinator.

5. Scope changes made without any formal agreement

   Several times the scope change was initiated before a formal agreement because the parties had mutual understanding and trust. Hence the contractor took the risk. Most times the changes in the technical, financial etc. elements of the project were agreed informally and completed before the formal agreement was made. There existed an inherent risk but since the decision making took more than 2-3 months the project

manager the works were executed on trust. The contract had a clause to pay 60 days after the work is approved, but the contractor was paid immediately after the formal agreement. This was a win-win situation for either of the parties.

The contractor expected least risk in executing the work before the formal agreement was done, it has done so in order to make sure the milestones were reached, and the Employer perceived it to be extremely important to reach milestones on time. The Employer was very positive in all phases of the project and had no disputes. The experience and size of the Employer played a major role in completing the project on time. Waiting for the formal agreement would have made it possible to execute only 50% of the project compared to the work completed.

6. Poor document control/Decision making by Employer

The Document control was not well managed by the Employer. A software package called share-point was used by the Employer to review the documents. The Employer expected the contractor to post all the information in that software so that they can put it in their process for reviewing. Several variation orders were posted in the software to be reviewed by a list of management officials and it took more than expected time for the management officials to review the documents and provide their approvals. The Employers team failed in quickly pushing the documents through for all the parties to review the documents, this caused a lot of delays and frustration to other parties. This forced the designers to work on other aspects without a confirmation from the approving parties.

During the interviews the managers stressed that the Moerdijk project was an extremely successful project, when dived deep into the reasons for the success of the project it was also identified that the mentioned reasons such as the behaviour and quality of the parties, communication etc. were important to also prevent the occurrence of scope creep as well, hence the author believes it is important to take the success factors also into consideration, to propose a solution. The overall key reasons for the successful execution of the Moerdijk project are presented below :

a. The experience of the employer

The employer of the Wind park Moerdijk project was highly stable financially. Hence the employer was very flexible with the cost increase and reimbursed the difference immediately to the contractor in a designated period.

b. Experience of Project manager

Project manager did not let the discussions influence the planning and tried to avert delays. When discussions were being held about scope definition and finances where the employer was of the opinion the issue was the contractor’s responsibility the timely involvement of the project manager ensured the work progress was not significantly influenced.

c. Proper communication between parties

The contract ensured that the employer's representative was always present on site for verification. if there was an issue it was always communicated through the representative. This has helped the contractor in establishing sound communication procedures with the employer.

d. Transparent and Open attitude of parties

The employer and the contractor had a transparent and open attitude towards each other and discussed everything on reasonable grounds. It could be debated in this case if the transparency and openness of the parties was due to the contract or the flexible attitude of the employer. Therefore, either of the parties were clear about their roles & responsibilities and had clarity on what to do & what to expect from each other.

e. Trust

The parties had trust in each other, this strong trust help the contractor's team to execute works confidently. None of the works executed from the design carried an uncertainty as to whether the extra work would continue.

f. Comprehensive organization

The employer organization is, according to the managers, comprehensively well structured. The organization has the responsibility of its people well established, which made the contractor's job easy. The contractor's team knew whom to contact for what, this clarity and proper means of communication kept the issues to the minimum and therefore resulted in the successful execution of the project.

6.4.1 Findings from Case III

Based on the interview responses and case documents the other issues which could have led to scope creep have been identified. The issues identified are compared to the scope creep factors identified from literature and with the gaps identified with the scope management model of the contractor firm and are presented in table 12.The table also presents which factor/cause showed impact in which phase during the project life cycle. The factors/causes are presented based on their mentions during the case III analysis. The following analysis considers only the barriers that were identified in the previous sections and occurred in practice in the Wind park Moerdijk project.

Table 12 Identified Scope creep factors/causes in case III

(A- CONCEPTION PHASE; B- DEFINITION PHASE; C- EXECUTION PHASE; D- OPERATION PHASE)

Rank	Factor/cause	PHASES			
		A	B	C	D
1	Poor communication			✓	
2	Improper assessment of scope			✓	
3	Ignoring small changes			✓	
4	Project team unfamiliar of changes			✓	

5	Lack of proper document control		✓	✓	
6	Change in project team			✓	
7	Informal decision making			✓	
8	Time pressure			✓	

From this case study analysis, it was found that

1. The scope creep factors present in this case are comparatively much lower than the ones present in the previous two cases.
2. Most of the identified scope creep factors in this project are present in the execution phase.
3. No concrete examples of scope creep activity could be identified in this case. It is possible that the scope creep activities in this project are less compared to other two cases however it is debatable if this is because of the chosen contract type i.e. UAV-GC or the financial stability and flexibility of the employer.
4. There are high chances that scope creep was overlooked in case 3 as the employer was flexible in compensating for cost overruns and therefore making the project extremely successful.
5. The maturity and experience of the employer must be taken into high consideration in this case.
6. The employer has clearly identified the do's and don'ts making the contractors job extremely smooth.
7. The contractor barely had any disputed negotiations with the employer during the execution process of the project.
8. There was high level of mutual trust between the parties, which is one of the major reasons for the success of the project.

6.5 Cross case analysis

This section presents the analysis of the case studies performed in the previous sub-sections. The similarities and differences between the cases and the scope creep factors identified in the cases will be discussed in this section. In the below table 13, an overview of the scope creep factors identified in the three cases are presented along with the phases in which the factors showed dominance due to the exposing of the vulnerabilities, which is followed by the discussion on similarities and differences observed.

Table 13 Identified scope creep factors/causes in all three cases

(A- CONCEPTION PHASE; B- DEFINITION PHASE; C- EXECUTION PHASE; D- OPERATION PHASE)

Source	Scope creep factor	Case I	Case II	Case III
		FIDIC YELLOW BOOK		UAV-GC
SCOPE CREEP FACTORS	Poor communication	B,C	A, B, C	C
	Informal decision making	C	B, C	C
	Poor decision making	B,C	B, C	-
	Experience of project team	C	B, C	-
	Time pressure	A, B, C	A, B	C
	Scope definition done by wrong people	-	C	-
	Ignoring small changes	B,C	A, B, C	C
	Ignoring stakeholders			
	Improper assessment of scope	B	B, C	C
	Discrepancy in contract documents	A	A, C	-
	Lack of proper document control	-	A, B	B, C
	Change in project team	-	B, C	C
FIDIC YELLOW BOOK	Vagueness of terms	A,C	C	-
	Autocratic power of engineer	-	C	-
	Conflicting clauses	C	-	-
	Dual nature of the engineer	C	-	-
	Adjustment clause 3.3	C	C	
	Project team unfamiliarity on tasks	C	C	C
	Appeasing the employer	B,C	-	-

From the analysis, it was identified that 11 of the 19 scope creep factors identified in the literature were present in at least one of the cases. The factors identified to be common to all the three cases are informal decision making, poor communication between stakeholders, time pressure, ignorance of small changes, project team unfamiliar on tasks and improper assessment of scope. Out of the 11 identified factors in the cases, 5 factors are present in at least two cases. The managers also raised several red flags with discrepancy in the

documents in the cases I & II, which could also be due to the newly formed employer organisation, according to the interviewees and therefore was not well structured.

During interviews the managers were asked to choose the most important factor according to them that could lead to scope creep. The managers chose the following factors (*in decreasing order of highest mentions*) 1) improper assessment of scope 2)poor communication with stakeholders 3) poor document control 4) time pressure and 5) informal decision to make changes were chosen by most managers as the most important factors that lead to scope creep. Compared to the literature findings order of importance 1) improper scope assessment 2) poor communication 3) conflicting requirements of stakeholders 4) complexity 5) experience of team 6) change in team and 7) Improper management of scope changes. 4 out of the 5 factors mentioned as important by the managers were present in all the three projects.

The cases I and II were governed by the FIDIC yellow book. From the nine flaws identified in the FIDIC yellow book in section 5, five flaws were identified during the analysis. Vagueness in the terms and clause 3.3 were found to be common cause for scope creep occurrence in both cases I and II. Whereas the other three causes were found in only one of the projects. Case III was governed by the UAV-GC hence the flaws identified in the FIDIC yellow book are not present in the project. It was also identified during interviews that two factors which were not identified in the literature were also causes for the scope creep to occur in the projects. Lack of familiarity of the tasks among the project team members was found to be common in all the projects whereas the second factor i.e. appeasing the employer was found to be causing the major damage in the case I.

From the table 13 it can be concluded that projects faced issues majorly during the execution phase followed by the definition phase. The cases I and II have also seen instances where issues surfaced during the initial phases impacting the project. The case II, which is governed by the UAV-GC, the entire responsibility, after the employer handovers the initial documents, lies with the contractor. This contractor taking the entire responsibility could possibly be a reason for a smaller number of scope creep occurrences in the project. However, as mentioned in case analysis the employer's financial stability and flexibility could also be a reason for the contractor to experience fewer instances. Therefore, the reason for lack of scope creep examples in the case III is debatable if it was due to the chosen contract type or due to the employer's flexibility, stability and maturity .

It was also observed from the examples identified in the cases that scope creep factors identified with literature, FIDIC and from the gaps present in scope management model of the contractor that it was not just one scope creep factor but their combination that has resulted in the scope creep activities. However it cannot be entirely concluded that one factor alone cannot cause scope creep as only three cases were studied.

The gaps present in the scope management, which were also identified with the scope creep factors i.e. informal execution of changes, poor document control were also identified causes that led to scope creep in the projects. The other gaps such as not focussing on the scope management plan, not reviewing the scope changes did not seem to contribute to major scope creep activities however the same cannot be concluded as only few scope creep examples were identified. Especially the scope creep examples due to improper management of changes could not be identified by the contractor's team. Therefore the impact of skipping such important steps during the process could not be assessed. The other gaps of not assigning clear responsibility did have an effect though which led to project members not being clearly aware about the developments of the project. The cause was found be present in all the three cases.

According to managers in general the lack of transparency, trust and openness were the primary reasons that led to disputes in the projects Deil and Vermeer. Whereas contracts leaning towards the Employer's favour, insufficient scrutinizing of documents, estimation errors and understaffing are identified as the reasons that added mileage to the issues in the projects. The interviewees agreed that the contractor organisation has failed to prevent the occurrence of scope creep due to factors such as poor document controlling and improper scrutinization of the documents, which are within the contractor's control and could have been averted if the organisation was not understaffed.

It should also be noted that most of the scope creep factors identified in the case analysis were present in the Deil and Vermeer projects, which were also governed by the FIDIC yellow book. Therefore the FIDIC yellow book also played a role in the occurrence of scope creep in the Deil and Vermeer projects. The contractor team's lack of solid understanding about the contract conditions was also a strong reason of too many disputes in the cases I & II. The managers associated with the Moerdijk project claim that proper communication and trust between parties led to the success of the project in terms of cost, quality and stakeholder satisfaction.

The managers agreed that scope creep was a problem which they haven't considered throughout the project development phases. All the interviewees concurred that scope creep had a damaging outcome on their projects but only after the discussion, which shows the project team members were unaware about the scope creep activities' occurrence and the damaging effects it had on the projects.

The direct cost of scope creep in the cases I & II are presented in table 14 for further understanding. From the table an inverse relation with the percentage of scope creep and the final project cost could be observed. However it cannot be concluded so, as scope creep data for only 2 projects could be collected. The scope creep amount in the case III was unidentifiable as the employer reimbursed most of the overruns therefore the scope creep effect is on the employer, which could not be collected. The research has not included the indirect cost of scope creep on the project and the contractor's project portfolio.

Table 14 comparison of the budgets of the project

Project Name	Original Project budget (euros)	Budget Increase %	Final project budget (euros)	Contract	Identified Direct cost due to scope creep (euros) [approximate figures]	Direct cost due to scope creep %
Deil	2.220.000	50	3.220.000	FIDIC YB	140.000	6.3
Vermeer	9.362.530	27	11.962.530	FIDIC YB	315.000	3.3
Moerdijk	6.450.000	8	6.966.000	UAV-GC	Information unavailable	Information unavailable

7

SOLUTION

7.1 Introduction

Based on the data and information from the previous sections, solutions to counter scope creep will be provided in this section. To identify the solution the causes of scope creep from literature, gaps identified with the contractor's scope management model and the FIDIC yellow book that were present in the cases are collected in the table 15.

Table 15 Sources of scope creep identified in the cases

Source	Scope creep factor
FACTORS IDENTIFIED IN LITERATURE	Poor communication
	Discrepancy in contract documents
	Poor decision making
	Experience of project team
	Time pressure
	Scope definition done by wrong people
	Ignoring small changes
	Lack of proper document control
	Improper assessment of scope
	Informal decision making
	Ignoring stakeholders
	Change in project team
GAPS IN SCOPE MANAGEMENT MODEL OF DV	Unclear responsibility
	Project team unfamiliarity on tasks

FIDIC yellow book flaws	Vagueness of terms
	Autocratic power of engineer
	Conflicting clauses
	Dual nature of the engineer
	Adjustment clause 3.3
Newly identified	Appeasing the employer

The table 15 presents the flaws identified during the case analysis in chapter 6 with sources being the scope creep factors identified from literature, the FIDIC yellow book and the gaps in the scope management model of Dura Vermeer. During the analysis a new factor “appeasing the employer” that led to scope creep was also identified, which is also present in the table 13. A few factors identified with literature were also identified with the gaps present in the scope management model of the company. The overlapping factors (informal decision making, ignoring stakeholders and change in project team) are shown in table 15 between the white lines.

From section 6.5 it could be identified that the 3 cases were affected by 5 common scope creep factors identified in literature. Which are informal decision making, poor communication between stakeholders, time pressure, ignorance of small changes, project team unfamiliar of the tasks and improper assessment of scope. Whereas, the common FIDIC yellow book flaws that affected cases 1 and 2 are vagueness in terms and adjustment clause 3.3. Therefore, these could be the factors which could affect the future wind farm projects and hence are the factors that should to be addressed for future wind farm projects to be better and thereby improve project delivery.

7.2 Solutions

The managers from the contractor’s firm, who were part of the empirical study in this research, during discussion opined that a proactive and robust tool, that guides managers during the definition and execution phases, is required to prevent scope creep. After having discussions with managers the most effective solutions are chosen and suggested.

A few potential solutions that are identified from literature to counter the factors causing scope creep are listed below:

1. BIM with 5D integration (Lu et al. 2016)
2. Location based schedules (Jongeling et al. 2007)
3. Fuzzy neural network (AI) (Motawa et al. 2007)
4. Dynamic systems modelling (Lee et al. 2006)
5. Data sharing and inter document linking (Bakis et al. 2007)
6. Constraint and internet-based collaboration tool (Lottaz et al. 1999)
7. Knowledge management (Sun et al. 2006)
8. Agile Scrum-ban integrated scope management model (Paul & Rahman 2018)

The solutions 1 and 2 are effective tools during the control phase, the managers agreed that BIM 5D is preferred over location based schedules. The location based schedules approach

requires a change in the tradition of activity based scheduling and also requires additional software packages. Therefore a major change in the approach is required to use solution 2 over BIM 5D, in addition the BIM 5D comes with a new dimension of cost compared to the 4D CAD in the location based approach. With BIM 5D the organisation is looking forward to the software and is betting high on this tool therefore the managers opined BIM 5D as an upcoming tool in the construction industry should be exploited to attain maximum benefits, BIM 5D comes handy not only during the execution but also during the bidding and scope definition phases as an effective communication, scheduling and estimation tool.

Regarding solution 3 and solution 4, The managers agreed that using fuzzy neural network and system dynamics modelling in change prediction is interesting, but they also expressed their apprehensions about the technologies and their implementation in the organisation in the near future. Accordingly, the solutions were not further considered for the research. Coming to solutions during the scope development phase, Solution 5 is already implemented in the organisation therefore it wasn't considered during the discussion.

Lottaz et al. (1999) proposed improving collaboration and negotiation process, which in turn leads to better change management, using constraint satisfaction techniques however the Scrumban approach brings in the advantages of solution 6, with lesser complexity and is more proactive with respect to changes therefore solution 8 was preferred over solution 6.

Sun et al (2006) has suggested using knowledge management techniques along with a change prediction tool in the execution phase however the approach is not proactive in the scope development phase and does not consider the soft skills of people when it comes to proper knowledge management.

Considering the above the agile Scrumban approach integrated with BIM, according to the author and based on the inputs of the managers, is a more appropriate solution. Therefore the following two solutions are chosen :

1. Agile Scrum-ban integrated scope management model
2. BIM with 5D integration

The advantage the solution brings is it coerces the involvement of stakeholders from the early stage of scope development and tremendously improves the scope assessment. In addition to the solutions, including a responsibility matrix in the scope management model to overcome the issue of unclear responsibility during the bidding and scope development phases from the authors view, is extremely promising solution regarding effective management of changes and in prevention of scope creep.

Involvement of stakeholders from the very beginning will help in efficient designing and planning and therefore in estabishing the project objectives within the boundaries. Similarly, having a proper responsibility assigned using linear responsibility chart such as RACI V *(responsible, accountable, consult, inform and verify)* during different phases of handover reduces the chances of information loss especially when there is shuffling in project management team and when the discussions are poorly documented. Hence taking note of the advantage of the responsibility chart it can be integrated with the Scrumban integrated BIM 5D to develop a more robust solution

However the above solution is more suitable for projects with higher budgets say above 100 million euros as the usage of the Scrumban, BIM 3D or 5D is an expensive procedure. On one

hand the implementation of the Scrumban approach requires an entire change in the organisations approach towards the projects on the other hands the BIM 3D or 5D have their own technological challenges and are expensive for a low budget project. The cases which were taken into consideration in this research are less than 15 million in budget. Therefore, employing the above mentioned recommendation will make the process expensive for the contractor organisation and risk losing the contract. Especially given the high competition in the market, contractors achieve contracts with a thin margin. Therefore the recommended solution is not suitable for low budget projects. Therefore the below recommendations are proposed taking into consideration the size of the project in terms of the budget.

The common factors identified from literature present in the cases are informal decision making, poor communication between stakeholders, time pressure, ignorance of small changes, project team unfamiliar of the tasks and improper assessment of scope.

The problem of informal decision making, and ignorance can to be prevented by making the managers aware about the impacts of doing such an activity without feeding into the change management system. The changes and its impact must be evaluated, formalised and then updated in the scope statement and other documents before implementing. It is important a change control board reviews and approves the change. Post the implementation, the changes have to be reviewed to ensure the implementation is appropriate. The contractor can focus on improving the soft skills of the project management team. In addition stakeholders must also be warned against making informal requests, which could lead to scope creep

The lack of proper communication both between internal stakeholders and external stakeholders is one of the root causes of scope creep. Communication has to be improved by establishing proper communication channels and thereby ensure there is no information loss. Responsibility has to be assigned properly to ensure the information is reached to the right person. for example a linear responsibility chart such as RACI can be used to solve the issue of unclear responsibility. This helps in proper communication between stakeholders and keeps the project team familiar about the tasks. Similarly, Time pressure is a factor which cannot be avoided however proper planning and clear responsibility reduces the occurrence of scope creep due to time pressure.

Poor assessment of scope is a factor which can be prevented through better understanding of the requirements of the stakeholders. Stakeholder analysis has to be performed during the requirements stage to identify the stakeholders and their interests have to be taken into consideration before the development of scope concretely. Scope creep has to be included in the WBS during the scope development process and a certain degree of impact should be taken into consideration.

Apart from the above Project charter is an invaluable instrument in monitoring and controlling the project costs, schedules and deliverables. The project charter can be used as an effective tool in the prevention of scope creep. The project charter should define scope, service and price clearly and therefore a detail plan should be developed to manage stakeholder expectations. Proper defining of project boundaries helps in easy identification of scope creep.

A case manager can be assigned to the projects who will just pass by to review the progress of the project after every milestone. The case manager will bring a different perspective to the project and can identify changes much more clearly than daily managers. Once the case manager studies the development of the project, he/she will be in a better position to identify/detect the occurrence of scope creep. The case manager should be able to compare documents and foresee the direction of the project.

The FIDIC yellow book has also contributed to the occurrence of scope creep in cases I & II. Therefore, FIDIC yellow book flaws should be altered through proper dialogue between parties and rewritten in the favour of the contractor to protect the contractor's interest during the negotiations stage.

Vagueness of the terms and procedures, conflicting clauses could be improved during the initial stages of the contract however the other flaws such as dual nature of the engineer and autocratic power of the engineer cannot be entirely scrapped as the contract is built on the basis of interaction between employer, engineer and contractor. Therefore, proper definition of the procedures and responsibilities of the parties could help is providing more clarity on the behaviour of the parties.

However, the option of favouring the contract conditions and clauses rests with the employer. Therefore, the contractor in case the FIDIC yellow book is unavoidable and unalterable should make its team more aware about the flaws that could lead to scope creep. Contract clarifications should be performed among parties during the pre-contract period, which can be an effective root cause treatment by preventing conflicts and encouraging transparency.

The case III, which was governed by the UAV-GC, had no or fewer issues compared to the cases I & II, which are governed by the FIDIC yellow book. According to the UAV-GC, the responsibility of a party is limited to the decisions taken by that party and therefore parties have better clarity on if's and but's. The UAV-GC is more open to having negotiations during the execution phases than the FIDIC yellow book. As mentioned earlier in Contracts chapter the UAV-GC works on the principle of fair policy whereas the FIDIC works on set of rules, which does not suit the dynamic construction industry. Therefore, ensuring clarity before the initiation of project helps in preventing issues at a later stage. Finally, to avoid scope creep there is no magic bullet than better awareness, improving soft skills of the contractor's and other parties' teams. Further a few more recommendations are provided below in section 7.3 for the contractor to follow to ensure scope creep is kept at bay.

7.3 Recommendations to Dura Vermeer

1. Literature has highlighted that scope creep occurrence is higher during the conclusion phase of the project, therefore seasoned managers are required to handle scope creep particularly conclusion phase of projects.
2. Re-baseline, when the changes are approved and incorporated into the project it is important to baseline either the schedule or the project plan. The cost and schedules should be adjusted after every change in scope is performed.
3. Break the project into major and minor milestones and perform verification and validation for every major milestone.
4. Priority must be given to contract during the initial stages to avoid issues down the lane.
5. Use key performance indicators (KPI's) to ensure the project is heading as per the plan. For example, earned value management, when people are working but no feedbacks are received or when team seem overconfident.
6. Avoid gold plating i.e. exceeding the scope of the project with the impression that value is being added, which consume time, budget and resources but may not improve customer satisfaction
7. Avoid appeasing stakeholders by doing favors, executing work packages without foreseeing effects and executing plans without scrutinizing them.
8. Encourage lean practices, which focusses on reducing waste. The practice plugs wastages and ensures quality is maintained at the same time.

7.4 Validation

Post the research work the entire research work especially the solutions recommended by the author were presented to two project director level professionals and their suggestions, opinions and inputs are presented below:

The recommendations were taken forward to the attention of two project director level professionals who have an overall experience of more than 20 years each and a total of 50 years. The research work, which consists of the scope creep factors, the loopholes present in the scope management process employed by the organization, the contribution of FIDIC yellow book towards the occurrence of scope creep, the research findings were all first presented to the experts.

The respondents were chosen based on their experience in the construction industry, their position within the firm Dura Vermeer, diversity in projects handled by them and their availability. Below are the opinions and suggestions provided by them:

Opinion & comments

1. Shuffling in project team will not necessarily have a negative impact, in fact it is done to improve the efficiency and effectiveness of the project implementation. However, it could lead to scope creep as mentioned in the research therefore changes in team should be brought into effect with proper coordination.
2. BAFO (Best And Final Offer) stage is crucial, therefore the right team should be formed to have discussions with the client. During this phase all the essential information such as the scope, the specifications, the expectations of the employer etc. should all be discovered.
3. Experts agreed that Scrum-ban addresses the issues, but they also mentioned that it should be ensured that things aren't done too much before the contract is awarded
4. Soft skills are the most important factor for the successful execution of the project, the experts expressed their apprehensions to what extent BIM alone can help improve it.
5. Time pressure, communication with stakeholders and improper management of changes are according to expert 1 the top three factors that contribute to scope creep.
6. Loss of information usually takes place when there are too many changes. Poor document controlling and project team shuffling are major contributors for information loss, but the rate of occurrence is much less.
7. BIM can come handy not only during the scope control phase but also during the scope definition phase.
8. BIM 5D implementation is a challenge in the organization not only in its development but also training people to use it.
9. BIM can also lead to conflicting requirements between stakeholders.
10. The tender development stage is a race, there is a lot of time pressure and the best quality must be presented. Tender phase along with time pressure there are high chances of the scope going off the path.
11. After BAFO the major task is collecting all the team members, which usually will also have a lot of time pressure making the scope vulnerable to digression. Therefore, this phase is equally crucial.

12. When there is time pressure, lack of communication flow, unhappiness, communication delays etc. in the team a lot of communication gaps are created.
13. It is important to know when to stop the iterations in the Scrumban process. Investing too much time on iterations is not financially feasible for the organization. Too many reworks could also lead to scope creep. There should be a very clear end to the iterative procedure.

Suggestions

1. Establish a change management team, whose only goal is to ensure the change are executed smoothly enabling the control of changes. A good system must be established and ensuring all the requirements are understood and validation is done.
2. A constant reference and analysis with the requirements, the scope, other related documents should be made to ensure that the path is right
3. Documents with more figures is easy to communicate than sentences.
4. Effective communication is extremely important where people with lesser degree of soft skills are working.
5. Work should be scored on a scale of 1-10 on a weekly basis " known as thermometer method" to make people understand what is going wrong. Lean planning approach can be employed where everybody in the team answers the work they did/will do yesterday, today and tomorrow and how they can help each other.
6. Gate reviews can be introduced in both the tendering and the realization phases. This gate reviews will introduce all the scope to do and the changes and every manager must be made aware about the project at that moment. The case manager can be assigned that job, the gate review process must be performed periodically irrespective of the milestone.
7. It is important to have more contact with our employees during the process, therefore a stage with internal validation must be included in the model.
8. Employers should be frequently updated where we stand during the process, It must be included in the model
9. Dura Vermeer is not familiar with the term scope creep, therefore making all the managers aware about the subject is essential to overcome scope creep.

7.5 Conclusion

In conclusion, the solution recommended in the above sub section addresses the causes of scope creep encountered in the cases. Therefore the fourth sub-research question "What are the appropriate strategies to follow to overcome the challenges of scope creep?" is answered in this chapter. In a nutshell the root causes of scope creep are connected to lack of proper communication, responsibility and involvement of stakeholders. The recommendations when implemented improves communication, assigns responsibility and forces the involvement of stakeholders from the very early stage.

The Scrumban and BIM tool works under the principle thread of identifying potential changes in a fairly early stage and eliminating them, which is known as proactive change management approach against the reactive approach, where the action is performed after the change event is encountered. The reactive approach to manage changes on one hand is a lengthy

procedure and leads to delays & disruptions in work on the other hand it also increases the likelihood of the occurrence of scope creep i.e. higher the changes involved in the execution stage higher are the chances of scope creep occurrence. Whereas in the proactive approach the potential changes are averted by predicting them and bringing them into effect even before its occurrence reducing the chances of scope creep occurrence.

The proposed tool through its iterative procedure reduces the occurrence of scope changes and scope creep by identifying the defects and flaws. The tool facilitates effective communication with all internal and external stakeholders including the engineer. However the tool is expensive for small projects hence is not feasible to implement for small projects. Therefore, the simplest and easy to implement recommendations must be followed to be cost conscious and prevent scope creep at the same time. Therefore, the recommendations such as to assign case manager, employ RACI V chart and project charter as effective tools, incorporate scope creep as risk event in WBS and avoid appeasing employer have been suggested.

On the other hand, the flaws of the FIDIC yellow book can be countered by developing awareness, both internally and externally, of the flaws and the damaging effects the contract template has on the project. The flaws in the FIDIC yellow book must be altered during the pre-contractual negotiations to avoid the negative effects during the project development. The Engineer's role has played a major part in the occurrence of scope creep in case I and the role is irreplaceable in the FIDIC yellow book. Therefore, better role clarification helps when employing the FIDIC yellow book. Apart from the above better awareness and improving soft skills can help majorly in preventing scope creep.

8

DISCUSSION,CONCLUSION & RECOMMENDATIONS

This chapter provides closure of the research. The previous sections have offered a detailed understanding on the concept of scope creep, the points of its emanation and its impact on the project during the conception, definition and execution stages. This chapter discusses the researcher's reflection on the subject followed by the conclusion, recommendations for future research and limitations encountered during the execution of this research. The closing section of this chapter will answer the primary and secondary research questions.

8.1 Discussion

The findings of this research are presented in this section followed by a discussion on the overall research, the analysis and the limitations of this research.

The research was carried out to identify and recommend solutions to overcome scope creep in onshore windfarm projects governed by the FIDIC yellow book. The research was first initiated by making a study on the concepts of scope creep, FIDIC yellow book and the scope of wind farm projects in the Netherlands, Which the author considers the prime keywords for this research. Further, to recommend a suitable solution to the problem firstly a literature review was performed on the concepts of scope change and scope creep to identify the potential causes and their impacts on the project, the study was extended on scope change as well in order to show a clear indication on the differences between both the concepts and how the concepts were related to each other. The literature study has revealed several factors that could lead to scope changes and scope creep and their impacts on the project.

Followed by the identification of the factors and effects of scope change and scope creep. The literature study was then extended to study the scope management model and change management model suggested by PMBOK and other researchers to compare it with the scope and change management models employed by the contractor in the succeeding stage. This part of the research revealed the gaps present in the scope management and change management process followed by the organization. This initial phase of this research was mainly concentrated on the literature and the findings are presented in chapter 4 sections 4.2 and 4.3. Then the scope management model and change management model of the contractor was studied and compared with the models suggested by literature. The contractor firm seemed to follow a pattern out of the textbook in fact a few more steps were employed in addition to the ones recommended in literature. However during the interviews different dimensions were explored and it was identified that problems did not only arise with the loopholes of the scope and change management models but also from other factors such as lack of proper communication, responsibility etc.

The research then proceeded to the analysis of the FIDIC yellow book and was compared to the UAV-GC. During this phase of the research extensive study work on the FIDIC yellow book was performed to identify how the FIDIC yellow book could contribute to scope creep. The FIDIC yellow book is an international contract template and it was mentioned during the initial screening round of interview that it can be abused very easily. The literature has drawn comparisons of the UAV-GC with the FIDIC yellow book and has highlighted that the former is defined much better and the gaps are much less when juxtaposed with the FIDIC yellow book. Several loopholes could be identified in the FIDIC yellow book but only the ones that could potentially lead to scope creep are presented in chapter 5.

In the second phase of the research three cases studies of onshore windfarms executed or being executed by Dura Vermeer were selected and studied. Post the case study interviews were conducted within Dura Vermeer with one project manager and one contract manager from each case i.e. six in total, to identify the scope creep examples and issues encountered by them during the lifecycle of the project. The interviewees were well experienced in infrastructure projects such as roads, bridges etc. but not much in onshore wind farm projects. The interview process has provided better understanding of the cases, its back story etc. The case analysis has helped in developing various perspectives on the issues encountered and therefore in preparing a set of suitable solutions. The interviews have revealed the presence of several elements of scope creep identified in the literature and the presence of scope creep in the projects. However it was not possible to analyse the positive and negative effects of scope creep as more study is required, but when having a helicopter view generally the presence of scope creep means it has a negative effect on the contractor and could be positive or negative for the employer.

In the final phase of the research, the study performed in the above sections i.e. scope creep factors, elements of the factors in the cases, FIDIC yellow book's contribution and the gaps identified in the scope management and change management model of the company were all combined to arrive at the core of the problem and therefore identify suitable set of solutions. A set of solutions were identified based on the problems revealed during the previous stages and the most feasible solutions were chosen based on the inputs given from the managers The managers opined that scrum-ban integrated scope management model and BIM could be a potential solution to counter the occurrence of scope creep. However, the recommendations were too complex and expensive for small budget projects, therefore simpler and easy to implement solutions were recommended to the contractor such that no major increase in the expense is witnessed. The solutions include assigning a case manager, assigning clear responsibility using RACI V chart, include the inputs of stakeholders during the initial stages of the project and so on, which are presented in section 7.2

Interestingly, not many of the managers were aware of the concept of scope creep, its impact and its presence in projects. Therefore making them understand the concept was a challenge. Therefore, a valuable takeaway in this research is not only confined to identifying the solution to prevent scope creep but also the fact that scope creep is an unaware term and preventing scope creep is a skill a manager should possess. On the other hand the presence of scope creep is difficult to identify and the mantra of "prevention is better than cure" is the best approach. Scope creep will eat away profits slowly, lead to delays and affect other projects in the portfolio. However, like scope changes scope creep are also inevitable but better preparation can reduce the degree of its impact on the project.

It can be concluded that the research has extended the knowledge or skill set on the subject scope creep to the professionals in the contractor firm and moreover the objective of the research was to recommend a suitable solution to reduce the occurrence of scope creep in onshore wind farm projects governed by the FIDIC yellow book

8.2 Conclusion

The primary objective of this research is to improve the scope management process and avoid the occurrence of scope creep. Following from the objective arrived the research question

"What are the suitable strategies to overcome scope creep in onshore wind farm projects, governed by FIDIC contracts, and thereby improve project delivery"

Firstly, the research findings to each sub-question are provided and in conclusion the solution to the primary research question is presented.

1. *What are the factors that could lead to scope creep and scope changes in onshore wind farm projects according to literature and project managers?*

In total, there are 28 commonly identified factors that could lead to scope changes and 19 factors were identified from literature and interviews that could lead to scope creep. Additionally the effects of scope change and scope creep on projects are also mentioned in the sub-sections 3.2 & 3.3. A clear link between the effects of scope change and factors leading to scope creep can be identified from the above mentioned sub-sections. The scope change and scope creep factors identified in literature and from interviews are presented in the tables 16 and 17 below.

Table 16 Scope change factors

Change in Employer requirement	Change in specifications	Design change	Lack of funds
Slow/poor decision making	Poor planning	Inexperienced project team	Change in stakeholders
Complexity	Unexpected site conditions	Design error/omission	Ambiguous design details
External factors	Lack of proper understanding of scope	Lack of enough data	Poor communication between parties

Risk and uncertainties	Increase in project budget	Alteration of design by engineer	Disagreements among contract documents
Poor workmanship	Optimism bias	Strategic misrepresentation	Outdated design
Value engineering	Unavailability of adequate resources	Lack of clear understanding of government policies	Challenges in technology, supply chain, finance.

Table 17 scope creep factors

Poor communication (no coordination) between stakeholders	Lack of a comprehensive project organization	Ignoring stakeholders	Informal decision to make changes
Project management decisions (Team members not aware about work)	Experience of team	Improper management of scope changes	Conflicting requirements of stakeholders
Scope definition done by wrong people	Complexity	Lack of proper document control	Improper assessment of scope
Ignoring small changes that lead to bigger impacts	Delay in project execution years after scope definition	Change in Project team	Time pressure /Unrealistic expectations i.e. too much in less time
Discrepancy in contract documents	Political volatility	Gold plating	

2. What were the effects of using FIDIC yellow book on the scope of the project?

Several flaws could be identified with the FIDIC yellow book and the flaws which according to the author could potentially lead to scope creep are enlisted below in the table. The FIDIC yellow book according to the interviewees can be easily abused and used to the convenience of the Employer. The contract template can further, also be modified therefore, being aware of these flaws will help the parties to have a clearer understanding and therefore, avoid scope creep to a possible extent. The identified flaws are presented in table 18.

Table 18 FIDIC yellow book flaws

FIDIC yellow book flaws	
Dual nature of the Engineer	Obligations on contractor
Flawed variation and adjustment process	Prolonged suspension of works
Unjust distribution of responsibility	Vagueness of terms
Autocratic power of engineer	Force majeure effects
Conflicting clauses within FIDIC yellow book	

3. *How is scope management and change management executed in practice by Dura Vermeer in onshore wind farm projects?*

From the research it was observed that the contractor firm Dura Vermeer is following the models recommended by literature with minor adjustments to improve the models. The steps such as validation is not included in the model suggested by PMBOK whereas this step provides the firm a confirmation on whether the people have interpreted the requirements and information provided by the employer in the appropriate manner. As a matter of fact this step provides a second round of verification. It was also observed that the steps in model used by the contractor firm were not followed in the same manner as suggested by literature; the order varied due to multiple reasons such as project type, size, information available at hand at that moment, inputs were given by employer during the very initial stages, time pressure etc. Therefore the order of the scope management process was not constant and was made to suit the demand. In addition to the model the organization also employed several software tools such as relatics, SAP etc to improve efficiency. However stronger the model was designed loopholes can still arise with poor soft skills of people, poor communication, lack of clear responsibility etc. leading to unclear goals, information losses and so on. In addition, the major reason for the occurrence of scope creep was identified to be informal changes executed by managers due to laziness to run the change through long scope change procedure, appeasing the client, ignorance and so on.

4. *What are the appropriate strategies to follow to overcome the challenges of scope creep?*

The following solutions according to the author are suitable and recommended to counter scope creep

1. BIM with 5D integration (Lu et al. 2016)
2. Location based schedules (Jongeling et al. 2007)
3. Fuzzy neural network (AI) (Motawa et al. 2007)
4. Data sharing and inter document linking (Bakis et al. 2007)
5. Constraint and internet-based collaboration tool (Lottaz et al. 1999)
6. Dynamic systems modelling (Lee et al. 2014)
7. Knowledge management (Sun et al. 2006)
8. Agile Scrum-ban integrated scope management model (Paul & Rahman 2018)

Based on the suggestions from the managers the Agile scrum-ban integrated model and BIM with 5D integration were identified as suitable solutions. However given budget constraints the contractor has to maintain its financial competency in the market to win the projects therefore the solutions are not practical for small budget projects. In order to overcome scope creep it is recommended to follow cost-conscious procedures to improve communication, proper assessment of scope, assigning proper responsibility, altering FIDIC clauses and so on. Post the study of the solution the recommendations were presented to project director level professionals for validation.

8.2.1 Main research question

What are the suitable strategies to overcome scope creep in onshore wind farm projects, governed by FIDIC contracts, and thereby improve project delivery?

To answer this main research question all the major aspects which could lead to scope creep were taken into consideration. Based on the literature study, case analysis, interviews, gasp present in the scope management model of the company and the FIDIC yellow book solutions were developed and presented for validation. The solutions were chosen and identified based on three root causes that could lead to scope creep they are 1) Lack of proper distribution of responsibility 2) lack of proper communication and 3) lack of early stakeholder involvement. However the proposed solutions are unsuitable for low budget projects as the implementation of the solutions makes the process more challenging and expensive than required. Therefore, keeping in mind the budget of the projects, cost conscious and easy to implement recommendations were proposed to prevent scope creep. The recommendations proposed are as follows:

1) To appoint a case manager
2) Use project charter to maximum advantage
3) Facilitate effective communication between stakeholders
4) seasoned managers to handle scope creep particularly conclusion phase of projects.
5) Include scope creep as a risk event in the WBS during the scope management phase with a certain degree of impact.
6) Prevent executing changes without feeding into the change management system or unofficially.
7) Re-baseline, when the changes are approved and incorporated into the project.
8) Inform stakeholders about the occurrence of scope creep and its effects when requests are made by them.
9) Break the project into major and minor milestones and perform verification and validation for every major milestone.
10) Priority must be given to contract during the initial stages to avoid issues down the lane.
11) Use key performance indicators (KPI's) to ensure the project is heading as per the plan. For example, earned value management
12) Avoid gold plating
13) Avoid appeasing stakeholders
14) Encourage lean practices, which focusses on reducing waste. The practice plugs wastages and ensures quality is maintained at the same time.

15) FIDIC yellow book, if unavoidable alter the clauses that lead to scope creep.

8.3 Limitations of this Research

1. Only 3 onshore wind farm projects were studied, to have a better picture about the causes and effects of scope creep issues in this setting more projects must be studied.
2. The perspective of only the contractor organization was considered for the research. The perspectives of the Employer and the consultant organizations should also be considered to understand the issue of scope creep more deeply.
3. Flaws in FIDIC yellow book that can lead to scope creep were studied during this research, The flaws in other contract templates should also be studied to come up with a more robust strategy.
4. The study was limited to scope creep in onshore wind farm projects in the Netherlands.
5. The number of people interviewed is not good enough, managers may not realize that they did experience scope creep in their projects, to add to it there were language barriers and ineffective communication due to pandemic. To develop a more sound understanding a greater number of people must interviewed.
6. The study was concentrated on the issues of scope creep faced in a single organization. This has its own limitations, hence there is a need for further research in this direction.

8.4 Recommendations for future research

In this section, recommendations for further research in the area of scope creep is provided. These recommendations also encompass the research limitations mentioned above:

1. Scope creep in brownfield project must be studied as the future of The Netherlands is more about brownfield projects.
2. The projects studied were less than 50 million in size, the issue of scope creep is much bigger and more dangerous in mega projects and complex project. Hence scope creep in mega projects and projects with high degree of complexity can be studied.
3. The research has only considered onshore wind farm projects in its study, diverse projects in different countries must be studies to develop a deeper understanding on the causes and effects of scope creep.
4. The research was focused only on the perspective of the contractor, A future research can be carried out in this direction to analyze the perspectives of Employer and Consultant organizations
5. During the research it was observed that the experience of the client plays a major role in handling scope creep. It is recommended to take the perspectives of clients as per their experience, expertise and type of organization i.e. public or private.
6. In order to thoroughly understand the relation between the application of the solutions and performance in construction projects a deeper investigation is necessary. Also, the implementation of the solutions is in their very cradle stage and contains more scope for research.
7. Among the recommended solutions employing Fuzzy neural network and Dynamic systems modelling are, according to the author, promising and challenging to

implement solutions. A research work can be carried out to implement these solutions to predict and identify scope changes much early.

8. Research can be performed in making a comparative analysis on the impacts of scope creep (uncontrolled growth), Scope Grope (inability to articulate requirements) and Scope leap (shift in strategic focus of the organization altering the backdrop under which the project is operating).

9

REFLECTION

The theme of this research runs on the thread of scope creep in the construction industry. Performing this research completes my MSc study, which has been a journey filled with a lot of learnings. The research topic was inspired after noticing that a lot of organisations are finding it difficult to deal with or as a matter of fact are even unaware about the term scope creep and its effects on the project and the organisation. The research was initiated by collaborating with Dura Vermeer and by narrowing down the research to onshore windfarm projects and further narrowing it down to the ones governed by FIDIC yellow book. This section describes several challenges and key learnings that I encountered during this research. The first step of the thesis began with conducting a literature review and exploratory interviews. By the start of the literature study it felt that much less research has been performed on scope creep in the construction industry as very few research papers were identified but as the research progressed articles relevant to synonyms of scope creep could be identified, which gave mileage for the research. The connection of contracts and scope management model towards the scope creep and how the flaws in them could lead to scope creep has not been explored hence the research questions were formulated.

The literature study began with studying on scope changes, scope creep and the scope management model and infringed into the study of FIDIC yellow book and its contribution towards scope creep. The literature study has revealed a lot of factors but my understanding on the term scope creep was not sound due to which a lot of factors which could lead to scope change and in turn could lead to scope creep were taken into consideration. Thanks to my committee members who checked me at the right time and guided me in the proper direction.

Three onshore wind farm projects were chosen as cases to be studied. The data acquisition method included both structured and semi-structured interviews. Carrying out the interviews was extremely testing; due to the pandemic all the interviews were held over video conferencing applications. The process was bumpy due to connectivity and device compatibility issues, Nonetheless perseverance won, and the interviews were carried out successfully. All the interviews were carried out in an extensive manner and covered a range of aspects especially on scope management. The interviews resulted in a lot of data which made the filtering & analysing of the data to determine the exact scope creep factors and examples from the cases quite challenging. The multi case analysis gave me an opportunity to get to know different issues experienced during different phases of the project. After studying the factors and effects of scope creep, the FIDIC yellow book contract and the scope management model of the company were analysed and the solutions were recommended based on the problems identified along with all the data gathered from the interviews and the root cause for the issues that were narrowed down.

With Consultations with my supervisors combined with my knowledge on project management and from literature, allowed me to come up with appropriate solutions. The complicated part was to explain clearly the term scope creep to the managers, as the managers were unfamiliar with the subject extracting the desired information from them such as the examples of scope creep during the case study was extremely difficult. The research also demanded the analysis of the FIDIC yellow book for which I extensively read the FIDIC yellow book and had to think critically about the contract to identify the flaws.

Many people from the contracting company were keen in the research and were happy to share their knowledge and experiences with me. The interesting discussions and opinions of multiple actors within the organisation provided me with great insights and enriched my knowledge, overall the experience was surreal filled with lot of challenges and learnings.

10

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APPENDIX

APPENDIX A

Table 19 Profile of practitioners/managers interviewed

Project	Interviewee	[redacted]	Designation	Experience (years)	Project experience	Number of interview sessions
Deil	1	[redacted]	Project manager	30	Infrastructure (roads, bridges), Energy	3
	2	[redacted]	Contract manager	20	Green & brown field projects (infrastructure & Energy)	5
Vermeer	3	[redacted]	Project manager	7	Energy	4
	4	[redacted]	Contract manager	20	Infrastructure and Energy	3
Moerdijk	5	[redacted]	Project manager	14	Infrastructure	2
	6	[redacted]	Contract manager	12	Infrastructure and Energy	3

Some of the quotes mentioned by the interviewees during the interviews are presented below:

Interviewee 1 : " bidding and tender phase went wrong, a lot of things in the scope were not assessed well enough"

Interviewee 2 : "we should have been more contract aware than just being interested only on the project"

Interviewee 4 : " we asked a lot of questions about the steps vs staircase, they were not clear initially and eventually they provided us an expensive design, which required a lot of effort"

Interviewee 4: "we could not communicate properly with this kind of system, changes requested were sometimes missed"

Interviewee 5 : " it wasn't a sound preparation; we were not clear what they were expecting from us"

APPENDIX B

Validation interviewees:

- **Expert 1**
  Armand Ellsworth : Project Director, Dura Vermeer
  Skilled in Operations Management, Highways, Construction, Management, and tendering
  Experience : 30 years
  Expertise : Roads, bridges, railways, buildings
- **Expert 2**
  Paul Bleijenberg : Product Manager, Dura Vermeer
  Skilled in operations management, risk management, Construction management
  Experience : 20 years
  Expertise : Roads, bridges, waterworks

Some of the quotes mentioned by the Validation interviewees during the interviews are presented below:

Expert 1 : "Putting the right people at the right spot at the right time is important, replacing people is inevitable when they don't fit into the work"

Expert 1 : "if the client's expectations are not clear it is highly likely to take the wrong turn which will lead to disputes"

Expert 1 : "BIM is not for one person but for an organization, therefore all members must be trained for it"

Expert 1 : " Tell people what our goal is, where are we on the horizon, where are we going wrong, what can we do to improve things"

Expert 2 : " Agree with the Scrumban procedure but there should be an end on the Scrumban process, and the end should be the start of our definitive design. The engineering perspective should also be considered"

Expert 2 : " we should not surprise our people with something they have not considered"

Expert 2 : "Would like to see integrating the scope and requirements in BIM and believe it could be a strong solution to scope creep"

APPENDIX C

Interview Questions :

1. Name
2. Discipline
3. Experience and role
4. Types of projects handled
5. Experience in wind farm projects
6. Date
7. Qualification

Scope changes

8. What is your opinion on scope changes
9. Do you think scope change is a major hurdle in achieving the objectives
10. How do u deal with scope changes

Scope creep

11. Do you have a clear understanding of the term scope creep?
12. What is the difference between scope creep and scope changes
    a. Scope creep is a synonym of scope change
    b. Scope creep is the process of controlling the project scope
    c. Scope creep occurs where the original project scope slowly grows outside the scope originally defined in the SOW
13. Did you experience scope creep in your projects and how often do u come across it
    a. What do u think are the main reasons for scope creep
    b. Do you think scope creep is/was an issue in the projects that you were part of
    c. Below are a few causes of scope creep identified in literature, choose the 5 most important factors that you think are leading to scope creep

Table 20 Scope creep factors (refer section 3.3)

Factors Causing Scope Creep
Poor communication (no coordination) between stakeholders
Lack of a comprehensive project organization

Ignoring stakeholders
Improper management of scope changes
Informal decision to make changes
Conflicting requirements of stakeholders
Project management decisions (Team members not aware about work)
Experience of team
Complexity
Time pressure /Unrealistic expectations i.e. too much in less time
Delay in project execution years after scope definition
Scope definition done by wrong people
Ignoring small changes that lead to bigger impacts
Improper assessment of scope
Discrepancy in contract documents
Lack of proper document control
Change in Project team
Political volatility
Gold plating

14. Do you think changes in scope can make way for scope creep?
15. Do you think planning failure is a reason for scope creep
16. How many change orders did you have in during the project tenure
17. What do think about the impact of scope creep in projects
18. Who do u think is responsible for the scope creep?
19. How is the responsibility and accountability between members distributed for managing and delivering work packages
20. What was the value of the variations and time and cost creep in projects
21. What according to you is an appropriate solution to control scope creep in projects?
22. What are the lessons learned about scope creep and scope control in this project
23. How do you define the project scope as in what tools do u use (to identify the tool that is being used)
24. How do u take ripple effect into consideration while bringing changes into effect (to check the link of scope baseline with available resources and drivers)
25. How well is scope defined during the front-end loading stage of a project ?
    a. Is project scope identified precisely??
    b. Does it match with the requirements and vision of the Employer's?
    c. Do you take into consideration how the Employer perceives your definition of scope ?
    d. How are situations where the project scope demands more than the fixed budget dealt?
26. How do you make sure that right information is available during the tender stage, scope definition stage and other stages?
    a. How is the estimation of a bid for a tender application performed? Do you use reference class forecasting?
    b. Do you consider the risks related to scope change and scope creep during the tender application development? i.e. is a budget allotted for contingency purposes?

27. What do you think are the reasons for change in requirements of Employers ?
    a. Have you come across situation where the Employer requirements were not clearly understood? If so, how often is it?
    b. Why do you think the understanding of Employer requirements gets unclear

28. How is the communication done between project teams at Dura Vermeer, during the design phase, execution phase and other phases?
    a. Do you hold a record of all the communication between key stakeholders?
    b. What is the general mode of communication with the stakeholders (*to get a picture of the potential vulnerabilities, misinterpretations and misunderstandings*)
    c. How are the recorded documents used with the Employer (*In order to check if the Employer is made aware of happenings and are, they kept informed about the progress)*
    d. Is every key manager updated about the changes performed?
    e. Is the consultant also informed about the changes?
29. Does the experience of Employer play a role in handling such unexpected issues

30. How are changes approached for works that have been completed already (i.e. they were part of the initial scope)?
    a. What are the considerations made in such situations? (*does the Employer acknowledge that time and resources were already spent on the work?*)
    b. How do you make sure that the project documents are in line Ice how are interfaces managed?
        i. internal interfaces
        ii. extremal interfaces
    c. How is the document control performed in a project? (*To get a picture of communication lags when changes are made to designs or scope i.e. both minor & major*)
    d. Did any stakeholder (such as NGO or environmental groups) have issues with the project?

31. Is the resource allocation for the project activities revised and updated according to the work? How often is it done?
32. When executing the onshore wind farm projects do/did you have any reference of projects done in the past and what were the learnings from the past projects ?
33. During the execution of a project, do you have a reference document as a point reference such that all the works, schedules, activities etc. are in line? Which is it?
34. Do you think having additional staff will assist in better communication and management of scope changes? (Idea is that adding additional resources will only treat the symptoms and not the illness)

35. FIDIC Yellow book
    a. What do you think are the conditions that are making way for scope creep
    b. What are the general problems that you come across and in which phase of the project do you encounter them
    c. When i.e. at which phase do you think there was the issue of scope creep in your project

    d. How did the Employer react when the issue of scope creep was brought to its attention
    e. How did the issue get resolved?
    f. what were the effects the company had to go through because of scope creep
    g. Did you see any early signs of warning
    h. How can they be better handled
36. Were any considerations made while taking up the assignment in order to avoid liabilities from scope creep and scope changes?
    a. How were the liability issues handled?
    b. What criterion is ideal in this case? i.e. Dealing directly with the Employer by by-passing lead consultant or with the lead consultant and not with the Employer to minimize transfer of risk?
37. Do you think the engineer who represents the Employer, taking calls on the design/execution (not designed by him) had/would lead to scope creep?
38. Do you think the engineer's intention to initiate variations can lead to scope creep?
39. Are there terms in FIDIC that are vaguely defined?
    For example : the term unforeseeable physical conditions- A discussion between contractor and engineer what means physical conditions is very well possible and the outcome is unsure. But in any case, it means wasting of time (scope creep). Is, for instance, the COVID19-pandemea a physical obstruction (see also subclause 18.1 under f)?
    Could you devise physical conditions or obstructions about which parties can doubt whether subclause 4.12 deals with them? Compare for instance § 29 UAV 2012
40. Do you think changes in laws, norms, rules and regulations could also lead to scope creep? ,
41. Would you like to add something on this topic?

APPENDIX D

Semi-structured interview on topics

a. Loose contractual terms
b. Ripple effects of scope changes
c. Project progress without having all the details
d. Decision making
e. Document Control
f. Negotiations between stakeholders
g. Estimation Failure
h. Constantly changing requirements
i. Collaboration between internal and external stakeholders
j. Pre-contractual conditions

APPENDIX E

Classification of the scope creep factors under 4 typical classifications namely organizational, Human, Technology based and external.

Table 21 Scope creep factors classification

Component	Factors Causing Scope Creep
Organisational Component	Lack of a comprehensive project organization
	Ignoring stakeholders
	Improper management of scope changes
	Conflicting requirements of stakeholders
	Change in Project team
Human Component	Poor communication (no coordination) between stakeholders
	Informal decision to make changes
	Experience of team
	Project management decisions (Team members not aware about work)
	Lack of proper document control
	Discrepancy in contract documents
	Scope definition done by wrong people
	Improper assessment of scope
	Ignoring small changes that lead to bigger impacts
	Gold plating
Technical Component	Complexity
	Time pressure /Unrealistic expectations i.e. too much in less time
	Delay in project execution years after scope definition
External	Political volatility