Causes of Delay in Construction Projects in Oil and Gas Construction Industry

أسباب التأخير في مشاريع البناء في صناعة النفط والغاز

by

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Abstract

Although construction delays are universal, the delays in the oil and gas industry are unique. The aim of the study was to establish the major causes of delay in the oil and gas construction projects and to group them in accordance with their importance and impacts. Qualitative method was used in a single case study adopted. The sample comprised 10 informants chosen based on a specified criterion and reached through the snowball sampling technique. The findings indicate that the scheduling of oil and gas construction projects is conducted up to standard and through the use of scheduling software. Scheduling, workflow management and delay recognition were problems established to be caused by the lack of a professional project manager on site; cash flow management problems caused by inadequate allocation of funds at the bidding stage. Procurement was established to be a secondary problem that emerged as a result of scheduling problems and workflow problems. With regard to design, the contractor's need to decrease construction costs through a cheaper design was found to be a factor in design changes. Issues related to client performance included bureaucracy and late honouring of certificates. Secondary causes such as rework, the rate of productivity, dispute management and delay analysis were also found to have great significance. Dispute management processes appeared to be another major cause of delay. Lastly, it was established that there were no active formal means of delay analysis. The delay was found to impact on contractual relationships, profitability and profit margins of both the contractor and the client, and the on the possible gains by the hosting communities. The limitations were methodological in nature. Future research should therefore test the results established through quantitative surveys. For practitioners, there is a need for a dedicated professional project managers in construction projects and honesty and transparency in contract bidding for continued business relationships.

الخلاصة

على الرغم من أن التأخيرات في البناء عالمية، لكن التأخير في صناعة النفط والغاز فريد. كان الهدف من الدراسة هو تحديد الأسباب الرئيسية لتأخير مشاريع بناء النفط والغاز وتصنيفها وفقا لأهميتها وآثارها وقد تم استخدام الطريقة النوعية في دراسة حالة واحدة اعتمدت وشملت العينة 10 مخبرين تم اختيارهم بناء على معيار محدد وتم التوصل إليه من خلال تقنية أخذ عينات كرة الثلج. وتشير النتائج إلى أن جدولة مشاريع بناء النفط والغاز تتم وفقا للمعايير ومن خلال استخدام برمجيات الجدولة. وجدير بالذكر أن إدارة الجدولة وإدارة سير العمل والتعرف على التأخير هي مشاكل تنشأ بسبب عدم وجود مدير مشروع محترف على الموقع ومشاكل إدارة التدفق النقدي تنجم عن تخصيص الأموال غير الكافية في مرحلة تقديم العطاءات. وقد تم اثبات بان عملية الشراء هي مشكلة ثانوية نشأت نتيجة لمشاكل تحديد المواعيد ومشاكل سير العمل.

وفيما يتعلق بالتصميم، تبين أن حاجة المقاول إلى خفض تكاليف التشييد من خلال تصميم أرخص كانت عاملا في تغييرات التصميم. وشملت القضايا المتعلقة بأداء العميل البيروقراطية والتأخر في إصدار الشهادات. كما وجد أن الأسباب الثانوية مثل إعادة العمل، ومعدل الإنتاجية، وإدارة المنازعات، وتحليل التأخير لها أهمية كبيرة. ويبدو أن عمليات إدارة المنازعات هي سبب رئيسي آخر للتأخير. وأخيرا، ثبت أنه لا توجد وسائل رسمية فعالة لتحليل التأخير. وقد وجد أن التأخير يؤثر على العلاقات التعاقدية والربحية وهوامش الربح لكل من المقاول والعميل وعلى المكاسب المحتملة من قبل المجتمعات المضيفة. كانت القيود ذات طابع منهجي. ولذلك يجب أن يختبر البحث المستقبلي النتائج التي تم التوصل إليها من خلال الدراسات الاستقصائية الكمية أما بالنسبة للممارسين، هناك حاجة إلى مديري المشاريع المهنية المتخصصة في مشاريع البناء والصدق والشفافية في مناقصة العقد لاستمرار العلاقات التجارية.

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Dedication:

I dedicate this dissertation to my beloved parents (Imad & Tamam), you are the reason behind whatever I achieved in my life. My sisters: Mariam, Noura, Rola, & Rim, you are my soul mates and my best friends till the very last day of my life. My brothers: Rami & Mohammad, you are the shoulder to lean on and my support.

My Husband: Rabie, you are the love of my life, & my other half. I want to hold your hand at 80 and say, "We made it". My baby Rayan: You're the apple of my eye and my inspiration. I love you to the moon and back.

Doctor Maria, the supervisor of this research, for her ultimate support and advice.

Thanks to every person who had a positive influence in my life.

Thank you all,

Marwa Imad Fanousse

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Chapter 1: Introduction

The construction industry in general is described by Mahamid, Bruland and Dmaidi (2012) as the tool through which the society's goal of development is achieved. It greatly impacts on the economy and is among the sectors which provide notable ingredients for economic development in all countries. However, it keeps increasing in complexity because of the process of construction itself and the parties involved in the process for instance the designers, consultants, clients, users, suppliers, contractors and subcontractors. According to Abdul-Rahman, et al. (2006), the construction sector is a representative of among the most complex and dynamic industrial sites. It deals with converting the specifications and plans for products, has multiple organizations involved, which face circumstances which in many cases result in delay. The complexity and the dynamic nature, therefore call for effective and efficient management of people, resources and work processes in order to achieve set goals.

1.1 Background

The construction industry is wide and different from other industries including infrastructure such as roads, dams, railways; residential and commercial buildings; and the oil and gas industry among others. Petroleum is critical to numerous industries and as such is of a critical concern in many countries. The oil and gas industry is composed of upstream and downstream components. While the upstream segment deals with the production and exploration, downstream deals with the processing and refining the crude products of oil and gas, their marketing and distribution.

1.1.1 Construction projects in the oil and gas industry

The construction industry in oil and gas sector is responsible for designing, planning, constructing and maintaining the upstream and the downstream facilities. The projects occur both upstream and downstream. Most of the upstream projects are considered to be megaprojects.

Although there is no universal definition for the term ‘mega project’, Fayek, Revay, Rowan and Mousseau (2006)define megaprojects as construction projects that are characterized by large costs, increased risks, lofty ideals, high visibility, increased risks and extreme complexity in a combination which notably challenges the stakeholders, impacts the community and goes beyond the limits of construction experiences. Lozon and Jergeas (2008) on the other hand define mega projects as construction projects whose cost exceed $1 billion. The single uniting definition is the large scope and the complexities that are involved in their design and execution.

Indeed, mega projects have challenges for instance the need to manage multiple, concurrent and complex activities while at the same time maintaining schedules that are tough together with tight budgets. Multiple partners, technical complexities, budget uncertainties, and aggressive schedules sometimes combine in such a manner that leads to decreased productivity and notable overruns in cost as well as schedule in the mega projects (Fayek, et al., 2006). This calls for even increased complexity in their management.

Other distinctions include the size of the project, the complexity in procurement contracting, environmental and human impact, scope creep and uncertainty, and time constraints. This event presents even more challenges, including the management and the integration of a huge labour force, competition for resources that are limited, and lengthy project schedules that

last numerous years. Clearly, these distinctions make the construction of mega projects and especially in the oil and gas industry different from other constructions.

Mega construction projects in the oil and gas industry are considered as among the most challenging in terms of success in delivery. Apart from their mega sizes, with budgets that exceed $500 million, there is often an overlap of the construction and the engineering phases (Chanmeka, Thomas, Caldas and Mulva, 2012). Some of the oil and gas projects are worth more than $7 billion, requiring about 7,000 labourers and an annual turnover of 300 percent (Jergeas, 2008).

The management of a mix of labourers working in pairs and performing a minimum of two varied activities within a day require thousands of jobs and each of the jobs requiring a mix of correct location, materials, access, tools, equipment, quality, safety, consumables, and different inputs (Jergeas, 2008). Chan (2011) notes that working on the construction projects in the oil and gas industry is hazardous and challenging because of the remoteness and the hostility of the work environment and the demanding nature of the work shift schedules which requires daily adjustment. Moreover, the construction projects are often delivered under conditions that are extremely burdensome for instance, harsh weather, frequent shortages of labour, and remote location of the construction sites. The hardships make it hard for the construction industry to work in an efficient manner.

The projects, moreover require engineering techniques that are advanced, reliable suppliers, experienced contractors, sufficient planning and project cost control and the execution of the construction in accordance with schedules. This therefore calls for a great need for the use of advanced technical resources and skills and especially as it pertains to labour, equipment and materials (Chanmeka, et al., 2012). This ought to be conducted by management, which should

have the capability of planning, organizing, and executing the project deliverables in an appropriate manner (Jergeas, 2008). The management and the execution of such large projects require project teams which are extremely experienced, that are used for the implementation of front end planning with high effectiveness, as well as the control of project schedules and cost (Chanmeka, et al, 2012).

1.1.2 Delays in the construction industry

The major target of construction projects is the minimization of schedule delays and cost overruns (Yang and Wei, 2010). Delay can be defined as the failure to complete the project within the time frame agreed upon in the contract (Gündüz, Nielsen and Özdemir, 2013). Abdul-Rahman, et al. (2006) defines delay as the slowing down of work without entirely stopping.

The delay has been used in construction claims to refer to two different matters which are related to each other. In the first place, the delay has been used to refer to the time within which a part of the construction project has extended beyond the original plan because of the circumstances that were not anticipated (Jae-Seob, 2009). JyhBin and ShenFen (2008) support this perspective of construction delay by defining it as the time overrun beyond the date of completion of a project. The term can also mean an incident that has an impact on a specific activity, but which has no impact on the completion of the project (Jae-Seob, 2009). Therefore, from these delays can either be task based or project based.

Gündüz, Nielsen and Özdemir (2013) denote that the success of a construction project is acknowledged when its completion is timely, according to the client's specification and within the budget. Although the success of a project is measured by its ability to meet quality, time and cost limitations, it is common to encounter construction projects that have met to achieve its goals of quality, time and cost within limits (Mahamid, Bruland and Dmaidi, 2012).

Delays experienced in construction are universal and are normally accompanied by overruns in cost. According to a survey, a third of the construction projects usually miss their schedule and cost targets (ShingTao Chang, 2002). Studies conducted in the developing and the developed countries demonstrate that construction delays are ordinary and among the most recurrent problems in the delivery of construction projects (Toor and Ogunlana, 2008). Moreover, Rao, Shekar, Jaiswal, Jain and Saxena (2016) consider delay to be among the most common, risky, complex and costly problems in construction projects and as such is often the source of claims and disputes resulting in lawsuits.

1.1.3 Classification of delays

The efforts towards schedule recovery are regarded to be fair in the case that the contractor and the client come to an agreement on the types of delays that they are responsible for and integrate them in the entire contract (Ng, Skitmore, Deng and Nadeem, 2004). The classification of delay is conducted based on the issue that interests the analysts. The determination of the types of delay is hard because of the problem of making a party responsible for the delay (Ng, et al., 2004).

Generally, construction delays have been classified in accordance with the liability, yielding two types including excusable delays and non excusable delays (Alkass, Mazerolle and Harris, 1996). They are commonly classified as critical delays or non critical delays; excusable or non excusable; compensable or non compensable delays (Ndekugri, Braimah and Gameson, 2008). Ng, et al. (2004) classifies delays as compensatory, non excusable and excusable.

Pall, Bridge, Skitmore and Gray (2016) classify delay into compensable and non compensable, inexcusable and concurrent. Moreover, Pall, et al. (2016) reports another study in which delay factors were classified into two major groups, including internal causes assigned to

the contractual parties to the project and the external causes which are out of the control of the involved parties. The current study considers delay types as compensable, excusable, excusable compensable, excusable non compensable, non excusable and concurrent delays.

1.1.3.1 Compensable delays

The compensatory delays are those that are caused by the client or their representative. Factors that cause compensable delays are the conditions or the events for which the owner is responsible for or is a direct cause. Mezher and Tawil (1998) support this in their statement that delays are regarded as compensable to contractors when the cause can be controlled, is as a result of a fault or negligence on the part of the owner. Finke (1999) argues that only two types of delay causes are relevant to the analysis of compensable delays: contractor related and non contractor related delays.

The analysis of compensable delays, enables the determination of the amount of recoverable delay costs. The analysis may be conducted during the late project stages because in practice, delay costs are not sustained until the completion date that was originally specified (Finke, 1999). There is also the alternative of analysing the compensable delays and damages quantified or liquidated as the project progresses (Finke, 1999).

What matters in this analysis is that the delay emanated from conditions and events that are compensable, non compensable, the separate action of both the compensable and non compensable events and conditions or the combined action of the compensable and non compensable events or conditions (Finke, 1999).

1.1.3.2 Excusable delays

Excusable delays cannot be attributed to the actions or the inactions of the contractor and practically include events that are unforeseeable. These kinds of delays take place when the

delay is by occurrences that cannot be blamed on either the contractor or the owner (Mezher and Tawil, 1998). Such events cannot be controlled in any way by the contractor and are not as a result of the contractor's negligence or fault (Alkass, Mazerolle and Harris, 1996).

When such events occur, the contractor is entitled to extensions in the case that the date of completion is affected. The delay can also impact on activities that are noncritical and as such requiring greater detail in the analysis in order to determine the need for an additional extension or whether the reduced float is justified. The excusable delays can further be compensable or non compensable.

1.1.3.3 Excusable compensable

Excusable compensable delays are those caused by the actions or the inactions of the owner. The contractors in this type of delay are entitled to both time and monetary compensation as a result of the delay (Alkass, Mazerolle and Harris, 1996). This kind of delay can manifest in delays in the approval of specifications by the owner or through change orders not planned for.

1.1.3.4 Excusable non compensable

Excusable non compensable delays are those where neither the owner nor the contractor is responsible and as such, the contractor is only entitled to time extension given that no ground for damages exist (Alkass, Mazerolle and Harris, 1996). Such include strikes that are non provoked, or the 'acts of God'.

1.1.3.5 Non excusable

The non excusable delays emanate from contractors and any other are regarded as excusable. They are also regarded as emanating from the action or the inaction of the contractor (Mezher and Tawil, 1998). Non excusable delays usually occur as a result of the actions or the

inactions of the contractor or the subcontractor. As such, it does not present them with any form of entitlement to delay, damages or time extension in the case that the delay proves to have impacted on the entire project. The owner on the other hand is entitled to liquidated damages for instance, in the case that the contractor does not have adequate human resource to complete the work in a timely manner (Alkass, Mazerolle and Harris, 1996).

1.1.3.6 Concurrent delays

Concurrent delays occur in situations where two or more delays, regardless of their type or liability occur at the same time and overlap to some extent (Alkass, Mazerolle and Harris, 1996). The case of the schedule delays that are concurrent is common in construction projects whereby there is an involvement of many parts (Casinelli and De Angelis, 2007). Also, some the delays are autocorrelated and interdependent leading to the examination of how the previous delays affect the delays that follow (Ng, et al., 2004). This means that the overall delay due a specific party may not be equal to the summation of the individual delays attributed to that party. Even though it is possible to identify the delay caused by a specific party there is a need for the establishment of the interactions and the entire impact of the delays on the construction project.

1.2 Problem statement

The performance of a contract directly impacts on project profitability (Gothand, 2003). Given that the future has its basis in the performance of the time dimension of the contract and given that time has an influence on money one can conclude that project planning has an influence on the construction profits. Profitability is therefore jeopardized in the situation whereby the schedule has impacted on or where there are delays. As such, construction delays are not just attributed to time extensions, but the economic implications that come with the

increase in the completion period. As such, delays can lead to issues that were not anticipated in the course of project delivery.

Construction projects are characterized by multiple participants and contractual relations (Jaśkowski and Biruk, 2011) and delay negatively impacts the participants, including contractors, consultants, and clients as pertains to the growth in mistrust, arbitration, adversarial relationships, litigation, cash flow issues and feelings of trepidation (Mahamid, Bruland and Dmaidi, 2012). Delays have the ability to jeopardize safety and quality, lengthen schedules and increase the cost of projects (González, González, Molenaar and Orozco, 2013).

Delays result in disruptions and productivity losses, late project completion, increase in costs that are related to time, claims of third parties, termination or the abandonment of the contract (Abdul-Rahman, et al., 2006). Aside from costs and extensions, they also result in disputes, protracted litigation and abandonment of projects.

The magnitude of delays usually ranges from one project to another. Having acknowledged the commonality of construction delays and the magnification of costs that would be implied in the case of delayed oil and gas mega projects, this presents a need to re-examine the case of construction project delays and especially in the oil and gas industry. More specifically, there is need to examine the issues that surround construction delay, including their causes, their level of importance and their impacts.

1.3 Research aim

The aim of this study is to establish the major causes of delay in the oil and gas industry construction projects and to group them in accordance with their importance and impacts.

1.4 Research objectives

1. To explore the ways of managing construction schedules in the oil and gas industry

2. To explore the major causes of schedule delays in the oil and gas construction industry
3. To explore the importance of the delays and their impacts on the stakeholders
4. To explore ways through which the schedule delays can be reduced and their impacts mitigated

1.5 Research questions

1. What are the ways of managing construction schedules in the oil and gas industry?
2. Which are the major causes of schedule delays in the oil and gas construction industry?
3. How important are the delays and what are their impacts on the stakeholders?
4. How can the schedule delays be reduced and their impacts mitigated

1.5 Justification

Delay has over the years been popular in the research of construction management and different studies on delay have conducted for various reasons. Studies have focused on the identification of the causes of the delays and the parties responsible for them as well as their nature and impacts (AlSehaimi, Koskela and Tzortzopoulos, 2013). Most of the studies on delay have been based on the type, causes, timing of the delay and its ability to be compensated for. However, not many studies have examined delay in the context of the complex, expensive and remote oil and gas construction mega projects.

Although some studies have been published with regard to the delays in construction projects within the discipline of construction management research, clarity in the analysis of the factors leading to the delay is not yet explicit, at least in the oil and gas industry (Doloi, Sawhney and Iyer, 2012). The majority of the published studies moreover have failed to demonstrate how the issues work together to impact on the time performance of construction projects (Doloi,

Sawhney and Iyer, 2012). This creates a need to concentrate on oil and gas mega construction projects as a means of bridging literature gaps.

Moreover, examining the already published studies, Jae-Seob (2009), denotes that Although many studies have been conducted that examine the causes of delay, none of these studies consider the change in productivity during the periods of delay, and this has led to the disputes resulting from the failure to identify the party that led to the delay and especially accumulated delays.

The other assumption regarding delay is that scheduling techniques usually make the assumption that the relationship between time and construction workers' productivity is linear which in reality, may not be true. Jae-Seob (2009) indicate that losses in labour productivity may not directly precede delay, but may come after, and as such, leading to further delays, and as such impeding the identification of the real causes of delay. Among the most importance issues that lead to delay is the loss of productivity and as such, there is a need to examine changes in productivity over the period of delay. The current research examines, among other issues, the losses that come through the changes in productivity.

Furthermore, AlSehaimi, Koskela and Tzortzopoulos (2013) established that although most of the studies' result is related to the project environment and the management of construction projects, the recommendations provided by the studies do not match the findings and as such, reducing the chance of finding an amicable solution to the construction problems. Moreover, the authors established that the recommendations of most studies are not practical and this is linked to the inability of the research methods to enable the discovery of the root issues and as such, leading to the identification of possible solutions.

Based on this finding, the current study also uses qualitative methods which enable the provision of comprehensive accounts of delays, their root causes and their impacts, enabling the discovery of the issues that are often bypassed by the other studies. The unearthing of such issues, therefore increases the relevance of the recommendations as a solution to the problems realized.

The current study is therefore useful as it not only brings new findings, but also addresses the issues that other studies have failed to address. It creates the potential of finding practical solutions to the delay problem that has become common in the construction industry at all levels. It is therefore useful to both scholars in the area of construction management and also to practitioners thus presents the potential of saving contractual relations, time and money, which are magnified in the case of mega oil and gas construction projects.

1.6 Structure of the remaining chapters

The remaining chapters are organized as follows: Literature review, conceptual framework, methodology, findings and discussion, conclusions and recommendations. In the literature review chapter, matters directly related to the research questions are discussed based on the findings and arguments of past authors. The purpose of the chapter is to form the ground for the identification of the research gaps and the conceptual framework through which knowledge will be generated.

The next chapter, the conceptual framework involves the presentation of the factors that potentially lead to delay based on the findings of the literature review. These factors are examined in the light of their relationship with one another and form the basis of the construction of research tools and data collection. The manner in which the tools are constructed and administered and how the data are analysed are discussed in the methodology chapter, which

also details the research approach and design under which the tools are based. Furthermore, the use of the methods outlined is justified and their validity and reliability is also discussed. The chapter is concluded through the discussion of the ethical considerations in the course of research.

The findings are presented and discussed with literature in the findings and discussions chapter. This is done in the light of available evidence in the literature. This is followed by the identification of the conclusive matters which are then presented in the conclusions chapter together with the limitations encountered in the research process, and recommendations for future research.

Chapter 2: Literature review

This chapter commences with the discussion of the management of schedules in the construction industry, which highlights scheduling techniques and their challenges. Moreover, the chapter also discusses the analysis of delays which enables the unearthing of the causes and responsible parties to the delay. Moreover, the weighting of delay causes in literature is also discussed, leading to the discussion of the various studies that highlight the important delay causes and their classification. The chapter is concluded through the discussion of the research gap.

2.1 Schedule management in the construction industry

The techniques of project management are defined by Argaw, Ajibade and Toong (2016) as a system comprising procedures, rules, methods and practices employed by persons in the discipline. Project management techniques are also employed in the management of the construction projects in order to enable the organization of people, activities and processes in a manner that flows with the constraints of time and budgets. This especially manifests in preparation, execution and control of construction schedules.

Scheduling in construction has been researched for the last 50 years. A schedule is defined by Jaśkowski and Biruk (2011) as a tool that is employed in the management of a construction project while a schedule plan is defined by Gothand (2003) as current decision making with the aim of having an influence on the future. Scheduling is inevitable in the execution of construction projects.

Because of the uncertainties and the complexities in numerous construction projects, time to time adjustments to the baseline schedule may not be avoided with the progression of the construction (Kyunghwan, 2009). As such, there is a need for a thorough and comprehensive

schedule analysis for the determination of what affects the schedule planned and the detailing of the events that led to the delay of the critical path (Gothand, 2003). The critical path is referred to as the longest path through activity network, which gives the minimum overall duration of a project (Gothand, 2003).

The project program of a contractor expressed as a schedule regardless of the phase of project development ought to be reliable in terms of the total make span, and in the timing of specific tasks and activities that have a relationship with the management of resources. As an impact of random conditions and events, an optimized schedule for a specific set of objectives which does not take into account the possible disturbances has the likelihood of leading to poor results (Jaśkowski and Biruk, 2011).

A scheduling system is regarded as robust in the case that can enable the anticipation of risks identified and is protected adequately against distortions which may take place in the course of project execution (Schatteman, Herroelen, Van de Vonder and Boone, 2008). Schedules that have stable baselines are needed because of advanced booking of the important equipment or staff as a way of guaranteeing their availability as well as the delivery dates required by subcontractors and suppliers (Jaśkowski and Biruk, 2011). When schedules are made having fixed dates of resource use, planning becomes easier as the contractor is able to manage the portfolio of the project and limit the spread of interference between projects (Jaśkowski and Biruk, 2011).

Where the projects involve non uniform, non cyclic and non rhythmical processes, the most popular techniques for planning are network based techniques (Jaśkowski and Biruk, 2011). Among them, the critical path method (CPM) is employed more often because it does not permit

the individual planning to account for the constraints in their entirety, which can take place in the construction operation as it regards to the technical operations and the market conditions.

Many efforts have employed the CPM for the determination of the overall duration of the project and the time for the commencement and completion of activities (Lorterapong and Ussavadilokrit, 2013). CPM is constructed assuming that the cost and duration of activities within a project are deterministic. The duration of a project as well as its critical path have a direct relationship and are practical similar durations given that the critical path gives the date of project completion (Gothand, 2003). As such, at the core of the preparation of construction schedules, the determination of a realistic critical path is vital.

The traditional methods of CPM scheduling have proven to be of help only in the case that the deadline of the project is not fixed and the resources unconstrained by either time or availability (Lorterapong and Ussavadilokrit, 2013). In the process of making updates, there may be claims between the contractor and the owner. In the case of a disagreement between the parties the claim may have to undergo dispute settlement which consumes time and costs. Nevertheless, the technique has been criticized widely for the incapability to cope with constraints that are non-technological (Lorterapong and Ussavadilokrit, 2013).

In the construction industries, the methods of schedule integration, schedule control, site layout preparation and the procedures for project start-up and completion as well as appropriate technologies are considered to be best practices (Argaw, Ajibade and Toong, 2016). Integrated schedules are among the best practices for the enhancement of productivity in industrial projects (Argaw, Ajibade and Toong, 2016).

Another management practice is constructability which is the integration of the experiences and the knowledge of construction into the design and planning phases of projects

(Kang, et al., 2013). However, the complication in the implementation of constructability is that numerous capital projects do not have it as an input because of the lack of the knowledge which can be harnessed through the use of IT. The use of IT also enables the reduction design errors and as such reducing the need for rework and ultimately helping in the control of schedule overruns.

2.2 Delay analysis

Finke (1997) states that the majority of construction projects is affected by some type of delay, but they are many times not analysed until the construction is finished, and when there is no chance of mitigating their impacts or avoiding constructive accelerations. This trend does not give an opportunity for the contractual parties to own up to the delay and enhance their schedule management for the prevention of future delays.

The major objective of delay analysis is the establishment of the issues that have an impact on the critical path and as a consequence, the completion of the project. Yau and Yang (2012) highlight that the identification of the factors that have an impact on the critical path and as a consequence, the project completion is the most significant dimension of delay analysis. The identification of the causes of schedule delays therefore forms the basis of the resolution of delays (Yang and Wei, 2010).

In the case that scheduling is sufficiently addressed by the contract, the delay analysis becomes facilitated, and as such, the contract becomes central through addressing particular matters, for instance the total float ownership and methods to be employed in the analysis of schedule delays (Casinelli and De Angelis, 2007). As a way of resolving claims between the construction parties, various techniques of delay analysis have been developed for the purpose of

analysing the cost and the time impacts caused by the changes in the schedule (Kyunghwan, 2009).

2.2.1 Delay analysis methodologies

According to Yang and Tsai (2011), the most common techniques for analysing delay include the global impact, adjusted as built CPM, net impact, the snap shot, windows, as planned expanded, collapsed but for (CBF), the isolated delay type (IDT), and time impact techniques. The current techniques employed for analysing delay have been employed in the settlement of delay claims following the project completion and as such, may not be well suited for the compression of schedules given that there is a need for the determination of delay liabilities as the project progresses.

2.2.1.1 As planned-as built

This methodology enables the analysis of the effect of the varied delays on the completion of projects through the examination of the variances in the activities with reference to the critical path of the program as planned and the as built as it pertains to their date of commencement, the duration and the finishing date (Braimah and Ndekugri, 2009). The issues that lead to the variances are then examined through the determination of the responsible parties to the delay. The method is regarded as inexpensive, easy to understand and use and is simple. The method, however fails to take into account the changes that are made to the critical path and is unable to handle complex situations of delay.

2.2.1.2 Impacted as planned

This methodology enables the incorporation of the events leading to the delay into a CPM program that operates on as planned. The addition of the delays is done chronologically for the

demonstration of the impact of the delays in the overall project (Braimah and Ndekugri, 2009). Aside from failing to integrate the changes in the critical path, this methodology holds the assumption of the validity of the sequence of construction as originally planned (Braimah and Ndekugri, 2009).

2.2.1.3 Collapsed as built

This methodology makes use of the as built CPM program as the foundation for the measurement of the impacts of the events leading to delay (Braimah and Ndekugri, 2009). The delays are eliminated from the program in a single shot or in a chronological manner for the development of a collapsed as built program indicating the progression of the program if the delays would not have occurred. The difference between completion dates from the original plan and the program is then computed to determine the delay. Although it enables the dependence on the actual site happenings, it ignores the possibility that the critical path may have migrated and a lot of effort is put in the identification of the as built critical path.

2.2.1.4 Window analysis

The delays in the construction industry, according to Jae-Seob (2009) have been analysed through the use of various means, including the critical path method (CPM) whereby the total project duration is divided into certain digestible time periods for instance on a month to month basis (windows). The division is controlled by the main milestones, notable alterations of the critical path, major delay occurrences and the dates when the schedule was revised (Braimah and Ndekugri, 2009). The deviations from the previous windows are then analysed, focusing on the critical path. The changes in the critical path during the analysis of the delay are not taken into account.

The schedule is first updated within the initial window through the use of as built information which is inclusive of the entire delays encountered within that window while keeping the remaining as planned scheduled in the succeeding windows (Braimah and Ndekugri, 2009). The analysis is repeated for all the other windows for the computation of the overall project delay. This methodology enables the integration of the dynamic nature of the project's critical path, but is expensive in terms of the time, the records required and the effort.

2.2.1.5 Time impact analysis

This is also known as the windows method (Gothand, 2003). This enables the chronological evaluation of the impact of delays through the incorporation of the delays on a CPM baseline which gives the representation of the actual project status just before the occurrence of delay (Braimah and Ndekugri, 2009). Its objective is the development of a snapshot image of the project every time it significantly affects the CPM schedule and accounting for the dynamic progression of events and project history and making comparisons between the time to time snap shots (Gothand, 2003). Moreover, the method enables the examination of the impacts as they take place taking into consideration the schedule status during such periods.

When the time impact analysis is comprehensive, it has the likelihood of demonstrating the daily increases in the date of completion, concurrent delays, float consumptions, acceleration of the project and the accurate simulation of the history of the project (Gothand, 2003). However, the technique is time consuming and enables the quantification of the effects of delay through time to time assessment of the status of the project. Braimah and Ndekugri (2009) also consider the method to be the most reliable but costly and time consuming and especially in circumstances whereby there are numerous delaying events.

2.2.1.6 Global impact technique

This method is simple and easy and is usually presented with a narrative. It is considered as a less accurate way of depicting the impact of the events causing delays. The computation of the total delay is through summing the total durations and ignoring scheduling errors and concurrencies and the alterations to the as built schedule and making the assumption that the critical path was impacted upon by all occurrences (Gothand, 2003).

2.2.1.7 The window snapshot method

This technique is used for the determination of the amount of delay on a project, the time of occurrence of the delay and its cause. The total duration of the project is divided into windows and the dates of the windows are made to coincide with major milestones, notable changes to the project plan or major delays (Mohan and Al-Gahtani, 2006). The correlations and the period of the as built data in a window are imposed on the as planned schedule with the correlations and the remaining activities after the window maintained.

The date of the completion of the project of the increased schedule is compared to as planned schedule which is established. The overall delay is the amount of delay as a result of the events that caused delay within the specific window. Following the determination of the amount of the delay, the delay causes are examined (Mohan and Al-Gahtani, 2006). The analysis is conducted for the windows (snapshot periods) and the total delay is computed as the sum of all delays. The weakness of the method is that it fails to scrutinize the types of delays before the analysis and as such, it is not possible to apportion responsibility to the delaying party (Mohan and AlGahtani, 2006).

2.2.1.8 The isolated delay type (IDT) method

This is among the methods that utilize the windows idea through the division of the total time of the project into windows (Mohan and Al-Gahtani, 2006). The window is inclusive of the entitlement schedule, showing who is responsible for the delay and the modifications done to the as planned schedule are effected in each of the respective windows. According to Mohan and Al-Gahtani (2006), the incorporation of the delays into a single shot in each of the windows is unrealistic because of the inability of the critical path to change in the course of the process. It is also impossible to determine whether conditions from the schedule of entitlements and concurrences are not accounted for (Mohan and Al-Gahtani, 2006).

2.2.1.9 Net impact method

This is also simple and easy to present and comprises CPM schedules or a bar chart that illustrates the planned baseline as well as the as built schedules. The plot indicated all the delays, suspensions, disruptions and holds the argument that the only logical conclusion is that there is overwhelming impacts delaying the project (Gothand, 2003). This becomes the basis for extension between the planned and the actual completion. The technique also fails to consider concurrent events leading to delay, scheduling and claimant errors and the changes that made to the as built schedule (Gothand, 2003).

Yang and Tsai (2011) report a study in which the majority of the respondents had an understanding of the techniques of analysing delay, and even though 79 percent used computer based techniques of project control and planning, the techniques may not help schedule analysts in carrying out delay analysis. As such, although delay analysis methods are available, their use requires software that can accommodate both schedule control and delay analysis.

Another problem is highlighted by Jae-Seob (2009). Following their analysis of the weaknesses of delay methodologies and their inefficiencies, the author proposed a new technique for delay analysis – accumulated delay analysis method (ADAM) for the analysis of schedule delays. The technique also includes the impact of productivity losses and the learning effect which all have an impact on the time delay of construction projects.

2.2.2 Causes of delays

The factors leading to delay have been identified as consultant, contractor, design, equipment, externality, labour, material, owner and project related factors. Toor and Ogunlana (2008) list the causes of construction delays as lack of practices of project management, differences between the construction and the design, insufficient system of procurement, inadequate resources, cultural issues, varied interests of stakeholders, cultural issues and lapses in communication (Toor and Ogunlana, 2008). Additionally, some of the causes of delays have been outlined as emanating from field interference, delays related to the subcontractor, materials shortage, design delays and changes and lack of labour (González, et al., 2013). These can be linked to the members of the project team, including general contractors and subcontractors, owners, designers and suppliers.

2.2.2.1 Designer/engineer related delays

The development of design commences through the identification of the needs of the employer through conceptual design and documents such as bills of quantities, specifications and drawings (Marzouk, ElDokhmasey and ElSaid, 2008). Delays occur as a result of delays in the development of the design, the preparation and the approval of drawings, and changes that arise from the parties to the project (Marzouk, ElDokhmasey and ElSaid, 2008).

Changes take place for numerous reasons, including administrative, constructive and formal reasons. Administrative changes take place when agreements are altered without the alteration of the scope or work or substantive rights. This type of change normally is not representative of the change in the amount of labour, material or the time needed for the performance of the base task (Niesse, 2004).

A formal change is written as an order and indicates changes in the contract cost or time. Although the modification of contracts is usually bilateral, there may be a provision for unilateral modification which is many times used when the parties are unable to reach an agreement. The modifications like that permit the parties to accomplish contingencies that are unforeseen without risking contract breach or needing to renegotiate (Niesse, 2004). Constructive changes on the other hand, are modifications that come from circumstances, conduct or instruments which are regarded in the same way as formal changes.

The changes that occur in the course of construction projects are inevitable (Alnuaimi, Taha, Al Mohsin and AlHarthi, 2010). Change orders are usually issued for the purpose of correcting or modifying the original scope or the design of work. These alterations or the modifications are conducted for numerous reasons, for instance client induced changes in scope and the resulting change requests by consultants as a result of new findings and design errors.

Moreover, many construction issues usually emanate from defects in the design which can be traced back to the process of design (ShingTao Chang, 2002). Changes occurring in the preliminary documents may result in delays in the overall project schedule. Another problem is the delay of the employer to make responses to the queries of the designer which may come up during the phase of development as a result of the incomplete documents received from the employer (Marzouk, ElDokhmasey and ElSaid, 2008).

The majority of the change orders that comes in the course of construction are the major causes of cost and time overruns, disputes and disruptions (Alnuaimi, et al., 2010). Niesse (2004) argues that when there is no current and meaningful information regarding changes, there is a likelihood that the circumstance will result in no decision or erroneous decision which may lead to an increase in the cost and the time effects on a project.

2.2.2.2 Client related delays

The understanding of clients as it regards the requirements of the project and their capability of explaining them to different parties is needed for ensuring scope as well as the technical specifications. The description given to clients in the construction industry includes the development of the project from its point of inception to the commissioning and finally utilization (Hatmok and Khasani, 2016). Clients work together with the contractors towards the completion of the project as agreed upon in the contract. Hatmok and Khasani (2016) posit that it has been accepted widely that the performance of a client is of importance in the success of the construction project.

Within a construction project, the types of clients vary and they can be classified in accordance with their type of institution or the experience they have in handling projects yielding private versus government clients and experienced versus inexperienced clients. Private clients refer to companies or institutions which require the help of contractors in the development and maintenance of their private property. The funding may come from them or from loans obtained from financial institutions. They are likely to have increased flexibility in matters for instance procurement unlike the government clients and as such making them faster and increasing their performance (Hatmok and Khasani, 2016).

Clients can also be grouped into sophisticated versus naïve clients or repeat versus one-off clients (Hatmok and Khasani, 2016). Hatmok and Khasani (2016) claim that frequent or repeat clients account for 60 percent of the construction work value, but about 95 percent in number are one-off clients. This means that they have little experience or the knowledge of construction projects and as such have a higher likelihood of understanding the manner in which the construction industry functions and their role is maximized for the success of projects. This also means that there is a higher chance of project failure when dealing with inexperienced clients (Hatmok and Khasani, 2016).

Client related delays include the lateness in the submission of the specifications and drawings, incorrect information regarding the site, and frequent changes to the design (Rao, et al., 2016). As it relates to financing, the role of the client is to make sure that the project is sufficiently funded and that payment approvals are conducted with ease and in a timely manner. Quick and appropriate decision making are thus of benefit in accelerating the progress of the project. Given that client organizations are many times complex, numerous problems arise in the internal decision making process. Other factors that affect the timeliness of the project include the release of information in a timely manner, the readiness of the project site and adequate project duration (Hatmok and Khasani, 2016).

2.2.2.3 Contractor related delays

The delays that emanate from contractors are often as a result of poor skills in management (Rao, et al., 2016). According to Lo, Fung and Tung (2006), poor management of the construction sites can lead to delays and impact on productivity.

2.2.2.4 Weather conditions

Operations in the construction industry are many times more sensitive to weather conditions for instance, wind, temperature, snow, rainfall and humidity (Moselhi and ElRayes, 2002). The level to which the project is sensitive to the parameters is variable given the particular nature of the projects and the techniques employed in executing them. Nguyen, Kneppers, García de Soto and Ibbs (2010) indicate that the productivity of construction is contingent and exposed to weather conditions. The conditions are seasonal, local and in certain times unusual and such conditions may lead to disruptions, delays and possible disputes between the parties to a project.

These types of delay are classified into weather event day, mud day, and rework day (McDonald Jr., 2000). A weather event day is the actual day in which the adverse weather condition was experienced leading to loss of production either partially or fully. The mud day is the partial or the full day lost while awaiting the availability of the site and the rework day is the period spent in repairing or reworking as a means of recovering from the impacts of either the mud or the event day. The owners and the contractors ought to consider the normal weather days for the period of the contract in scheduling and the development of production rates (McDonald Jr., 2000).

In the case that the adverse conditions of weather lead to time and cost overruns, the contractors, many times submit claims for additional time. Except for special situations, delays associated with weather are compensable only through time extensions (McDonald Jr., 2000). Weather delays are as such excusable non compensable because the weather is regarded as an act of God. Moselhi and ElRayes (2002) posit that numerous construction contracts have particular clauses which enable the regulation of the conditions and bases for the submission of weather

related claims. The clauses usually stipulate that claims related to weather must be supported by right documentation which substantiate that the weather conditions in the course of construction were unexpected and abnormal and adversely affected the construction schedule (Moselhi and ElRayes, 2002).

2.2.2.5 Site conditions

Differing site conditions are often encountered in works involving excavation. The variation of the site conditions are of importance because of discoveries that take place when events are discovered and the time required in follow up procedures. This is because, in all circumstances, the work has to stop while the owner's decision is sought. Bonhomme (2008) denote that the changes to the scope of the contract that are brought about by contrary site conditions as well as changes to the design significantly affect both the owner and the contractor. On the side of the contractor, this means the reduction in margins and for owners; this may have the implication of delays in start-up operations (Bonhomme, 2008).

2.2.2.5 Rework

Another source of delay is rework. This is defined as the unnecessary attempt towards redoing an activity or a process that was implemented incorrectly the first time (Love, Edwards, Irani and Goh, 2011). Rework has been highlighted as a problem in engineering and construction projects and manifests from errors and design changes (Love, et al., 2011). The failure to deliver on schedule and budget on megaprojects, usually impact negatively on the image of the company as it regards to its capability to meet commitments to the stakeholders (Love, et al., 2011).

2.2.2.6 Other causes

Faridi and El-Sayegh (2006) indicate that other delays are associated with finance, contractual relationship, scheduling and planning. Delays associated with finance include late

payments, inadequate financial resources, poor management of cash flow, and the instability of the financial market.

Abdul-Rahman, Takim and Wong Sze (2009) define late payment as the paymaster's failure to render payments within the required time of honouring certificates as envisioned in the contractual agreement. Late payments emerge due to poor business and financial management by the client, withholding by the client, invalid claims by the contractor, delays in interim payment certification by the consultant, inaccurate valuations of the work accomplished, inadequate documentation and the involvement of numerous parties in the process of payment (Abdul-Rahman, Takim and Wong Sze, 2009). Parties involved in payment claim processes may lead to the delay of payment and the delay of a single party may impact on the entire payment supply chain.

The shortage of resources is indicated by Abdul-Rahman, Takim and Wong Sze (2009) as the leading cause of construction delays in Indonesian high rise projects. Resources include finances, equipment, human and material resources. The lack of funds has the likelihood of affecting the cash flow, leading to the delay in possessing the site which as a consequence leads to the overall project delay.

The management of cash flow is defined as the process through which cash flow is monitored, analysed and adjusted (Abdul-Rahman, Takim and Wong Sze, 2009). Causes of poor cash flow include too many projects handled by the contractor within the same period, the instability of the financial background of the contractor, underbidding of the project by the contractor, lack of cash flow forecasting, capital lockup and poor credit arrangements. The most significant dimension of cash flow management is the avoidance of extended periods of cash shortages which come from having huge gaps in the inflows and the outflows of cash. Abdul-

Rahman, Takim and Wong Sze (2009) further indicate that cash flow is critical to the construction industry, and is ease is essential in the delivery of successful construction projects. This means that when cash flow is well managed, the time performance of a project is enhanced.

Poor economic circumstances for instances the rate of inflation and currency have the likelihood of significantly affecting the cash flow of a project and in the end, its timely performance. The financial market instability issues include the inflation of labour, material and transportation costs, increased rate of interest in loan repayment and increased rate of foreign exchange for plants and materials that are imported.

2.3 Weighting of delays

Different studies on delays and their impacts have used various methodologies for the weighting of delays in order to realize their importance and their impacts. The most common type of way of weighting has been through the use of relative importance index (RII) which is executed through the use of data from Likert questions. This means that the studies that utilize the RII technique are quantitative in nature. The same trend has been realized in studies on the delay of general construction industry and those specific to the oil and gas construction industry.

2.3.1 Studies on delay in the construction industry

Gündüz, Nielsen and Özdemir (2013) aimed at identifying factors leading to delay of construction projects in Turkey and analysing them through the use of the relative importance index technique. The author identified 83 factors which were then grouped into nine and visualized through the use of the fish bone (ishakawa) diagram. The identification was by means of an in-depth review of literature and interviews with the experts of the construction industry. Following the ranking of the factors through the use of the relative importance index, the factors

leading to delay from the most important include contractor, owner, consultant, design, material, equipment, labour, project and finally externally related problems.

Rao, et al. (2016) sought to identify the main causes of delays in India's construction industry and particularly in Manipal Town. The authors also used literature review and survey techniques. The survey comprised 42 factors grouped under six categories and weighted using the Likert scale comprising 5 points. Moreover, following the collection of data, analysis was conducted through the use of the relative importance index through Ms Excel software. The major cause of delay was found to be owner related factors.

Lo, Fung and Tung (2006) conducted a study with the aim of collecting the perception of practitioners of civil construction and other construction stakeholders on the level of significance of the delay causes. According to the results, the respondents had the tendency of admitting their own faults in the top ten delay causes.

Andi, Lalitan and Loanata (2010) carried out a study with the aim of representing the perception of the owners and the contractors as it regards the delay factors which many times occur in finishing and structural works. Data was collected through questionnaires which were distributed to 198 respondents. The most significant cause of delay was perceived by both parties as the changes in design.

Marks and Ellis (2013) conducted a study which was aimed at evaluating the relative significance of the major causes of delay in Guyana. Owners, contractors and contractors were included in the study. According to the findings, the major causes of delay include poor site access, weather conditions, unforeseen ground or site conditions, over optimism in project durations and the necessary variations. The authors ranked client related delays as the major category.

Another study was conducted in the Indian construction industry by Doloi, Sawhney and Iyer (2012). The authors developed a structural equation model (SEM) which gave a representation of four important latent variables with data collected through questionnaires. The total number of respondents was 77 and was a mix of designers, clients, contractors and architects. The results show that client related factors are the most influential to the schedule performance of the construction projects. More particularly, the client issues led to the reduction of commitment and the increase in inefficiency of the contractor. This was followed by the lack of efficiency in planning the construction project.

The major purpose of the study of Yang and Wei (2010) was the identification and the ranking of the causes of delay in the design and the planning phases of construction projects. Questionnaires were administered to architects and engineers involved in construction projects in Taiwan. The authors gathered responses from 95 persons and quantified the importance of the factors through the relative importance index. Changes in the requirements of clients were found to be the major cause of construction delays.

Aibinu and Odeyinka (2006) also reported another study whereby eight categories of delay factors were analysed, including design team, project, external, plant, material, equipment, contractor, and labour related factors. Six factors were established to significantly contribute to delay and this included the unforeseen conditions on the ground, alterations initiated by the client, inadequate experience of the contractor, necessary alterations, low speed of decision making and poor supervision on site.

Aibinu and Odeyinka (2006) report a study in which 83 delay factors were analysed using the RII technique in Hong Kong. The principal factors leading to delay were identified as poor

supervision and risk management, slow decisions on alterations, unforeseen conditions of the site, and necessary alteration works.

González, et al. (2013) analysed the causes of delay of projects that were never completed within their schedule using both qualitative and quantitative techniques. Two indicators were used: reasons for non compliance, which was used for the analysis of failures in scheduling and the delay index, which was used for the measurement of the impact of delays. The scheduling failures were found to be caused by planning inefficiencies and subcontractor related issues and planning was most harmful to the time performance of the construction projects.

Toor and Ogunlana (2008) conducted interviews and questionnaire surveys on a major construction project that was ongoing in Thailand with the purpose of exploring the most notable problems leading to construction delays. The top issues highlighted were factors that were related to the contractors, designers and consultants.

The aim of the study conducted by Faridi and El-Sayegh (2006) was to define the significant factors that lead to construction delays. Questionnaire surveys were administered to professionals linked to the construction industry in the UAE. Based on the analysis through the use of the relative importance index, the top causes of delay include drawing approvals, insufficient planning, and the slowness of the decision making processes of the owner.

Arditi, Nayak and Damci (2017) aimed at exploring the relationship between the organizational culture of a company and construction delay. The authors administered questionnaires to construction companies in India and the US. The results reveal that construction industries have a dominant clan culture while those in India have a market culture and that time delay durations are lower in the US compared to India. Although there are a

number of causes of delay, the authors report a significant relationship between organizational culture and delay and therefore recommend an increased alignment to an organizational culture that would enable the reduction of delays.

Gardezi, Manarvi and Gardezi (2014) sought to identify the delays leading to time extension of projects. The authors considered 50 projects in Pakistan, whose timelines had been extended. The data revealed 27 factors which were then used in the development of a questionnaire and administered to professionals in the construction industry. According to the results, the domestic issues in the country were identified as the main causes of delay in project completion.

Mezher and Tawil (1998) report a study in which 11 owners, 10 engineers and architects and 15 contractors were surveyed randomly in Lebanon. 64 major causes of delay were grouped into 10 and ranked using the relative importance index. There was a general agreement as it pertains to the ranking of the main categories of the delay factors. While the owners were more concerned about financial implications, contractors were more concerned with contractual relationships and the engineers and architects considered project management more highly (Mezher and Tawil, 1998).

Kadry, Osman and Georgy (2017) conducted their study to develop increased understanding of delay causes in countries having higher geopolitical risks, measure the impact of the delays on the overall completion of the project and capture the impact of country and project characteristics on project delay. According to the findings, countries having high geopolitical risks experience unique causes of construction project delays.

Braimah and Ndekugri (2009) aimed at the development of a framework for the reduction of the attendant disputes and helping in the enhancement of the efficiency of dispute resolution.

Among the major issues examined was the awareness and use of methodologies for analysing delays. The authors established that simpler methodologies are often preferred to the complex ones, although the complex methodologies have a greater reliability in comparison with the simpler methodologies.

The obstacles identified by the use of such methodologies include lack of sufficient information on the project, the employment of programs that were not in the form of CPM and poor update of the programs in use. Based on these results, the authors argued that the enhancement of the current programs and practices of record keeping can improve the utilization of the methodologies in place and as such facilitating smoother resolution of claims related to construction delays.

2.3.2 Studies on delay in the oil and gas construction industry

Ruqaishi and Bashir (2015) conducted a study which was aimed at establishing the causes of oil and gas construction projects' delay in Oman. The study was quantitative in nature, involving the collection of data through questionnaires from 59 projects managers in varied organizations. The authors established that out of the seven significant causes, only one appeared to be unique to the oil and gas industry: poor communication with vendors in the stage of procurement.

Fallahnejad (2013) aimed at identifying and ranking causes of construction delay in gas pipeline projects in Iran. The authors studied 24 pipeline projects and further extractors 10 factors that were regarded as leading to delay with the conferment of 10 experts from multiple disciplines. This led to a list of 43 factors which were ranked through a questionnaire survey. The 10 major factors were found to be unrealistic duration set for the project, importation of

materials, materials related to the client, change orders, land expropriation, methods of selecting contractors, obtaining permits, the cash flow of the contractor and payments to the contractors.

Silvianita, Rosyid, Marina-Chamelia and Suntoyo (2017) examined the impact of delays in the development of jacket structure. The authors used event tree analysis (ETA) and established that there is usually a delay of between 1 day and 8 weeks. Moreover, these delays were established to be caused by multiple factors.

2.4 Management or mitigation of construction delays

The usual remedy for delay is the acceleration of the remaining activities through the use of more resources or alternative methods of construction (Ng, et al., 2004). This inevitably leads to additional costs. Another way that has been used by the majority of the construction contracts is to handle project delays through the provision of clauses that allow for the request for extension of the submission of additional claims for the recovery of costs following an appropriate notice that the events that they encounter in the cause of delivery have the likelihood of, are leading to or have led to delays in the project completion.

AlSehaimi, Koskela and Tzortzopoulos (2013) conducted a study which sought to understand the causes of delay with regard to the explanatory and descriptive nature of delay research which may have led to the inadequacy is in solving managerial issues in the construction industry. The authors argued that construction problems can be solved eliminated through alternative approaches to research and as such, leading to developing and implementing tools that can provide the solution to construction problems including delay. The author thus insinuates that effective research is also a remedy for delays as the recommendations can enable a change in the manner in which the construction project schedules are managed and thereby leading to different results.

2.5 Research gap

Most of the delay analyses have been quantitative in nature as it regards to their impact on the schedule performance on projects and as such, not allowing for the qualitative analysis of the causes of delays (González, et al., 2013). Moreover, the studies attempt to extract delay factors from different sources and require the participants only to weight them. The problem with such methodologies is that they silence the subjects of delay who have a better understanding the context within which they function. This therefore impedes the capability of the research to get to the core issues of delay, and as a consequence, there has been no significant change in the delays over the last 50 years within which the issue of construction delays has been researched. The current research seeks to fill this gap by using exploratory techniques that will enable the unearthing of the root of construction delays and as such leading to more practical, implementable recommendations.

Chapter 3: Conceptual framework

Conceptual frameworks are defined by Jabareen (2009) as products of qualitative theorization processes. Green (2014) posits that theoretical framework ought to be employed in the situation where research is underpinned by a single theory and that the conceptual framework is drawn from concepts from different theories and results to direct the research. In a broad view, qualitative research has the objective of describing and explaining a pattern of relations which can be accomplished only with a collection of categories that are conceptually specified. The chapter therefore presents a pattern of relationships between concepts derived from literature that pertain to causes of construction delay.

3.1 Causes of construction delay

Based on the literature reviewed, the causes of construction delay are either primary or secondary. The primary causes are those that are directly caused by parties or circumstances involved while the secondary causes are those that come as a consequence of the primary causes and as such further delaying the construction process. These factors are presented in the figure 3.1.

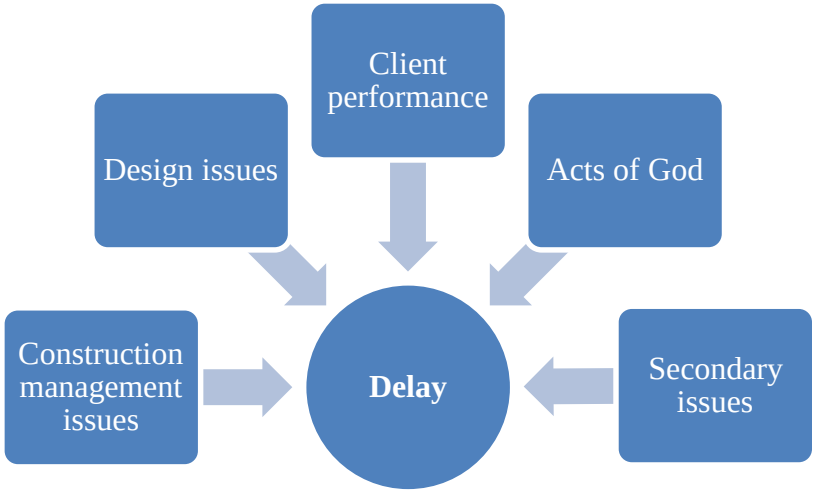

Figure 3.1: The conceptual model

3.2 Description of the variables

According to the figure 3.1, the causes of construction delay are classified into five, including construction management issues, design issues, client performance, acts of God and secondary issues.

3.2.1 Construction management issues

This is a general term that has been used for the presentation of all the issues that are related to the management of the construction project and which have been identified in literature as having the potential to cause delay in construction projects including procurement, scheduling and workflow management, delay recognition and cash flow management. According to literature, issues related to procurement have been identified for instance the lack of equipment or material, lateness in the delivery of the materials all of which lead to the interruption of the workflow and as a result, delay. Scheduling and workflow management issues are related to the knowledge and use of scheduling techniques, the recognition of the workflow processes, including activities that have to precede others and which need experts that have to be booked early enough, the recognition of work processes that may lead to delay because of the involvement of external authorities, for instance processes that require approval and as such starting them early, coming up with time limitations that are realistic and which incorporate human factors among others.

Delay recognition has been recognised as a construction management issue given that in the case that small delays are not recognised, recorded and accounted for, they eventually lead to big delays and as such, the failure to have a mechanism in place that identifies delays is itself a source of delay. Lastly, cash flow management has been recognised as a source of delay as the

lack of cash to pay suppliers and workers may lead to delays. Moreover, the management of cash flow entails issues of payment of the subcontractors and the construction workers who if not managed well, are likely to have industrial actions which are all sources of delay.

3.2.2 Design issues

Two issues have been identified that are related to the design, including review of designs and site assessment. With regard to review of design, it has been established that issues related to the same include the recognition and the handling of design errors, and change orders. Site assessment on the other hand has been classified under design as it includes the evaluation of the site of construction in order to predict any related issues and incorporate them into the design. As such, failure or poor site assessment can lead to unprecedented issues during the construction processes that require redesign or rework, leading to delays.

3.2.3 Client performance

The performance of client includes issues, for instance the type and the experience of the client. With regard to the type, literature listed clients as being either private or government. While private clients have been identified as the fastest in decision making, government is prone to bureaucracies that end up in delay. Moreover, while the government has more access to skilled and experienced representatives, private clients may vary in their skill set and their experience with construction issues, thus leading to unnecessary change orders, issues and disputes. Also, client performance includes their financial position and their access to additional finance to complete the project. Furthermore, the process of awarding contract has the capability of impacting on the construction schedules as poorly awarded contracts could mean a lack of resources on the part of the lowest bidder, the lack of experience of the contractor among others which may in the end delay the completion of the project.

3.2.4 Acts of God

This is an umbrella word that is used for all occurrences that are not under the control of the construction parties for instance adverse weather conditions. However, there is a possibility of managing the same through a thorough prior investigation of the historical weather conditions of the area for instance, whether hurricanes, landslides, flash floods occurred before and having designs that incorporate strength enough to hold the structures even in the case of such acts of God. However, the disruption that comes with such acts may not be avoided.

3.2.5 Secondary issues

These include all the other delays that resulted from the primary delays already stated. These include recovery, which the period within which the contractor has to wait before they can repossess the construction site following acts of God. Another secondary issue is rework which can result from different issues, including acts or God, design error, or a change order or the contractor's own error. Also, the rate of productivity is another secondary issue. A decrease in productivity can occur due to the reduction in the morale of the construction workers as a result of the management issues, rework or recovery. Lastly, dispute management processes, including delay analysis can be regarded as a secondary source of delay. This comes from the lost time in the identification and assigning responsibility of delay, seeking compensation or even litigation.

Chapter 4: Methodology

This chapter involves the presentation of the research method and design, sampling and data collection, data analysis, validity and reliability and the ethical considerations. More particularly, the qualitative research, case study strategy, purposive sampling, in-depth interviews, and thematic content analysis are discussed. Their selection and their use are justified. Moreover, the rigour of the qualitative method chosen is discussed. The purpose of the methodology chapter is to provide a clear and detailed account that also contributes to the rigour of the research.

4.1 Research method

There are two research methods: qualitative and quantitative methods. Qualitative research comes from constructivism and interpretivism which is contrary to quantitative research that comes from imperialism, rationalism and positivism (Umeokafor, 2015). The quantitative paradigm embraces the ontological position that only a single truth exists and is such is independent of the researchers, the perception of the participant and is consistent. Its epistemological position holds that the researcher and the phenomenon cannot influence each other and therefore are independent of each other. The implication is that only verifiable knowledge is considered to be truthful and valid (Umeokafor, 2015). The quantitative research is founded on deduction, which involves the movement from general theories and ideas to particular circumstances and is therefore good for testing theories (Umeokafor, 2015). Quantitative methodologies include statistical surveys, experimental studies, longitudinal and cross sectional studies.

The qualitative paradigm on the other hand has its basis on inductive approaches which suggest theories from specific circumstances (Umeokafor, 2015). In qualitative research, the

study object and the researcher are not isolated and as such are not entities that are independent (Umeokafor, 2015). This implies that the researcher has the ability to influence the study object and therefore the participant has the likelihood of providing information that is biased while the researcher's interpretation may influence the research results. Other factors that may influence peoples' perception and the manner in which they interpret phenomena include their culture, thoughts, beliefs and even religion (Umeokafor, 2015).

The research in the construction industry is majorly founded on the built and natural environment, the human community a mix of the three or any of them. Therefore, the research paradigms can be used, but this is dependent on research questions, societal factors and the research aims. In the current study, qualitative research was chosen. This follows the need to fulfil the aims of the research which are founded on the need for exploration, thus requiring a technique that would enable the comprehensive view of the subject matter.

The choice of qualitative research also comes from the statement of Dainty, Bagilhole and Neale (2000) indicating that objectivity in the determination of social reality cannot be accomplished through exclusively using rationalist methods. Moreover, quantitative techniques employ too few variables and do not take context into account (Mukhopadhyay and Gupta, 2014). Although the current research includes few variables, classified into five categories, their in-depth examination requires the consideration of contextual issues, mainly oil and gas construction and as such, cannot be achieved through the use of quantitative techniques.

However, the use of qualitative methods comes with its own set of disadvantages. The research conducted using the qualitative paradigm according to Umeokafor (2015) are open to reactivity, bias, are hard to reproduce, hard to generalize the results and may easily be criticized and are too subjective. Qualitative research is also dependent on the researcher's knowledge

(Umeokafor, 2015). These challenges are however, addressed and minimized in the course of establishing evidence.

4.2 Research design

Research design makes sure that the evidence gathered addresses the study's research questions and is of importance for ensuring rigour and coherency (Dainty, Bagilhole and Neale, 2000). Qualitative methodologies include participant enquiry, ethnography, case studies as well as qualitative surveys. Case study is chosen for the current research. Case studies are a significant strategy in qualitative research.

Case study research is defined by Gaya and Smith (2016) as an analysis of a single or numerous cases with the intention of capturing the complexity of the study objective. Case studies are also defined as a comprehensive, pragmatic investigation of a current phenomenon in its exact context. Furthermore, Hidenori (2016) defines case studies as the strategy which emphasizes on the comprehension of the dynamics within single settings (Hidenori, 2016). From the definitions provided, the use of case study strategy is mainly on the basis of its capability to enable a more comprehensive view of the phenomena examined within their context and therefore offering an opportunity for depth.

Gaya and Smith (2016) hold the argument of the valuable nature of the case studies in inspiring the development of new ideas and explaining the development of new theory and specifically in the case that theory needs to be extended or generated (Gaya and Smith, 2016). Cases that are information rich are, those are cases through which an individual has the ability of learning numerous issues that are meaningful to the objective of the research. Given that the current research is aimed at discovering the underlying core issues leading to the delays in oil and gas construction projects, the use of case study design therefore is important for the

formation of theory from the data collected. Moreover, case studies are deeply connected to the core intentions and values, are descriptive, particularistic and heuristic. Also, the study of cases which are rich with information leads to the generation of insights and comprehensive understanding as opposed to empirical generalizations.

The current research also makes use of a single case rather than multiple cases. Single case studies Gaya and Smith (2016) usually provide data that is extremely convincing for the testing of theories as long as there are sufficient and unique features within the case for meeting the objectives of the study. Therefore, this justifies the selection of a single case. However, case studies are not without flaws. Hidenori (2016) states that case studies are vital and attractive, although sometimes questions arise with regard to their sufficient rigour. The case considered is the construction processes in the development of ultramodern infrastructure for the production of oil and gas in Africa.

4.3 Sampling

To achieve depth and comprehensiveness, and avoid vain repetitions, there is need to select a few subjects from whom the data can be collected. There are two ways through which this can be achieved, including probability and non probability techniques. Probability sampling is defined as the process through which a part of the population is chosen as they possess attributes which can be regarded as representing the wider society but in smaller numbers (Higginbottom, 2004). This leads to generalizations of the results obtained from the small population. Probability sampling techniques are suited for quantitative research methods.

Qualitative techniques practically but don't exclusively use non probability techniques of sampling and this has the meaning that the results of the study are not intended to be generalisable (Higginbottom, 2004). These non probability techniques use some sought of

selection criteria, but which is not grounded on the need for representativeness, but the collection of rich data. Such include convenience and judgment sampling.

Convenience sampling involves the selection of respondents based on their availability and reach. On the other hand, Higginbottom (2004) defines purposive sampling as judgmental sampling, which involves consciously selecting specific elements or subjects for inclusion in the sample by the researcher. The determination of the sampling technique used is made on the basis of the methodology adopted and the topic investigated and not the need for the development of findings that can be generalized (Higginbottom, 2004). Judgment sampling is used in the current research.

The power and the logic of purposeful sampling technique are embedded in the selection of cases that are information rich for comprehensive study (Benoot, Hannes and Bilsen, 2016). The nature of the sampling technique enables the choice of subjects that fit a certain criteria determined by the researcher and which favours the collection of rich data. The respondents are chosen are chosen based on their experience in the oil and gas construction projects, the diversity of their functions and skills within oil and gas construction projects, and their willingness to provide information. When used at a meta level, purposeful sampling in qualitative research is advocated for as a way of solving the pragmatic limitations of resources, information access, expertise and time (Benoot, Hannes and Bilsen, 2016).

The determination of the sample size is not driven by the need for generalization, but to fully investigate the topic chosen and provide data that is information rich (Higginbottom, 2004). This means that the sample size is likely to be smaller in non probability samples in comparison with probability samples. In the selection of participants, adequacy involves thoughtfulness in decision making as too little is likely to put adequate breadth and depth to risk and too many

participants may lead to unwieldy or superficial volumes of data (Cleary, Horsfall and Hayter, 2014). Cleary, Horsfall and Hayter (2014) for instance indicate that when the interviewer is experienced, and when the topic is clearly defined, a small number of interviewees that are well selected have the capability of producing information that is highly relevant for analysis.

For the current study, ten persons were selected for interviewing, including a government official (representing the local authorities), the authorized representative of the client, the contractor, two different subcontractors, the architect, the consultant, two different representatives of the community in which the project is hosted, and a representative of the civil society groups. Care was taken to ensure the diversity of the respondents in order to obtain their full perspective that is based on their experience, involvement and observation of the project progress.

In order to reach these people, there was need to employ an additional strategy – snowball sampling technique. A sampling process is regarded to be snowball if the informants are accessed by the researcher through the contact information given by other informants (Noy, 2008). The process of referral is repetitive as the researcher is referred to the informants by other informants. The snowball sampling technique is used mostly in different disciplines for accessing participants when other avenues for contact are not fruitful and at times the major technique through which informants are selected. Noy (2008) further denotes that the snowball procedure is specifically effective in obtaining information from populations that are hidden. Occasionally, the technique is also used for accessing participants that do not suffer marginalisation and stigmas but on the other hand have a high social status (Noy, 2008). In the current research, the respondents listed have high social status and heavy responsibilities and as such making it hard to reach them. Therefore, a single person was identified and following a

successful interview, the informant was asked to suggest a suitable person based on the criterion provided.

4.4 Data collection

There are numerous techniques for collecting data in qualitative studies. While primary data collection methods include observation, participant interviews and focused group interviews, secondary methods include literature reviews. Interviews were employed in the current study. Also, interviews come in different types including unstructured interviews, semi-structured interviews and fully structured interviews.

According to Gaya and Smith (2016) detailed, in-depth or semi-structured interviews conducted face to face is the most common data source in qualitative cases. Therefore, in-depth interviews were used as the main technique for data collection in the current research. Beale, Cole, Hillege, McMaster and Nagy (2004) define in-depth interviewing as a conversation having a specific purpose and which places emphasis on the perspective of the informant regarding life, self as well as experience and which is expressed in the informant's own words. In-depth interviews are further referred to as the technique designed for eliciting vivid pictures of the perspectives of participants on a research topic (Milena, Dainora and Alin, 2008).

The interviewing methods are motivated by the need to learn all that the informant is capable of sharing regarding the research topic (Milena, Dainora and Alin, 2008). In the course of in depth interviews, the informant is regarded as the expert and the interviewer as the student. The interview itself was semi-structured in nature, allowing for the researcher to seek clarification on matters that appeared to be unclear. This enhanced the student position of the researcher and enabled probing for more information as the situation dictated.

In-depth interviewing in qualitative research is considered to be an approach that is egalitarian in nature which leads to the development of relationships and rapport with the informants through focusing on the participants' perspectives of their experiences (Beale, et al., 2004). This relationship building was further enhanced through face to face interactions between the researcher and the informant. Irvine (2011) considers the lack of a face to face contact between the interviewer and the interviewee as restricting the increase in the rapport that comes with a natural encounter. When visual cues are absent, this is also regarded as having the potential to affect the level of depth of meaning which an interviewee can convey. Moreover, the referral process also contributed towards the enhancement of rust and rapport as the interviewer was introduced by a former informant.

Data was recorded through the use of audio recorders. For each participant, the researcher explained the level of confidentiality that would be accorded to them and the manner in which the data would be handled. Following these explanations, the participants' consent was sought as it regards the used of audio recorders. All the participants had no problem with the recording, making it the only method of recording the participants' views and observations.

4.5 Data analysis

According to Benoot, Hannes and Bilsen (2016) the techniques of synthesizing qualitative methods have the potential of generating answers to questions that are complex and provide insights that are valuable and novel for the development of theory. The data was analysed through the use of thematic content analysis. The technique was considered to be appropriate in enabling the synthesis of the data gathered into insights that can be argued with literature.

Nagai (2015) regards content analysis as a quantitative tool used in the determination of the presence and the frequency of certain words, themes or concepts. Oliveira, Bitencourt, Zanardo dos Santos and Teixeira (2016) define content analysis as a collection of analytical methods whereby objective and systematic procedures are used for describing the content of messages through the use of quantitative or qualitative indicators which allow for the inferring of knowledge. Thematic content analysis, on the other hand, involves the description of content on the basis of themes.

There are three stages of conducting content analysis, including pre-analysis, exploration and treatment (Oliveira, et al., 2016). In the stage of pre-analysis, the objectives of conducting content analysis are defined and the material is chosen by relevance as it relates to the objective and is organized for analysis. The material may be either in the oral or written form, dialogue or monologue. At this stage, the data collected was first transcribed word by word, followed by the arrangement of the research objectives in a manner that enabled the identification of various questions whose answers were directed towards the fulfilment of such research objectives.

At the stage of exploration, coding is conducted. This is a way of indexing the text for the purpose of establishing a structure of themes and the ideas related to it. These codes can be descriptive in nature, or analytical and as such requiring reflection. While quantitative coding aims at identifying the frequency of the use of particular words and others related to it, qualitative coding involves the identification of the absence or the presence of a specific topic in the content that requires analysis for the purpose of gaining an understanding of the manner in which it is presented as well as its uniqueness, leading to increased depth (Oliveira, et al., 2016). This stage was accomplished through reading and re-reading the various responses and identifying major themes which included those presented in the conceptual framework and those

that emerged in the course of the interviews. This process was done for all the responses of the ten informants.

In the last stage of thematic content analysis, the responses were arranged together into a narrative format which enabled the removal of repeated statements, and identifying both the agreeing and the conflicting concepts. This process was done manually in order to classify not based on frequency and word relatedness, but meaning as expressed by the individual respondents.

4.6 Validity and reliability

Challenges continue to be encountered as it pertains to the demonstration of the validity and transparency of qualitative research and this may emanate from its ontology and epistemology (Umeokafor, 2015). Sarma (2015) indicates that qualitative research lacks rigour because of the use verbal reports, interview transcripts, and notes which are many times regarded as soft data, but this cannot hold because there is a level of inseparability of qualitative and quantitative data. The qualitative research technique also involves subjectivity and the manner in which it impacts on objectivity, cannot be generalized and is hard to replicate. The qualitative sampling is generally not considered as being representative and as such, the findings may not apply to a different environment (Sarma, 2015).

Contrary to the qualitative approaches, the quantitative technique is considered to be rigorous because it involves objective measurements, direct manipulation, as well as statistical tests. When data collection is conducted through qualitative means, quality, integrity and quality are of extreme importance given that the reliability is used in the same way as consistency (Gaya and Smith, 2016). Given that the current research is entirely qualitative in nature, various ways

were employed in ensuring that the research is rigorous and is valid and reliable to a satisfactory degree.

The criteria for evaluating the truthfulness of quantitative data for instance internal validity, reliability, objectivity and generalization are not appropriate for the assessment of research carried out within a naturalistic environment. It is of necessity to specify ways and terms of examining and establishing the reliability and the trustworthiness of qualitative research that has the capability of providing alternatives to the reliability and the validity in quantitative approaches (Gaya and Smith, 2016). There are two basic criteria for the assessment of qualitative studies: authenticity and trustworthiness. Trustworthiness is composed of four criteria, including credibility, transferability, dependability and confirmability of data (Gaya and Smith, 2016). Moreover, these can be examined through the trustworthiness, consistency, applicability and the neutrality of the data (Sarma, 2015). The researcher ensured that these concepts are reflected on the conduct of the research and on the results obtained.

Researchers employing the qualitative paradigm use the method of triangulation which encompasses the employment of varied sources of evidence, the ideas of different participants, member checking, the researcher's reflectivity, and peer debriefing for ensuring trustworthiness and rigour (Umeokafor, 2015). N the current research, triangulation was achieved through the use of informants from different angles, ensuring that there is diversity in the perception of respondents regarding the same issue of delay. More particularly, the informants were drawn from the communities hosting the construction, government and private organizations as well as civil society groups, and the participants of the construction projects including contractors, architects and subcontractors. Data triangulation through the employment of different data

sources is vital for the research credibility. Triangulation ensures that the data can be confirmed and as such reducing the effects of bias (Sarma, 2015).

Aside from just their diversified backgrounds, truthfulness was ensured through examining the level of consistency of their perceptions and evidence. Moreover, the selection of the informants was in such a manner that their level of experience with construction projects in oil and gas industry was considered, ensuring that their accounts and statements are valid and dependable. Therefore, the use of the purposive – snowballing sampling techniques is of importance in ensuring the rigour of the current research.

Developing a theoretical framework that is well informed of guiding case study enables the enhancement of rigour, credibility and consistency in qualitative case studies (Gaya and Smith, 2016). The gain of coming up with a theory is the increased capability of interpreting the data gathered and to connect it to the research. The thorough review of literature and the development of a relevant conceptual framework is another way through which rigour is achieved. This is done in two ways. In the first place, the variables and the relationships between them enabled the development of valid and relevant interview questions. Moreover, the theory is used in explaining the research results through comparing and examining contradictions and the arguments of the respondents in order to come up with concluding statements which can be used in theoretical development.

Also, the researcher chose face to face interviews on site. When the researcher is engaged at the research site for long, it increases the credibility of the findings through the development of contextual familiarity of the researcher (Sarma, 2015). Credibility can also be added through the researcher's professional background (Sarma, 2015). Given that the researcher is in the

pursuance of a postgraduate degree in construction management, the researcher is familiar with management issues and theories and these aids in the achievement of validity and reliability.

4.7 Ethical considerations

According to Beale, et al. (2004) there are three primary ethical principles in qualitative research, including mutual respect, non-manipulative and non coercion as well as the support for the values of democracy. Mutual respect involves the opening of individual perspectives for the comprehension of others' points of view and the provision of the rationale for individual actions. Non coercion means that the participants provide full consent as regards to their participation while non manipulation means that the participants are fully informed of the objectives and procedures of the research.

Greenwood (2016) argues that the participants in management research do not have the tendency of being exposed to notable intervention and may not have a pre-existing connection with the researcher as in the case of doctors versus patient and may not be highly vulnerable as is the case of medical research. Based on these, research in the fields of management is free of interventions, rational and independent subjects and therefore the subjects do not require much protection (Greenwood, 2016). The consent of participants in management research sometimes could mean the provision of access by the management.

Ethical principles were adhered to in the current research in many ways. In the first place, individual consent was sought before conducting the interviews. Given that the participants were referred to the researcher by those that had been interviewed, this helped in explaining the purpose and use of the research, and in persuading the would-be respondents to accept to participate in the research. As such, the consent provided by the respondents was based on their

full knowledge of the research. Also the respondents had a choice to participate or not, making the inquiry process voluntary and free of coercion.

Lastly, the study assured the respondents of complete anonymity. This was to ensure confidentiality in order to enable them to provide as much information as they could. Although the interviews were audio recorded, care was taken in ensuring that all the recordings were kept out of reach. Furthermore, the process of transcription was crafted in a manner that concealed the identity of the respondents after which the recordings were destroyed and discarded. Care was also taken in the presentation of the results such that no participant was referred to by their identity and the company and the location further concealed.

Chapter 5: Findings and discussion

This chapter involves the presentation of the findings realised following the analysis of the interviews. The findings are arranged in accordance with the various themes that were extracted from the research questions and the conceptual model that was used in the development of the interview questions and the emerging themes from the research. Moreover, these findings are compared with literature in order to establish contradictions, explain them in the context of the case studied and in the end establish conclusive arguments.

5.1 The management of construction schedules in the oil and gas industry

The respondents indicated that the schedules within the construction industry varied, with some schedules stretching over the years and some within a few months. When construction is required, they explained that an overall design of the project and its phases would be done, and each of the phases awarded to a contractor depending on the specific expertise required including installations. The overall design includes an estimated time frame, although the contractor is required to come up with schedules and workflow processes that would culminate into the period estimated. Furthermore, the respondents appeared to be aware of scheduling and cost budgeting techniques, and admitted to using software in the production of the master schedule. This was done by a professional project manager employed by the company, but not attached to the project. The master schedule is therefore handed to the consultant who also acts as the overall site manager and a copy to the procurement officer on site.

Kyunghwan (2009) indicated that because of the uncertainties and the complexities in numerous construction projects, time to time adjustments to the baseline schedule may not be avoided with the progression of the construction. However, based on the accounts of the respondents, it appears that the scheduling ends at that point, and what remains is to interpret and

follow the schedule and adapt to changes as they occur. Some of the changes realized in the execution of the project schedules included inadequate time frames that are sometimes provided for activities and especially those that are critical. This makes it difficult to adhere to the critical path and as such, delays are experienced. This is supported by Jaśkowski and Biruk (2011) in the statement that as an impact of random conditions and events, an optimized schedule for a specific set of objectives which does not take into account the possible disturbances has the likelihood of leading to poor results.

Ng, et al. (2004) explained that the usual remedy for delay is the acceleration of the remaining activities through the use of more resources or alternative methods of construction. Nevertheless, the respondents indicated that the cost allocations were not sufficient enough for accelerating the project through the addition of more workers. This is because; there are instances where skilled labour was required, as such, adding more persons appeared to be more expensive than delaying the completion of activities. Another problem that was highlighted was the assumption that materials are available. The scheduling did not provide for issues including possible delays in the procurement of materials, labour and equipment.

5.2 The major causes of delay in the construction industry

The classification of delays as derived from the analysis did not differ from what was presented in the conceptual model.

5.2.1 The role of construction management issues in delay

The respondents tended to consider the construction management issues are ranking high as a cause of delay in the construction industry. According to Lo, Fung and Tung (2006), poor management of the construction sites can lead to delays and impact on productivity. Although the contractors did not hold the same view, every other respondent felt that the contractor had a

large contribution to make. Just as indicated in the conceptual framework, the issues indicated tended to point out to the scheduling, recognition of the delays, cash flow management and procurement as some of the ways through which the management was failing. While some literatures indicate that site management is the responsibility of the contractors, others show that the management of the site is mainly conducted by the consultant. In the current research, the issues brought out as contributing to delays and which are related to the manner in which construction sites are managed were seen as shouldered by the main contractor.

5.2.1.1 Cash flow management

According to the respondents, the bidding for construction projects has to take into account the profit margin and costs. These costs vary because of the changes in the level of inflation and currency and especially for products that must be imported. Because the contractors usually use the bill of quantities provided for by the architects and quantity surveyors, problems usually arise because of items not included which sometimes only discover during the construction process. As such, there is a possibility that costs escalate once the site is taken over. Also, when it comes to the overhead costs, aside from the increases in labour costs, the rate of productivity of workers on wages vary. This means that especially at the beginning before the work stabilises, a lot of costs are involved. In the case that the inflow of money from the client is not steady and sure, the probability that cash flow problems will arise is very high.

Also, depending on the client, the interviewees mentioned that the management of the company contracted to rarely provide additional funds for the continual execution of the project as a way of controlling for expenditures on site. Therefore, in the case that the project runs out of the money, the manager on site has to seek ways of obtaining more cash through processes including claims, some of which may not be easy to justify. Moreover, the site manager usually

examines weaknesses in the contract, including the possibility of inducing the need for change orders, all in the bid to find an opportunity to get more money from the client for continued construction.

Following the inquiry of why the additional costs are not usually examined before hand and included in the contract, the respondents mentioned that the persons involved in bidding differ from those whom the work is committed, and as such, some of the errors in the estimation of the project costs are only discovered on site. The respondents also indicated that this bidding process takes into account other firms and therefore, the objective of the persons responsible for ensuring that the firm wins the contract is to use all means to ensure the contract is awarded. Since all the other firms behave in the same manner, submitting an initially high figure reduces the firm's chance of winning the project. This revelation introduces one of the primary causes of construction delay in the oil and gas industry: underestimation of costs.

Although the literatures on construction delays do not give an account of the use of cost estimation techniques, there are methods available for capital budgeting that ought to enable the estimation of costs and margins for projects in a manner that takes care of issues for instance inflation or the reduction in the value of money. Aside from capital budgeting tools, reference also indicates that there is usually an allowance for costs that may arise and which are not budgeted for and the calculation of such costs is based on a percentage of the total budget. Therefore, it is not a question of the lack of funds to deal with emergencies as budgeted, but a bid to make more money from the project through taking advantage of the circumstances and the open clauses in the contractual agreement.

5.2.1.2 Scheduling and workflow management

The respondents explained that as a way of cost savings, the project manager is usually an engineer that is well versed with the construction processes and not a professional project manager. As a result, the tools for scheduling are never exploited to the full, although the respondents agreed to their use. The project manager therefore has the role of ensuring that the schedules initially constructed are followed, each work is carried out according to plan and that the right work is being conducted. In this case, the consultant also acts as the project manager and is also the representative of the lead contractor. In the process of conducting all these duties, coordinating all parties to the project and ensuring that the right work is being conducted, handling human resource issues and management related problems, it becomes difficult to fully deliver on issues related to the project schedules. Moreover, because of the inclination to engineering, matters of scheduling and updating of schedules are ignored, leading to the late recognition of prolonged work.

5.2.1.3 Delay recognition

The respondents indicated that the process of recognising delays is crippled by the lack of a professional construction manager. As indicated, the performance of multiple roles does not allow for the keen examination of schedules and progresses in order to report small delays that may trigger other delays. Petty delays are therefore unnoticed and the problems underlying such delays are not recognised until the delay becomes significant enough. One of the respondents noted that when such petty delays are noticed in good time and especially their causes, issues may be addressed faster and the project put on course. Such issues, according to the participants include changes in productivity, or absenteeism that may be indicative human resource management issues which may result in an industrial action if not addressed. As the participants

noted, the major issue was not that the site manager could not perform, but that the combination of duties did not allow for the sufficient monitoring and recognition of petty delays, or the time to follow up on issues in order to realise possible problems that require early intervention. As such, the real problem appeared to be the lack of a dedicated professional project manager on site.

5.2.1.4 Procurement

The projects, moreover require engineering techniques that are advanced, reliable suppliers, experienced contractors, sufficient planning and project cost control and the execution of the construction in accordance with schedules. Chanmeka, et al. (2012) moreover reiterates that this call for a great need for the use of advanced technical resources and skills and especially as it pertains to labour, equipment and materials.

Materials and equipment are needed from time to time. Moreover, the construction site may not accommodate all the materials and equipment needed. Therefore, given that the payment for the work done is made based on the level of completion, and because of the need to control the cash flow, purchasing is a continuous activity throughout the project's lifetime. The ability to predict needs and the time it will take for the suppliers to fully deliver is paramount as it enables the timely arrival of the supplies required. This function is usually done by a procurement officer in collaboration with the engineer. The respondents indicated that this process is controlled by three factors: the bill of quantities, the construction schedule and the experience of the procurement officer.

While the bill of quantities indicates the amount of materials required for the various construction works, the construction schedule is the tool required for the prediction of the time within which delivery should have been made and the procurement officer's skills and

experience enable the identification of the best supplier that will deliver quality, within a timely manner and at competitive costs. Delays are experienced when any of the three factors are affected.

For the first factor, one of the respondents gave an example of a situation in which a design error is encountered, therefore leading to a redesign, which consequently affects the materials required, their quantities and the supplier. The meaning is that aside from having to cancel orders that may have been made, the ability of the procurement officer to find another supplier who can flexibly deliver quality within a short period becomes a challenge. This is especially because some of the materials required in the oil and gas industry are specialised, requiring specialised manufacturing industry. The implication is that such materials may not be produced within the country where the construction work is in progress, and because of their Specialty and possible weight, clearing and forwarding procedures and logistics have to be accounted for in calculating the lead times. Delay is therefore inevitable in such circumstances.

With regard to the construction schedule, problems may only occur when there is an error in the organisation of the workflow processes such that work that ought to be completed before another fails to be indicated within the schedule. Indeed, the respondents indicated that such situations have occurred when there was a mix up in the activities, which is only recognised when the time has come. This places pressure on the procurement in the case that the materials and equipment required needed to be purchased beforehand.

Lastly, one of the respondents indicated that it is critical to have a procurement officer that is supportive, understanding of the construction sector and with the experience of the unique and challenging requirements of the oil and gas industry. This set of competencies according to the respondent is critical in the determination of the right materials and the right suppliers.

Moreover, another respondent explained that one of the issues that is usually ignored is the negotiation skills of the procurement officer.

The respondent further explained that there are circumstances in which the support of the suppliers is critical to the continuance of the work. This support comes in the form of supply conditions, indicating when payment ought to be made. The respondent further indicated that in the interest of cash flow, many times, suppliers have to release supplies on debt and must remain committed when it takes long for contractor to honour the commitment with the suppliers concerned. This is for instance the situation whereby because of the nature of the material, it cannot be purchased cost effectively in bits, is expensive and is vital in different stages of the project. The capability to negotiate terms that are favourable to the contractor based on the circumstances on site is critical. In the case that suppliers decline to cooperate or wait for the honouring of certificates before payments can be made to them will certainly lead to delays.

5.2 .2 The role of design issues in delay

Just as indicated by the literature, the respondents highlighted that design related delays emanate from two sources: site assessment and design reviews. These two factors are interrelated.

5.2.2.1 Site assessment

Given that oil and gas projects many times involves underground works, site assessment involves more than the examination of the ground conditions. One of the respondents specifically noted that the accuracy of the assessment of the geological formations and faults around the construction area is of importance for drilling and underground installation works. Giving an example of the situation, the respondent noted that various geological formations are handled differently for instance areas with salt domes or where the underground water table is higher.

Another issue that was deemed to be of importance is the environmental assessment. One of the respondents further indicated that issues that affect the environment may arise, and if they are not handled well, it may lead to problems with activists and civil society groups. These groups may push for government regulations that may demand for greater resources for compliance, which may exceed contingency costs, leading to delays.

5.2.2.2 Design reviews

Design reviews are conducted based on three factors: error in design, change orders and differing site conditions. The respondents noted that although the aim of design is accommodating any issues that may arise, including the concerns of the client and the site issues, sometimes errors occur with regard to constructability. The concept of constructability is viewed in terms of the availability of the materials that ought to be used, their cost, environmental impacts and aesthetics. In such cases, the design has to be changed to what the contractor can realise using the resources that are available. The respondents noted that most of the cases, design reviews can be instigated by the contractor in order to save on the material and labour costs. More complex designs mean increased complexity and cost of specialised labour, increased cost of importation of non-locally available materials among others. To save on such costs, the contractor sometimes demands for the design review to something cheaper on their side. This process of review can lead to delays as the decision and the approval of the client is awaited.

5.2.3 The role of client performance in delay

Most of the respondents felt that the construction process is the duty of the contractor's team and therefore the client did not require performing in any way except for meeting certain obligations. However, the respondents in the construction industry noted that the performance of

the client has been just as vital as other participants. Issues that were considered to be related to the client include the type and the experience of the client, the financial capability of the client and the process of awarding contracts.

5.2.3.1 Client type and experience

The interviewees noted that dealing with the government on oil and gas projects sometimes lead to delay because of the hierarchies of decision making and approval processes that must be followed. Moreover, the respondents noted that especially when the matters has to be decided upon by way of voting by legislators, a lot of politics emerged and time had to be spent in trying to gain the support of legislators. Moreover, they noted that both experience and lack of experience were hurting. In the case of a previous bad experience even in a different sector, a lot of mistrust and caution delayed decision making and where no experience existed, personal interests were the hardest to deal with. The private clients on the other hand were easier to deal with as the decision makers could be reached easily and the issues discussed. These issues are in agreement with the literature that regards the bureaucracy of government as delaying decision making and approval processes.

5.2.3.2 Financial issues

Although the respondents noted that decision making took longer when the government was the client, the contractors had the advantage on financial matters. They noted that many times, increasing the actual costs of government projects did not attract as much scrutiny as in the case of private clients. Moreover, the government has access to finance and as such, the risk of nonpayment is lessened. However, the respondents also noted that government contracts required a high level of liquidity on the part of the contractor because the honouring of the certificates took longer than expected. Therefore, because these monies would eventually be

paid, the respondents indicated that they needed their own sources of funds to carry on with the work to completion rather than waiting for sometimes years before payment can be made.

One of the ways of mitigating possible cash flow problems was proposed as splitting the project into phases, such that certificates needed to be honoured per phase and not in the course of construction processes. The challenge of waiting for long periods for waiting therefore means that the contractors had to channel funds from other projects instead of financing as the use of loans to develop government projects would adversely impact on their cash flow when the loans are due for the payment of interest rates. On the other hand, the private clients were regarded as tending to obtain funding first before engaging a contractor and as such, their finances were more reliable, although an increase in cost attracted numerous issues including possible litigation or project suspension.

5.2.3.3 Contract awarding processes

The management and the execution of such large projects require project teams that are extremely experienced, that are used for the implementation of front end planning with high effectiveness, as well as the control of project schedules and cost (Chanmeka, et al, 2012). The respondents, however, did not consider the process of awarding contracts as a major factor in construction delays. They noted that as less experienced firms tended to hire more experienced employees to counter for their lack of experience in the oil and gas construction industry. They also noted that irrespective of the firm awarded, there are minimal requirements that have to be met, and that construction practices are similar across firms, with the difference as being the level of malpractice. Giving an example of cost escalation, they noted that the practice tended to be almost universal, with the exception that the costs escalated more significantly for some firms in comparison with others, and that in some firms, it was obvious, while in others, it was hidden

in the form of compensations for some delays that the client had no understanding of but were included in the contractual agreements.

5.2.4 The role of acts of God in delay

Literature indicates that weather conditions are the most common acts of God. Operations in the construction industry are many times more sensitive to weather conditions for instance, wind, temperature, snow, rainfall and humidity (Moselhi and ElRayes, 2002). The level to which the project is sensitive to the parameters is variable given the particular nature of the projects and the techniques employed in executing them. Moreover, studies show that weather conditions are only regarded as causing delay in the case that they are proven to be adverse and unanticipated.

One of the participants indicated that the process of scheduling ought to take into account the weather patterns of a given area such that construction activities are planned considering the possible changes in weather. The participants further noted that weather is not usually an important cause of delay in the oil and gas industry in Africa. When asked to explain, the respondents further highlighted that drilling and production of oil majorly take place in areas that are semi-arid or desert and as such, weather problems are not expected, except for excessive heat and the reduction of water levels. Moreover, such areas are relatively stable and do not experience much of earthquakes and landslides.

5.2.5 The role of secondary issues in delay

Secondary issues were also considered to be the cause of delay, although the respondents did not highlight much about them, except for dispute resolution.

5.2.5.1 Recovery

Most of the studies on delay consider recovery as the period that the contractor has to wait, especially in the case of adverse weather conditions. However, the respondents indicated

that adverse weather conditions were not common. This makes recovery not applicable within the oil and gas construction projects in Africa.

5.2.5.2 Rework

Literature also shows that rework occurs especially following design changes or the errors made by the contractors or the subcontractors in the construction process. The respondents indicated that the contractor had not experienced major rework that emanates from construction errors. Moreover, they indicated that some of the changes that had occurred were stimulated by the contractor, and therefore, this in one way led to the synchronisation of the expected changes to the ongoing work thus reducing delays associated with rework.

5.2.5.3 Rate of productivity

Contrary to rework and recovery, the changes in the rate of productivity were considered by the respondents to be a major silent source of delay. One of the respondents, particularly noted that in many cases, it is never recognised and as such, when the work is completed in a slower manner than expected, the consideration of the contractor is to increase the number of workers in order to accelerate the activities or to seek ways of extending the schedule. Moreover, they acknowledged that the recognition of the changes in the level of productivity requires keen monitoring and especially as it regards to which workers had now become slower, a complex work that can only be achieved through a dedicated project manager.

5.2.5.4 Delay analysis and dispute management

The respondents appeared to be aware of the delay analysis as it pertains to the establishment of the causes of delays and assigning of responsibility for the delays. They particularly stated that delays are often overlooked and only referred to when there is a need for

time extension or when the contractor is seeking avenues through which to demand additional finances for the project by means of compensation. This means that at the time that the need arises, different team managers are asked to give their account of the happenings in order to establish where the client is specifically involved in order to seek compensation in accordance with the contractual agreement. The implication is that there is no active monitoring and recording of delays, their causes, and the responsible parties. Also, the analysis of delays was stated as arising when the delay is significant, and where the stakeholders for instance the civil society groups were raising complaints.

Given the situations that call for delay analysis and the manner in which it is conducted, the process is never conducted as prescribed in theory and there is no methodology that is specifically employed. In fact, the respondents tended to be surprised that formal methods and even software existed for conducting a delay analysis which could be embedded in the scheduling software. The lack of specific knowledge of delay analysis methodologies, their use and importance for the construction processes can be explained as the cause of escalated delays.

With regard to the management of disputes, the respondents indicated that most of the construction parties often preferred the courts as their way of solving disputes. Disputes included issues, for instance compensation by government, environmental concerns, and at one point on the choice of the contractor. The disputes were always registered when all arrangements had been done and the claimants sought for certificates of urgency. In some cases, the construction had to be put on hold when certain payments had been advanced and which could not be recovered. This especially happened at the beginning of the construction project, but issues settled with time, leading to a more stable and peaceful construction process. Other disputes included delays and escalated project costs.

While some of the disputes were solved faster, and especially those that required a temporary stoppage of the construction process, the disputes that did not require work to stop took very long. At some points, work had to be interrupted in order to honour court proceedings because the decision makers that were required to provide approvals were engaged. This finding is in agreement with literature which shows that litigation is among the major consequences of delay. In some cases, according to published work, compensation is sought from the contractor to cater for the losses from late completion of the project.

5.3 The impact of delays on various stakeholders

From the statements of the respondents, the impacts of the delay can be classified into three: impact on contractual relationships, impacts on profitability and profit margins, and the impacts on the possible gains by the hosting communities. In the first place, even though delays emanate from different sources, they greatly affect the contractual relationships between the client and the contractor. For delays that are induced by the contractor, a lot of mistrust and blames emerge. This comes from the contractor's bid to frame the client as the cause of the delay and contractor's justification in order to receive compensation for the delays induced. This is especially heightened by the lack of formal delay analysis, reducing the assignment of responsibility to blame game and the search for evidence to force one party into taking responsibility.

On the other hand, other blames that both the client and the contractor do not have control over include court injunctions. According to the respondents, the client has the expectation that the contractor will understand that the delay was beyond the client's control and as such, an only time extension ought to be sought. In the situation that the contractor uses contractual loopholes in order to extort more finances from the client, a feeling of dissatisfaction

arises between the contractor and the client and this may cause the client to frustrate the contractor in later times through means such as prolonged honouring of certificates.

In the second place, delays in the oil and gas industry construction projects have adverse impacts on profitability and profit margins. Oil and gas, being much needed commodities, and having wide fluctuation of prices, the failure to complete construction projects in time present major losses of potential income. Especially because expected production units can be measured in terms of barrels per day, it is possible to prove the economic losses associated with delays. On the side of the contractors, the respondents indicated that the delays that come from client related issues and for which they are unable to seek compensation present major loss of revenues. Aside from the increased costs of overheads to meet schedules, inflation can drive the prices of materials and equipment higher than the cost if the delay was avoided, thus presenting significant and unrecoverable losses.

Lastly, the delay was explained as having impacts on the hosting community. This loss is especially through the opportunity to gain from the project through supplies or through employment. Moreover, the context under which the data were collected was such that the community were promised a percentage of employees and a percentage of income from the completed project to their local government. This means that when the completion is delayed, the number of months of delay represents the losses in the monthly sustenance of would be dependent families and local government projects which would have been realised from the retained earnings from the project. Delay therefore is undesirable for all the stakeholders.

Chapter 6: Conclusions and recommendations

Although construction delays are universal, the delays in the oil and gas industry are unique because of the environment within which the construction is carried out, the need for specialised materials, skills and equipment, the lengthy time schedules and the costs associated. The aim of the current study was to establish the major causes of delay in the oil and gas construction projects and to group them in accordance with their importance and impacts. The objectives of the study included to explore ways of managing construction schedules in the oil and gas industry; to explore the major causes of schedule delays in the oil and gas industry; to explore the importance of the delays and their impacts on the stakeholders and to explore ways through which schedule delays can be reduced and their impacts mitigated. Following a thorough review of literature, the causes of delay, their major classifications and importance were put together into a conceptual framework.

As opposed to the quantitative method, the qualitative method was used to establish evidence for the existence, importance and impacts of these delays. In line with the research method, a single case study was adopted as the best strategy to enable the collection of in-depth data within its concept. 10 informants were chosen based on a specified criterion and the participants reached through the snowball sampling technique. These participants were diversified, enabling the gathering of diverse points of view that was considered to be useful for ensuring the dependability and the truthfulness of the findings. The data collected was analysed manually through the thematic content analysis technique and the results presented and discussed in a narrative format.

6.1 Summary of findings

As expected, the issues surrounding the management of constriction schedules in the oil and gas industry and the causes of delays had deeper roots that what is presented in the literature. More particularly, studies have in the past come up with possible reasons and asked the respondents to merely rank these delays without the consideration that there could be deeper issues than what is thought of. The findings indicate that the scheduling of oil and gas construction projects is conducted up to standard and through the use of software. This is however done away from the construction site and with time estimates that sometimes may not be realistic.

Moreover, the master schedule produced sometimes has errors as it regards to the workflow processes, a problem that is difficult to correct except through adaptation. This is because; the professional that prepares the schedule only produces the master schedule which is handed over to the procurement and the consultant for interpretation and execution. As such, the problems encountered as a result of the schedule itself are solved through adaptation and no modification.

With regard to the major causes of delay, some of the cases presented by literature are not the real causes. For example, the literature regards the problems associated with the construction management as being scheduled and workflow management problems, lack of delay recognition, cash flow management and procurement. While these problems were acknowledged, the findings indicate that the real problems underlie these and are many times not discovered. For example, scheduling, workflow management and delay recognition were problems caused by the lack of a professional project manager on site; cash flow management problems were established to be

caused by the inadequate allocation of funds at the bidding stage. Procurement was established to be a secondary problem that emerged as a result of scheduling problems and workflow problems.

The design issues, including site assessment and design reviews were found to be two fold. While the provisions in literature were established to be true for the oil and gas construction projects, literature does not indicate that sometimes, the contractor's need to decrease construction costs through a cheaper design may stimulate design changes. The findings further indicate that the argument of the contractor is often not what is presented to the architect, but constructability.

Given that government was the client in the case studied, the respondents did not highlight much about the private clients. The performance of the client was found to be of importance and the issues which addressed the potential of delays had included slow decision making due to bureaucracy, and late honouring of certificates. According to the findings, the process of awarding contracts was not considered to have any significance in the examination of the delays.

Another factor that was found to lack importance was the acts of God. Although it is highlighted much in the literature, the findings indicate that due to the context of the study, the occurrence of such acts including adverse weather, landslides and earthquakes was not probable. This made the respondents to fail to consider it as a possible cause of delay. Based on this, recovery which is presented in the literature as mud days was found to be insignificant as a secondary cause of delay.

However, other secondary causes such as rework, the rate of productivity, dispute management and delay analysis were established to have great significance. Although rework was not rated highly, it was considered to be a factor, given that errors are inevitable. With

regard to the rate of productivity, the respondents denoted that little attention has been given in relation to the changes in productivity during construction processes. It was therefore an issue that the respondents needed to discover.

Dispute management processes appeared to be another major cause of delay. The findings indicate that the stakeholders in the oil and gas construction industry solve their problems through court processes. Moreover, the result indicates that the situation is made worse by the conduct of disputing parties given that they make submissions when considerable preparations have been done, leading to certificates of urgency and stoppage of irreversible work. Disputes identified ranged from the relationship between the client and other stakeholders (land compensations, and environmental issues among others) to the problems of awarding the contracts, escalated project costs and observed delays.

Lastly, it was established that there were no active formal means of delay analysis. According to the findings, the identification and assignment of responsibility to the delays was done based on the account of the team leaders and decision makers and this was mainly brought up by the contractor in their search for compensation. As such, it was established that there is no management of delays in the course of the construction progress. These relationships are further summarised and ranked in accordance with their importance in the figure 6.1.

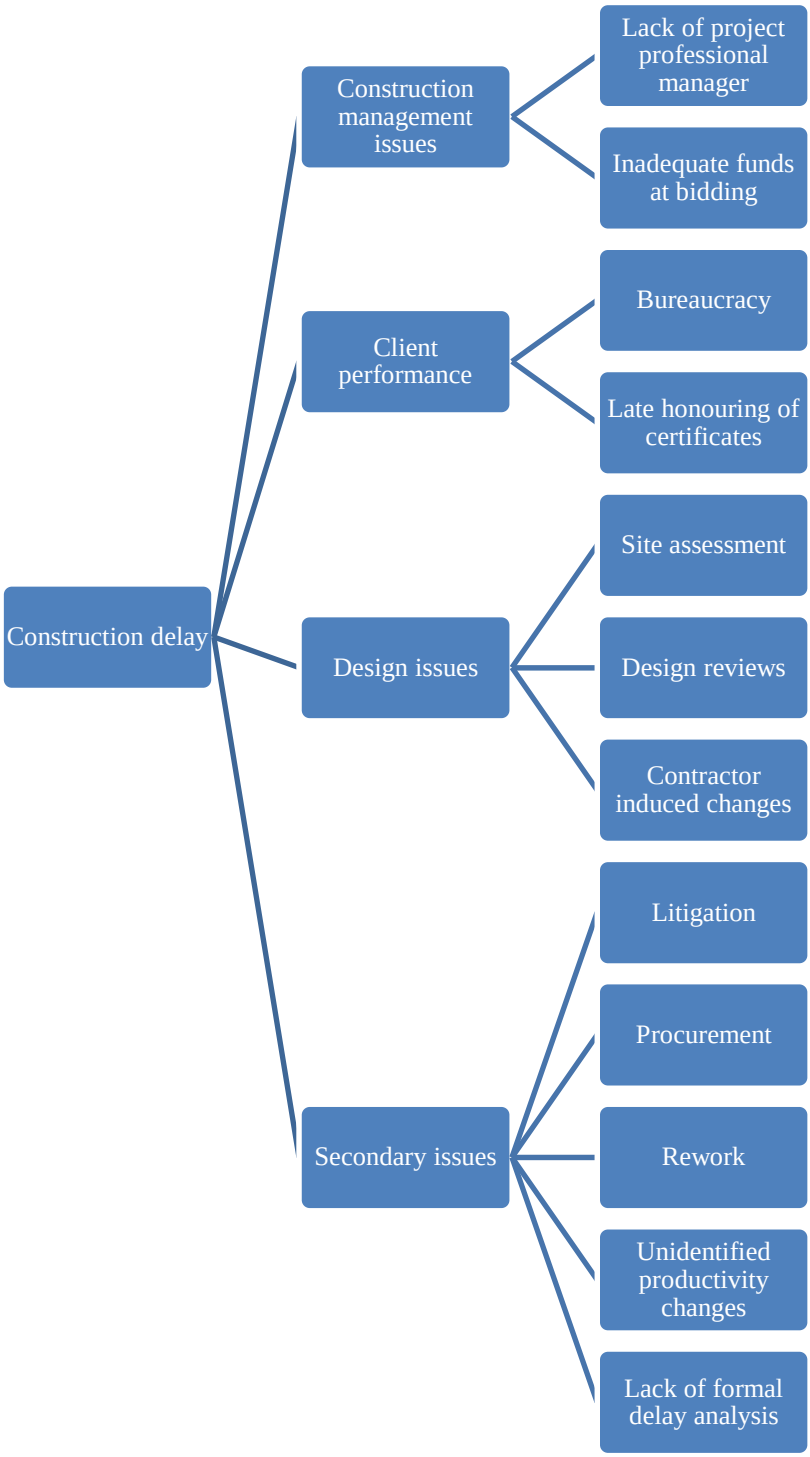

Figure 6.1: The summary of the significant causes of delay in the oil and gas projects

The delay was found to impact on contractual relationships, profitability and profit margins of both the contractor and the client, and the on the possible gains by the hosting communities.

6.2 Study limitations

In the course of research, a number of limitations were established. In the first place, the limitations were methodological in nature. This pertains to the arguments against qualitative research as being less rigorous and to an extent, regarded as not scientific. This limitation was overcome, however through various ways also identified as enhancing the dependability and truthfulness of the qualitative research.

Secondly, the study used a single case study. This means that the accounts of the various respondents emanated from their own experiences, and their own situations. Some of the issues may not apply in a different environment. For instance, the geological setting that makes acts of God, not a factor in construction delays may change depending on where the study is conducted. Moreover, there are issues that were raised, including certain matters pertaining to the personal interest of legislators as part of the government decision making body in high profile projects such oil and gas projects. While the government may be the client in some projects, this may not remain true for all construction projects in the oil and gas industry. Moreover, the efficiency of government operations and the level of a civil activism varies from one country to another and from one region to another. Given that there is some level of regional similarity, the findings of the current study may only be applicable in the oil and gas industry in Africa or other countries but with similar settings.

Lastly, even with the assurance of anonymity, there was still some level of withholding of information and especially what would put the respondents in bad light. This means that the level of depth anticipated may not have been fully achieved. However, the data gathered is considered to be sufficient enough for the fulfilment of the research objectives.

6.3 Recommendations for future research

Based on the weaknesses that have been pegged on the methodology adopted, it is of importance to confirm the results of the research and especially as it pertains to the new findings. Given that quantitative research is solely suited for such confirmation, the researcher recommends that future research should test the results established through quantitative surveys. The statistical manipulation that comes with quantitative research will therefore provide an objective means that will test the relationships established in the current research, bringing the new causes of delay into perspective. The emphasis on a similar context comes from the fact that it is acknowledged that some of the results may not be generalised to other contexts.

6.4 Recommendations for practitioners

The findings of the current research bring about issues that need to be addressed as a way of tackling delay and mitigating its impacts. In the first place, there is a need for dedicated professional project managers in construction projects. Instead of giving, the responsibility to the consultants, the professionals would have the sole duty of ensuring that schedules are practical, are customised to the unique site challenges and the assumptions used in coming up with the schedules verified. Moreover, a professional project manager would also have the duty of ensuring that petty delays are noted and their causes established. This would involve an active formal delay analysis that is incorporated into the scheduling software. The software would enable multiple reporting points regarding the work progress against the planned activities and as

such enabling the ease of the identification of delays and recognising their cause and assigning responsibility for the delay.

Although the practice of reducing the bid price in order to win contracts appear to solve problems, one can also argue that the increased respect for a construction firm that completes the work within schedule and at the bided cost would generate greater profitability in the long run. There is therefore a need for honesty and transparency for continued business relationships. When reasonable pricing is applied, this will also solve the problem of induced design changes thereby easing the construction processes. If these two critical issues are addressed, they have the potential of enabling a great change in the schedule management within the construction industry in the oil and gas projects.

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Appendix 1: Interview questions

1. What is your take on schedules within the construction industry in the oil and gas projects?
2. How do you come up with master schedule for the entire project?
3. Who is in charge of the work of coming up with the master schedule?
4. What is the scope of work of the person in charge of preparing the master schedule?
5. Do you ever encounter errors during the execution of the schedule? If yes, what type of errors and how do you handle them?
6. How would you rank delays issues attributed to management? Justify
7. So in your opinion, what are these issues?
8. What is your take on the management of cash flow by the contractor as a cause of construction delay
9. Where do you think the problem originates from?
10. At what point is delay recognized in oil and gas construction projects?
11. What usually happens so that materials are not procured in time or as they are needed?
12. Is the site usually assessed before the design of the project? If yes, what then causes site related delays?
13. What stimulates the need for design reviews?
14. What issues have you experienced with the client that in your opinion has led to delay of the project
15. Are issues like weather conditions, earthquakes, floods etc been a factor in the occurrence of delays?
16. So has there been any need for recovery time following such occurrences?

17. Have you experienced circumstances where the work had to be repeated? What was the cause of rework?
18. During these times of delay, was the rate of productivity a consideration? if yes, how did it affect delay?
19. What ways did you use to assign responsibility for delays? Was the process also a contributor to delays?
20. What about disputes arising. How were they solved and how did they affect delays?
21. Now, how do the delays affect you as a stakeholder of the current project?