RESOLUTION OF MANAGEMENT ISSUES WITH MEGA PROJECTS

SCELO MHLONGO

STUDENT NUMBER: 20609156

MASTER OF BUILT ENVIRONMENT

FIELD OF RESEARCH IN PROJECT MANAGEMENT

FACULTY OF ENGINEERING AND BUILT ENVIRONMENT

DURBAN UNIVERSITY OF TECHNOLOGY

Supervisor: **Dr Ayodeji Olatunji Aiyetan**

Date: **25 May 2019**

RESOLUTION OF MANAGEMENT ISSUES WITH MEGA PROJECTS

SCELO MHLONGO

SUBMITTED IN FULFILMENT OF THE REQUIREMENTS OF THE DEGREE OF MASTER OF BUILT ENVIRONMENT IN THE DEPARTMENT OF CONSTRUCTION MANAGEMENT & QUANTITY SURVEYING, FACULTY OF ENGINEERING AND THE BUILT ENVIRONMENT AT THE DURBAN UNIVERSITY OF TECHNOLOGY

SUPERVISOR: DR A.O. AIYETAN

MAY 2019

Abstract

South Africa is a developing country with many construction projects that are being undertaken. The study aims to contribute to the resolution of issues around the management of projects. Previous studies have revealed that there are many failures in the erection of mega projects. This study was based in three provinces in South Africa - KwaZulu-Natal, Gauteng and Western Cape. A mixed method research approach incorporating both qualitative and quantitive methods was used to collect empirical data from stakeholders working on mega projects. The data was collected using a structured questionnaire and focused individual interviews. The study established that management issues such as the lack of stakeholder engagement and poor logistics planning play a role in the failure of mega projects. The level of use of this research targeted companies which are at 8GB and 9GB and within those companies, professionals such as project managers, architects, quantity surveyors, foremen and site agents. The study recommends that in order for mega projects to be successful, stake holders must mitigate turnaround time on taking decisions. Also, sound decisions must be taken for effective delivery of mega projects. Findings suggests that plant down time contributes to the failure of a project. Regular plant schedule checking is done daily prior to plant operation. Findings on logistic management revealed that the leading factor is public safety. It is recommended that safety of public around projects needs to be managed closely by responsible site agents and safety officers. The change of designs during construction must be avoided since this brings unexpected material expenditure which impacts on the project costing. All cost occurring during design changes must be charged to the architect fees, unless the changes were unforeseen.

Keywords: Stakeholder, plant, production, supervision, logistics, heath and safety.

DECLARATION

This dissertation, except where indicated in the text, is the candidate's own work and has not been submitted in part, or in whole, at any other University or University of Technology.

This research was conducted at the Durban University of Technology under the supervision of Dr A.O. Aiyetan.

SUBMITTED BY:

………………………………………………………

Mr S Mhlongo Student no.:20609156

APPROVED FOR FINAL SUBMISSION:

………………………………………………………..

Dr A. O. AIYETAN: Supervisor PhD: Construction Management

…………………………………………………………

MR F.C. FESTER : Head of Department Construction Management and Quantity Surveying

DEDICATION

This dissertation is dedicated to my beloved wife, Mrs N Mhlongo, my mother Mrs PZ Mhlongo and my boys Yandisa and Mawande Mhlongo, my entire Mhlongo family, Also I cannot forget my RCCI Pastors and entire RCCI family (Restoration Christian Center International). Without your prayers and your support I wouldn't have completed this work.

ACKNOWLEDGEMENTS

Glory be to GOD ALMIGTY for the guidance in the successful completion of this study. May HIS grace and mercy continue to overflow in my life. LORD this is for your glory!

A special thanks goes to my supervisor Dr A.O. Aiyetan for the guidance and mentorship until the successful completion of this study. All your efforts are highly appreciated. May the Lord bless you Dr.

I would like to thank my HOD, Mr F.C. Fester and the entire Construction Management and Quantity Surveying staff for their support and constant encouragement throughout this study.

Thanks to Mr D. Singh for the vital role he played in the successful completion of this study.

Thanks to Dr Saths Govender for editing the work.

Thanks to the Durban University of Technology for the financial support, it has helped me in many ways.

To the research participants, without your assistance and cooperation, this study would not have been completed,thank you so much for everything.

Special thanks goes out to my friends and colleagues; your support, prayers and encouragement kept me going. Thank you.

A heart felt gratitude goes out to the Mhlongo family; thank you so much for being my pillars of strength and strong support system. I would not have made it this far without your prayers and support. Thank you for all the sacrifices.

TABLE OF CONTENTS

List of Table

List of figures

List of appendices

Chapter 1

RESOLUTION OF MANAGEMENT ISSUES WITH MEGA PROJECTS

1.1 Research Introduction

There is always a percentage of risk involved when erecting mega construction projects; however there are many ways to improve the odds of escaping the negative consequences of such risks. Construction of mega projects is an essential aspect of development in cities, states and individual livelihoods. The problem associated with this is the timeframes. Substantial infrastructure projects are normally economic transformers, for example, the Dubai intercontinental airport is the world's most eventful, accounting for 21% of Dubai's employment and 27% of its GDP (Garamo, Matzenger and Palite 2013).

The lack of ability of the client and the project team to come to mutual agreements and understandings; based on the inclusive overview of the construction processes from initiation to completion, is a persistent motive for delays in delivery dates. Either party may be unaware of the environmental effects that may hinder the construction process. This view is sustained by Sambasivan and Soon (2007) who emphasize the difficulty of delays in the global phenomenon. The construction undertaking involves a plethora of tasks, requiring task management personnel to drive the construction team for effective production. It was estimated in the year 1999 that there were more than 1500 hefty construction projects internationally at diverse phases of financing or construction, in zones such as oil, power, shipping and trade. Additionally, the sum, the intricacy and the range of the projects have been increasing speedily over the past few decades (Miller and Lessard 2012).

Owing to this, numerous guides have been drawn up to assist participants to understand the management of mega projects. Articles and books give guidelines on how to manage the mega project without failure; an example would be 'Management of Major Construction Projects (NEDC)' where the author identifies the importance of the strong points, calibre and control of the project/ construction manager. Reports such as these will assist in increasing information and equipping participants for the successful completion of many mega projects. The rapid rate of modernization and projected elevation of progress of the nation's economy have shaped a considerable market for the construction trade over the preceding decades. With the overview of a number of monetary policies aimed at growing investment in fixed assets and to fast-track the infrastructure developments, an increase in extraordinary profile mega construction projects such as King Shaka International Airport have been undertaken (or in the process of completion) in the past five years.

Mega construction projects are characterised by hefty investments, abundant intricacy, supplementary stakeholders and widespread influence. Mega contructruction project refer to project of with sums over eight hundred thousand upward also involving large numbers of participants which have a great social and economic impact (Mork Et 2015). Despite these achievements, the construction trade has been disparaged for constructing meagre quality construction work, delays and budget overruns with truncated success and usefulness. Problems including elusion of the submission of the procurement system, dishonest contracts and illicit sub-letting are some of the conjoint challenges encountered in construction procurement. Despite a succession of government improvement on the construction trade, these adverse conditions persist. With this in mind, it is imperative to implement a practical and operative device to advance project management and governance of mega construction projects.

According to Smith (2009), worldwide mega projects are likely to become progressively common in the engineering and construction trade. Participants at the Engineering Foundation Research conference defined a mega-project as ‘a high impact technically complex project which requires careful advanced planning, last three or more years, has significant impact on the public and industry, employs thousands of people and typically over billions of Rands’. The upsurge in the prerequisite for mega-projects are attributed to decline and shortages of present infrastructure, predominantly highways, bridges, water and sewage treatment plants; immense infrastructure development required by third world states to advance their economy; improved methods for the accrual and reduced bearing of perilous wastes on the environment, and the enduring need for forceful private development and massive industrial projects.

The very nature of these requirements infers that satisfying them falls within the description of a mega project. It is then indispensable that both advocates and implementers of mega-projects fully understand the influences involved in their preparation, implementation and inclusive management. Charrett (2000) states that on one approximation, 65% of mega projects are failures. Project scoping and risk provision are fundamental to refining these conclusions. Overall, the success percentage of mega projects is less than the success percentage of minor projects.

1.1.1 Causes of challenges

1.1.1.1 Lack of knowledge

1.1.1.2. Lack of experience

1.1.1.3. Lack of skills

1.1.1.4. Imcompitant human resource

1.1.1.5. Poor managerial capacity

1.1.1.6. Corruption and political instability

1.1.1.7. Lack of capital and technology

1.1.1.8. Low level of productivity

1.2 Research Problem statement and it setting

The construction trade is one of the major industries in the world. However, there are a number of management problems that influence the delivery of mega projects such as: stake holder management, financial and cost management, production management, quality management, social and political influence management, material management, plant management, manpower management and poor project planning.

1.2.1 The sub-problems

Sub-problem 1: Project stake holders do not actively engage in their duties at the beginning as well as during the project implementation. This results in project delays due to the changes that have to be made during project implementation, example: changes to designs.

Sub-problem 2: Improper plant management leads to project delays and over costing, example: the machine has to be hired for a certain number of days on site.

Sub-problem 3: Site management teams fail to allocate relevant resources to improve production of work as well as improper program management.

Sub-problem 4: Weak supervision of workers on site during project construction. Labourers are not given proper instructions on a daily basis and no follow up occurs on whether they are complying to the instructions.

Sub-problem 5: Insufficient social facilitation management which courses public strikes and community unrest.

Sub-problem 6: Failure to manage the usage of material on site leads to material wastage.

Sub-problem 7: Failure to manage health and safety which leads to injuries.

Sub-problem 8: Failure to manage logistics planning on the mega project.

1.3. Research Questions

What are the main aspects that contribute to the poor stake holder management of the projects?

How can the plant be improved by management when undertaking construction of the project?

How can the lack of production management be avoided in the mega projects?

Why is the supervision of workers weak on construction projects?

What are the factors that contribute to the insufficient social facilitation of the projects?

What are the main issues that result in material wastage during construction of the mega projects?

What are the factors that contribute to the poor management of health and safety in the mega project?

What are the main issues that results in the poor logistics planning in mega project?

1.4 Aims and objectives

1.4.1 Aim

The overall aim is to evaluate quality of management relative to mega projects delivery with the view of evolving mitigating strategies.

1.4.2 Objectives

The chief objective is to develop a solid project management guideline to assist the South African construction trade to improve the development of mega projects.

Objective 1- To identify and assess the various causes of challenges of mega projects.

Sub- Objective 1- To identify main factors that causes project stake holders to fail to participate in the delivery of projects.

Sub-objective 2- To investigate the reasons contributing to improper plant management.

Sub-Objective 3- To assess reasons of poor production management.

Sub-objective 4- To assess factors influencing the weak supervision of workers.

Sub-objective 5- To assess the reasons of poor social facilitation toward the project.

Sub-objective 6- To identify and assess reasons affecting material wastage and how this waste can be avoided.

Sub-objective 7- To identify and asses reseans affecting health and safety and how can be avoided.

Sub-objective 8- to assess reseans of poor logistics planning

Objective 2- To evolve mitigate strategies through system dynamic approach to resolve the challenges of mega projects (Causes of challenges).

1.5 The importance of the study

Since the development of hefty scale assembly projects is progressively credible, it is currently a favorable period to inspect if construction managers can meet the expense of a 'business as usual' attitude to mega project organization. The purpose of this study is to improve understanding of the issues exclusive to mega projects, chiefly national mega-projects, and recognize superior construction management practices that may be implemented to meet these demands. Mega construction projects denote an intentional option towards accomplishing sustainable development purposes in evolving countries. Specifically, these projects are characterised with the need for extraordinary design expertise and technical abilities (Othman 2013).

Large scale projects like roads, railways and pipelines usually become easy to decompose into independent geographical projects or subprojects that may face local uncertainties such as sporadic geological or climatic conditions (Levitt,Scott and Orr 2011). Furthermore, the research seeks to develop an approach that will contribute positively towards the construction of mega projects. The presence of several unalike backgrounds such as languages and traditions amongst the project stake holders has the possibility of creating frequent difficulties (Orrill 2008). This study addresses the fact that these management issues arise due to the occurrence of status hierarchies, differing customs and values, and communication obstacles. Therefore, in order to diminish these issues and the adverse outcomes that they inflict on construction projects, this study provides recommendations to strategies currently engaged to resolve them.

1.6 Theoretical and conceptual Framework

Management Theory

The construction industry is very significant to the growth of the economy in the world. Though it contributed just around 4.06% and 4.32% as its own portion to the national GDP in the primary and subsequent quarters of 2014, it remains a key player in the national economy (Ugochukwu 2015). However, the construction industry still faces many challenges, some are new and some are centuries old and this becomes a challenge to construction managers since they have to provide a resolution to all of these challenges.

The construction manager must manage, deflect, or mitigate the result or situation that affects the success of the mega project. Hence, the major responsibility of the construction manager is to plan, organize, schedule, implement, manage, monitor, control as well as track construction progress (Ugochukwu 2015).

Conceptual framework

The concept of this study is to acquire the critical variables that influence the success of the mega project. Therefore, the conceptual model is for the single-mindedness of detecting the acute success aspects and trials in the mega projects (Baba,Makhdumi and Farruk, 2017). Introducing conceptual critical success factors and models for construction projects takes into account diverse constraints to observe performance of the mega projects. The model takes into viewpoint influences connected to the team that manages the project as well as the stakeholders. The structures of the models involve a number of factors such as stakeholder management, production management, plant management, supervision of workers, social facilitation, material wastage, health and safety as well as logistics planning.

1.7 The assumptions

Based on the problems and sub-problems put forward above, the following assumptions were made as factors that can affect the management of mega projects: poor communication between the project stake holders, improper planning of the professional team, under quoting and over quoting on Bills of Quantities, ignoring the inputs of the end users, allowing wastage of material on site and advancing bribes when taking on the project.

1.8 The chapter structure

Chapter 1 discuss the introduction of the research and also touch on aims and objectives of the study giving the important of the study.

Chapter 2 discuss the literature review of the study.

Chatper 3 methodology

Chapter 4 research findings and analysies

Chapter 5 Resolving management issues through system
Chapter 6 conclussion and recommendations

Chapter 2: Literature Review

Introduction

This chapter covers the critical issues in the management of mega projects. With the management issues identified in mega projects, the factors that influence the management aspects are discussed. Many mega projects face difficulties due to escalating management issues. These issues are addressed and each factor is reviewed to minimise the risks involved in the construction of mega projects.

Previous studies

Several research have been conducted in different areas of the world after year 2005 with respect to mega projects. Some examined the management of mega projecject, while others used predictive model to escertain construction of mega project. Some of the early authors who studied the mega project are Dedongs,Fang and Fu (2019) in Chine. Caldas and Gupta (2017) in USA, Mulder (2019) in SA. Others, such Soldurlund (2017), Shenhar (2017) in USA as well Priemus (2010) in Europe. There are many others authors who researched on mega project such as Y. Qui in Chine (2008). X. Ren (2008) in Beijing who reseach in megaproject developments in Beijing. What are the key indicators of mega sustainable construction project by G. Wu,G. Qiang, J, Zuo in China (2018).

Previous research on mega projects

Country	Research topic	Author	Completion date
China	Impact of Control and Trust on Megaproject	W. Dedong;S. Fang & H. Fu	2019
USA	Critical factors impacting the performance of megaproject	C. Caldas & A. Gupta	2017
South Africa	Trust in Major and Mega Project	M. Mulder	2019
Norway	A reflection of the state of the art in Megaproject	J.Soderlund	2017
USA	The Three Secrets of Megaproject Success	Aaron Shenhar	2017
Europe	Mega-project: Dealing with Pitfall	H. Priemus	2010
China	Governance of institutional complexity in megaproject	Y. Qui;H Chen, Z Sheng & S Cheng	2019
Beijing	Mega projects Developments in Beijing	X. Ren	2008
China	What are the key indicators of mega sustainable construction project	G. Wu, G. Qiang, J.Zuo; X. Zhao & R Chang	2018
China	Megaproject: a case study china's three gorges project	S. Luk & J. Whitney	2017

Korean	Development of Bugdet-Constrained Rescheduling method in Mega Construction Project	S. An;S; Woo; C. Cho & S. Lee	2016
South Africa	Impact of Exobititant in mega project in Durban	P. Xulu	2014
USA	Megaprojects management and leadership:a narrative analysis of life stories-past and present	S. Sankar	2015
SA	An exploratory study on the legimacy of energy megaproject	P. Moloi	2018

2.1 Stakeholder management

This concerns the relationship between an organisation and the interested groups or stakeholders. These associations influence the people and their organizations, and may perhaps be a beneficial or undesirable stimulus on any fruitful project (Pampliega 2013). Historically, stakeholder organization has been advocated as the main component of accumulative progression on the success of construction projects (Pampliega 2013). Preceding research concentrated on the necessity for a practical guide to convey successful stakeholder management in the construction industry. The following factors are possibly the main causes of poor stakeholder management: stakeholder management verdicts, meeting accountabilities throughout the life of the project, internal stakeholder alliance in relaying stakeholder management tasks, stakeholder dynamics and the utilization of accessible methods for stakeholder assignation (Mowlus, Endogan & Ogunlana 2014). The long course of design and implementation of construction projects involve communication, teamwork and dialogues among the various project stakeholders which also involve but are not restricted to: the client, designers, outworkers, local authorities and over-all project atmosphere (Winch 2010).

The relationships that are created by project stakeholders directly and indirectly influence the construction project and has an impact on the total successful close of the project (Takim 2009). The diverse participants involvement both unswervingly and incidentally on the project are also considered categories since the project stakeholders management is vital to success of the project. The other concerning influences upsetting the stakeholder management method is the appointment of a project manager with an extraordinary capability and apparent assessment of substitute solutions. This project manager should also ensure operative communication concerning the project and its stakeholders, set mutual goals and objectives for the project, and explore the stakeholders' requirements and anticipations (El-Sawalhi 2015).

2.1.1. Stakeholder management decisions

Stakeholder management decisions is an entrenched strategic management system and is absorbed by the construction industry as an important concept for successful implementation of the project (Collige & Hant 2013). However, there remains a deficiency of knowledge on what strategies, tools and practices to transmit to make sure that the decisions taken by the stakeholders are properly implemented on the project. It has been debated that a considerable portion of the stakeholder's management literature is infused with uncertain conventions and conjectures, often encouraging the use of apparatuses that dearth authentication (Colling & Hant 2013). The assortment of opinions does not contribute in clarifying of ideals, values or practices for the industry.

2.1.2. Responsibility through the project life cycle

The participation of stakeholders comes with their own corresponding prospects from the project. Satisfying the anticipations of the stakeholders is a priority and should be kept in mind throughout the mega project life cycle. These are the following broad based planning guide points at project inception: Project planning and design, project implementation and operation of the mega projects. These are tools that should be implemented at the beginning of the project to ensure the efficacious conclusion of the mega construction project (Atkin & Skitmore 2008).

2.1.3. Stakeholder dynamics

This the gradation to which stakeholder statements call for instantaneous consideration. Understanding stakeholder dynamics and their impact on the management of mega project is crucial (Kujela, Havela & Savage, 2015). An example of the dynamic nature of stakeholder interest is that the stakeholder participation and management should be constant throughout the mega project lifecycle (Takim 2009). The reasons concerning the change in stakeholder interest is determined by how the stakeholder is monitored as the mega project progresses.

2.1.4 Stakeholder alliances

This is the method through which clusters with alike or dissimilar viewpoints can exchange thoughts and pursue solutions that go further than their own visualizations of what is promising (World Wildlife Fund (WWF) 2000). Managing mega construction projects to achieve success necessitates team work among the client, the professional team and the construction team; and sharing the available abilities and capabilities to complete the project with all existing resources. Stakeholder partnerships is the method of building up a strong project team which will make a collective decision amongst the key stakeholders of the mega project to evade or address the concerns pertaining to the mega project (Jamal & Gezt 2010). The purpose of stakeholder collaborations is to construct a strong stakeholder team (Jamal & Gezt 2010). However, the right to be involved in stakeholder alliances does not habitually happen, it requires the aptitude to execute efficiently in the role.

2.1.5. Techniques for Stakeholder engagement

This is a process with the end goal of success for the organisation or initiative (Yang 2011). The use of the relevant techniques and skills among the mega project stake holders is also a contributory factor to successful stake holder management of mega construction projects (Yang 2011). Different techniques have been applied to advancing the stakeholders thought processes such as the Delphi technique, tactical requirements analysis, design check, stakeholder rotation, reliable valuation methods and public enquiry (Newcombe 2012). The gradation of awareness of the practices and how they are applied is however, not exposed in the literature (Newcombe 2012).

Some important issues that can have positive results in the management of stakeholders for mega projects have been derelict. These comprise: determining the authorities and accountability for the leadership of the stakeholder management among the in-house stakeholder, the collaboration need with the stakeholders and who should be involved in the collaboration with the mega project life cycle as well as the stakeholder dynamics (Mowlus et al. 2014).

2.1.6. Hiring the project manager with competency.

The role of the project manager is the most significant one in terms of project performance (Foster,Royer & Lunt). Foster,Royer & Lunt (2017) further mentions that project managers carry the responsibility for aligning the performance of the project and its stake holder with overarching project goals. Fundamentally, they play a dynamic role in shaping the project culture and forming links between the stakeholders (Foster,Royer & Lunt).

Managing and hiring the stake holders is the responsibility of the project manager. If the project manager is not competent, the project bears the negative consequences since it is the project managers job to link the stakeholders. Once the project manager has identified the stakeholder, it is important to ascertain their commitment and involvement in the project; one of the most critical aspects being to develop and control relationships with all individuals that the project impacts (Executive Work Place 2016). The health, well-being and engagement are important for project success and if stake holders are in poor health or disengaged, there are significant negative risks for the project (Research Insight 2014).

2.1.7 Transparent evaluation of the alternative solutions

Transparency within the stake holders refers to stakeholders being able to discuss all project matters with no hidden agendas (Weber 2017). It is beneficial to the project that stakeholder share information like finances, contracts and even personal information that not everyone is aware of (Weber 2017). Providing a deep level of transparency will not only make the stakeholders job easier, but it can also create a good atmosphere for the project to run more efficiently (Weber 2017).

The inconsistent interests of numerous stakeholders (a collective characteristic in most projects) adds to the level of hesitations that have to be overcomed in the project (Jain 2014). Stakeholders view the project from unalike outlooks with diverse anticipations and the conceivable hidden quest of 'What is in it for me?' makes it tremendously problematic to create a shared end point (Jain 2014). Trust between the stakeholders must be the initial point of the project to produce value for all the stakeholders (Jain 2014).

2.1.8 Ensuring effective communication between project and its stake holders

Most of the mega construction projects face the same challenge: communication (Gina 2013). This is mainly because there are many individuals project managers should connect with from the very start, throughout the project operation and appraisal. Furthermore, they all want to be interconnected with in a different way (Gina 2013). Communication can diverge depending on the role a person has on the project and the stage of the project (Gina 2013). All stakeholders in the mega project must learn to connect successfully for the project to be fruitful. Stakeholder communication is the one of the principal points of project management. Arrange in a line the different objectives, benefits, and expectations of the stakeholders unswervingly contribute to the success of the project (Turkulainen et al. 2015).

2.1.9 Setting mutual goals and intentions for the project

This refers to everyone following the same mind-set and pulling in the same direction for the success of the project (Jones, 2015). In order to develop a shared understanding of the project requirements, it is required to capture all goals and objectives from various departments of the project and stakeholders across the project (Jones 2015). Jones (2015) further mentions that whatever method is used to capture goals and objectives should result in a clear and agreed upon set of project objectives.

As people wouldn't commence a road trip without ascertaining where they are going, the same logic applies when scheduling a project (Jones 2017). An absence of direction and indistinct goals are among the prevalent motives of why projects are unsuccessful (Jones 2017). Jones (2017) states that while it may be impossible to foresee every conclusion, taking time at the outset to outline and resonate intentions and goals can drastically escalate the fortuity that your team fruitfully concludes a project.

2.2. Plant Management

Plant management refers to the management of construction plant and equipment in construction site (Wiki 2018). The construction of mega projects has exacerbated the rate of change and moreover, witnessed widespread development of mega civil engineering and construction projects. As a result, the demand on the machines were increasingly deployed as an economical alternative to costly labour resources (Hendrickson 2013). In the earlier days, the powering system of the machines were steam. This was clumsy and inefficient but in the 1950's a new modern diesel system was introduced with more potential for work (Edward, Aloke & Li 2015). Current construction project managers must therefore chase the effective operation of their apparatus for the business to be profitable, and thus the company endurance would be guaranteed (Hendrickson 2013).

According to Amarald Group Publisher (2009), there are three factors that affect plant management. These are: plant maintenance, downtime and health/safety. In the construction of mega projects, many are in tune with the construction plant charges which require unalike utilisations in order to make it effectual in the construction site (Aadal et al. 2014). There are also other factors that affect plant management, such as commissioning expert mechanics to upsurge the superiority of the plant and having enough fuel to avoid plant down time (Bahru & Malaysia 2014). Contained by the broader subject of construction management, other principal themes are recognized namely productivity, optimisation, robotics and automation, machine control and operators and competence (Edward and Holt 2009).

2.2.1 Plant maintenance

Plant maintenance refers to the maintenance activity carried out on equipment to ensure that it is reliable and can perform its function (BinJabar 2008). Plant maintenance has had a immense influence on the success of the mega projects, namely, it optimizes production systems in order to meet its long term objectives. In general, a production system where plant maintenance is not given attention may contribute to the poor management of the mega projects (Aimienrovbiye 2010). Proper maintenance of the plant during the construction phase can significantly reduce the overall operating cost on the mega project, while increasing the productivity of the plant (BinJabar 2008). To ensure effective operation which is regarded as competent construction, adequate apparatus accessibility, worker and conservational safety as well as preserving extraordinary quality production normally hinges on on how plant managers are capable of maintaining the plant and equipment during the construction of the mega project (Enofe & Aimienrobiye 2015).

Traditionally there are 3 types of upkeep that have been eminent and discerned by the nature of the task that they are as follow:

Preventive Maintenance refers to the maintenance of certain services on the apparatus and programming the interventions of addressing their weaknesses in the most favorable time (Garamo, Matzeng &Palite 2013).
Corrective maintenance refers to maintenance which is fated to correct flaws with the equipment and that are transferred to the maintenance division by the oparater (Garamo,Matzeng & Palite 2013).
Predictive maintenance refers to the constant reports on the rank and functioning dimensions of the fitting by knowing the values of certain variables (Garamo, Matzeng &Palite 2013).

2.2.2 Plant Downtime

Plant downtime is the time or period recorded when the plant is off-line and not producing any product or adding any value to work on site (Lean manufacture 2009). Construction plant downtime for mega projects can have major delays on production and, as a consequence, increases the cost of the project. Therefore, the accurate prediction of downtime of the plant should be considered prior to project planning (Edward, Aloke and Li 2010). Effective management of the plant and utilisation of historical data should be used to achieve a considerable positive effect and improve the performance of the plant in the mega construction project (Edward et al. 2010).

2.2.3 Health and safety

Working near a plant in the mega project can have a high risk. Particular care should be taken to make sure that project participants working at the plant are safe. The increase of accident and incident caused by the construction plant in the mega projects affects the production on site. Duty holders are encouraged to follow the holistic approach to avoid any accident caused on site (Construction Industry Council (CID) 2008). CID Recommends that duty holders conduct risk assessments to identify any risks that may result in accidents on the construction site. Health and safety risks can also lead to downtime and affect the productivity of the construction plant (Edward & Holt 2008). More than just affecting production, accidents and wounds can bring countless losses to individuals, organisations and communities. Safety is an inevitability and should be implemented to avoid preventable loss of property, injury or death (Rashid, Bassion & Bawazeer 2007).

2.2.4 Productivity

It is an economical extent of output - of a worker, machine or total economy in formation of a mega project (Manjeri 2011). Manjeri (2011) states that in the business domain, output measures the investment in capital such as buildings, machine, raw material and labour. Construction productivity principally depends on plant performance. Dependable measures of productivity is the yield per work-hour being accomplished by the plant (Manjeri 2011). Productivity progress in the mega construction trade has a chief bearing on expanding the GDP (Manjeri 2011). Due to an increasing number of plants in mega projects, productivity gains momentum (Alexander 2015). Laufer and Alexander believed that if plant management is taken into consideration in the mega project, production in the project will succeed.

2.2.5 Plant Optimization

This term refers to plant yield where efficiency is maximized in the construction site along with the plant facility energy and plant use and implementation (Mattigly 2012). The goal is to find a cost effective alternative with a high performance under the given limitations by maximizing the desired factors and minimizing undesired ones (Griffin 2015). During difficult times in construction, plant optimisation can be a solution to increase productivity (Griffin 2015).

2.2.6 Robotics and Automation Plant

This is the standalone plant that can operate on their own and completely unattended which frees people for more complex, high-value and sensitive tasks that require human attributes. This can be emotional intelligence or judgment (Frost and Sullivan 2017). Today's mega construction projects are characterized by complicated designs under a short building period while the demand of quality cannot be compromised (Bock and Langenberg 2014). Bock and Langen (2014) believed that the project manager of mega projects prefer to use robotic and automatized plants to cut down costs and to obtain good quality work thus forgetting the challenges of using a robotics plant (Bock and Langenberg 2014). According to Bock and Langenerg (2014), the challenges of using robotics in construction is that production of construction is complex and ill-structured which may require more quality management systems. The corporeal environment of construction is frequently more antagonistic to machines and people, so machine design must be sturdy and vigorous to account for intemperance of weather, dust and unanticipated forces (Bock and Langengberg 2014). As much as robotics and atomisation in construction seems to be more advantageous in quality and production, it can create major social issues in communities since less people are employed in the construction of mega projects (Civil Engineering home 2017).

2.2.7 Plant operators and competence

Competence is a question of the ability to effectively apply experience in performing a specific task properly (Freeman 2013). The operation of a construction plant involves machinery controlled by an operator at all times when in use. The improper use of machinery has resulted in a number of serious accidents and injuries in South Africa (Healthy and Safety Inspectorate (HSI) 2017). HSI (2017) states that in many cases this is due to the failure of ensuring that operators are adequately trained and assessed to operate the plant. If the operators are not trained, it can have a negative effect on the project such as delays due to slow productivity or delays that may be caused by plant downtime (Bryant 2014). Construction vehicles and mobile plants are used on most construction sites. If used correctly by trained, competent persons they are useful tools that assist with production without harming anyone (Nortje 2009).

2.3 Production Management

Productivity in the construction of mega projects is the key driver for project success. Poor productivity leads to project failure (Sezer 2014). Productivity is also a key driver for growth and prosperity in any country. To manage productivity, there is a requirement of understanding the factors affecting productivity (Sezer 2014). There are countless motives for construction corporations to emphasize improvement in productivity when they construct mega projects. A number of reports have confirmed that there is a cumulative opening between remunerations and output which, in the long run, is unmaintainable (Loosemore 2014). Makulsawatudom & Emsley (2010) state that there are several number of reasons, which are contributing to poor production management, these are: a deficiency of material, unfinished drawings, inspection delays, ineffectual supervisors, instruction times, shortage of tools and apparatus, meager communication and deprived site conditions.

2.3.1 Lack of Material

Consideration needs to be given to material flow through the supply chain up to installation site. Material can signify up to 70% of the projects construction budget, hence any way to diminish wastage and improve output will have a cost and time benefit (Donyavi & Flanagan 2009). In respect of lack of material potential for improvement, Donyavi & Flanagan (2009) suggest that clients should make progress payments when supplies have been transported. Implanting better systems of work, exploring the quality of material to be used and introducing material management meetings should be implemented to advance co-ordination concerning site and office. Material indicates major expense in a construction site, so overall cost can be reduced by controlling procurement cost. The early procurement of material may hold up capital interest charges sustained on the surplus inventory of material (Zeb et al. 2015).

2.3.2 Incomplete Drawing

The study that was conducted by Makulsawtudom, Emsly & Sinthawrong (2009) reflect that unfinished drawings have a significant effect on output, mainly because clients offer restricted time and budget for designers to finish the design in order to accelerate the bidding process, which result in unfinished, impractical and conflicting drawings. This negatively affects the production during the execution stage of the project.

Change or amendments of work require an adjustment in the contract price, or the completion date should be allowed only by written change. The incomplete drawing leads to the scope adjustment which may also cause adjustment in the prices and that affects the production on site. All changes made on the drawing also needs to be specified and be recorded in an official document (Watten 2011).

2.3.3 Inspection Delays

Inspection needs to be carried out regularly to make sure that it propels the cash flows on site. Once there are delays in inspection, the productivity will be affected (Gascuena, Burgo & Fernandez 2011). Scheduling weekly site inspection visits, fixing dates and times without changing it, is preferred, to increase the production on the mega project (Gascuena et al. 2011).

2.3.4. Incompetent supervision

In any construction site, supervision has a key role in production on site (Christodoulou 2016). Christodoulou (2016) states that characteristic supervisory purposes comprise preparation and assigning work, making decisions, observing performance and acquiescence, providing leadership, encouraging team work, and warranting staff participation. If all the mentioned is not taken care of, production becomes poor. The consequences of inadequate supervisory results in unsupervised workers producing poor quality work and working at a slow rate (Alberta health services 2015). Having adequate supervision on site is the key to increasing production while inadequate supervision could lead to poor production (Infrastructure Health and Safety Association 2015).

2.3.5 Instruction times

This is the exact time of issuing instruction to co-workers (Sergeant 2016). The author further mentions that in construction sites, it is normally specified that variation instruction or any other form of instruction must be in writing however, the time is not stipulated. It is vital to issue instruction in a good time frame. If the variation instruction is issued late, the changes that need to occur might not be implemented timeously in the project (Fischer and Liu 2012). Correct timing instruction could increase the effective production in the construction site (Fischer and Liu 2012). Timing is a crucial factor in the construction industry due to the massive implications therefore all stakeholder need to be very careful when instructions are issued (CIDB Section 3 Guide 2013).

2.3.6 Deficiency of tools and equipment

Tools and equipment are vital for progress and to meet targeted production (Makulsawatudom and Emsley 2009). Good project production can be easily achieved when all tools and equipment are available in the construction site. It is difficult to hold workers accountable for poor production if they were not given the necessary tools and equipment Project Management Book of Knowlegde (PMBOOK 2012). Shortage of tools and equipment in mega projects can result in major production losses as well monetary losses to the construction company (Compbell 2018).

2.3.7 Poor communication amongst construction team

Mega construction sites are characterized as complex, fragmented, dynamic and involves project stakeholders. Effective communication is essential to achieve good production (Gamil and Rahman 2017). Poor communication has many consequences in construction such as poor production, cost overruns and time overrun (Gamil and Rahman 2017). If the team involved in construction fails to communicate about matters and challenges on site, production is affected (Gamil and Rahman 2017). All construction project implementation necessitates communication between specialists in numerous phases of construction to make sure that production and progress of the project is being achieved (Tipili, Ojeba and Ilyasu 2014). Therefore using appropriate communication methods can resolve construction problems which may hinder the site productivity (Tipili, Ojeba and Ilyasu 2014).

2.3.8 Poor site conditions

This refers to the surface and subsurface condition of the construction site (Exponent 2017). Effective site condition ensures that production is maximised on site (Designing Building Wiki (DBW) 2018). Cautious sizing and positioning of temporal amenities can help diminish travel times, overcrowding, waiting times and makes the site an operative workplace with healthier working morale (DBW 2018). Production and productivity are affected by variables such as site conditions (Abrey 2014).

2.3.9 Improper construction methods

This is the process of adding structure in the real property (Wikiversity 2018). Improper construction methods often lead to poor production (Stanley 2015). Construction activity is required to be carried out using the best practices, methods and tools. When proper construction methods are not followed, the production is negatively affected (Sunjka and Jacobs 2013).

2.4 Supervision of workers

Supervision of workers is the general direction, coordination and oversight of the workers in the construction of the mega project (Victoria 2008). New workers can present hazards on a construction site if they are not properly trained and supervised accordingly (Lochbaum 2017). Workers can cause serious damage to themselves and other workers if they are not supervised when they are given a certain task. Before tasks are assigned to workers, managers should check whether they have the skills and knowledge required to perform that particular task (Lochbaum 2017). On mega projects, workers supervision has a significant role in production as well as in averting mishaps.

Supervising tasks consist of preparation and allocation of work, decision making, and performance observing, providing leadership and ensuring workforce involvement. Therefore, supervision means that the manager is heavily involved in the running of mega construction projects and ensures that production and health and safety is effectively managed (Wolters 2016). Wolters (2016) believes that poor supervision can be experienced if supervisors do not have leadership skills. This author also mentions that poor communication between supervisors and workers is a major factor in supervision. While it is not a secret that construction locations are some of the utmost treacherous workplaces in the world, several injuries can be prevented each year if there is adequate supervision on the construction site.

Poor training of workers, usage of wrong tools and labour dispute are some of the factors which affect the workers management (Coxwell 2014). Monitoring of teams performance, ensuring teamwork and developing teams, facilitating workforce involvement and failure to apply disciplinary procedures are mentioned as some of the factors affecting supervision of workers (Anderson 2005).

2.4.1 Poor training of workers

Lack or poor training refers to a lack of the requisite qualities or resources to meet a task (McDonald 2014). Personnel can contribute to the triumph of the company if they are taught how to complete their tasks, trained in different coursesonsite or at different locations during orientation. The production rate can be very low if personnel don’t know how to accomplish their jobs self-assured. Untrained personnel could devote a substantial amount of time pursuing help to execute their job or they could execute their task to their understanding which may lead to poor quality (Amo 2013). Even supervisor needs to be accurately selected and like all recruits on construction sites, they must to be proficient. This will involve training, for example, the Construction Industry Training Board (CITB) offers a 2-day training course for construction site safety supervisors (Wolters 2016).

2.4.2 Inadequate leadership skills by supervisors

Inadequate leadership is defined as the lack of aptitude to influence people or groups in the project (Maxwell 2007). Collins (2005) defines inadequate leadership as the lack of setting revelation, inclinations, objectives and influence in every aspect of our culture. Leadership is one of the most important skills required in the construction industry due to promptly altering project loads, workforce and corporate structure. The modern construction entity has had intense fluctuations over the earlier years (Hagberg 2006). On many projects, the labour on the job has the biggest influence on project victory or catastrophe so if there is a shortage of leadership skills, project production can suffer the most (Hagberg 2006). Hagberg (2006), mentions that if supervisors lack leadership, all elements of the project suffer - especially production.

2.4.3 Poor communication between supervisor and workers

This refers to the communication break down between the supervisor and his subordinate during the construction period (Shanock & Eisenberger 2006). Whenever there is a communication break-down between the supervisor and subordinate, project performance is affected. The supervisor should play a major role to develop good working relationships with their workers to make sure that communication among the team is positive (Wayne & Ferris 2010). Subordinates who are perceived to have good communication with their supervisors are seen to be using significantly more articulated dissent than subordinates who are perceived to have low communication with their supervisor (Kassing 2009).

2.4.4 Supervisors lack of planning

It is an organization aspect carried out by the managers and supervisors that make a job easier for their subordinate (Bonga 2012). If the supervisor fails to plan his work, his subordinate will suffer the most since there will be no work direction and proper instructions by the supervisor (Bonga 2012). The supervisor should involve his workers to improve planning; this helps to get the buy-in and encourages workers to take responsibility for their own development (Bonga 2012).

2.4.5 Supervisor failure to allocate work and tools

When a duty is created, or a announcement of being conveyed as a result of implementation of an activity - that duty or announcement must be directed to particular users with the correct tools to action it (IBM 2011). This process is known as work and tool apportionment.

2.4.6 Failure to monitor team performance

Monitoring means to check if what was set out to do is completed in the correct time frame (European Social Fund 2016). This refers to the supervisor failure to set objectives, motivate and give support to the team members (Europe and Scotland 2017). Monitoring is a consistent process that methodically collects information within quantified pointers to offer supervision and the main stakeholders with data on the scope of advancement and accomplishment of objectives (Kessler and Tanburn

2014). If performance is not monitored, the accountability of workers becomes obsolete and workers tend to shift responsibilities in the case of poor performance (McEwan,Ruissen,Eys,Zumbo and Beauchamp 2017).

A practice that enables the management of performance of personnel through preparation, consistent evaluations and response is a way of encouraging personnel to reach their complete potential in line with the department's aims (McEwan,Ruissen,Eys,Zumbo and Beauchamp 2017).This process enables the supervisors to deal effectively with inadequate performance and equally permits recognition of outstanding performance (McEwan,Ruissen,Eys,Zumbo and Beauchamp 2017). Consistent disappointment by an employee to meet the compulsory performance principles set out by the supervisor results in discussions with the employee. A project programme without a sturdy internal observing structure often cannot be efficiently appraised (Kessler and Tanburn 2014).

2.4.7 Facilitating workforce involvement

Workforce involvement refers to the provision of systems to enable the active participation of workers in design, development, implementation and continuous improvement of performance systems (Centre for Chemical Process Safety (CCPS) 2017). CCPS (2017) further states that effective workforce involvement comprises developing a written plan of action regarding workers participation and consulting with workers on the developments of elements of the project management system.

Workforce involvement provides a consultative relationship between supervisors and workers at all levels of the project (CCPS 2017). Workers are encouraged to have voice and are given the ability to have influence in the project (Office of Rail Regulation 2016). There is a growing body of evidence indicating that operative worker participation and discussions in the project has an affirmative influence both in specific workers and the organisation as whole (ORR 2016).

Workers who are participating are dedicated and feel appreciated, this is mirrored in grander job satisfaction and lesser likelihood of departure from work (ORR 2016). Current research proposes that high-involvement work practices can improve the optimistic beliefs and approaches allied with employee engagement, and that these practices can produce the categories of unrestricted behaviours that lead to greater performance (Konard 2006).

2.4.8 Failure to apply disciplinary procedures

In any communal system, regardless of its nature, it is significant for the contributor to regulate a set of instructions that will control the behavior of its associates and should be practical in order to function efficaciously (Staff Training (ST) 2017). Similarly so, it is important in the construction of mega projects to regulate a set of instructions to standardize the association between the employees and the supervisors in the practice of a corrective technique (ST 2017).

If corrective actions are not applied to a certain worker, the co-workers tend to follow same pattern. In the case of misconduct by an employee, supervisors must ensure that disciplinary procedures are followed. This helps to improve the performance of the employees (Claassen 2018). Applying disciplinary procedure in terms of misconduct encourages all workers to behave in a good manner (Claassen 2018).

2.4.9 Ensuring teamwork and developing team

The accomplishment of a project will be contingent on how well-organized project teams are in implementing project goals and aims during the project management lifespan (Lacerena,Marlow, Tannenbaum & Salas 2018). Lacerena,Marlow, Tannenbaum & Salas (2018) states this will be impacted, in part, by how well work tasks are harmonized to specific aptitudes, how well associates work within a cluster and whether project tasks are successfully ranked. Here, superiors can help by guaranteeing that project goals and objectives are plainly voiced, making the correct work tasks, and boosting teamwork and responsibility (Lacerena,Marlow, Tannenbaum & Salas).

To evade superfluous glitches, supervisors should start with the work and not the team. This warrants that the correct people are assigned to the work assignments that fits their capabilities (Anderson 2015). Each member is positioned on the project because of core aptitudes that are considered compulsory to advance project aims or intentions (Anderson 2015). In making assignments, it is crucial for project managers to have an unblemished idea of specific skills, character and enthusiasms that employees have (Underson 2015).

Shared or contact work is a central prerequisite on projects (Muslihat 2018). Here, operative teamwork transpires when each participant involved in a communal assignment is clear about the precise tasks he is accountable for finishing (Muslhat 2018). Noticeably distinct task assignments will inspire personal liability and diminish the possibility of confusions and clashes among project team members (Muslihat 2018).

2.5. Project social facilitation

Social facilitation is the processes involving different people and institutions in pursuit of one common objective, this is done to mobilize communities around the program and projects to obtain their support and participation (Phala 2014). Frequent dissimilar and sometimes discrepancy benefits can be exaggerated, both certainly and damagingly, during the course of infrastructure and construction projects. Waning to confront and encounter the distresses and anticipations of the stakeholders involved has given rise to numerous project catastrophes. One way to address this matter is through a hands-on method to project decision making. Whether the involvement mechanism is operative or not, hinges on the client/owner (Terry, Thomas & Martin 2013). There is an accumulative call for grander public involvement in founding science and technology policies, in line with democratic ethics. An assortment of public contribution measures exist whose purpose is to access and encompass the public, reaching from the public hearing to the unanimity conference.

Inopportunely, an overall deficiency of practical contemplation of the value of these approaches ascends from misunderstanding as to the suitable targets for evaluation. Given that the excellence of the output of any contribution exercise is problematic to regulate, the authors recommend the necessity to contemplate which facets of the practice are desirable and then to measure the incidence or quality of these practice characteristics (Rowe, Lenny & Frewer 2011). The public participation can work through legal committees that were chosen and nominated by the councilors. The accountabilities of councilors comprise formulating policies and preparation of undertakings that help the community participate in social, economic and political duties in their areas (Bonga 2012).

Despite the importance of citizen participation, a number of reasons have resulted in low participation in service delivery. These are the following aspects: absence of community buy-in, community turbulence, non-payments of compensations (Bonga 2012). Also when the legal framework is not clear on the citizen participation, the local government acts do not refer to citizen participation (Kwena 2013). Some other factors which affect project social facilitation are location of the project, poverty and lack of information disclosure (Ekung, Okonkwa and Odesola 2014).

2.5.1 Lack of community buy-in

Projects are idealized without propagation by the government to the people. This information is essential to avert any misinterpretation of project initiatives. Due to the fact that project documents are often drafted in technical language, this prevents proper understanding except for the well-educated few (Kwena 2012). Such lack of understanding causes lack of community buy-in and it is a disadvantage to the communities.

2.5.2 Lack of legal framework

For each project to extract natural resources from the ground, there are rules that govern the right and responsibility of governments, companies and citizens (National Resources Governance Institute, 2015). It is crucial for everyone involved with information to be aware of the potential legal issues and to demonstrate an understanding on the prominence of security, discerning security actions and following guidelines. These issues that should be tackled incessantly in an ‘awareness of the project’ program (Wong 2009).

2.5.3 Community unrest

Productivity has been worsening on construction locations due to community discontent leading to a undesirable influence on the price and value of construction. According to the Department of Labour’s current statistic, the number of protests recorded in 2013 is greater than the overall number of protests recorded in the previous years (CIDB 2015).

2.5.4. Non-payments of compensation

Non-payments of compensation refers to the failure of delivering promises made to the parties such as famers and communities, who were utilizing land for other purposes other than construction or mining (Lawyers for Human Rights 2014). Before the construction of mega projects commences, developers must obtain permission from the concerned parties (such as government and communities) around the area of the project (LHR 2014). The construction industry is one of the crucial industries around the world, however this industry also has a damaging impact. Construction often pollutes air and soil and can disrupt farming activity and community life (LHR 2014). LHR (2014) emphasizes that communities throughout the world struggle to defend their rights to their land, to their environment and to their resources when it comes to construction. Although construction companies promise payments of compensation and jobs, the community is affected negatively and see no benefit in the construction of those mega projects (LHR 2014). Nonpayment of compensation causes the community to strike against the project which affects the projects commencement and development (LHR 2014).

2.5.5. Location of the project

Location of the project concerns a place, a position or a spot where the project is situated (Zenun 2011). The interest of the community can depend on the location of the project; if the project is located closer to the public, the interest of the community increases (Department of Water and Sanitation 2016). Whereas if the project is located a distance away from the community, the participation of the community decreases. The exposed site always attracts people and they would want to have an input since the project is visible (Mnengwane 2014).

2.6 Material wastage in mega project

Wastage of construction resources on site denotes the variance between resources transported to the construction site and those that are actually used for the construction work (Onabule, 2012). From Onabule (2012), it can be asserted that construction wastes are those resources delivered to site for construction and are not used in the actual construction components. This supports Seeley (2010) who states that not all resources distributed to construction sites are used for the purpose for which they are ordered. Furthermore, Formoso, Isatto, and Hirota (2014) express waste as: "any losses produced by activities that generate direct or indirect cost but do not add any value to the product".

Rational management of materials to circumvent waste is an essential deliberation for dropping construction cost and construction period. Therefore, there is a need for competent resources to control output and cost in construction projects. The overall objective of any on-site management actions should be focused to provide full-guard on construction resources and to achieve effectual usage of such resources (Mohammed and Anumba 2006). Many projects lack the generation of profit due to the material waste that occur during the implementation of the project (Ayegba 2013). Ayegba (2013) also believes that the following are factors of material wastage: impairment by mishandling, re-work due to reduced workmanship, insufficient stowing amenities on site, postponement in material stock, insufficient administration, reduced site safekeeping, modification of designs, over ordering of construction material as well as theft and vandalism.

2.6.1 Damage by mishandling

This is the material damage due to improper material movement from the suppliers to storages and from storages to the construction (Kumar, Sakthivel, Elongovan and Arularasu 2015). If the material is mishandled it gets damaged and becomes waste (Kumar, Sakthivel, Elongovan and Arularusu 2015). Handling and storing material involves deverse operations such as hosting masses of steel with cranes, driving trucks encumbered with concrete blocks, carrying bags or material physically, and amassing palletized bricks or other materials (Chao and Henshaw 2014). The well-organized supervision and storage of material are vital to the trade. In addition to raw materials, these actions deliver a constant flow of parts and assemblies through the workstation to guarantee that materials are accessible when required (Chao and Henshaw 2014). Unfortunately, the mishandling and improper storage of material often results in damages which causes material waste (Chao and Henshaw 2014).

2.6.2 Re-work due to poor workmanship

The construction business is thriving and as a result, Brandon construction lawyers are witnessing an increase in construction defect claims (Cotney construction law 2017). One of the major zone of apprehension is reduced workmanship which is the lack of skill and quality rendered into creating a product or finishing a project (CCL 2017). Most defects in construction of mega projects are due to human error, human error translates to poor performance in workmanship and once the error has been identified, the work is required to be redone and material used is wasted (Mydin 2014). According to research conducted by Building Research Establishment (BRE) (2012), 90% of mega projects have major wasted materials caused by poor workmanship. Most building materials such as cement and concrete cannot be reused, once rework is required; this type of material gets wasted (Othman and Mydin 2014).

2.6.3 Inadequate storage facilities on site

The law says that every portion of a construction site must be in decent order and every place of work must be sanitary. The objective is to attain what is called a respectable standard of housekeeping throughout the site (Health and Safety Executive 2017). HSE (2017) also indicates that all service providers must plan, manage and monitor work so it is concluded out safely, minus risk to health, and material wastage - this includes cautious scheduling of material storage. All material needs to be stored by considering the space available, access, powerlines, fire protection and distances between store rooms and spot where material will be used. If all this is not considered, this will result in great loss of material (Reclamation Safety and Health Standards 2009). It is crucial that all waste accumulated should be at the point of origin as they transpire and it should not be permissible to lie about for any span of time (RSHS 2009).

2.6.4 Delay in material supply

The material delay is associated with material control on site; this is to ensure the availability in required quantity at the proper time (Agyekum 2012). The material controller must have a solid plan of anticipated materials and accurate time of material delivery. If delays occur on the delivery of material, it must be identified and necessary arrangements should be made to avoid waste of material due to delays of supply (Agyekum 2012). A strategy to reduce material waste and production cycle time, inventory and flow variation is the usage of just-in-time (JIT) deliveries, which has been widely applied in the manufacturing industry (Darvik and Larsson 2010).

2.6.5 Inadequate supervision

Inadequate supervision refers to the oversight of the supervisor to be able to guide their subordinate in avoiding material wastage (Landen, Bauer & Kohn 2003). Inadequate supervision results in poor production which leads to waste (Landen, Bauer & Kohn 2003). By improving pre-eminence of supervision on site and hiring accomplished supervisors, the capacity of material wasted can be compacted (Adewuyi and Odesola 2015). Supervision of work on site can impact in material being wasted or material being saved. The sooner the supervisor identifies the incorrect method of construction the lesser the material to be wasted and the later the error being identified the more material will be wasted (Kulatunga, Amaratunga, Haigh and Rameezdeen 2013).

2.6.6. Poor site security

Site security are the measures in place on site to make sure that the site is protected over the period of the project (Millis 2017). The risk of poor site security measures in mega construction sites can result in serious injury or high material wastage (Aviva 2011). If the site is easily accessible through any number of access points and none questions unauthorized personnel on site, that site has high risk of material wastage (Bowen 2017). A noble security structure not only gives workers a sense of protection at their work place, but also maintains belongings and other infrastructure in the building development (Andy & Andrew 2011).

2.6.7 Alteration of designs

Alteration of designs are defined as changes of design in the project. These changes may happen at any stage of the project (General Service Administration 2014). GSA categorized alterations into to two basic scales: alteration during planning and alteration during project implementation. Material wastage occurs in the alteration that happens during project implementation (GSA 2014). Most of the material wastage in mega projects occurs when the designs are altered and that material cannot be re-used since it either becomes damaged during changes or it can no longer be used since the scope of work has completely changed (Bordens & Abbott 2011). Bordens & Abbott 2011 advised that this material wastage can be minimized by having a proper planning in design phase and solid communication among the project team during the construction phase. Due to alteration of designs for reasons such as deterioration, corruption, or fashion, many construction materials and components are changed and the old materials become wasted (Cosgun and Salgin 2012).

2.6.8 Over ordering of construction materials

Material ordering refers to the purchasing of construction material from material suppliers. This could be simpler but in many cases the process goes wrong, resulting in material wastage (Mathew 2015). Mathew (2015) says that it is usual practice to slightly over order material such as bricks or roof tiles to accommodate waste that can happen during material transportation however, it must be at a lower percentage. The material procurers must check the material in hand to avoid double ordering of material and over ordering the material (Denis and Pontille 2015).

2.6.9 Theft and vandalism

Inadequate security is the main cause of vandalism at construction sites. Pipeline collapse, broken windows, robbery etc. can cause significant losses to the project. According to John and Itodo (2013), robbery and destruction can be key price components of a construction project because of their effects and allied problems. Burglary and defacement may lead to waste where supplies like cement is stolen by incompletely opening the sack and concealed for a period of time until the cement coagulated or was about to be relocated from storage; being unaware to the fact that it was opened, the content gets spilled, leading to waste (Berg & Hinze 2017).

Theft and defacement on building sites have a number of antagonistic financial effects due to the charge of employing or substituting stolen items, insurance excesses, accumulative insurance payments and costs of cultivating new security measures (Sakurai, Mayhew and White 2008). Non-financial costs are also experienced. For example, waiting for stolen items to be replaced may suspend the building process, and hence builders' output. This may affect the status of companies. The expenses ascending from burglary and impairment at building sites will finally be supplemented to the cost of building new homes.

2.7 Health and Safety Management

Construction health and safety (H&S) has extensively been the focal point of many in the South African Construction industry, considerably the stakeholders (CIDB 2015). Construction health and safety also called occupational health and safety, refers to the right of every employee to carry out daily work in a harmless environment (Wakeling 2017). Wakeling (2017) further explains that working in construction should include the uppermost degree of bodily, psychological and social well-being of workers. While it is recognized that many trade associations and specialized societies including contracting administrations and others have made momentous determinations to progress H&S within the construction of mega projects, overall construction H&S is hardly improving at the rate expected (CIDB 2015). The factors that affect the health and safety in mega projects are human factors and, legislation and financial issues (Enshassi 2013). Jannadi (2007) mentioned that maintaining safe working conditions, establishing safety trainings, continuous safety inductions and supervision will improve health and safety. The other factors are ergonomics, space, lighting,cleanliness of construction site and clear movement routes (Health Knowledge 2017).

2.7.1 Human factors

Human factors refer to environmental, organizational and job factors. Human and individual characteristics influence human behavior at work and in turn affects health and safety during the construction process (Heath and Safety Executive 2017). HSE (2017) further mentioned that human factors are concerned with what people are being asked to do, who is doing it and where they are doing it. Human error can be defined as any inadvertent or insufficient choice, taken at any level in the ladder of an institute, which is, or was unsuitable in a given situation (Vondrackova 2016). Human factors can be described as the dealings of individuals with each other, with apparatus and amenities as well as with the management schemes in place (Mallard 2016). Mallard (2016) mentions that indulging and improving human issues and its impact on occurrences require single-minded ideas on people, such as their behaviors, requirements, aptitudes, characteristics, confines as well as creating a maintainable and safe working environment.

To prevent incidents in mega construction sites, it is required to have a comprehensive understanding of the root causes of incidents and to address them holistically (Mallard 2016). The other factor that should be taken into consideration when looking at human factors is that everyone in the workplace is indeed only human and they are fallible (Mallard 2016). Health and safety in mega projects need to be supervised and monitored on a daily basis, since this can cause projects to be stopped in the case where incidents and accidents happens. In most mega projects, hazardous behavior is deliberated to be the utmost noteworthy factor in site mishaps and thus provides indication of meager safety culture (Enshassi 2013). All construction work must be carried out in a very compliant manner and meet the necessities of operational safety, monetary efficacy, the environment and in certain cases, national security.

2.7.2 Legislation

This refers to the laws that guide operations in the construction industry and has significant ramifications (Stewart 2015). The standards, regulations and legislation are part of the modern construction sectors whether in manufacture, designer or use, but an accurate and comprehensive understanding for legislation is required (Stewart 2015). The aim of the legislation is to ensure that in all building projects, whether mega projects or minor projects, new buildings or renovations, people working on that project should be protected with occupational health and safety (Gladwin and Civin 2014). Gladwin and Civin (2014) mentioned that the legislation calls for anyone who fails to comply with laws and regulation could be subjected to a fine or imprisonment of up to 12 months.

If the legislation are ignored by the participants in the mega project , severe incidents and accidents may occur . Legislation need to be implemented before construction commences. A client needs to obtain a construction working permit from the provincial directors for the planned work and this applies to projects ranging from 13 million ZAR and more (Glading and Civin 2014). If legislation are ignored in the construction project, the project automatically falls into the risk category since legislation is at the heart of the project. It should be mandatory for construction companies to go through the full compliance process before being on the client data-base, not only on paper. This will reduce the number of incidents in the industry (Leshoedi 2017).

2.7.3 Financial issues

Occupational harm and ailments are not only problems of well-being, but they are also problems of finances, since they stem from work, and work is a monetary activity (Dorman 2000). Dorman (2000) also states that the role of economic factors in the workplace such as ill-health affects the economic prospects for workers, enterprises, nations, and the world as a whole.

2.7.4 Safe working conditions

The building and construction trade is marked by a great level of abrasion and countless severe work accidents in the world (Workplace Denmark (WD) 2017). WD (2017) says that in order to avoid work accidents and other well-being related difficulties among the employees in the construction site, it is imperious that both employers and workers maintain safety in working environments. WD (2017) further states that most collective accidents in the building and construction industries are:

- Falls from elevation points such as roofs, scaffolding or ladders.
- Falls at ground level such as when walking on slippery or uneven surfaces.
- Mishaps with power tools or machines
- Heavy lifting accidents

2.7.5 Poor safety trainings

At the administrative and site level, meager construction H&S performance is attributable to an absence of management assurance, derisory supervision and scant H&S training (CIDB 2017). In most workplaces, mishaps are an annoyance for the worker and a bother for human resource division. However at construction sites, mishaps have the prospect of being life threatening (Riddell 2017). Riddell (2017) states that employers do need to alleviate safety vulnerabilities to construction workers, but the workers need to keep in mind a list of safeguards themselves when working in such menacing conditions. Leaders in construction must strive to train workers in construction for the sake of their lives and the progress of the project. If employees are not trained in the principles of Health and Safety, the construction environment, and how to protect themselves and other stakeholders around the site, the company may find itself paying the price for accidents and injuries that may occur on site (Ramasamy 2017). Ramasamy (2017) emphasizes that due to the scarcity of resources or a lack of awareness during the construction of mega projects, many business leaders do not think to invest in safety officer training, causing not only their staff to suffer, but their business too.

If training is taken into consideration during project execution, there are three ways it will benefit the project:

- Project would be compliant with health and safety
- A safe and healthy workplace boosts productivity during execution of the mega project.
- Funding health and safety training can save money in the project.

2.7.6 Poor safety inductions and supervision

Health and safety induction is the continual process of educating employees on the site health and safety culture and processes with the aim of safety compliance at all times. This will ensure that employees feel safe, comfortable and are made aware of health and safety procedures (Heath and Safety Executive 2017). On construction sites whether great or minor, control has a main role to play in averting incidents and accidents (Christodoulou 2016). A poor health and safety culture can be disastrous for the mega project, the owner, and the employees. This makes it important to invest more time and money to ensure induction and supervision are adhered to on the project (Martinelli 2017). A good reputation is a critical part of the project and it can bring a great volume of investors, improved community interest and a larger number of individuals who are eager to want to participate in the project (Martinelli 2017).

2.7.7 Ergonomics

Ergonomics refers to the term used by health professionals and marketing mavens with a cavalier attitude; for others it covers everything under the sun (Salonen 2016). Ergonomics can improve health and safety by reducing accidents and potential for injury as well as ill health. It can improve performance in production (Health and Safety Executive 2018). Ergonomics is a science concerned with the 'fit' amid people and their work - it also puts people foremost, taking into reason their competences and confines (HSE 2018). Ergonomics purposes is to make sure that responsibilities, apparatus, information and the atmosphere fit each member of staff.

2.7.8 Lighting

Space, lighting and cleanliness on a construction site is also important since it is impossible to work around the site with limited space or light (HSE 2018). Lighting at work is crucial to the health and safety of each person using the site as a workplace. If it is easy to see a threat, this would result in a lower number of incidents on site (HSE 2018). Reduced lighting can not only disturb the well-being of human beings on site but also causes symptoms of eyestrains, migraine and headaches. It is linked to 'sick building syndrome' in the new and refurbished building (HSE 2018). Poor lighting in a construction site can indicate a substantial cost to the construction company in the form of standing time during incident and payment for those who are affected by incidents (HSE 2018).

In order for that construction work to endure efficiently and securely in phases of inadequate natural light, it is imperative that a site is fitted with suitable artificial lighting (Dessigning Building Wiki (DBW) 2018). DBW (2018) further states that lighting can be used inside for over-all movement and for working on the site itself, outwardly for illuminating entrances, storage and circulation areas, and can also be an operative form of warning for trespassers.

In some ways it could be believed that the more light that is delivered on construction site, the better. However, there are also certain undesirable influences of light; copious light can be treacherous and dazzle people on site – making it difficult to see, while little light can make it tough for a worker to see plainly (Risk Management 2018). Environmental considerations when installing lights are playing a progressively important part of health, safety and well-being contemplations and regulation. The impression of the lighting on the immediate environment needs to be installed in a way that minimizes incidents on sites (RM 2018).

2.8 Logistics planning

Logistics in construction is a multi-faceted procedure which attempts to guarantee (at the precise time, cost and quality) accomplishments such as material stock and management, schedule control, site structure and apparatus setting, site corporeal flow management, traffic activities on and around the construction site and information organization related to all services flow (Procopious 2010). Construction logistics can be demarcated as “the management of the flow of materials, tools, and equipment (and any related object) from the point of discharge to the point of use or installation” (Ruwanpara 2015). Logistics is defined as the cohesive preparation, organization, supervision, dispensation and control of the complete flow of resources and properties as well as the allied information flows (Ruwanpara 2015).

Handling the stream of resources, guaranteeing its quality, inspecting the quantity, allotting the storage zones, managing the inclusive process, activating the orders, and apprising the contributors are chief hindrances in logistics management (Ruwanpura 2015). The construction logistics plan needs to be created and installed as a sign board on site, the plan must be inducted with all site personnel (Jones 2015). Jones (2015) mentioned that a detailed route for access needs to be planned and the planners need to consider the existing building around the site and also consider buildings to be constructed. All traffic and pedestrian management measures need to be included in the traffic management plan and signage in that regards need to be displayed in an accurate position around the site. The following have an impact on the logistics and logistic planning during the construction of the mega project: neighborhood buildings, access routes, delivery and storage, delivery times, public safety, parking spaces, noise and vibration from plant, crane and hoists locations (Jones 2015).

2.8.1 Neighbourhood buildings

This refers to the infrastructure surrounding the mega construction site during the construction process (Odeh 2016). Most of the project takes place in the area where people are already residing and this means that in order to implement the mega project effectively, the surrounding cities should be informed (Thomas and Costa 2017). Thomas and Costa (2017) mentioned that one of the most important reasons is that equipment and material need to be delivered during the project. This automatically involves the community around the site since they are also road users. Other than material delivery, another factor to consider is heavy noise and air pollution which also affects the neighborhood (Thomas and Costa 2017). The logistics plan that focuses only on the construction site but ignores the nearby buildings and infrastructure can create major problems in the mega project. Hence the logistics plan needs to consider the neighborhood building and infrastructure (Thomas and Costa 2017). Thomas and Costa (2017) mention that prior to commencement of the project, a good neighborhood policy needs to be implemented to promote transparency. This should be done through signs with contact details for complaints and suggestions. This brings us back to the issue of social facilitation during implementation of the mega project. All projects need to have a delegated experienced social facilitator to make sure that the surrounding community have access to participate in the implementation of the mega project.

2.8.2 Sites access routes

Site access routes can be defined as points or places allocated in construction for accessing and exiting sites (Procopious 2010). Poor site access during construction of the mega project can create a negative impact on productivity (Procopious 2010). Poor access to construction sites leads to poor production in the project due to delays that occur during material deliveries (Andy 2010). Andy (2010) suggests that to resolve or improve the free access on site, the vehicle and plant access gates should be separated from the exit gate. However, this may not completely resolve the poor site access.

2.8.3 Delivery and Storages

Building and construction materials suppliers face the challenge of infrequent delivery times and stowage of several construction materials (Tecca 2017). For example, gas-concrete blocks necessitate distinctive packaging and storage conditions to prevent the obliteration of the block's material (Tecca 2017). Innumerable paint, dry mixes and sealants necessitate distinctive temperature and humidity settings of storage (Tecca 2017). Once it is established what materials are required for the project, it is also required to plan on how those materials will be received and stored on site (Nibusiness 2018). Nibusiness (2018) further mentions that spaces for storing should be identified during the early design phases of a project and it should be certified that they are evidently distinct at the start of the project. The identified area must be delivery friendly for all kinds of materials to minimize traffic on site. Once the type and quantities of the materials is known and when they will be required during the project, the ordering process can commence and the proper planning in material delivery can be done.

2.8.4 Delivery Times

This refers to the time taken or required to deliver the material on site (Risku and Karkkainen 2004). If time is not considered, material delivery or ordering can have a undesirable impact on the logistics of the mega project (Risku and Karkkainen 2004). Risku and Karkkainen (2004) state that some materials need to be transported exactly at the time of use in order to minimize material storage issues.

2.8.5 Public Safety

Public Safety refers to the welfare and protection of the general public during construction of the mega project (Uslegal 2018). Logistics is about the movement of materials and equipment from where they originate to where the workforce needs it to be. Most of the time construction sites are located around communities and public safety should be considered when planning logistics (Assignar 2017). Assignar (2017) mentions that construction logistics can minimize traffic around the community and includes abnormal load vehicles that move in and out of the community, hence the safety of the public needs to be a priority. When the number of vehicles increase in the area, the surrounding communities become victims of accidents if safety is not considered during logistics planning (Michael 2015). The number of sign boards and visual warnings need to be installed not only on site but also within the community where the vehicles will be moving (Michael 2015).

2.8.6 Parking Spaces around sites

This is the space to be utilized for vehicle and plant parking around the construction site (Lowa State Universirty (LSU) 2016). During logistics planning, project managers should allow space for parking on site otherwise this can cause major problems during the construction of the mega project

(LSU 2016). LSU (2016) further states that it is important that all drivers around the site follow the traffic and parking rules and regulation to ensure that traffic is not blocked on site and bottlenecks are avoided. If the parking is not considered during logistics planning, the workers may park their cars anywhere around the construction site. Some may even block entrance ways and that can create traffic around the construction site (Tsaxiri 2018).

2.8.7 Construction noise pollution

Noise pollution refers to the noise made by the plant in the construction site (Varela-Margolles 2018). Noise is generally deliberated to be an disagreeable sound due to amplitude or volume of loudness and any modality making resonance or offensive audio (Getha and Ambika 2015). Getha and Ambika (2015) further define construction noise as: a noise that ascends from an activity at a construction site that comprises work due to destruction, work related to tactic, and building renewal work. Noise should be included when planning logistics since this can play a crucial role in management of logistics on site (Designing Building Wiki (DBW) 2018). DBW (2018) further states that noise around the site can be exceeded to the point where it may block and destroy communication on site. If those who are on site cannot communicate clearly, this can have a adverse impact in the construction of a mega project. Site noise can interfere with speech as it is impossible to hear what anyone is saying; this plays a role in receiving directions, warnings and other important communication cues (Vaidyanathan 2014).

2.8.8 Crane location

Cranes are machines that are used for lifting or moving loads or materials up, down, sideways, vertically, or horizontally (Makys 2013). The position effects fluency, cost and total consumed time of a building (Makys 2013). Prior to crane location, the following should be known - type of crane, length of beams, the location of beams, the methods of crane fixation and their maximum heights, the methods of construction material supply, methods of crane assembling and disassembly as well electronic power requirements. These factors assist to determine a good crane position (Makys 2013).

Makys (2013) further states that if the previously mentioned is not taken into consideration, it can create measure issues with logistics on site. It is advisable that the crane should be placed outside the floor plan of constructed structure. The location of the crane is close to their shape, position and characteristics of loads to be transported by crane (Irizarry and Karan 2012). During logistics planning the location of the cranes must be taken into consideration to make sure that they are not placed in a way that obstructs vehicles and plant (Irizarry and Karan 2012). Cranes are the central piece of apparatus that should be addressed by the preparation process, and their specific models and layout are the chief yields of that process (Shapira and Ben-David 2017).

2.8.9 Movements of vehicles on site

On average, about 7 employees die annually as a consequence of mishaps relating to vehicles or mobile plant on construction sites (Health and Safety executive 2015). HSE (2015) further mentions that the law states that the supervisor must organise a construction site so that automobiles and pedestrians using site paths can travel around safely. Respectable preparation can help to diminish automobile movement around a site, for example, landscaping to demarcate access and parking areas (HSE 2015). To ensure the safe movement of vehicles and plant on and around site, speed limits should be visible enough within site, alongside a banksman available to supervise entrance and exit from site to ensure safety on site (Haupt 2014). If the above mentioned are not not taken into consideration, the logistic planning is affected and have an adverse impact on the construction of the mega project.

2.8.10 Planning of work

Planning of work is a fundamental and challenging activity in management and execution of construction projects which involves the selection of technology to be used, estimation of required resources (Mellon 2016). Construction planning calls for a plan to complete a construction project centered on budget, work roster, and accessible resources (Riddell 2014). Poor work planning can negatively affect the logistics around construction site since work can be all over the site and block moving plant and equipment.

When construction planning is conducted, it is imperative to fathom that decisions on how to establish the project are either budget or schedule oriented (Riddell 2014). Riddell (2014) futher states that construction is a trade where there is an arrangement of proceedings that must be concluded in order to make sure that work on site does not contradict. Proper planning of work is crucial to advance productivity, lessen delays, deliver the best assembly arrangement, balancing the need for labour and organize various inter-reliant activities as well as provision of free logistics on site (Magalhaes, Mello and Bandeira 2017).

2.8.11 Schedule for plant, labour and material management

Project scheduling is well-defined as the procedure of defining when project events will happen contingent upon distinct periods and model activities (Uke 2017). Schedule limitations postulate when an activity should begin or close, based on period, precursors, external forerunner relationships, supply availability, target dates or other time restrictions. The physical resources in the construction of mega project account for a substantial quantity of money and time (UK Essays 2017). Uke (2017) states that it is important to the victory of the mega project that these physical assets are managed and planned properly.

Good project management must dynamically chase the competent use of labour, material and equipment (Hendrickson 2008). Hendrickson (2008) further state that it is the role of the project manager and site organization team to guarantee that the three chief physical resources: labour, plant and materials, are managed competently and efficiently. Failure to do so will result in postponements and often expenditure caused by circumstances like resource scarcity, resource line up, disadvantaged plant output and meager labour relations.

2.8.12 Use of Banksmen on site

Banksmen refer to the trained operators who directs vehicle movments on and around site (HSE 2017). The duties do not only involve small vehicles but involve large vehicles delivering materials, cranes during lifting operations (Designing buildings wiki 2017). Bankmen must identify areas of danger around the site; this help to minimize accidents on site (DBW 2017).

During logistics planning of mega project banksman should be allocated around sites to make certain that the traffic movement is controlled on site (Building safety group 2018). Other than incident on site, the absence of banksmen can affect the entire operation on site since it can block the movements of vehicles on site (BSG 2018).

Chapter 3

Research Methodology

3.1 Introduction

In this chapter, methods and procedures used in gathering information for this research will be discussed along with the data gathering. The methodology applied in this study specifies the techniques, methods and procedures that were used for achieving the information needed to form the research questionnaire, interview question, data collection, analyze data and present findings. The methodology undertaken in this research is deliberated in the accompanying sections.

3.2 Description of research

This is a vigilant and comprehensive study into a precise problem, concern, or subject using the scientific method (Kowalczyk 2017). It is a systematic inquiry to describe, clarify, predict and control the detected phenomenon and also comprises inductive and deductive methods (Kowalczyk 2017). It is referred to as searching for and gathering information, usually to answer a particular question or address a specific problem (College of San Mateo 2016). The purpose of the research is to discover new knowledge, describe phenomena, and be able to predict, enable, explain phenomena and enable theory developments (Goddard and Melville 2001).

3.3 Categories of research

The study incorporates two categories of research approaches, namely:

3.3.1 Descriptive Research

It can be described as a declaration of businesses as they are current, with the data having no regulation over variables. Moreover, eloquent studies may be categorized as basically the effort to define, pronounce or classify ‘what is’, while investigative research endeavors to establish why it is that way or how it came to be (Dudovskiy 2018). According to Dudovskiy (2018), descriptive research is “aimed at casting light on current issues or problems through a process of data collection that enables them to describe the situation more completely than was possible without employing this method”.

The type of question that the data asks ultimately determines the type of approach that is necessary to complete and conduct the research. In descriptive studies, the primary concern is to find out “what, how, and why” types of question. Descriptive studies can also be quantitative or qualitative and it can encompass the collection of quantitative data that can be arranged along a scale or numerical form such as marks on a test or the number of times a person chooses to use a definite feature of a interactive program, or it can define classes of information such as gender or outlines of interface when using technology in a group situation.

3.3.2 Experimental Research

Research designs are either experimental or non-experimental. Experimental research is conducted mostly in laboratories in the context of straightforward research (Luzzi 2011). Luzzi (2011) further explains that the principal benefit of the experimental design is that it affords the chance to identify cause-and-effect relationships. In experimental research, the instigator influences circumstances for the resolution of shaping their result on behavior. Subjects should be oblivious of their membership in an experimental group so that they don't act contrarily.

Experimental research is the study that strictly adheres to a scientific design (Harland 2014). Harland (2014) further explains that the purpose of experimental research is to seek to outline a relationship between 2 variables- the dependent variable and independent variable. Once finalizing experimental research, a correlation between a precise aspect of an entity and the variable being considered is either supported or rejected.

3.4 Research Paradigm

This refers to the set of similar beliefs and agreements shared between scientists about how problems should be understood and addressed (Patel 2015). Chilipunde (2010) mentions that the research could have any standard grounded on the following centrism: phenomenology, positivism or triangulation paradigm.

3.4.1 Phenomenology paradigm

Welman (2005) state that the data observation is not the authenticity but an clarification of reality. Fellows and Liu (2007) state that a paradigm is a theoretical framework which involves a scheme by which people view events. Johnson and Duberley (2000), and Alvesson and Deetz (2000) mention that minds are not inert receivers of sense data; rather they habitually select, limit, organize, and construe involvements of outward reality. They further state that it is impossible to disconnect the data from assumptions due to cultural legacy, especially regarding the philosophical dualism (between visible and the imperceptible mind) and technological attainments. Phenomenological paradigm assumes that reality is communally constructed and therefore understanding of it is subjective, wide-ranging across circumstances and cultures, and is intentionally ideological.

3.4.2. Positivist Paradigm

The positivist paradigm deals with the social world on the ontological postulation that realism is outward and objective (Chilipude 2010). Philipude (2010) says positivist paradigm tries to investigate into this reality on the epistemological assumption that physical sciences are the foundation for understanding the societal world and hence the justification for carrying out studies is to disentangle universal laws that rule underlying relationships through empirical studies that are not value-laden.

3.4.3 Triangulation Paradigm

Regardless of the nature of the research, robustness and neutrality is principal (Chilipude 2010). This is what the triangulation paradigm defines. Fellows and Liu (2012) describe triangulation as the use of two or more research methods to examine the same, such as an experiment and interviews in a case study. The resolve of choosing this method is to abolish shortcomings of the phenomenological and positivist paradigms whilst attaining the rewards of each, and of the combination – a multi-dimensional assessment of the subject, gained through combined effect.

3.4.4 Phenomenologist paradigm

Phenomenologist paradigm focuses more on social actors, which are human beings, as opposed to social artefacts or objects (Saunders 2009). The phenomenologist philosophy is based in interpretivism, focusing on truth as interpreted by human actors. Thus reality for the phenomenologist is constructed or interpreted through the interactions of human beings and their environment (Creswell 2003). In this case a deeper understanding of the world of social actors is required, in order to better make sense of meanings attached to reality by social actors (Saunders 2009). Reality is thus made up of social actors, social agents, social artefacts, and their interaction within the context of both the observed and the observer (Creswell 2003).

3.5. Research approach

Plans and actions for research span the phases of broad assumption to comprehensive methods of data gathering, exploration and interpretation. Cresswell (2007) mentioned that the prominence of demonstrating the research method is an operative strategy to upsurge the legitimacy of social research.

3.5.1 The qualitative approach

Qualitative research is primarily exploratory research which is used to obtain the understanding of underlying reasons, opinions and motivations (DeFranzo 2011). DeFranzo (2011) further mentions that this kind of research is used to uncover trends in thoughts and opinions and allows the data to dive deeper into the problem.

3.5.2 The quantitative approach

Quantitative research is used to enumerate the difficulty by way of producing numerical data that can be converted into practical statistics. It is normal to quantify attitudes, views, behaviors, and other distinct variables (DeFranzo 2011). The quantitative approach is chosen as the methodology of this study because the purpose of the research concerns the resolution of management issues with mega projects. It also involves explaining of the various factors and challenges in the construction of the mega project.

3.6 Research process

The research process allows the systematic workflow that is required to achieve the research. The research process can also be defined as a simplistic way of efficiently tracing and finding information for the research study. This study is programmed in the following manner: identify the problem, review the literature, data analysis, and data reports including clarification and reporting. The process involves exploring to identify the main problems that impact the construction of mega projects and it establishes the measures that can minimize those problems.

3.7 Research method

Research methods is the all-inclusive term, while methods of data collection and data analysis characterize the core of the research methods. McCrindle (2011) introduces methods as techniques and tools that are required for doing research, and methods provides the researcher with the means to gather, sort and analyze the data. McCrindle (2011) states that data comes in two forms namely:

3.7.1 Primary Data

Primary data is a type of data which by no means occurred before, hence was not previously published (Mccrindle 2011). Mccrindle (2011) further mentions that primary data is collected for detailed purposes and they are analytically examined to find solutions to research questions. The data used in this study was obtained by surveying prevailing literature concerning the management issues in the mega project, the cause of management issues in mega project and the impact they have. There are four key segments of primary data:

Measurement- gathering of numbers representing amounts.
Observation- Capture of events, phenomenon or situations experienced.
Interrogation- data acquired by probing or asking.
Participation- data developed by experience of doing something.

In primary data collection, the data is collected by using methods like questionnaires, interviews, focus groups, observations, case studies, diaries and critical incidents.

3.7.2 Secondary data

This is the category of data that has been circulated in periodicals, magazines, the media, books, online portals and additional sources (Mccrindle 2011). Secondary quantitative research methods and procedures are frequently universal, like formulas for calculating the mean, median and mode for a set of data. In qualitative research, each research question is advanced separately and distinct measures are established to construe the primary data taking into account the exclusive characteristics of the research (Mccrindle 2011).

The 3 advantages of secondary data are:

Readily available
Less expensive than primary data
Easily collected

The secondary data for this study was gathered from numerous international and national sources, journals, articles, theses, books, reports, conference papers and the internet. The primary data for this research was obtained by distributing questionnaires and conducting interviews.

3.8 Sampling

3.8.1 Sample

A sampling in research suggests a sub-set of a population of concern. Sample consisted of construction companies ranging on CIDB grade 9 and Civil construction companies ranging 9PE as well as professionals that are involved in construction industry. Sampling is very important as it was not possible to examine the entire population. The population of the study was situated in the Kwa-Zulu Natal Province,Western Cape and Gauteng. It was selected for the following reasons:

The guaranteed inclusion of active contractor from CIDB register and CE.
It took into account what was feasible to meet the aim of this research.

In order to meet the aim and objective outlined, this study adopted KwaZulu-Natal, Western Cape and Gauteng construction companies as the focus of the study. However the focus was on the general building and civil category.

3.8.2 Sample frame

The composition of sample frames included KwaZulu-Natal, Western cape and Gauteng construction companies which are on CIDB grade 9 on the construction record service and who are dynamic in general building (GB) and Professional engineering.

Therefore, in this study the sample entailed of the following: construction contractor, civil construction and professionals involved in construction industry:

Sample Frame Table:3.1

	GP	WC	KZN
Construction contractors	21	8	4
Civil Contractors	20	11	12
Project Managers	12	4	8
Civil Engineers	8	5	10
Site Agent	11	3	10
Quantity surveyors	7	2	5
Plant Foremen	3	1	5
Social Facilitator	2	1	1
Planning Engineer	2	2	2
Safety officer	2	1	2

The interview sample frame consisted of three key individuals

Table: 3.2

Construction contractors	5
Project manger	15
Site Agent	5

3.8.3 Sample size

This indicates the number of respondents that were surveyed related to this study. According to the CIDB registered contractors, there is a total of at least 33 GB and 43 CE registered contractors (Grade 9) in KwaZulu-Natal, Gauteng Province and Western Cape. This number makes it impossible to dispense questionnaires and accept responses from everyone. Leedy (2014) advises that investigators should try to capitalize on the sample size and offers the following recommendations for selecting a sample size:

For small population with fewer than 100 people of other units, there is little point in sampling, survey the entire population.
If the population size is around 500, 50% of the population should be sampled.
If the population size is around 1500, 20% should be sampled.

Calculation of exact sample size is an important part of research design (Charan and Biswas 2013). Charan and Biswas (2013) futher declare that it is imperative to comprehend that diverse study designs need different methods of sample size calculation and one formula cannot be used in all designs. The following formula will be used to calculate sample size:

Sample size =

N = population size • e = Margin of error (percentage in decimal form) • z = z-score.

$$ss = \frac{Z^{2} * (p) * (1-p)}{c^{2}}$$

Where:

Z = Z value (e.g. 1.96 for 95% confidence level)
p = percentage picking a choice, expressed as decimal
(.5 used for sample size needed)
c = confidence interval, expressed as decimal
(e.g., .04 = ±4)

3.8.4 Sampling Techniques

There are two main sampling approaches mentioned by Leedy et al. (2005). Probability sampling allows the members of the population to be epitomized in the sample. In this research, samples were chosen from the greater population by a system known as random sampling where each member of the population has an identical chance of being chosen. The many sampling procedures engaged in the selection of a probability sample are simple random, stratified random, systematic and cluster sampling.

Simple random sampling allows the sample to be chosen by simple random selection whereby every member of the population has an equal chance of being selected. Stratified random sampling happens in population which consists of different groups, the samples are selected equally from each one of the group so as to be represented equally. Cluster sampling sub-divided a huge area into smaller units. A country can be sub-divided into regions and further into towns. The clusters must be as similar to one another as possible with each cluster containing an equally heterogeneous mix of individuals. In non-probability sampling, individual elements of population are not represented equally and member of the population have little or no chance of being sampled.

3.9 Research Instrument

The methods of research undertaken for this research for the issuing of questionnaires to the grade 9 GB/CE/PE as well as professionals involved in construction like, project managers, civil engineers, plant supervisors. The development of the questions was around a typical Likert Scale, using a five-point gauge. Questionnaires were used to interpret, understand and gauge experiencing construction professionals relating to the resolution of management issues with mega projects, causes and impacts.

3.10 Questionnaire design

The questions were designed to address this study objectives and sub-objectives. Questionnaires are a respectable technique of attaining data from a great number of people or people who may not have time to join an interview or take part in experiments. The questions presented in the questionnaires are designed in a way that enables participants to take their time, think about it and come back to the questionnaire later.

Participants can state their views or feelings confidentially without worrying about the conceivable response of the researcher. The questions are designed to encourage participants to answer the questions as honestly as possible so as to avoid the researcher drawing false conclusions from this study.

3.11 Data collection

The distribution of questionnaires electronically was done via email accompanied with the letter of information and consent. Participants were asked to return completed questionnaires either via email or hard copies. The participants were encouraged to return the questionnaires in whatever way that suited them. The entire distribution and collection of questionnaires was conducted morally and in an ethical manner, also ensuring sensitivity. All participants were not forced to submit questionnaires.

3.12 Data analysis

The most appropriate measures were formulated to address the five-point Likert scale used in answering. This allowed for consolidation of the most frequent responses and is shown as a percentage based on the configuration.

3.13 Reliability and validity

Assessing the quality of research is crucial if findings are to be exploited in practice and combined into care delivery (Noble and Smith 2015). Noble and Smith (2015) further mention that evaluating the dependability of study conclusions required researchers to make decisions about the accuracy of the research in relation to the application and suitability of the methods assumed and veracity of the final inferences.

Reliability refers to the scope of which assessments are reliable, just as having dependable cars (cars that start every time it is required), we strive to have dependable, unswerving devices to measure research. *Validity* refers to the exactness of an assessment and whether or not it measures what it is supposed to measure. Even if a test is dependable, it may not deliver a valid measure. The questionnaire were run through a pilot test and the researcher judgmentally evaluated the questions in terms of its validity. The researcher ensured that the information gathered was accurate, the results tested and checked and the information was realistic.

The contractors and project managers as well as other professionals made up a population size that was estimated at 76 contractors, 24 project manager and 85 other professionals. Therefore, from the 85 questionnaires that were distributed, 3 Contractors, 17 project managers and 35 professionals returned completed questionnaires making the study valid. It was also noted that questionnaires had no missing data and all questions had been answered satisfactorily.

3.14 Limitations

There are only a few mega projects around in selected provinces and around South Africa as whole, which made it possible to get the gist of the information. Participants possibly felt that their ranking reflected on their performance abilities in the management of mega project.

CHAPTER 4: RESEARCH FINDINGS AND ANALYSIS

This chapter presents and deliberates on the outcomes attained from the questionnaire in this study. The questionnaire is the key instrument that is used to gather data and is dispersed to 90 individuals who have worked in the construction of mega projects. The data collected from responses is analysed with SPSS version 24.0. The results will present the descriptive statistics in the form of graphs, tables and figures for quantitative data. Inferential methods include the use of matrix tables which present Kaiser-Meyer-Olkin measure, Bartlett's Test and chi-squre test values. The condition is that Kaiser-Meyer-Olkin measure of sampling adequacy should be greater than 0.50 and Bartlett's Test of Sphericity less than 0.05.

4.1 Response to questionnaires

One questionnaire was used for the study which included one core questionnaire which will be analysed in the next chapter.

4.1.1 Response to Main Questionnaire

Table 4.1 presents the respective response rates of contractors who have involved in the construction of mega project in South Africa.

Table 4.1: Contractor's response

	Frequency	Percent
KwaZulu Natal	48	60.0
Gauteng	11	13.8
Western Cape	21	26.3
Total	80	100.0

In total, 92 questionnaires were administered and 80 were returned completed, which gave a response rate of 94%.

4.1.2 Response rate

The subsequent steps were in use in order to rally the response percentage:
The respondents were guaranteed anonymity,
The covering message made a gentle plea to the respondents,
The extent of the questionnaire was to a minimum for a study of this extent, and
Phone calls were continuously made to prompt respondents about finishing the questionnaire.

4.1.3 Missing Values

Missing values in questionnaires are unavoidable, though not desired, as some respondents may have an incomplete understanding of some aspects. The questionnaire was designed in a manner that offers respondents the opportunity of an ‘unsure’ option rather that attempt to rate a factor wrongly.

4.2 Demographic data

This section summarises the biographical characteristics of the respondents. It divulges their experience, knowledge, age, kind of organisation they work for and their position.

4.2.1 Region

Figure 4.1 indicates the provincial dissemination of the respondents. The majority of respondents were from KZN (60.0%), with the smallest number being from Gauteng (13.8%) ($p < 0.001$).

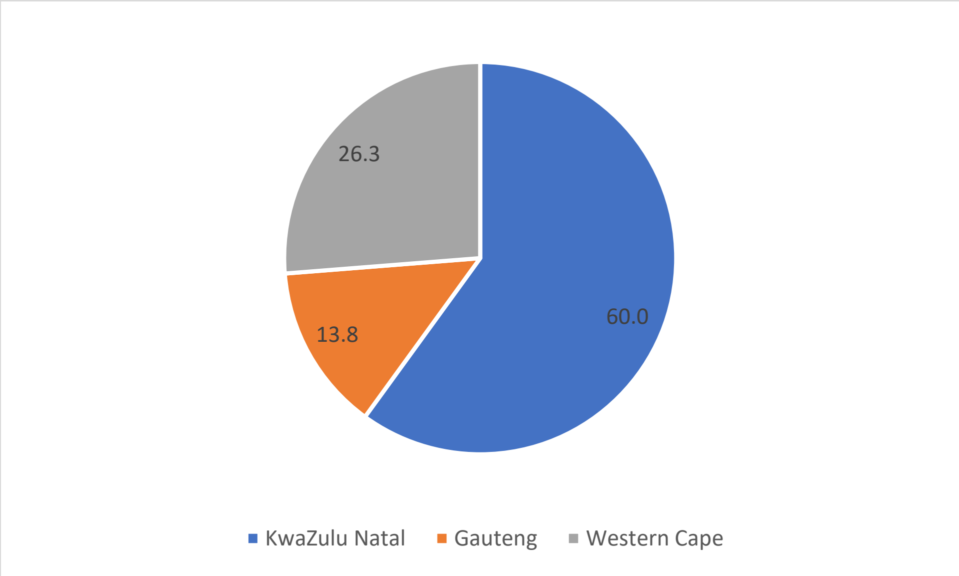

Figure 4.1: Region distribution

4.2.2 Gender

The table 4.2 below indicates that the male gender predominates (77.5%). The female rspondents was 33%. There were significantly more male respondents (approximately 3 times as more) ($p < 0.001$).

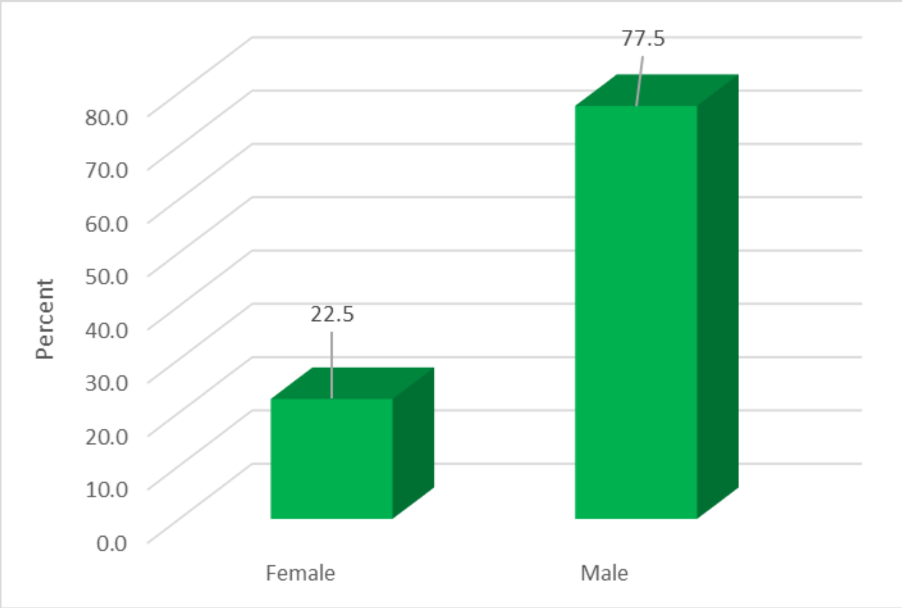

Figure 4.2: Gender

4.2.3 Respondents' age

Figure 4.3 specifies the occurrence of respondents' age. Respondents that are over the age of thirty predominate (77.6%). Those between the age bracket of 18- 24 are 22.6%. Based on this, respondents that make up the survey sample have adequate knowledge. They have a pronounced probability of being responsible, and sufficiently experienced.

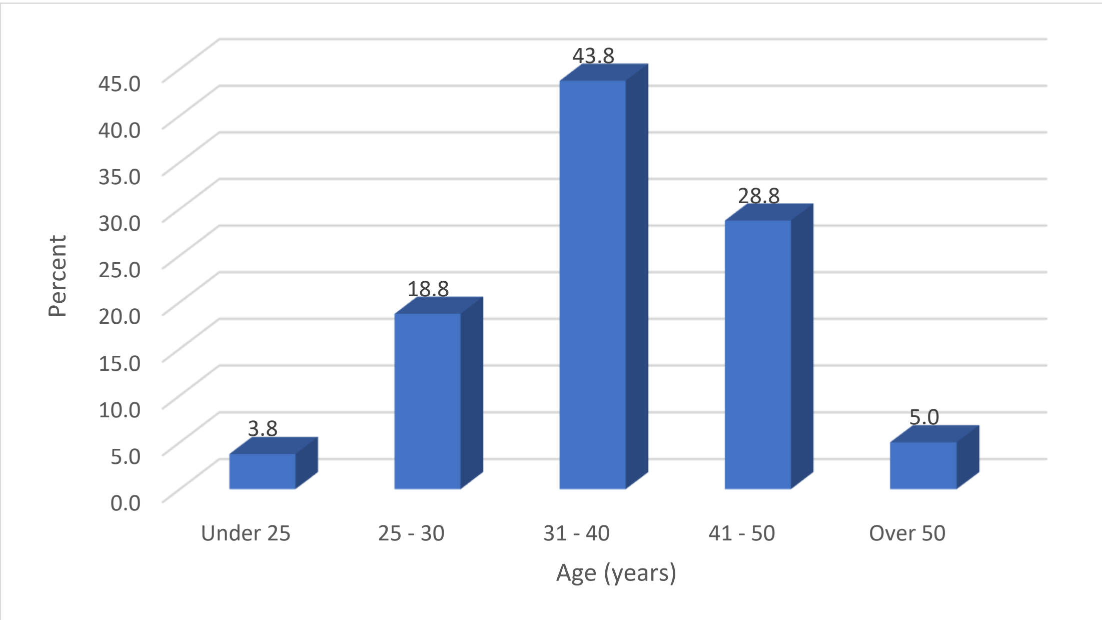

Figure 4.3: Respondents age

4.2.4 Respondents highest formal qualification

Figure 4.4 specifies the highest academic qualification of the respondents. Fifty percent (50%) of the respondents have diplomas, and they dominate in the sample. Following closely are respondents with B Tech degrees (20%). Next is postgraduate (15.5%). A fraction constituting 7.5% does not have relevant qualification in the industry they are employed in, but they do have matric certificate.

The analysis reveals that well qualified employees are working in the industry. Therefore, their performance is expected to be optimal. It also indicate that their discernments can be trusted.

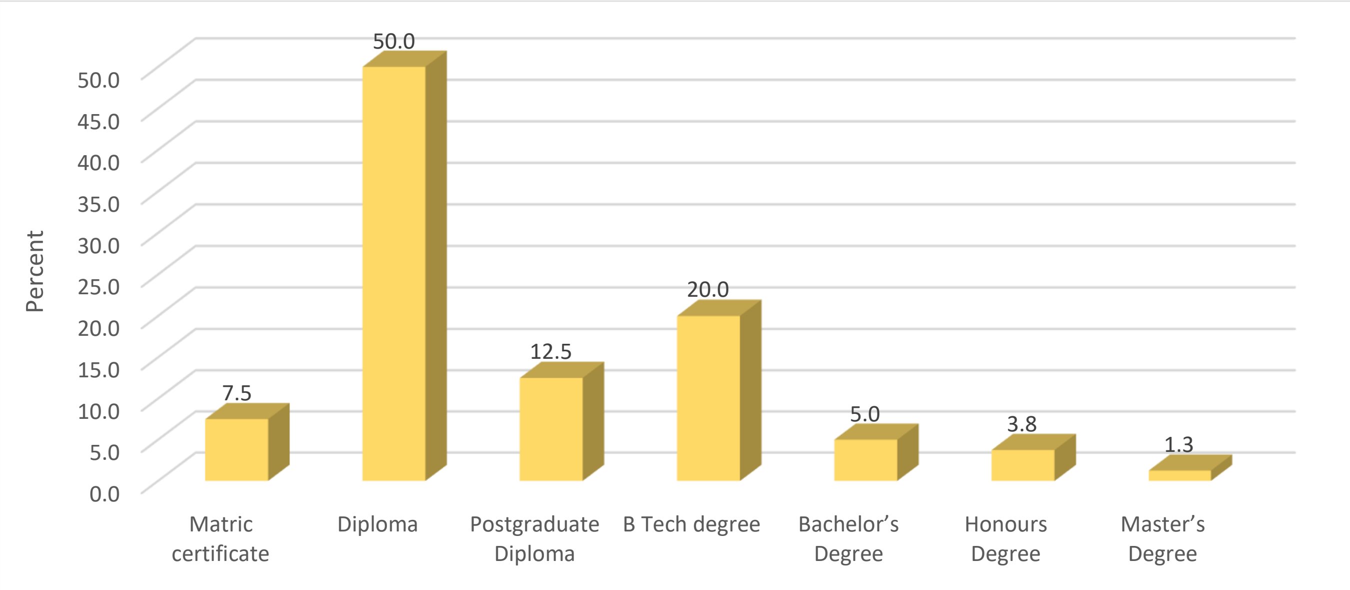

Figure 4.4: Highest qualification of respondenst

4.2.5 Respondents CIDB grading

Figure 4.5 indicates the CIDB grading of the companies that respondents work for. Eighty percent (80%) of the companies are CIDB grade 9 meaning they have a capacity to handle mega project, while 20% who are in grade 8 also have been involve in construction of mega projects.

The analysis reveals that respondents have been involved in the management of mega project which make the information that they provide to be valid.

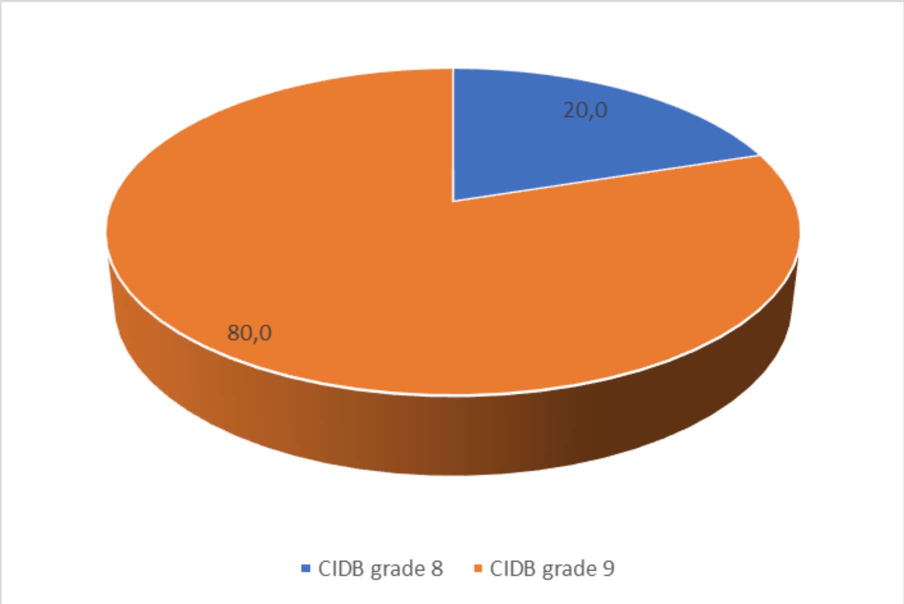

Figure 4.5: Respondents CIDB grading

There were four times as many grade 9 respondents as there were grade 8 ($p < 0.001$).

4.2.6 Status of respondents in their organisation

Figure 4.6 specifies that work supervisors (23.8 %) predominate among respondents. Following closely by senior managers and other which are both (21.3%). Followed by Site Agents (15%), Trainees (12.5%). The lowest response is relative to directors/managing members/principals (6.3%)

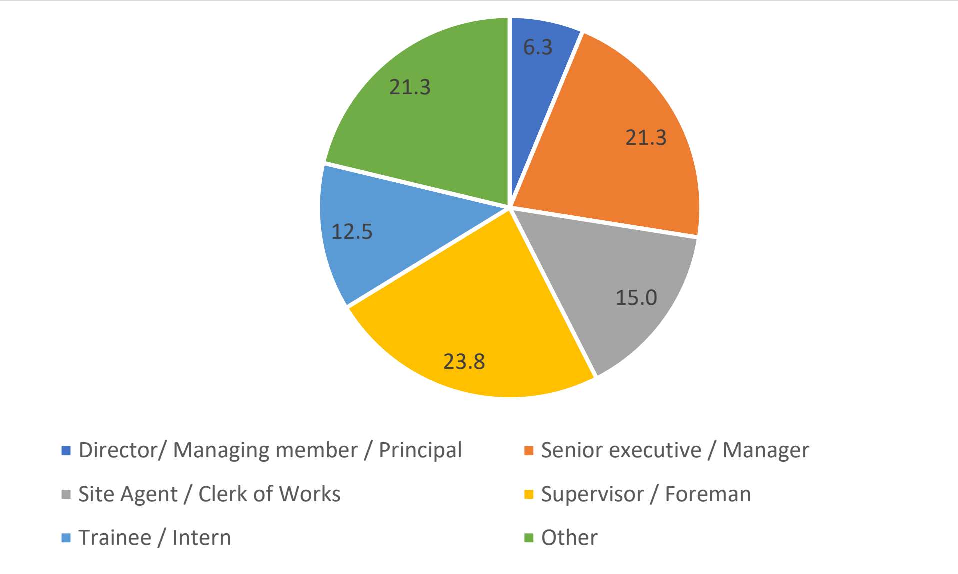

Figure 4.6: Respondents rank in their organisation

4.2.7 Respondents' years of experience

Figure 4.7 indicates the respondents' experience in the industry, 31.3 % of the respondents have between six to ten years' experience in the construction industry, and they lead in the sample. Following closely are respondents with eleven to fifteen years, totalling 22.5 %. Respondents with twenty-one to twenty-five years of age representing 17.5%. While those who have between sixteen to twenty years' experience have 16.3% representation and only a fraction of respondents (11.3%) have twenty-six years of experience and the least is thirty-one years to thirty-five years experience, representing 1.3%. The analysis indicate that the industry is highly dominated by young and energetic people representing an overall percentage of 53.8%, who have sufficient experience and ought to be producing good quality projects. A respondent that has obtained up to five years is considered to be well-informed in his/her discipline, therefore the data attained from these respondents is deemed reliable.

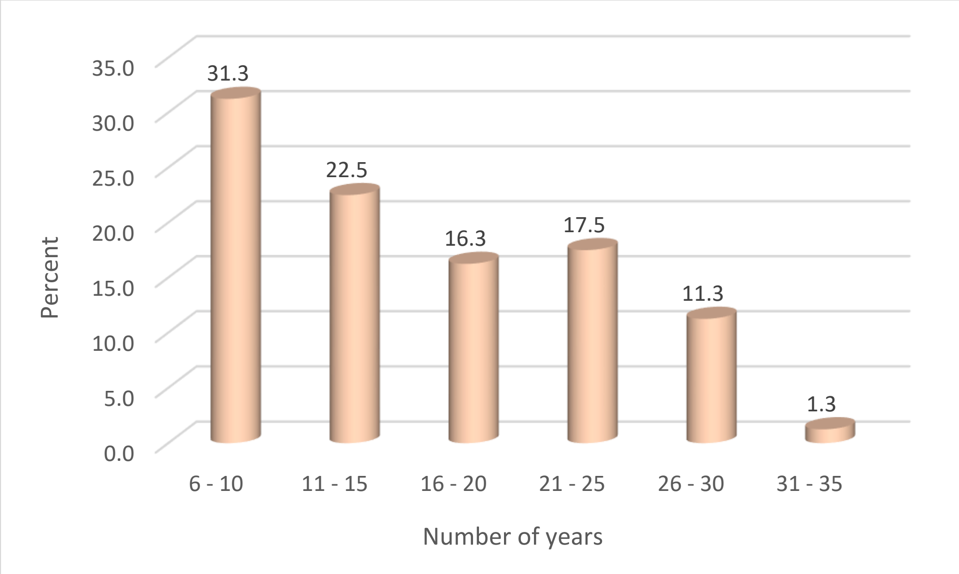

Figure 4.7: Respondents experience in the industry

4.2.8 Type of facility being constructed

Figure 4.8 presents the type of facility being constructed by respondents. The predominating (31.3%) type of facility that respondents have been involved with is residential houses. Followed by any other form of buildings (23.8%). Next is Hotel/Motel buildings (18.8%). Next is industrial Firm Park (15%) and lastly sport field construction (11.3%). It can be presumed from the analysis, that respondents have been involved in the construction of facilities that have a long period and bring an affluence of capability in answering the questionnaire.

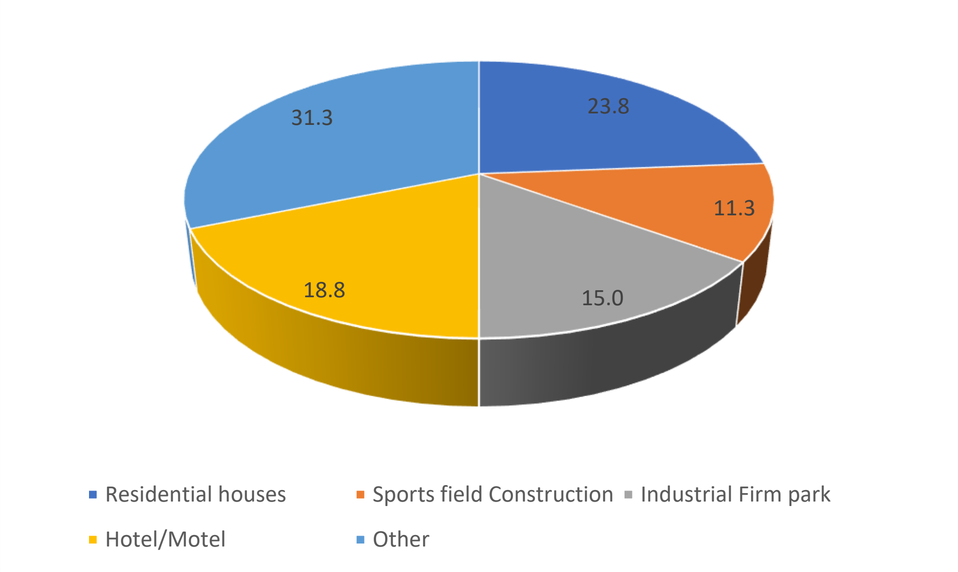

Figure 4.8: Type of facility building

4.2.9 Number of floors of facility

Figure 4.9 indicates that most of respondents (57.5%) have been involved in the construction of facilities with 3-5 floors. Followed by two floors structures (30.0%) and those who have six floors and above (7.5%). Only a fraction of respondents have experience in the construction of single floor facilities. Founded upon this, respondents are thought to have suitable capacity for responding to the questionnaire.

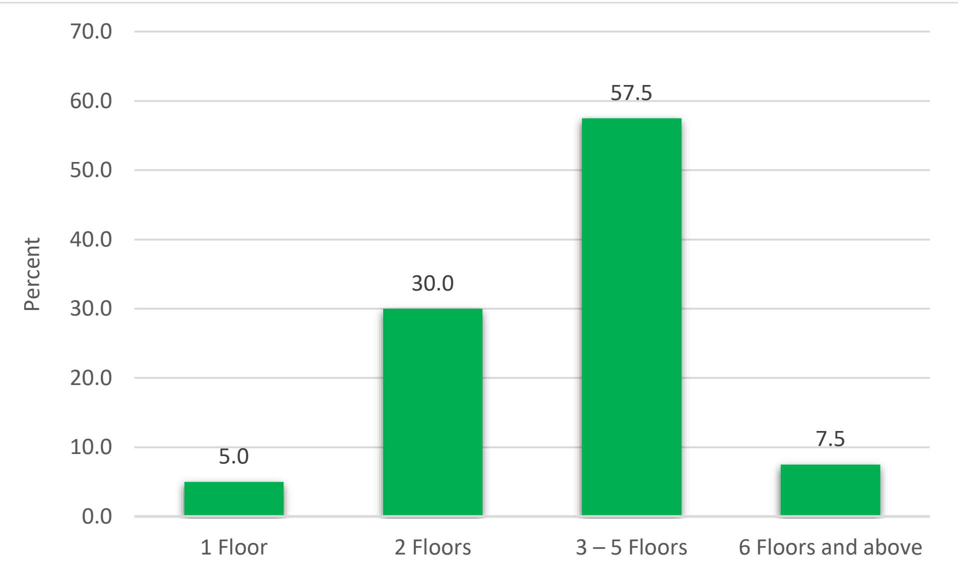

Figure 4.9: Number of floors of facilities being constructed

There were significantly different numbers of floors being constructed ($p < 0.001$).

4.2.10 Project scope details

Table 4.3 presents the mean with regard to budgets and project duration. The mean for initial and final costs are R2258.83m and R2838.13m correspondingly. The mean gross floor area is 151.58 weaks. It indicates that the project respondents are involved with are outsized and that the respondents are likely to be experienced and mature practitioners.

Table 4.2: Project scope details

Factor	Descriptive statistics		
	Valid numbers	**Mean**	**Std. Dev.**
Initial cost (Rm)	80	2258.83	1443.96
Final cost (Rm)	80	2838.13	1781.29
Final Construction Period at Tender Award (in weeks)	80	151.58	62.55

4.3 Analysis of main questions in first questionnaire

Questionnaires were used in the collection of data. A five-point Likert scale including "Unsure‟ (U) and "Does not‟ (DN) choices were used to measure the discernments of the respondents. Tables 4.4 to Y indicates the perceptions of respondents relative to the management issues of the mega projects to a scale of 1 to 5, and a MS (mean score) ranging between 1.00 and 5.00. MSs were calculated for each statement to permit an understanding of the percentages comparative to each point on the response scale. Given that there are five points on the scale, and that 5 – 1 = 4, the ranges were determined by dividing 4 by 5 which equates to 0.8. Subsequently, the ranges and their definitions are as follows:

>4.20 ≤ 5.00 between a near major influence;
> 3.40 ≤ 4.20 between moderate influence to a near major influence;
> 2.60 ≤ 3.40 between a near minor to moderate influence / moderate influence;
> 1.80 ≤ 2.60 between a minor to near minor influence / near minor influence, and
> 1.00 ≤ 1.08 between a minor to near minor influence.

4.3.1 Reliability tests

The two most imperative features of precision are **reliability** and **validity**. Reliability is computed by taking several measurements on the same subjects. A reliability coefficient of 0.60 or higher is considered as “acceptable” for a newly developed construct. The result of the item analysis conducted to define the consistency of the summated scores calculated for the several feature categories reported in this section.
The table below reflects the Cronbach’s alpha score for all the items that constituted the questionnaire.

4.3.1.1 Cronbach’s coefficient α test

Test for the internal reliability of the factor in each category were conducted by determining their Cronbach’s coefficient a value.

Table 4.3: Cronbach’s coefficient α value for all factor categories

	Section	**N of Items**	**Cronbach's Alpha**
3b3	Challenges encountered by management in managing mega project	8	0.703
4a4	The influence of challenges experienced during the implementation of the mega project with regards its delivery	8	0.649
4.1	Stake holder management related issues	9	0.649
4.2	Plant related issues	5	0.642
4.3	Labour and workers related issues	6	0.555
4.4	Materials-related issues	5	0.573
4.5	Production-related issues	7	0.602
4.6	Social/community- related issues	5	0.749
4.7	Health and safety related issues	6	0.630
4.8	Logistics planning related issues	11	0.711
5.1	Stakeholder management	6	0.661
5.2	Plant management	2	0.682
5.3	Production management	2	0.722
5.4	Supervision of workers	6	0.662
5.5	Social facilitation	6	0.755
5.6	Material wastage	5	0.639
5.7	Health and safety	4	0.705
5.8	Logistic management	3	0.612

The reliability scores for all segments surpass the recommended Cronbach’s alpha value of 0.600 for a newly established construct. This designates a degree of suitable, dependable scoring for these segments of the research. The following sections had marginally lower values:

Labour and workers related issues

Materials-related issues

4.3.1.2 Results of factor analysis

Factor analysis was conducted to test the agreement between factors in each category. The results of the analysis are presented in Table 4.4.

Table 4.4: Summary of factor analysis conducted for category analysis

	Section	Kaiser-Meyer-Olkin Measure of Sampling Adequacy	Bartlett's Test of Sphericity		
			Approx. Chi-Square	df	Sig.
3b3	Challenges encountered by management in managing mega project	0.667	114.094	28	0.000
4a4	The influence of challenges experienced during the implementation of the mega project with regards its delivery	0.739	87.760	28	0.000
4.1	Stake holder management related issues	0.568	94.553	36	0.000
4.2	Plant related issues	0.578	48.793	21	0.001
4.3	Labour and workers related issues	0.597	66.224	36	0.002
4.4	Materials-related issues	0.614	84.958	36	0.000
4.5	Production-related issues	0.574	57.377	36	0.013
4.6	Social/community- related issues	0.782	48.817	10	0.000
4.7	Health and safety related issues	0.543	89.428	28	0.000
4.8	Logistics planning related issues	0.509	170.258	66	0.000
5.1	Stakeholder management	0.672	149.436	15	0.000
5.2	Plant management	0.504	62.074	15	0.000
5.3	Production management	0.500	64.025	15	0.000
5.4	Supervision of workers	0.637	111.548	15	0.000
5.5	Social facilitation	0.735	157.205	15	0.000
5.6	Material wastage	0.657	142.420	15	0.000
5.7	Health and safety	0.549	144.767	15	0.000
5.8	Logistic management	0.501	99.643	15	0.000

All of the conditions are satisfied for factor analysis. That is, the Kaiser-Meyer-Olkin Measure of Sampling Adequacy value should be greater than 0.500 and the Bartlett's Test of Sphericity sig. value should be less than 0.05. The statements that constituted section S24b4.6 loaded perfectly along a single component. This indicates that the statements that constituted these sections perfectly measured what it set out to measure.

It is noted that the variables that constituted the remaining sections loaded along 2 to 5 components (sub-themes). This means that respondents identified different trends within the section. Within the section, the splits are colour coded.

Table:4.4 (a):Stake holder management

Rotated Component Matrix[a]			
Factor	Component		
	1	2	3

Stake holder decisions	0.611	0.253	0.185
Stake holder responsibility through project life cycle	0.480	0.033	0.355
Stake holder dynamics	0.274	0.223	0.714
Stake holder collaboration	0.754	-0.043	-0.117
Techniques for stakeholder engagement	0.246	0.203	0.727
Hiring competent project manager	0.751	0.139	-0.081
Transparent evaluation of alternatives solutions	0.163	0.732	-0.208
Ensuring effective communication among the stake holder.	-0.138	0.845	0.163
Common goals and objectives for project	0.350	0.567	0.065
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.			
a. Rotation converged in 4 iterations.			

Table:4.4(b): Plant management

Rotated Component Matrix[a]		
	Component	
Factor	1	2
Plant maintenance	0.816	-0.222
Plant downtime	0.809	0.111
Health and Safety	0.556	0.093
Plant productivity	0.483	0.340
Plant optimization	0.198	0.651
Robotics and automation of plant	0.048	0.795
Plant operators and competence	-0.339	0.438
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.		
a. Rotation converged in 3 iterations.		

Table:4.4(c): Production Management

Rotated Component Matrix[a]			
	Component		
Factor	1	2	3
Lack of material on site	0.507	0.420	-0.306
Incomplete drawings	0.775	-0.075	0.039
Inspection delays	0.458	-0.041	0.658
Incompetent supervision of work	0.035	0.658	0.372
Instruction time	0.751	0.195	0.050
Lack of tools and equipment	0.252	0.154	0.720
Poor communication amongst construction team	0.208	0.502	-0.077
Poor site conditions	-0.069	0.814	-0.063
Improper construction methods	0.070	0.324	0.472
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.			
a. Rotation converged in 6 iterations.			

Table:4.4 (d): Labour management

Rotated Component Matrix[a]			
	Component		
Factor	1	2	3
Unskilled site manpower	0.664	0.074	-0.064
Inadequate leadership by supervisor	0.751	-0.024	-0.001
Poor communication between supervisor and workers	0.688	-0.419	-0.084
Supervisor lack of training	0.579	0.369	0.209
Failure to allocate work and tools by supervisor	0.165	0.657	-0.131
Failure to monitor team performance	-0.025	0.658	0.152
Workforce involvement	-0.084	0.539	0.007
Failure to apply disciplinary procedures	0.119	0.441	0.635
Teamwork and team developments	-0.100	-0.172	0.852
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.			
a. Rotation converged in 4 iterations.			

Table:4.4(e): Material management

Rotated Component Matrix[a]				
	Component			
Factor	1	2	3	4
Material shortage due to damage by mishandling	-0.022	0.030	0.886	-0.021
Re-work due to poor workmanship	0.779	0.013	0.353	0.252
Inadequate storage facilities on site	-0.290	0.288	0.280	0.630
Delay in material supply	0.106	0.731	-0.166	0.383
Inadequate supervision	-0.059	0.794	0.187	-0.105
Poor site security	0.644	0.340	0.374	-0.077
Alteration of designs	0.843	0.138	-0.121	-0.188
Over ordering of construction materials	-0.128	0.078	0.122	0.821
Theft and vandalism of material	0.553	-0.508	0.435	0.118
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.				
a. Rotation converged in 7 iterations.				

Table:4.4(f): Social facilitation Management

Component Matrix[a]	
	Component
Factor	1
Lack of community buy-in	0.771
Delay or Non-payment of Compensation	0.691
Community unrest, Military & communal crises	0.685
Lack of legal framework	0.727
Location of the project	0.709
Extraction Method: Principal Component Analysis.	
a. 1 components extracted.	

Table:4.4(g): Health and safety management

Rotated Component Matrix[a]				
	Component			
Factor	1	2	3	4
Health and Safety human factors	0.057	-0.124	0.122	0.872
Legislation	0.004	0.248	-0.302	0.605
Financial issues	0.041	0.077	0.906	-0.032
Safe working conditions	0.417	0.453	0.358	-0.050
Poor safety trainings	0.877	0.093	0.114	0.139
Poor safety inductions and supervisions	0.930	0.005	-0.075	-0.057
Ergonomics	0.434	0.635	-0.421	0.158
Lighting	-0.059	0.900	0.118	0.009
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.				
a. Rotation converged in 6 iterations.				

Table:4.4(h): Logistics planning management

Rotated Component Matrix[a]					
	Component				
Factor	1	2	3	4	5
Neighbourhood buildings	0.046	0.881	0.053	0.062	0.070
Site access routes	0.200	0.862	-0.034	0.054	0.058
Delivery and storages	-0.378	0.269	0.491	0.479	0.250
Delivery times	-0.059	-0.307	0.284	-0.480	0.621
Public safety	-0.013	0.147	-0.288	0.126	0.681
Parking spaces around sites	0.248	0.439	0.468	-0.009	-0.270
Construction noise pollution	0.623	0.153	0.095	0.069	0.553
Crane location	0.832	0.226	-0.042	0.071	-0.074
Movements of vehicles	0.818	0.045	0.363	0.154	0.004
Planning of works	0.059	0.078	0.798	-0.117	-0.029
Schedule for plant, labour and materials	0.163	-0.123	0.711	0.244	-0.068
Use of banksmen on site	0.215	0.018	0.072	0.862	0.027

Factor analysis is a statistical technique whose key goal is to minimise data. A distinctive use of factor analysis is in survey research, where a researcher wishes to characterize a number of questions with a small number of presumed factors. With reference to the table above: the principle component analysis was used as the extraction method, and the rotation method was Varimax with Kaiser Normalization. This is an orthogonal rotation method that diminishes the number of variables that have great loadings on each factor. It makes the interpretation of the factors simpler.

Factor analysis/loading show intercorrelations between variables. Items of questions that loaded similarly imply measurement along a comparable factor. An examination of the content of items loading at or above 0.50 (and using the higher or highest loading in instances where items crossloaded at greater than this value) effectively measured along the numerous components.

It is noted that the variables that set up the various sections loaded along 2 or 3 components (sub-themes). This means that respondents recognized dissimilar trends within the section. Within the section, the splits are colour coded and codes are separated as follows: Code 1 is yellow; Code 2 is green and Code 3 is blue. Grounded upon the factor analysis loadings (rotated component matrix) obtained for factors, the majority are greater than 0.50. It is thought that the items for all factor categories have good agreement and this means that the factors sufficiently define these categories.

4.5 Main Questionnaire Analysis

4.5.1 Resolution of management issues with mega projects

Table 4.5: Management issues- factors

	Factor	Response (%)							Mean Score	Standard Deviation	Rank
		Unsure	Does not apply	Minor...Major							
				1.00	2.00	3.00	4.00	5.00			
3.2	Plant Management	1.3	0.0	0.0	3.8	21.3	45.0	28.8	4.00	0.82	1
3.5	Material wastage	0.0	0.0	0.0	2.5	26.3	53.8	17.5	3.86	0.72	2
3.8	Logistic Planning	0.0	0.0	0.0	2.5	35.0	56.3	6.3	3.66	0.64	3
3.3	Production management	0.0	0.0	0.0	2.5	43.8	42.5	11.3	3.63	0.72	4
3.1	Stake holder management	0.0	0.0	1.3	10.0	32.5	42.5	13.8	3.58	0.90	5
3.4	Labour management	0.0	0.0	0.0	5.0	53.8	35.0	6.3	3.43	0.69	6
3.7	Health and safety management	2.5	0.0	5.0	28.8	51.3	12.5	0.0	2.73	0.75	7
3.6	Social facilitation management	0.0	1.3	22.5	46.3	28.8	1.3	0.0	2.09	0.75	8

Table 4.5 displays the respondents' rating of the challenges encountered by management in managing mega projects. It is prominent that all factors in the category have 2.09 ≤ MSs ≤ 4.00, which indicates that the factors have between a near minor to major influence on the challenges encountered by management in managing mega project.

The most significant factor in this catergory is plant management (MS=4.00). Mega projects are large projects that rely mostly on machines to execute the tasks of the project. This machines range from excavating, trucks, cranes and other lifting machines, mixers, dumpers and so on. These machines breakdown due to wear and tear and may lead to stoppage of work and ultimately adversely affect productivity. Further, since this are mega projects, dependence on machine for work execution is high, as manual effort if deployed to execute the work will take considerable length of time to complete, that may not be economically viable. This agrees with Handrickson (2013) which state that there demand on the machines were increasingly deployed as an economical alternative to costly labour resources.

The second most significant factor is material management (MS=3.86). The lack of adequate control on materials stemming from storage, waste, pilfering, application and cutting waste constitute sources of material loss. Therefore, most of the project experience inadequate management of material and stands as one of the issue in delivering mega projects. This has led to most of the projects failing or be completed way over estimated project value.

The third most significant factor in this category is logistic planning (MS=3.66). The inability to plan and manage logistics negatively affects project delivery. The lack of planning is planning to fail. Inadequate planning may lead to slippage of activities, cause rework which would lead to materials and time wastage; these all affects the time of project delivery and overall cost figure for the project. Poor logistic planning contribute to the failure of mega project. The skill to plan for logistics need to be acquired by participants who are involve in the management of mega projects.

The fourth significant factor is production management (MS=3.63). Mega projects are complex in nature. There are a lot of activities that go on at the same, which involve a lot of operating operatives. There are a lot of sections and different heads of sections. The coordination of these all may be difficult. Any slip may be grave. Therefore, it demands extreme care and adequate competency. Production is key to any project whether its minor or mega. However, it is crucial to manage the production on the mega project since production can also be used as tool to major project performance.

Stake holder management (MS=3.58) and labor management (MS=3.43) are least significant factors in this category. The inability to manage the two mentioned are likely to fail the mega projects. The communication and information sharing of the stake holder is the key to the delivery of mega projects.

Healthy and Safety management (2.73) and social facilitation management (MS=2.09). These are the most least significant factors in this category. The chi square p-values indicate that the scoring patterns are more towards one side than the other (that is either major or minor or in-between), as all of the p-values are $p < 0.001$. Poor community involvement in the mega project can have a undesirable impact in the conveyance of the mega project.

Table 4.6: challenges to the factors of management issues

Factor	Response (%)							Mean Score	Standard Deviation	Rank
	Unsure	Does not apply	Minor..Major							
			1.00	2.00	3.00	4.00	5.00			
Plant Management related issues	0.0	0.0	0.0	1.3	28.8	60.0	10.0	3.79	0.63	1
Material wastage related issues	0.0	0.0	0.0	3.8	23.8	62.5	10.0	3.79	0.67	2
Logistic Planning related issues	0.0	0.0	0.0	1.3	35.0	57.5	6.3	3.69	0.61	3
Stake holder management related issues	0.0	0.0	0.0	10.0	35.0	52.5	2.5	3.48	0.71	4
Production management related issues	0.0	0.0	0.0	8.8	43.8	38.8	8.8	3.48	0.78	4
Labour management related issues	0.0	0.0	0.0	16.3	60.0	21.3	2.5	3.10	0.69	6
Health and safety management related issues	0.0	0.0	10.0	37.5	43.8	8.8	0.0	2.51	0.80	7
Social facilitation management related issues	0.0	0.0	30.0	47.5	20.0	1.3	1.3	1.96	0.82	8

Table 4.6 presents the respondents' rating of the influence to the challenges encountered by management in managing the mega project. It is remarkable that all factors in the category have between 2.09 ≤ MSs ≤ 4.00, which specifies that the factors have between a near minor to major influence on the challenges encountered by management in managing mega projects.

The factor with the most significant influence relative to challenges is plant management related issues (MS=3.79). Plant management issues have been most dominant amongst factors which causes challenges in the management of mega projects. This may be as a result of the complexity of the departments. Mega projects are driven by many plants including earth moving plant, cranes, trucks and so on. These all wear and tire with incessant breakdowns requiring maintenance, purchases of plant that may institute delays.

The second most significant factor is material wastage related issues (MS=3.79). The management of material is most critical factor in the management of the mega project to avoid fund unnecessary expenditure. Poor material waste management leads to the project to over-spend the project budgeted amount. This is stemming from application waste, preferring attributable to the large and complex nature of these mega projects. A further significant factor is handling or transportation waste. These are lot of units composed in mega projects. From each of these units, similar waste area is generated.

The third most significant factor is logistics planning (MS=3.69). Logistics planning could be a difficult task if there is a lack of competent personnel. There are numerous task in mega projects, one leading to another with different approaches. This is relative to the methods of construction of each task. All of this must be seen to link each other and avoid slippages, which may have great consequences.

The least significant factor in this category is social facilitation related issues (MS=1.96) followed by health and safety related issues (MS=2.51). Poor social facilitation management in any project leads to strikes and riots in the project, therefore it is very important to have an equipped and skilled social facilitator in a project. In most project health and safety management is not taken as a serious matter, forgetting the penalties that may be occurred in case of any accident. These has been rated high and improvement relate to accident and hazards on site due to the training on health and safety given to workers. Prior to commencement of daily work, health talk is given to workers. This has contributed to the reduction in accident causing injuries and fatality. This may be the likely reason for the rating of this factor by respondents.

4.5.2 Resolution of management issues with mega project

Table 4.6(a): Resolution of management issues with mega project

Factor	Response (%)							Mean Score	Standard Deviation	Rank
	Unsure	Does not apply	Minor...Major							
			1.00	2.00	3.00	4.00	5.00			

Stake holder related issues										
Stake holder decisions	0.0	0.0	1.3	20.0	43.8	35.0	0.0	3.13	0.77	1
Stake holder responsibility through project life cycle	0.0	0.0	1.3	12.5	62.5	23.8	0.0	3.09	0.64	2
Ensuring effective communication among the stake holder.	0.0	0.0	0.0	17.5	56.3	26.3	0.0	3.09	0.66	2
Transparent evaluation of alternatives solutions	0.0	0.0	0.0	16.3	62.5	21.3	0.0	3.05	0.61	4
Stake holder collaboration	1.3	0.0	0.0	23.8	66.3	8.8	0.0	2.85	0.56	5
Techniques for stakeholder engagement	0.0	0.0	1.3	45.0	41.3	12.5	0.0	2.65	0.71	6
Stake holder dynamics	6.3	0.0	7.5	35.0	46.3	5.0	0.0	2.52	0.72	7
Common goals and objectives for project	1.3	0.0	6.3	51.3	37.5	3.8	0.0	2.39	0.67	8
Hiring competent project manager	3.8	2.5	41.3	38.8	12.5	1.3	0.0	1.72	0.75	9
Plant management issues										
Plant downtime	0.0	0.0	0.0	7.5	20.0	63.8	8.8	3.74	0.72	1
Plant maintenance	0.0	0.0	0.0	7.5	28.8	51.3	12.5	3.69	0.79	2
Health and Safety	0.0	1.3	5.0	22.5	58.8	12.5	0.0	2.80	0.72	3
Plant productivity	3.8	0.0	5.0	30.0	56.3	5.0	0.0	2.64	0.67	4
Robotics and automation of plant	1.3	2.5	10.0	32.5	48.8	5.0	0.0	2.51	0.75	5
Plant operators and competence	1.3	0.0	21.3	31.3	35.0	10.0	1.3	2.38	0.98	6
Plant optimization	25.0	0.0	2.5	45.0	26.3	1.3	0.0	2.35	0.58	7
Labor related issues										
Unskilled site manpower	0.0	0.0	0.0	11.3	38.8	48.8	1.3	3.40	0.70	1
Workforce involvement	5.1	0.0	3.8	24.1	64.6	2.5	0.0	2.69	0.59	2
Teamwork and team developments	0.0	0.0	3.8	33.8	53.8	8.8	0.0	2.68	0.69	3
Failure to allocate work and tools by supervisor	2.5	0.0	6.3	27.5	60.0	3.8	0.0	2.63	0.67	4

Failure to monitor team performance	1.3	0.0	5.0	33.8	55.0	5.0	0.0	2.61	0.67	5
Poor communication between supervisor and workers	0.0	0.0	6.3	35.0	53.8	5.0	0.0	2.58	0.69	6
Failure to apply disciplinary procedures	2.5	0.0	7.5	48.8	35.0	6.3	0.0	2.41	0.73	7
Supervisor lack of training	1.3	0.0	13.8	56.3	26.3	2.5	0.0	2.18	0.69	8
Inadequate leadership by supervisor	0.0	0.0	15.0	53.8	30.0	1.3	0.0	2.18	0.69	8
Material management related issues										
Alteration of designs	0.0	0.0	3.8	1.3	7.5	42.5	45.0	4.24	0.93	1
Re-work due to poor workmanship	0.0	0.0	0.0	3.8	16.3	52.5	27.5	4.04	0.77	2
Delay in material supply	0.0	0.0	1.3	3.8	28.8	60.0	6.3	3.66	0.71	3
Material shortage due to damage by mishandling	0.0	0.0	0.0	8.8	46.3	40.0	5.0	3.41	0.72	4
Inadequate storage facilities on site	0.0	0.0	12.5	51.3	31.3	5.0	0.0	2.29	0.75	5
facInadequate supervision	5.0	0.0	7.5	61.3	22.5	1.3	2.5	2.26	0.74	6
Theft and vandalism of material	2.5	0.0	26.3	41.3	23.8	5.0	1.3	2.12	0.91	7
Poor site security	0.0	3.8	31.3	47.5	13.8	3.8	0.0	1.90	0.79	8
Over ordering of construction materials	6.3	24.1	32.9	30.4	5.1	1.3	0.0	1.64	0.70	9
Production management related issues										
Incomplete drawings	0.0	5.0	2.5	1.3	6.3	38.8	46.3	4.32	0.87	1
Lack of material on site	0.0	0.0	0.0	1.3	31.3	62.5	5.0	3.71	0.58	2
Inspection delays	0.0	0.0	1.3	21.3	53.8	22.5	1.3	3.01	0.74	3
Instruction time	0.0	0.0	3.8	21.3	48.8	26.3	0.0	2.98	0.80	4
Lack of tools and equipment	0.0	0.0	2.5	23.8	55.0	17.5	1.3	2.91	0.75	5
Poor communication amongst	2.5	1.3	0.0	20.0	66.3	10.0	0.0	2.90	0.55	6

construction team										
Incompetent supervision of work	1.3	0.0	10.0	53.8	28.8	6.3	0.0	2.32	0.74	7
Improper construction methods	8.8	0.0	25.0	46.3	18.8	1.3	0.0	1.96	0.73	8
Poor site conditions	5.0	8.8	30.0	38.8	13.8	3.8	0.0	1.90	0.83	9
Social facilitation management issues										
Lack of legal framework	2.5	0.0	2.5	15.0	68.8	11.3	0.0	2.91	0.61	1
Community unrest, Military & communal crises	1.3	0.0	12.5	40.0	46.3	0.0	0.0	2.34	0.70	2
Location of the project	3.8	0.0	27.5	32.5	28.8	7.5	0.0	2.17	0.94	3
Lack of community buy-in	15.0	6.3	21.3	43.8	13.8	0.0	0.0	1.90	0.67	4
Delay or Non-payment of Compensation	22.5	7.5	22.5	32.5	15.0	0.0	0.0	1.89	0.73	5
Healthy and safety related issues										
Legislations	0.0	0.0	1.3	2.5	33.8	52.5	10.0	3.68	0.74	1
Health and Safety human factors	0.0	0.0	0.0	26.3	46.3	26.3	1.3	3.03	0.76	2
Lighting	1.3	5.0	11.3	21.3	50.0	11.3	0.0	2.65	0.85	3
Safe working conditions	0.0	0.0	6.3	31.3	60.0	2.5	0.0	2.59	0.65	4
Ergonomics	17.5	0.0	12.5	31.3	36.3	2.5	0.0	2.35	0.77	5
Poor safety inductions and supervisions	0.0	2.5	41.3	50.0	6.3	0.0	0.0	1.64	0.60	6
Poor safety trainings	1.3	1.3	43.8	46.3	7.5	0.0	0.0	1.63	0.63	7
Financial issues	6.3	1.3	45.0	37.5	10.0	0.0	0.0	1.62	0.68	8
Logistic planning related issue.										
Public safety	0.0	0.0	1.3	1.3	5.0	48.8	43.8	4.33	0.74	1
Site access routes	0.0	0.0	2.5	17.5	27.5	37.5	15.0	3.45	1.03	2
Neighborhood buildings	0.0	2.5	6.3	21.3	21.3	35.0	13.8	3.29	1.15	3

Delivery times	0.0	0.0	1.3	10.0	56.3	31.3	1.3	3.21	0.69	4
Crane location	0.0	20.0	3.8	17.5	35.0	22.5	1.3	3.00	0.87	5
Construction noise pollution	0.0	5.0	3.8	32.5	33.8	17.5	7.5	2.92	1.00	6
Parking spaces around sites	1.3	6.3	12.5	46.3	22.5	3.8	7.5	2.43	1.05	7
Movements of vehicles	1.3	1.3	15.0	37.5	36.3	7.5	1.3	2.41	0.89	8
Schedule for plant, labor and materials	0.0	0.0	7.5	50.0	41.3	1.3	0.0	2.36	0.64	9
Delivery and storages	0.0	0.0	5.0	57.5	35.0	2.5	0.0	2.35	0.62	10
Planning of works	0.0	0.0	6.3	53.8	40.0	0.0	0.0	2.34	0.59	11
Use of banksmen on site	8.8	6.3	50.0	27.5	6.3	1.3	0.0	1.51	0.70	12

Table 4.6 (a) displays the respondents' rating of the resolution of management issues with mega project encountered by management in managing the mega project. It is prominent that all factors in the category have between 2.09 ≤ MSs ≤ 4.00, which indicates that the factors have between a near minor to major influence on the challenges encountered by management in managing mega projects.

Respondents were requested to rate the sub-factors to these factors influencing challenges to the mega project based on the identified factors of mega project.

Relating to stake holders related issues, stake holder decision (MS=3.13) has the most influence on the smooth running of the project. It is the intention and wishes of the frequency of a project that matter, therefore their decisions on any matter have great influence on the outcomes of the project. This is followed by stake holder responsibility through life cycle (MS=3.09) . The contribution of the stake holders at each stage of the life cycle of the project have influence on either it performence cost, quality and construction period.

Depending on the appropriateness of the decision, the affect may be good or bad.

The factor with the least influence on these section is hiring of the competent project manager(MS=1.72). The decision to hire a manager is for the stake holders, since it is a stake holder who managed the project. The decision may be influenced due to interest which may jeopardise objectiveness in the process of hiring a manager. Influence may lead to hiring a good or bad manager that may or may not adversely affect the delivery of the project.

On plant management related issues, Plant downtime (MS=3.74) is the most influencing factor. Downtime may result due to wear and tire on machines, failure of some parts and lack of adequate maintenance. Maintenance scheduled may be drawn up for each heavy machines to mitigate their breakdowns. Next to plant downtime is plant maintenance(MS=3.69). The lack of adequate and regular maintenance of plant will cause these plants constant breakdown. In the mega project it is important that plants are maintained regularly.

The least significant factor in this category is plant optimization (MS=2.35). This factor may be rated least as a result of good optimization plan in place, relative to the machines. This could be based on the fact, it is not only one type of plant for specific jobs or task is owned by company, therefore usage of plant is evenly distributed.

On labour related issues, unskilled site manpower(MS=3.40). The one factor that is very difficult to manage on site is manpower. It is said that in construction labour need to be forced to do work due to the hard and difficult nature of the risk involve theirin. The task of lifting and transporting heavy loads, mixing and fixing jobs.

Next is workforce involvement (MS=2.69).Construction activity is carried out in gangs of labours, This gangs are composed of individuals with different attitude towards work. Some that will want to be lazy at work and some willing to work. All these not working at the same rate affect productivity and makes the management of labour difficult.

The least significant factor in this category is inadequate leadership by supervisor (MS=2.18). Due to the competent managers and supervisors involved in mega projects, these projects do not experience substandard inadequate supervision. The fact being this project involved huge sum of money and all eyes are on such projects. This helps workers to put on their best perfomance.

On material management related issues, alteration of designs (MS=4.24) is rated as the most influence in this category. The change of designs on the project add to the material wastage since some changes are made after construction has been done which involves cutting to allow fixing of the new designs. Delays also occur due to during the changes of designs. The second most significant is rework due to poor workmanship (MS=4.04). This rated the second in waste generation project. Poor and lack of standard workmanship will attract rework, which may cause damage to material that have been used and result in wastage. It also attracts time wastage and these all delete the cost figure of the project to the disadvantage of the client.

The least factor necessitating influence of some sort on project in this category is over ordering of construction material (MS=1.64). Due to the recent developments of the technology of various devices. It has offered accuracy of measurement, therefore adequate ordering of construction material have being made possible. Following this with more influence or project challenges is theft and vandalism of material (MS=2.12). The non-availability of material due to stealing and destruction is not so common, except during strike, which is rare. Therefore this factor has less influence on the project.

On production management related issues, incomplete drawing(MS=4.32) is rated the most in this category. This results in unnecessary delays, stoppage of work and incurring of cost. Next to this is lack of material on site(MS=3.71). This has the same effect as incomplete drawings because it institutes delay on the project.

The factor with the least rating in relation to production management related issues is poor site condition(MS=1.90). In a mega projects, the site condition may be appropriate. The provision of PPE sanitary tools and good environment to work, these have little influence on the project and probably the reason for it rating. Next to poor site condition is improper construction methods (MS=1.96). This will result in rework materials wastage, delays, bad image, poor competitive advantage and so on.

On social facilitation issues lack of legal framework (MS=2.91) is rated the most influential factor causing challenges on this category on mega project. These may border on the issue of the staff developments incentives and disciplinary measures. There must be standards to use for all workers, in order to command respect and productivity. Next is community unrest and strikes(MS=2.34). The lack of adequate representation of the community on the project probably relates to employment and other top position securing on the project may lead to community or communal crisis and resulting in a slow progress and low productivity on the project.

The least related factor in this category is delay or non-payment of compensation(MS=1.89) with respect to mega projects. Preliminary investigation and feasibility report must have been made prior to the award and commencement of the project. Therefore, compensation to individuals or groups must have been taken into consideration. Therefore, this factor has little or no influence on the project.

On health and safety related issues, legislation is rated the most significant factor effecting the delivery of mega projects. This is related to the punitive measures to be met to individuals that are found guilty regarding health and safety rules which have caused significant impact to project and the image of the industry. A good legislation in place will assist in curbing or reducing health and safety related issues. Next to this is health and safety human factors (MS=3.03). This concerns the various health and safety regulation that workers might adhere to at work during execution of tasks. The use of PPE and attitude towards fellow workers at work.

The least significant factor in this category with negligible influence on the completion of mega project is financial issues (MS=1.62). With reference to a mega projects, all that is required for the execution must have been taken care of it mega project in terms of financials.

The most significant factor under logistics planning related issues is public safety (Ms=4.33). Failure to communicate with communities during during execution of the project can have severe counsequences for the successful completion of mega projects. Communities distancing themselves from the project can prove to be severe factor. Failure to allocate safety warning signs by contractors can create dangerous situations. Public failure to comply with rules and regulations can develop miscommunication between community and construction team. Plant operator's failure to comply with safety rules and regulation can create injuries and accidents on the project.

The second most significant factors under this category are site access routes (Ms=4.33).

- Bad site conditions.
- Site surroundings buildings.
- Wet sites.
- Improper site layout planning.
- Site location.

All above mentioned can have an impact on site access routes and this this can have a negative impact on the project.

The least significant factor under this category is the use of banksmen of site (Ms=1.51).

- Lack of training for banksmen.
- Poor positioning of banksman on site by the site foremen.
- Failure to provide distinctive clothing for identification.

4.7 Impact of management issues on mega project delivery

	Cost							Quality							Time						
	Not Influential ……………………………. ………..Very Influential					Mean	Standard Deviation	**Not Influential ……………………………. ………..Very Influential**					Mean	Standard Deviation	**Not Influential ……………………………. ………..Very Influential**					Mean	Standard Deviation
Factor	**1.00**	**2.00**	**3.00**	**4.00**	**5.00**			**1**	**2**	**3**	**4**	**5**			**1**	**2**	**3**	**4**	**5**		
Stakeholder Management	0.0	0.0	13.8	31.3	55.0	4.41	0.72	1.3	0.0	3.8	37.5	57.5	4.50	0.69	0.0	0.0	3.8	21.3	75.0	4.71	0.53
Plant Management	0.0	1.3	1.3	12.7	84.8	4.81	0.51	0.0	3.8	6.3	16.3	73.8	4.60	0.77	0.0	0.0	1.3	5.0	93.8	4.93	0.31
Production Management	0.0	1.3	1.3	8.8	88.8	4.85	0.48	0.0	2.5	26.3	23.8	47.5	4.16	0.91	0.0	0.0	1.3	12.5	86.3	4.85	0.39
Supervision of workers	0.0	8.8	36.3	43.8	11.3	3.58	0.81	1.3	1.3	10.0	36.3	51.3	4.35	0.81	0.0	2.5	11.3	36.3	50.0	4.34	0.78

Social Facilitation	25.0	48.8	22.5	3.8	0.0	2.05	0.79	56.3	35.0	7.5	1.3	0.0	1.54	0.69	41.3	37.5	12.5	7.5	1.3	1.90	0.98
Material wastage	0.0	1.3	2.5	96.3	0.0	4.94	0.37	1.3	1.3	5.0	15.0	77.5	4.66	0.75	0.0	1.3	10.0	25.0	63.8	4.51	0.73
Health and Safety	0.0	15.0	65.0	16.3	3.8	3.09	0.68	6.3	47.5	40.0	6.3	0.0	2.46	0.71	2.5	41.3	47.5	7.5	1.3	2.64	0.72
Logistic Management	0.0	0.0	1.3	47.5	51.3	4.50	0.53	0.0	2.5	16.3	38.8	42.5	4.21	0.81	0.0	1.3	5.0	20.0	73.8	4.66	0.64

	Production							Company image							Competitive advantage						
	Not Influential ……………………………… ………..Very Influential					Mean	Standard Deviation	**Not Influential ……………………………… ………..Very Influential**					Mean	Standard Deviation	**Not Influential ……………………………… ………..Very Influential**					Mean	Standard Deviation
Factor	**1**	**2**	**3**	**4**	**5**			**1**	**2**	**3**	**4**	**5**			**1**	**2**	**3**	**4**	**5**		
Stakeholder Management	0.0	1.3	2.5	16.3	80.0	4.75	0.56	1.3	3.8	23.8	50.0	21.3	3.86	0.84	1.3	26.3	32.5	27.5	12.5	3.24	1.02
Plant Management	0.0	1.3	1.3	5.0	92.5	4.89	0.45	0.0	18.8	51.3	23.8	6.3	3.18	0.81	5.0	38.8	38.8	13.8	3.8	2.73	0.90
Production Management	0.0	0.0	2.5	5.0	92.5	4.90	0.38	0.0	3.8	20.0	27.5	48.8	4.21	0.90	0.0	10.0	35.0	25.0	30.0	3.75	1.00
Supervision of workers	0.0	1.3	0.0	10.0	88.8	4.86	0.44	2.5	38.8	35.0	18.8	5.0	2.85	0.93	17.5	45.0	22.5	11.3	3.8	2.39	1.02
Social Facilitation	50.0	36.3	7.5	1.3	5.0	1.75	1.01	5.0	13.8	28.8	36.3	16.3	3.45	1.08	21.3	32.5	32.5	11.3	2.5	2.41	1.03
Material wastage	0.0	1.3	2.5	5.0	91.3	4.86	0.50	0.0	25.0	46.3	23.8	5.0	3.09	0.83	15.0	50.0	21.3	10.0	3.8	2.38	0.99
Health and Safety	1.3	21.3	53.8	21.3	2.5	3.03	0.76	1.3	17.5	21.3	31.3	28.8	3.69	1.11	8.8	36.3	30.0	22.5	2.5	2.74	0.99
Logistic Management	0.0	0.0	1.3	18.8	80.0	4.79	0.44	0.0	20.3	43.0	26.6	10.1	3.27	0.90	8.8	42.5	23.8	18.8	6.3	2.71	1.07

Table 4.7 reveals the respondents’ rating of the impact of management issues on mega project conveyance. It is notable that all factors in the category have between 2.09 ≤ MSs ≤ 4.00, which indicates that the factors have between a near minor to major impact on the factors encountered by management in managing mega projects.

The table below has been divided into sections for rating of impact in cost, quality, time, production, company energy and competitive advantage**.**

Table 4.7 (a): Influence factors of impact of management issues on cost

	Cost							
	Not Influential ....Very Influential					Mean	Standard Deviation	Rank
Factor	**1.00**	**2.00**	**3.00**	**4.00**	**5.00**			
Material wastage	0.0	1.3	2.5	96.3	0.0	4.94	0.37	1
Production Management	0.0	1.3	1.3	8.8	88.8	4.85	0.48	2
Plant Management	0.0	1.3	1.3	12.7	84.8	4.81	0.51	3
Logistic Management	0.0	0.0	1.3	47.5	51.3	4.50	0.53	4
Stakeholder Management	0.0	0.0	13.8	31.3	55.0	4.41	0.72	5
Supervision of workers	0.0	8.8	36.3	43.8	11.3	3.58	0.81	6
Health and Safety	0.0	15.0	65.0	16.3	3.8	3.09	0.68	7
Social Facilitation	25.0	48.8	22.5	3.8	0.0	2.05	0.79	8

Table 4.7(a) presents the identified management issues of mega projects on cost. The factor of management issue on mega projects that affect cost most, is material wastage(MS=4.94) due to the complex nature of mega project consisting of many departments units and units of production. It is difficult to have 100% control of waste. Supervision becomes difficult, this provide for workers not to be too conscious on application,cutting and handling waste. Next to material wastage is production management (MS=4.85). Production management refers to all efforts and processes to be taken to maintain high level productivity. These include material ordering, storage, selection of the best and economical matters of construction. All of these involve either the hiring of personnel to ensure the timeous provision of these and avalibility of material. These are the likely reasons productivity management is expensive to maintain.

The least factor affecting cost is logistic management (MS= 4.50). This is likely due to the fact that most mega projects are executed by large firms and have a good logistic framework that has been in use over time which is functional.

Table 4.7(b) Influencing factors of management issues on quality

	Quality							
	Not Influentia......................Very Influential					Mean	Standard Deviation	
Factors	1	2	3	4	5			Rank
Material wastage	1.3	1.3	5.0	15.0	77.5	4.66	0.75	1
Plant Management	0.0	3.8	6.3	16.3	73.8	4.60	0.77	2
Stekeholder management	1.3	0.0	3.8	37.5	57.5	4.50	0.69	3
Supervision of workers	1.3	1.3	10.0	36.3	51.3	4.35	0.81	4
Logistic Management	0.0	2.5	16.3	38.8	42.5	4.21	0.81	5
Production Management	0.0	2.5	26.3	23.8	47.5	4.16	0.91	6
Health and Safety	6.3	47.5	40.0	6.3	0.0	2.46	0.71	7
Social Facilitation	56.3	35.0	7.5	1.3	0.0	1.54	0.69	8

Table 4.7(b) present the influencing factor of management issue on quality of product The factor that most affects quality is material management (MS=4.66). This may be in the form of adequacy in availability, during production. Contractors may be tempted to compromise on quality by not using the correct ratio of mixing and not in sufficient quantity with respect to painting and other production materials thereby adversly affecting the qulity of product.

Next to material wastage is plant management (MS=4.60). Faulty plant is likely to give wrong results. This is relative to the weighing of different materials for mixing, Also the adquecy of tools and plant to execute tasks neatly and more quickly. Therefore, plant management has both positive and negative impact on the quality of production.

The factor with the least impact on quality is social facilitation(MS=1.54). Arguable, workers could be edquately compensated and given a good welfare that caters for their interest. Therefore, workers have nigligible worries and can focus on the job putting in their best effort resulting in high standard of perfomence and productivity.

Table 4.7(c) Influencing factors of management issues on time

Factor	Time							Rank
	Not Influential ....Very Influential					Mean	Standard Deviation	
	1	2	3	4	5			
Plant Management	0.0	0.0	1.3	5.0	93.8	4.93	0.31	1
Production Management	0.0	0.0	1.3	12.5	86.3	4.85	0.39	2
Stekeholder management	0.0	0.0	3.8	21.3	75.0	4.71	0.53	3
Logistic Management	0.0	1.3	5.0	20.0	73.8	4.66	0.64	4
Material wastage	0.0	1.3	10.0	25.0	63.8	4.51	0.73	5
Supervision of workers	0.0	2.5	11.3	36.3	50.0	4.34	0.78	6
Health and Safety	2.5	41.3	47.5	7.5	1.3	2.64	0.72	7
Social Facilitation	41.3	37.5	12.5	7.5	1.3	1.90	0.98	8

Table 4.7(c) reveals the influence of management issues on time, the factor that mostly affect time is plant management(MS=4.93). Plant that are in good condition, given regular maintanence are likely to be used for a considerably longer time without breaking down. A hitchfree performence of plant engenders high productivity and early delivery of the project. The contrary is the case, if plant are not regulary maintained.

Next to plant management is production management(MS=4.85). Production should be presided with adquate planning. The lack of planning is planning to fail. A good plan must take into consideration a lot of factors, and therefore is time consuming. A mega project is complex, it will therefore require reasonable time to produce a workable plan for the projects.

The least factor affecting time is social facilitation(MS=1.90). This may be due to the virious standard social facilitating that are available, which will imply mere selecting an appropriate one for implementation that does not take a lengthly period to effect.

Table 4.7(d) Influencing factors of management issues on productivity

	Production							
	Not Influential....................Very Influential					Mean	Standard Deviation	
Factors	**1**	**2**	**3**	**4**	**5**			Rank
Production Management	0.0	0.0	2.5	5.0	92.5	4.90	0.38	1
Plant Management	0.0	1.3	1.3	5.0	92.5	4.89	0.45	2
Supervision of workers	0.0	1.3	0.0	10.0	88.8	4.86	0.44	3
Material wastage	0.0	1.3	2.5	5.0	91.3	4.86	0.50	4
Logistic Management	0.0	0.0	1.3	18.8	80.0	4.79	0.44	5
Stekeholder management	0.0	1.3	2.5	16.3	80.0	4.75	0.56	6
Health and Safety	1.3	21.3	53.8	21.3	2.5	3.03	0.76	7
Social Facilitation	50.0	36.3	7.5	1.3	5.0	1.75	1.01	8

Table 4.7(d) indicates the impact of the factors of management issues on production. The factor with the most impact is production management (MS=4.90). A mega project is large. Therefore, the issues of production is varied and complex and should be given high priority or attention. A slip in process may have great impact on production. This may be a reason why production management factor has significant impact on production levels of mega project.

Next to production management is plant management (MS=4.89). This corroborates the earlier analysis, stating that mega projects are driven by machines. This has great impact on production.

The factor that has the least impact on production is social facilitation (MS=1.75). Competent workers are being employed to handle mega projects and are compensated adequately; therefore this factor has negligible impact on production.

Table 4.7(e) Influencing factors of management issues on company image

	Company image							
	Not Influential ....Very Influential					Mean	Standard Deviation	
Factors	**1**	**2**	**3**	**4**	**5**			Rank
Production Management	0.0	3.8	20.0	27.5	48.8	4.21	0.90	1
Stekeholder management	1.3	3.8	23.8	50.0	21.3	3.86	0.84	2
Health and Safety	1.3	17.5	21.3	31.3	28.8	3.69	1.11	3
Social Facilitation	5.0	13.8	28.8	36.3	16.3	3.45	1.08	4
Logistic Management	0.0	20.3	43.0	26.6	10.1	3.27	0.90	5
Plant Management	0.0	18.8	51.3	23.8	6.3	3.18	0.81	6
Material wastage	0.0	25.0	46.3	23.8	5.0	3.09	0.83	7
Supervision of workers	2.5	38.8	35.0	18.8	5.0	2.85	0.93	8

Table 4.7(e) indicates the impact of the factors of management issues on company image. The factor with the most rating is production management(MS=4.21). Production reveals how quickly the project can be delivered. It also indicates the competency level of the company, reveal the crop of staff, the machinery and how the technology copabilities of the company. These reflects on competitive advantage as well as rate of partronage by client.

Following production management is stakeholder management (MS=3.86) which has an impact on company image. A good decision will engender good operation and result. A bad decision may also have a negative impact or the operation of th company revealing the image of the company. The factor with the least rating in this construct is supervision of worker (MS=2.85). Supervision of workers has a negligible impact or company image probably due to the competent staff employed to handle such large projects.

Table 4.7(f) Influencing factors of management issues on competitive advantage

	Competitive advantage							
	Not Influential ....Very Influential					Mean	Standard Deviation	
Factors	**1**	**2**	**3**	**4**	**5**			Rank
Production Management	0.0	10.0	35.0	25.0	30.0	3.75	1.00	1
Stekeholder management	1.3	26.3	32.5	27.5	12.5	3.24	1.02	2
Health and Safety	8.8	36.3	30.0	22.5	2.5	2.74	0.99	3
Plant Management	5.0	38.8	38.8	13.8	3.8	2.73	0.90	4
Logistic Management	8.8	42.5	23.8	18.8	6.3	2.71	1.07	5
Social Facilitation	21.3	32.5	32.5	11.3	2.5	2.41	1.03	6
Material wastage	15.0	50.0	21.3	10.0	3.8	2.38	0.99	7
Supervision of workers	17.5	45.0	22.5	11.3	3.8	2.39	1.02	8

Table 4.7 (f) presents the impact of factors of management issues on the competitive advantange of the company. The factor with the most rating is production management (MS=3.75); hw well production of the company is directly propotional to the wellness of the workers and state of plan and equipment. This revolves around the education background of employees. The plant and equipment availability to the company and welfare package to workers. All this work has a combination to dertemine the level of satisfaction of workers. The happier the worker are, the higher the productivity and

ultimately impact on the project delivery positively and attract repeat of contract.

Next to production management is stakeholder management (MS=3.24), there are knowlegeble and unknowlegable clients in the construction trade. Their contribution to the construction junctures of a project could either make good of product or negatively affect it. These contribution in either way have an impact on the final product and affect contractors competitive advantage in both ways. A knowledgeable client will contribute positively in terms of ideas on construction methods with positive impact on quality of production.

The factor with the least rating in this construct is supervision of workers (MS=1.02). Based on the ongoing argument regarding suspension, it could be deemed that it has a negligable impact on the competitive advantage of a company as resulting on the competency of supervision coupled with the high qualifications of staff.

CHAPTER 5: RESOLVING MANAGEMENT ISSUES THROUGH SYSTEM

5.1 DYNAMIC APPROACH

SD METHOD

SD modelling method has been used (Forrester, 1968; Stermann, 2000) and adopted to develop conceptual models (Wolstenholme, 1992; Robinson, 2008) by extracting the causal feedback mechanisms among the various control variables under the different variables for resolution of project delivery of mega projects. Based on the principles suggested by Forrester (1968) and Von Bertalanffy (1974), the construction industry was taken as a structure having a composite set of subsystems, which necessitates performance in a synchronised fashion to accomplish the anticipated conclusion of successful delivery of mega projects. Investigations concerning numerous aspects of construction and application of SD to evolve resolutions have been taken up by quite a few academics since the previous four decades. Some examples of SD application in construction can be seen from the works of Cooper (1980, 1993), Abdel-Hamid (1984); Ford and Sterman (1998a, 2003b); Rahmandad and Hu (2010); Owens and Leveson (2011) and Parvan, Rahmandad, Haghani (2012, 2013) to name a few.

Also, Lyneis and Ford (2007) provided a comprehensive discussion regarding SD application on numerous facets of construction delay and rework in their review work “System Dynamics Applied to Project Management”. Further, Han, Love, Peña-Mora (2013) suggested that as construction projects are known to include composite, inter-dependent, inexact and labour-intensive work, the industrialized model can succor project managers to comprehend the dynamics of how the construction process works and its intricate relationship with labour, cost and schedule. As the construction projects are getting progressively intricate, particularly with mega projects in which plant and stakeholder's management input play an important role relative to their delivery. There is a need to evaluate plant efficiency, materials availability, level of supervision and decisions of stakeholders visa vesa the productivity and project delivery in the industry in an all-inclusive way. Understand the system theoretically and derive mechanisms in order to improve policy intercessions before developing generalised calculable models.

SD principle in this study was embraced because of its arduous structural framework, which supports producing and exhibiting data used to build a conceptual model (Forrester, 1994; Lane and Oliva, 1998) and offer avenues to understand the phenomena through mechanisms clearly without any complex quantitative analysis; that would be more useful for the stakeholders in the construction industry without professional knowledge such as clients and contactors to overcome that mega project poses (Forrester, 1968, 1969; Lee, Choi and Park 2005; Montibeller and Belton 2006; Park, Kim, Lee, Han, Hwanga, Choi Min, 2013). Furthermore, according to scholars such as Olaya (2012) and Sterman (2000), unlike many mechanistic systems or physical modelling, SD is based on the principle of operational thinking with a feedback mechanism of information-decision-action and influence on the environment. This feedback mechanism offers the dynamic hypotheses with unique explanatory power to diagnose the problems and visualise the behaviour of the system under different scenarios. Therefore, although, the ultimate aim of the investigation is to develop quantitative SD model and simulate to develop policy scenarios, the scope of this research is restricted to the development of conceptual models diagrams.

5.2 Causal Loop Diagrams (CLDs)

Mega projects are influenced by three major elements of the projects such as resource (materials), productivity and plant efficiency. Each aspect influences the projects independently based on the interlinkage and interaction of the various variables under these aspects. The interlinkage of the various variables under each aspect and their influence of the project is discussed through conceptual SD models and CLDs.

5.3 Resource (materials):

Figure 1 presents the conceptual SD model developed based on the CLDs among the various variables influencing resource in terms of materials in the project. Under a business as usual situation, demand for materials/ resources requires procurement and then storage of the materials. Appropriate procurement and adequate storage lead to the efficient use of the materials. Consequently, there is reduction in wastage which leads to letter of demand on the materials through the feedback relationship (R1). Further, storage requires adequate and proper physical infrastructure, and the availability of physical infrastructure reduces the wastage there by reducing the demand on the materials through CLD R1A, and reinforcing the CLD R1. Similarly, demand for materials requires better handling that needs competent and skilled labour.

Availability of skilled labour leads to efficient use of materials and consequently lesser wastage. As a result, it reduces the demand on the additional material requirement through CLD R1B. R1B thus reinforces R1. Thus, availability of physical infrastructure for proper storage, availability of skilled labour for handling of materials and storage leading to effective use of materials and lesser wastage of materials consequently reduce the demand on the materials.

On the other hand, demand of materials enhances the cost of the project thus leading to decrease in the creation (and availability) of physical infrastructure storage. In the absence of adequate and appropriate storage, wastage is likely to occur. As a result, there shall be more demand of materials through CLD B1. Thus, augmentation of physical infrastructure for storage and competent personnel (labour) are the important aspects to consider to reduce the demand on materials and need to be leveraged upon for the efficient delivery of mega projects.

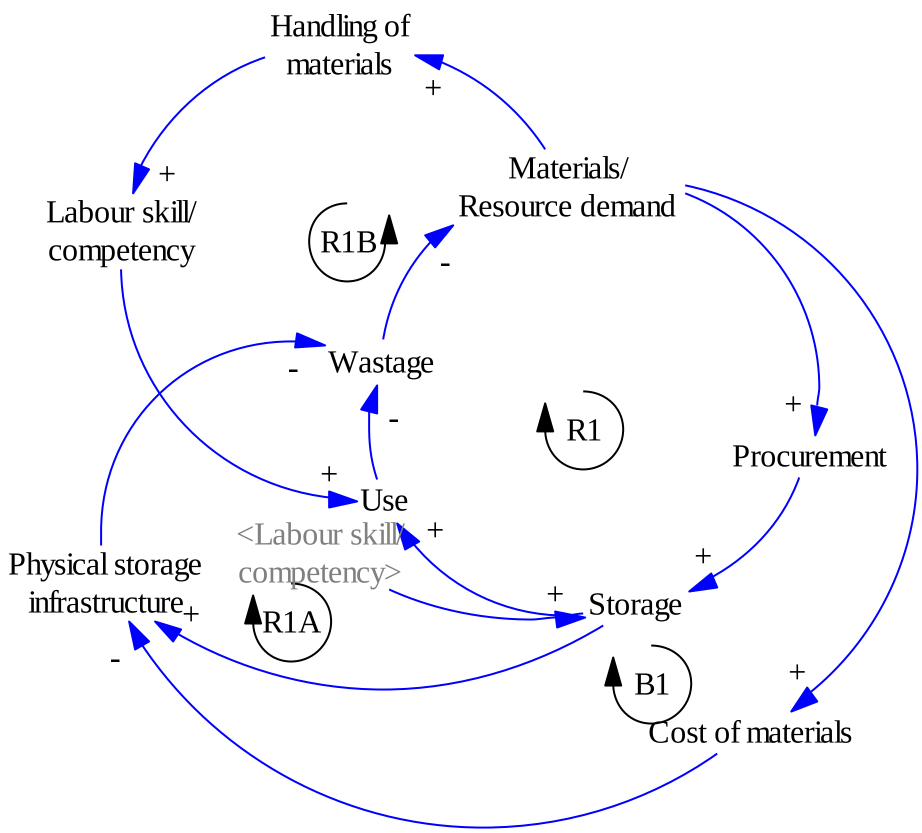

Figure 5.1. CLD for materials (resource)

5.4 Productivity

Figure 2 presents the conceptual SD model and CLDs for productivity. Productivity, in other words the progress in work, is a function of availability of materials or resources and competent/ skilled labour. An appropriate procurement process assists in availability of materials in the project which consequently enhances the productivity through CLD RP1. Similarly, recruitment of labour aided by training and skill enhances the availability of competent labour force, which leads to increased productivity through CLD RP2. However, supervision of both procurement of material and labour force is essential which if done will effectively, increase productivity.

On the other hand, recruitment and training of labour is expected to increase the project cost which in turn might lead to reduction in training activities through CLD BP1. The reduction in training will lead to lack of skilled labour which consequently affect the productivity negatively. Similarly, increase in cost of project is also likely affect the procurement negatively, which essentially is expected to reduce the availability of materials and consequently will hamper productivity through CLD BP2. Thus, availability of competent labour, training and skill enhancement and procurement are the leverage points to be considered for higher productivity. Also, supervision should be considered as a critical aspect for enhancement of productivity. However, project cost should be kept under control otherwise it is expected to hamper the project both through reduction in availability competent/skilled labour and materials.

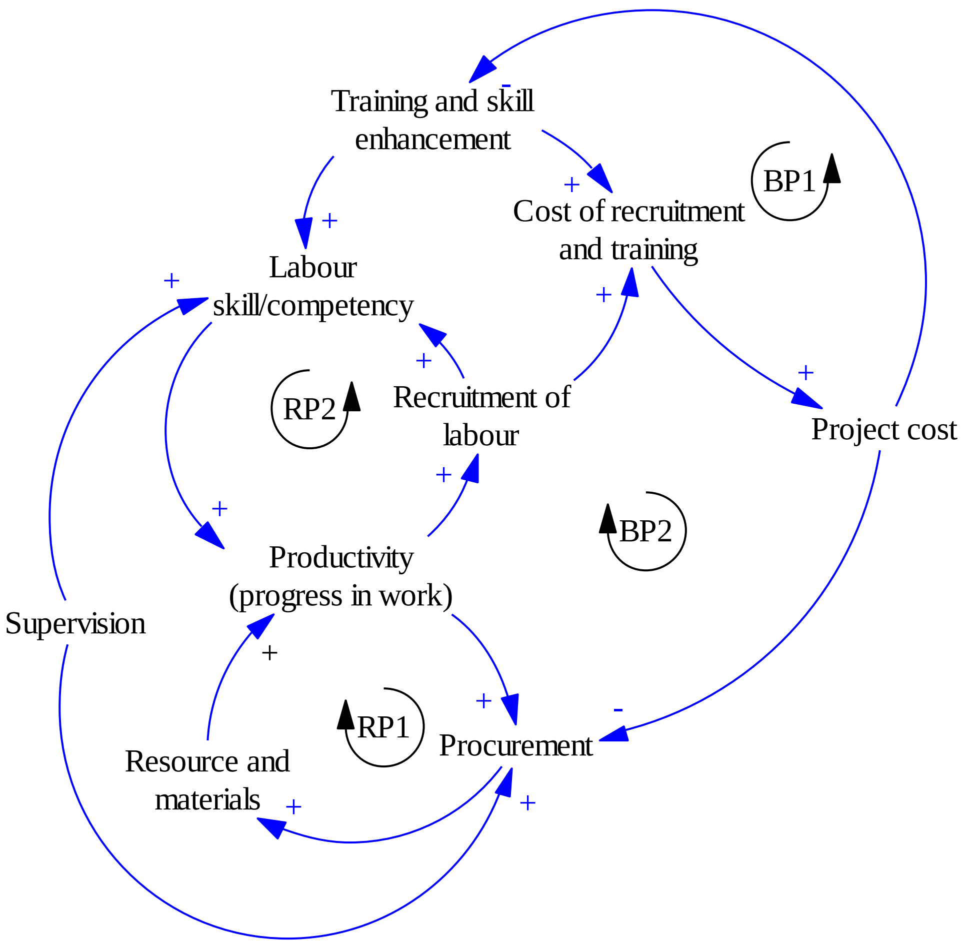

Figure 5.2. CLD for productivity

5.5 Plant efficiency

The conceptual model and CLD for plant efficiency is presented in Figure 3. Plant efficiency is considered as a function of operation and management. Operation and management increases the plant efficiency which leads to higher production through CLD RPE. However, operation and management depends on organisational structure, which is expected to recruit and train skilled personnel. Recruitment and training will lead to availability of skilled and competent personnel, who will enhance the operation and management of the plants through CLD RO. So CLD RO reinforces CLD RPE, thus enhancing the plant efficiency.

Further, availability of skilled labour increases the maintenance efficiency which in turn increases plant efficiency through CLD RM. Thus, CLD RM reinforces CLD RPE. Consequently, plant efficiency is enhanced through operation and management, and maintenance with the help of skilled labour. However, operation and management, maintenance and recruitment and training of the labour are likely to increase the project cost. The increase in project cost will negatively affect the availability of skilled and competent labour, which in turn will affect the plant efficiency negatively through CLD BPC. So, availability of skilled and competent labour is the leverage point to be considered for increasing the plant efficiency, however, project cost should be kept under control.

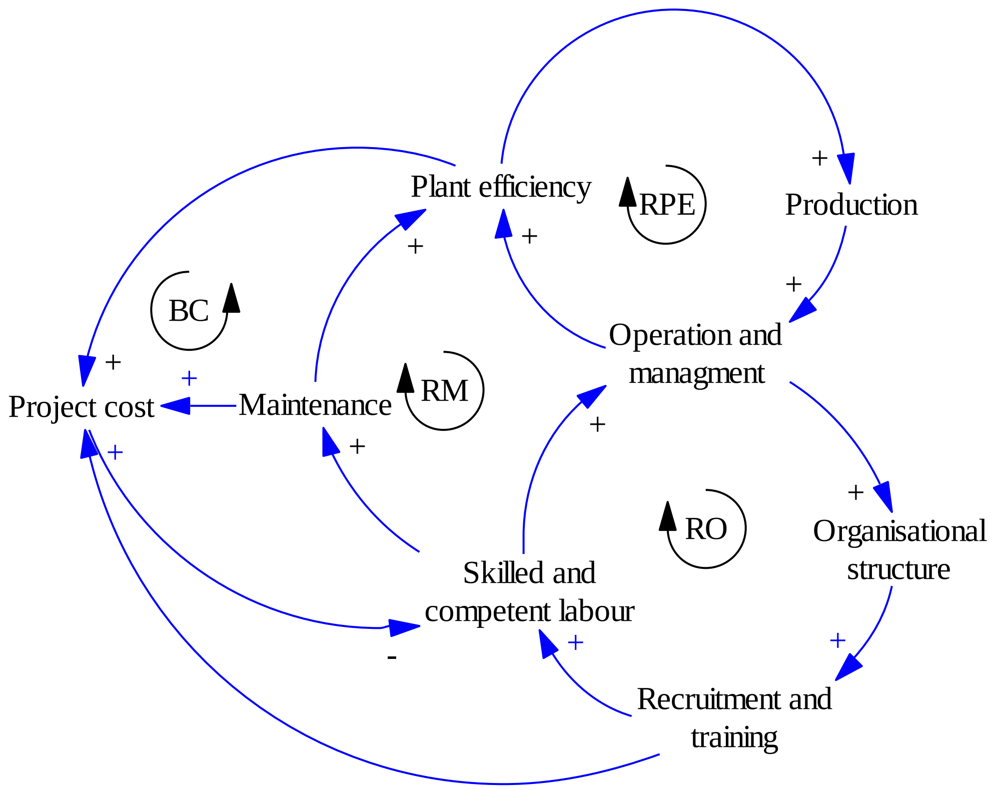

Figure 5.3. CLD for plant efficiency

5.6 Conclusions based on System Dynamics

Policy formulation based on the system dynamic approach, adequate storage facilities and competent personnel are recommended to mitigate against materials wastage. A good storage facility will keep materials from getting damaged due to the conditions of storage and qualified personnel to handle these materials in a manner to avoid damages from poor handling. In order to maintain high levels of productivity, it is recommended that competent skilled labour, a good materials procurement system, constant training of workers and adequate supervision must be put in place. Plant efficiency is paramount to the level of productivity in mega projects, as they are characterised by machines. Competent skilled labour availability throughout the project duration is recommended. This both for operation of the machines and maintenance.

Chapter 6: Summarry, Conclusions and Recommendations

6.1 Introduction

This chapter discourses deductions and commendations ascending from the inspection of the pertinent collected works and the discoveries derived from the analysis of data. The literature study advocated that mega projects face a host of management issues ranging from those caused by stakeholder managment, plant management, production management, supervision of workers, project social facilitation,material wastage, health and safety and logistics planning. The literature study investigated the approach of management taken by construction management team in three provincence of South Africa which are KwaZulu-Natal, Gauteng and Western Cape. An empirical study was conceded to test the cogency of the hypothesis. One set of the questionnaires was arranged for grade 8 & 9 GB contractors and specialists. The results were organized based on data gathered.

The research methodology is detailed in Chapter 3. The chapter also points to respondents of the pilot interviews and what input was gained from this. The procedures involved in compiling the questionnaire are also discussed. The outcomes of the survey are given in Chapter 4 and 5, with input from the construction advisors and contractors. The empirical enquiry revealed the need for training of stakeholders in construction, lack of plant management, poor supervision of workers,lack of production management, lack of social facilitation, poor health and safety management and lack of logistics planning.

6.2 Conclusions

In chapter 4, this study ranks the factors explored by their average mean scores on management issues, resolution of management with mega projects. The leading factors is plant managemnt. Following closely was the factor of material management . Followed by logistic planning. Based upon the factor analysis conducted in the preceding chapters, it is resolved that all aspects acknowledged for each category satisfactorily describe the subproblems by the significance of the loadings attained for each category of sub-problems, which were greater than 0.50 in all cases.

Each category was reviewed and the factors that impact on each management issue were identified.

From findings of the research, the subsequent conclusion can be made with regards to “plant management”

- Plant down time was rated the most under plant management. Whenever the plant is not in use on site it impact on project cost and lose of time and this demand a need for proper plant schedule.
- Plant maintenance, the poor plant maintenance leads to plant down time.Maintened plant gurantees the operation of plant on site which mitigate the lose of time due to plant down time.

In summary it can be concluded that regular plant maintenance is a necessity to ensure that construction program is not affected.

Based on the outcomes from the research, the succeeding conclusion can be made in relation to “logistic management”

- Under this category, the leading factor is public safety. Safety of the public is key to every project and if there is no proper logistic management plan developed for community leaving around site, servire compensation cost can occur in the project.

In summary it can be concluded that safety awareness need to be made for community around project area.

From the research findings, The ensuing conclusion can be made in relation to material management

- Respondents ranked alteration to design as a leading factor impacting material management. The change of designs during construction must be avoided since this brings unexpected material expanditure which impacts highly on the project costing.
- The other factor that was rated high under material managemen is re-work due to poor workmanship. This relates to poor supervision of work during construction.

In summary it can be resolved that proper plant management is a necessity in the mega project.

Based on the research findings, The next conclusion can be made in relation to production management

- The leading factor in this catergory is incomplete drawing. Which can create lots of re-work after designed have been updated.
- This is closely followed by the lack of material on site; when there is no material on site the production get affected. The project gets delayed which lead to increasing project expenses.

In summary it can be established that that training of workers to maintan the quality of the product is required in the mega project.

From findings of the research, the ensuing conclusion can be made in relation to stakeholder management

- Stakeholder decisions was rated high amongst the factors that affect stake holder decisions.
- Respondents also rated stakeholder responsibility through project life cycle as one of the factor thar impact on stakeholder management. The lack and shift of responsibility amongst the stakeholder can cause serious problem for the project.

In summary, it can be inferred that most stake holder lacks communication which leads delays in taking decisions.

Based on findings of the research, the subsequent conclusion can be made on in regards to labour management

- The factors that was ranked as the highest is unskilled manpower. This relates inexpiirienced team or individuals who have shortage of required skill which impact on quality of work on site.

In summary, it can be resolved that the regulary training is a necessity in mega project.

From the findings from the research, the subsequent conclusions can be made concerning health and safety .

- Lagesilation was identified and ranked as most impacting on healthy and safety.
- Health and safety human factor was found to be second most significant factor that impact on heathly and safety. Humanbeings tend to ignore the operation’s rules and that ignorance of those rules leads to death and injuries.

In summary, it can be concluded that there is a necessity for old lagesilation to be revised due to change of times.

From the findings from the research, the following conclusion can be made regarding social facilitation.

- Lack of legal framework was ranked high by respondents and communities tends to ignore the formal procedures if they want to be involved in the project.
- Community unrest, military and communal crises were ranked high by respondents; strikes and unrest are very common currently. This has blocked many projects in the country and there are community forums that have been allowed to have a share in the project which lead to many project failures.

In summary, it can be concluded that community involvments is a necessity in mega project.

6.3 Recommendations

From research findings, it is clear that construction of mega project need to address all management issues related to the management of mega projects.

Under plant management the responsible plant supervisor must design the plant schedule for the entire project duration, close management by the site agent must be applied to avoid plant down time. Plant supervisor make sure that he communicates is plant schedule to plant hire consultant.

It is recommended that the regular plant maintenance alternative full time plant machenical engineer must be employed on the mega project. The budget to remunerate the machenical engineer must allowed in the project budget.

The findings of the study revelas that there is remarkable need for proper logistic planning, the safety of public around projects need to be managed closely by responsible site agents and safety officers. The safety harzads must placed around site to mitigate incidents and accidents which which may lead to injuries or death.

Site access routes also impact on logistics planning; this can lead to major project delays which can escalate cost of the project. The proper site layout plan that caters for on site and sorroundings can help to provide clear guidelines on site access routes.

It is recommended that the drawing from the architect must be detailed enough to avoid design changes. All cost occurring during design changes must be charged to the architect fees, not unless the changing were unforeseen and not because of the poor designs.

After findings under material management all work done needs to be regulary inspected during construction to limit the material wastage. Introduction of poor workmanship fines to the responsible workers and their formen can help in keeping all responsible individuals alert and highly consetrated on work.

It is recommended that solid plan of material management must be developed. Also communication among construction material management team including suppliers need to engage often to make sure that all materials are available on site. Storemen need to be provided with training to mitigate delays related to materials.

The turn around time for decisions to be taken for projects must be a minimized to mitigate project delays. Stakeholder need to understand that decision delays leads to project delays.

The project participants need be clear about who is doing what. In this case site organogram needs to be developed and placed in a visible area.

Proper training needs to be provided for workers to make sure that the end results are of the required quality.

Following research findings, the following conclusions were made regards workforce involvement. Strict work management plans to be developed for each project to make sure that workers are forced to do what is required of them.

Some of legislation are for years and they can not be implemented in this years where there are lots of changes which involve technologies. Some legisilation need to be reviewed.

Daily healthy and safety inductions need to be done on site every morning before any work commences.

Community workshops and induction need to be done regulary during project inception up to project hand over.

Professional community engagements need to done following all processes and engagements with community leaders to inform them of the project.

References

Aadal, H., Rad, K. G., Fard, A. B., Sabet, P.G.P. & Morshedi, R., 2014. *Impact of plant and equipment in construction industry*. Maxwell Science Publication. Research Journal of Applied Sciences, Engineering and Technology 7(11): 2371-2375.

Abdel-Hamid TK. (1984). "*The dynamics of software development project management: an integrative system dynamics perspective"*. PhD thesis, MIT Sloan School of Management, Cambridge, MA.

Abrey, M and Smallwood, J.J. (2014). *The Effects of Unsatisfactory Working Conditions on Productivity in the Construction Industry. Procedia Engineering,* Adewuyi, T. O., & Odesola, I. A. (2015). *Factors affecting Material Waste on Construction Sites in Nigeria*. Journal of Engineering and Technology (JET),6. (1): 82-99.

Agyekum, K.2012. *Consultants perspective on material waste reduction in Ghana.* Kwame Nkrumah Univirsity of Science and Technology.

Aiyetan, A.O. (2015). *Determinants of Skill Shortages of Construction Workers at the Eastern Cape Province of South Africa. Conference of The Ninth Built Conference of Association of Schools of Construction of southern Africa*, Durban, 09-11 August, pp. 454-467

Aiyetan, A.O., Smallwood, J.J., and Shakantu, W. (2014). *A Systems Model for Project Delivery Time Implementation*, Journal of Construction. 7(2), 40-50.

Aimienrovbiye, G., 2010. *Maintenance impact on Production Profitability*. Linnaeus University. Thesis no: TEK 028/2010.

Amo, T., 2013. *The negative effects of training in workplace*. Shaw Academy.www.pearsonx.com.

Anderson, L. M., & Pearson, C. M. (2005). *Tit for tat? The spiraling effect of incivility in the workplace.* The Academy of Management Review, 24(3), 452-471.

Underson, L. 2015. How too increase teamwork to ensure project success. https://www.projecttimes.com/lisa-anderson/how-to-increase-teamwork-to-ensure-project-success.html?

Andy, K. W. & Andrew, D.F. 2013. *Causes leading to poor site coordination in building project*. City University of Hong Kong.

Albert health services, 2015. *Supervisor roles and responsibilities on occupational health and safety hand book* https://open.alberta.ca/dataset

Aloke, D., Edward, D., Wright, M. & Love, H.A., 2006. *Job satisfaction and Job Commitment. A study of quantity surveyors in Nigerian Public Service*. Federal University of Technology. International Journal of Business and Management 7(5).

Alwi, S., and Hampson, K. (2003). *Identifying the Important Causes of Delays in Building Construction Projects*. In Proceedings the 9th East Asia-Pacific Conference on Structural Engineering and Construction, Bali, Indonesia, 2003

Alzahrani J. I., Emsley M. W. (2013). The Impact of Contractors' Attributes on Construction Project Success: A post construction evaluation. International Journal of Project Management, 31, 313-322.

Alexander, L. 2015. *What do successful project manager do*. Project management. Http://mitsmr.com/1Ekwuru

Amarald Group Publisher, 2009. *Construction plant and equipment management*. Lounghborough University. Journal of Engineering, Design and Technology 7.

Assaf, S.A. and Al-hejji, S., (2006). *Causes of Delay in Large Construction Projects*, International Journal of Project Management. 24(7), 349-357.

.

Assignar.2017. The importance of logistics on construction sites.

Atkin, B. & Skitmore, M., 2008. *Construction Management and Economics: Stakeholder management in construction.* Queensland University 26(6): 549-552.

Ayegba, C. 2013. *An assessment of material management on building construction sites*. Vol 3(5). Federal University of Tehnology

Aviva plc. 2011. *Securing our future corporate responsibility report 2011*.

Baba, T; Makhdumi,A & Farrakh,A. 2017. Project Management approach in mega construction projects in developing countries. Herriot Watt University.

Bahru, J. & Malaysia, T., 2014. *Major emergency assessor*. University Manual of occupational safety and health. University Teknologi Malaysia.

BinJabar, H., 2003. *Plant maintenance strategy: Key for enhancing profitability*. University of Pretoria. www.MaintenanceResources.com

Bottari, T., 2014. *Construction Management news, resources, best practise: Managing Construction Megaprojects*. https://aconex.com

Bock, T. & Langenberg, S. 2014. *Changing building site: industrialization and automation of building project.* Architectural design/ Vol 84. https://doi.org/10.1002/ad.1762

Bonga, B.M., 2012. Partnership as a strategy in implementing sustainable community development in Mandeni municipality. *Master of Art Community work, University of Zululand.*

Bowen, K.J. 2017. *Construction site security protect employees, the public, property assest and the bottom line.*

Berg, R. & Hinze, J. 2017. *Theft and vandalism on construction sites.* https://www.researchgate.net/publication/245283626_Theft_and_Vandalism_on_Construction_Sites

Bryant, N.V., 2014. Nevada renewable energy training project:Geothermal power plant operator. https://www.osti.gov/servlets/purl/1343618

Charrett, D. & Loots, P., 2000. *Challenges in achieving successful mega project*. Melbourn TEC Chambers. (online). http://mtecc.com.au.

Charan, J. & Biswas, T. 2013. How to calculate sample size for different study designs in medical reseach? http://www.ijpm.info/article.asp?issn=0253-7176;year=2013;volume=35;issue=2;spage=121;epage=126;aulast=Charan

Chilapunde, R.L., 2010 Constraints and Challenges faced by Small, Medium and Micro Entreprise Contractorsin Malawi MSC. Nelson Mandela Metropolitian University.

Center for Chemical process safety (CCPS). 2017. *Guidelines for risk based process safety*. Emergency Management. American Institute of chemical engineers.

Chao, L.C. & Henshaw, J.L. 2014. *Material hangling and storages*. United state department of labour.

Christodoulou. A., 2016. *The important of supervision on construction sites*. https://app.croneri.co.uk/feature-articles/importance-supervision-construction-sites

Construction Industry Council Board (CIDB), 2008. *Safety of site and mobile vehicle*: committee on Construction Safety. CIC/CMT/041/16. www.cic.hk//cic-cmt-p-041-16.com

Construction Industry Development Board. (CIDB) 2015. Labour and Work Conditions in the South African construction industry.

Construction Industry Development Board (CIDB) (2007). *Skills for Infrastructure Delivery in South Africa: The Challenge of Restoring the Skills Pipeline. Pretoria: CIDB*

Construction Industry Development Board (CIDB) (2013). *Section 3 executing a construction project: Pretoria: CIDB*

Compbell, C., 2018. Losing money by not using the inventory management techniques. https://www.shopify.com/blog/inventory-management

Collige, W.H. & Hant, C.F., 2013. *Evolving design and stakeholder contribution to briefing process*. Procs 29th Annual ARCOM Conference, 2-4 September 2013. 137-146

College of San Mateo.2017. Institution reseach. https://collegeofsanmateo.edu/

Collins, J. 2005. Level 5 leadership: *the triumph of humanity and fierce resource. Hbr.org/2005/07*

Coxwell, J., 2004. *Negligent supervisors on construction sites*. Article by Coxwell and Associates.

Cotney Cosntruction Law (CCL). 2017. Poor workmanship leads to construction defects. https://trentcotney.com/construction/poor-workmanship-leads-to-construction-defects/

Cooper KG. (1980). *Naval ship production: a claim settled and a framework built, Interfaces, 10(6). 20-36.*

Cooper KG. (1993). *The rework cycle (a series of 3 articles): why projects are mismanaged; how it really works . . . and reworks . . . ; benchmarks for the project manager.* PMNETwork February (for first two articles); Project Management Journal March (for third article).

Cosgun, N, & Salgin, B. 2012. *Cosntruction and demolition waste in Turkey*. Book in waste management

Claassen, J.G. 2018. The failure of an employer to follow the provisions of its own disciplinary code and procedures. https://www.austensmith.co.za/the-failure-of-an-employer-to-follow-the-provisions-of-its-own-disciplinary-code-and-procedures/

Civil Engineering Home. 2015. *Construction technology*. Vol 5 (3). https://civilejournal.org/index.php/cej

Creswell, W.J. 2007. *Qualitative Research designs: selection and implimantation*. https://journals.sagepub.com/doi/10.1177/0011000006287390

Dainty, A.R.J., Cheng, M. and Moore, D.R. (2003*). Redefining Performance Measures for Construction Project Managers*: An Empirical Evaluation, Journal of Construction Management and Economics. 21, 209-218.

Darvik, L. & Larsson, J. 2010. *The impact of material delivery deviation on cost and perfomence in construction projects*. Chalmers university of technology.

Daniels, R.C. (2007) Skills Shortages in South Africa: A Literature Review.

Danso, H. (2012) *Construction Workers Satisfaction with Work Provisions Requirement Dimensions in Ghana's Construction Industry*. International Journal of Engineering and technology. 2(9), 1-2.

Denis, J. & Pontille, D. 2018. *Maintenance and urban assemblage in Paris*. https://hal-mines-paristech.archives-ouvertes.fr/hal-01866852

Department of water and sanitation guide, 2016. *Annual report*.
http://www.dwa.gov.za/documents/AnnualReports/AR%202016-17_

Development Policy Research Unit (DPRU) Working Paper 97/121.

Design Building Wiki, 2018. *Site inspector for construction works.*
https://www.designingbuildings.co.uk/wiki/Site_inspector_for_construction_works

DeFranzo, S.E. 2011. What Is The Difference Between Qualitative and Quantitative Research? Retrieved from https://www.snapsurveys.com/blog/qualitative-vs-quantitative-research/

Donyavi, S. & Flanagan, R., 2009. *The impact of effective material management on construction site performing for small and medium sized construction enterprises*. School of Construction University of reading.25th Annual ARCOM conference, 7-9 September 2009.

Dorman, P. 2000. *The economics of safety, health and well-being at work: An overview. Geneva: International Labour Organisation*; 2000. Available at www.ilo.org/public/english/protection/-safework/papers/ecoanal/ecoview.htm

Dudovskiy, J. 2018. Discriptive research. https://reseach-methodology.net/

Edward, D.J., Aloke, D. & Li, H., 2001. *Intelligent construction plant information management*.17thannual ARCOM conference, 5-7 September 2001. University of Salford. Vol.1, 169-77.

Edward, D.J. & Holt, H.G., 2008. *Construction workers health and safety knowledge: Initial observation on some test –result data*. Journal of engineering, design and technology. Vol.6, 1. Queensland University.

Ekung, S.B., Okonkwo, E. & Odosola, I. 2014. *Factors influencing construction stakeholder engagement outcome in Nigeria*. University of Uyo. Vol 15 (2) 101-114

El-Sawalh, N. 2015. *Factors affecting stakeholder management in construction industry projects in the Gaza Strip*. https://doi.org/10.1080/15623599.2015.1035626

Enofe, O.M. & Aimienroubiy, G., 2015. *Maintenance impact on production profitability*. Linnaeus University. Thesis no: TEK 028/2010.

Enshassi, A. 2013. Safety and productivity in the construction industry.
https://www.researchgate.net/publication/299020038_Safety_and_Productivity_in_the_Construction_Industry

Executive work place, 2016. *Creating a workplace that works for employees and employers*. Society for human resource management.

Exponent. 2017. Differing site condition.
https://www.exponent.com/services/practices/engineering/civil

European Social Fund. 2016. *Perfomence and thematic reports the ESP to social innovation*

European and Scotland. 2017. Understanding the influence of localism and professional ideologies.
https://journals.sagepub.com/doi/full/10.1177/2066220317697659

Ford, D. N., Sterman J. D. (1998a). *Dynamic modeling of product development processes. System Dynamics Review, 14(1), 31-68.*

Forrrester, W. J. 1968. Industrial dynamic after the first decade. https://www.scribd.com/document/228973983/FORRESTER-1968-Industrial-Dynamics-After-the-First-Decade

Formoso, C.T., Isatto, E.L. & Hirota, E. 2014. Method for waste control in the building industry. Unversity of Fedaral Do Rio Grande do Sul.

Foster, G., Royer,D. & Lunt,D. 2017. *Future climate potentially without precedent in the last 420 million years*. Nature communications.

Frost, S. & Sullivan, K. 2015. *The new age disruptive innovative*.https://www.plantengineering.com/articles/tag/frost-and-sullivan

Freeman, S. 2013. *The plant operators competency*. https://www.pressreader.com

Fischer, M., & Lui, R., 2012. *Creating high quality work instruction for construction workers*. Stanford University.

Garamo, N., Matzenge, S. & Palite, R., 2013. *Mega project: the good, the bad and better*. Article July 2013 McKensey Global Institute. http://www.mckensey.com

Gascuena, N.V., Burgo, J.F. & Fernandez, J.P.R., 2011. *Factors affecting productivity: Inspection delays*. University of Castilla.

Geetha, M. & Ambika,D. 2015. *Study on impact of noise pollution at construction job site.Vol 5 (1)*

Gladwin, C. & Civin, A. 2014. *The consumer protection act: direct marketing*. http://www.derebus.org.za/consumer-protection-act-direct-marketing/

Gina, 2014. *A cultural profile of construction project organization in the UK*. Built environment, university of Wolverhampton.

Griffin, B,. 2015; *nonhplomonic virtul construction and for robust walkng*. https://doi.org/10.1177/0278364917708249.

Gamil, Y. & Rahman, I. A., 2017. *Identification of causes and effects of poor communication in construction industry*: a theoretical review. Vol 1 (4). https://www.ijournalse.org/index.php/ESJ/article/view/36

Genaral services administration (GSA). 200. *Alteration in existing buildings and historical structures*.https://www.google.com/search?q=General+services+admnistration+alteration+to+designs&oq=General+services+admnistration+alteration+to+designs+&aqs=chrome..69i57.36202j1j7&sourceid=chrome&ie=UTF-8

Goddard. W & Melville, S. 1996. Research methodology: an introduction for science and engineering students. https://www.worldcat.org/title/research-methodology-an-introduction-for-science-engineering-students/oclc/37685450

Han, S., Love P.E.D., Peña-Mora, F. (2013). *A system dynamics model for assessing the impacts of design errors in construction projects. Mathematical and Computer Modelling, 57, 2044-2053.* http://www.admiralpersonnel.com.au/news/4-essential-qualities-of-construction-workers/: (2014) 4 Essential Qualities of Construction Workers, 5 September 2014.

Haupt, T. 2014. Construction health and safety in South Africa-CIDB. http://www.cidb.org.za/publications/Documents/Construction%20Health%20and%20Safety%20in%20South%20Africa.pdf

Harland,D. J. 2014. *An introduction to experimental research.* https://cemast.illinoisstate.edu/downloads/hsrs/types_of_research.pdf

Hagberg, N.C., 2006. *Key attributes for successful leadership in construction: project managers and superintendents*. Retrospective Theses and Dissertation, 898. http://lib.dr.iastate.edu/rtd/898. Iowa State University.

Health and safety Inspectorate. 2017. *Annual report*. Department of mineral resources republic of south Africa.

Health and safety executive (HSE). 2017. Introduction to human factors.

Health Knowlegde. 2017. Appreciation of factors affecting health and safety at work. https://www.google.com/search

Hendrickson, C., 2013. *Intelligent construction plant management*. The plant management research group, the built environment research units, University of Wolverhampton.

IBM, 2011. *Error Messages Guide: Supervisor failure to allocate work and tools*. Netcool 7(3).

Infrastructure health and safety association, 2015. A specialized approach to health and safety. Vol. 15 (1). https://www.ihsa.ca/pdfs/products/IHSAV151-IHSA-Magazine-Vol-15-i1.pdf

Irizarry, J. & Karan, E.P. 2012. *Optimazing location of tower cranes on construction sites through gis GIS and BIM integration*. http://www.itcon.org/2012/23

Jamal, T. & Gezt, D., 1995. *Collaboration theory and community tourism planning*. Annuals of Tourism Research, 22(1): 186-204, 1995. University of Galgary.

Jannadi, M.O. 2017. Factors affecting the safety of the construction industry. https://www.tandfonline.com/doi/abs/10.1080/09613219608727510

Jain, A. 2014. *Transparent Collaboration Amongst Stakeholders - The Key To Project Performance*. International Institute of Projects and Program Management

John, A. O. & Itodo, E.D. 2013. *Professional views of material wastage on constriuiction sites and cost overruns.* University of Logos.

Jones, R. 2015. *Implications for practice in low-income and middle-income countries*. US national library of Medicine institutes of health.

Kassing, J.W., 2009. *You are the kind of guy that we all want for a drinking buddy: Expression of para social interaction on Floydlandis.com.* Social and Behavioural Sciences. Western Journal of Communication, Vol, 73 (2) 182-203. Arizon University.

Khatleli, N., 2000. *The impediments to efficient mega project implementation in South Africa*, Proceedings of the 32nd annual ARCOM conference, 5-7 September 2000 University of Wits 2: 803-812.

Khalid, Z. 2014. An optimal-dimensionality sampling scheme on the sphere with fast spherical harmonic transforms. https://arxiv.org/pdf/1403.4661.pdf

Kujela, J., Havela, L. & Savage, G., 2015. Project management journal: Project stakeholder Management 46(6). Nottingham Trent University.

Kulatunga, U., Amaratunga D., Haigh, R. and Rameezdeen R. (2013). *Attitudes and perceptions of construction work force on construction waste in Sri Lanka*. Management of Environmental Quality, 17(1): 57–72.

Konrad, M. A., 2006. *Engaging employees through high-involvement work practices*. The universirsity of Western Ontario.https://pdfs.semanticscholar.org
Kowalczyk, S.T. 2017. Modelling the research data lifecyle. https://doi.org/10.2218/ijdc.v12i2.429

Kwena, G.N. 2013. Factors affecting community participation management of development through local authority service delivery action plan: *a case study of kilgoris constituency, Narok Country. University of Africa*

Kumar, C.N.A., Sakthivel, M., Elangovan, R.K. & Arularasu, M. 2015. Analysis of material handling safety in construction sites and counter measures for effective enhancement. Article 742084

Lacerenza, N.C., Marlow, L.S., Tannenbaum, I.S. & Salas, E. 2018. Team development interventions: Evidence-Based approaches for improving teamwork. University of Colorado Boulder. Vol 73 (4) 517-531.

Landen, M.G., Bauer, U. & Kohn, M. 2003. *Inadequate supervision as couse of injury deaths among young children in Alaska and Louisiana*. https://www.ncbi.nlm.nih.gov/pubmed/12563059

Lawyers of human rights (LHR). 2014. *Unfair labour practice*. https://www.labourguide.co.za/general/1510-unfair-labour-practices

Liu, T. 2017. Trangulation revisited: Strategy of Validation or Alternative. https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1468-5914.1992.tb00215.x

Loosemore, M., 2014. *Rebalancing the construction productivity debate*. Proceedings 30th Annual ARCOM conference, 1-3 September 2014. 1327-1334. University of New South Wales.

Lochbaum, D. 2017 The Nuclear Regulatory Commission and Safety culture: Do as I say, not as I do. Union of concerned Scientist. http://www.ucsusa.org

Lowa State University. 2016. Construction parking spaces. https://www.parking.iastate.edu/ticket

Lyneis, J. M. and Ford D. N. (2007*). System Dynamics Applied to Project Management. System Dynamics Review, 23, 157-189*

Lean manufacture, 2009. *Declaring energy the ninth waste*.

Leshoedi, I. 2017. Business perspective of construction health and safety in South Africa. http://www.labour.gov.za/DOL/downloads/documents/useful-documents/occupational-health-and-safety/mbsa.pdf

Luzzi, J. 2011. Experimental research. https://studylib.net/doc/5888961/experimental-research

Magalhaes, R.M.., Mello, L.C.B. & Bendeira, R. 2017. Is construction project planning really doing it job.https://www.researchgate.net/publication/233351081_Is_construction_project_planning_really_doing_its_job_A_critical_examination_of_focus_role_and_process

Mallard, D. 2016. *The human factors in safety and operations*. https://www.ehstoday.com/human-factor-safety

Majeri, S. 2011. *Productivity measurement benchmarking.*

Makulsawtudom, A. & Emsley, M. and Sinthawanarong, K. 2009. *Critical factors influencing construction productivity in Thailand*. Journal of construction in developing countries, 19 (1): 53-63.

Maxwell, J., 2007. *Developing a leader within you. Vol. 75(74).*

Mattingly, B. 2012. *What is plant optimization*. Vol 8(20):30-42

Mattew, S. 2015. Practical approaches to construction constracting. https://www.amazon.com/Construction-MBA-Practical-Approaches-Contracting/dp/0071763252

Martinelli, K. 2017. *How to develop a successful employee induction programe.* https://www.highspeedtraining.co.uk/hub/employee-induction-checklist/

Makys, P. 2013. *Tower crane location on site for building.* Slovak University of Technology.

McCrindle, M. 2011. Methology- Research guide. https://www.google.com/search?q=McCrindle+(2011+research+method&oq=McCrindle+(2011+research+method+&aqs=chrome..69i57.35621j0j7&sourceid=chrome&ie=UTF-8

McDonald, C., 2014. *Lack of skilled workers a challenge facing construction industry*. www.riskmanagmentmonitor.com Cyberisk forum.

McEwan, D., Ruissen, R.G., Eys, A.M., Zumbo, D. B., &Beauchamp, R.M. 2017. The effectiveness of team work training on teamwork behavior and team perfomences. https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0169604

Mowlus, J., Endogan, S. & Gunlat, P., 2014. *Stakeholder management in construction projects: A life cycle based framework.* Doctor of Philosophy in Construction of Heriot Watt University.

Mork, A., 2015. *Stratigraphic significance and spatial distribution.University of Bergen*. https://www.researchgate.net/publication/271823370

Montibeller, G. and Belton, V. (2006). *Causal maps and the evaluation of decision options - A review. J Opl Res Soc 57, 779-791*

Mohamed, F.S. & Onumba, C. 2014. *Context awareness in construction management-key issues & issues enabling technologies. Vol 2 (4) 7-12*

Mnengwane , J.J.J, 2014. *The effectiveness of public participation in environmental Impact assessment in selected Southa African case studies.* University of North West

Miller, R. & Lesserd, D., 2001. *Understanding and management risk in large engineering projects*. MIT Sloan School of management paper 4214-01.

Millis, N. 2017. *Problem on construction sites*. https://bizfluent.com/info-8216575-problems-construction-sites.html

Michael,K. 2013. *Major hazards on construction sites*. https://www.hsimagazine.com/press-release/major-hazards-on-construction-sites

Mullay, M., 2012. *Mega project: How different are they*, Really? *www.pmeducate.com*

Muslihat, D. 2018. Why you need a good teamwork for project success. https://zenkit.com/en/blog/why-you-need-good-teamwork-for-project-management-success/

Mydin, A.O. 2014. *Relationship between workmanship quality and common building defects of low-cost construction project.*

National Economic Development Office of construction, 2006. *Highlighting trends in South African Construction Industry* Mega Projects. 1st edition.

National Resource Governance Institute. 2016. Corruption needs to be called out and tackled across the entire extractive industry value chain. http://www.oecd.org

Newcombe, R. 2003. From client to project stakeholders: a stakeholder mapping approach. Construction Management and Economics, 21: 841-848.

Nortje, N. 2009. Construction vehicles and mobile plant. http://forum.safebuild.co.za/index.php?threads/construction-vehicles-and-mobile-plant.11/

Nibusiness Info. 2018. *Safe storage off drums and intermediate bulk containers.*

Office of Railand and road, 2016. *Development and maintaining staff competence. Railway safety publications 1*. https://orr.gov.uk/__data/assets/pdf_file/0016/4264/developing-and-maintaining-staff-competence-rsp1.pdf

Olaya, C., 2012. Models that Include Cows: *The Significance of Operational Thinking. In Proceedings of the 30th International Conference of the System Dynamics Society.* - System Dynamics Group, St Gallen, Switzerland

Odeh, I. 2018. *Shaping the future of construction-a landscape in transformation.* http://www3.weforum.org/docs/WEF_Shaping_the_Future_of_Construction.pdf

Onabule, P. 2014. *Waste dumpers turning to West Africa.* https://www.nytimes.com/1988/07/17/world/waste-dumpers-turning-to-west-africa.html

Othman, A. 2013 Challenges of mega construction projects in developing countries. International Journal of Organisation, Technology and Management in Construction. Vol 5 (730}

Owens, B. D., Leveson, N. G. (2011). *Procedure rework: a dynamic process with implications for the "rework cycle" and "disaster dynamics*. System Dynamics Review, 27(3).

Park, M., Kim Y., Lee, H., Han, S., Hwanga, S., Choi Min Ji. (2013). *Modeling the dynamics of urban development project: Focusing on self-sufficient city development*. Mathematical and Computer Modelling, 57, 2082-2093.

Parvan, K., Rahmandad, H., Haghani. A. (2013) *Empirical Study of Design-Construction Feedbacks in Building Construction Projects.* Proceedings of the 31st International Conference of the System Dynamics Society

Pampliega, S., 2013. *Stakeholder Management in the construction sector: Stakeholder management in construction project.* CEU Business School.

Phala, D., 2014. *IDT- Social facilitation and EPWP best practice*. 4th EPWP Municipal Summit, 27-28 November 2014. St Georges Hotel.

Pitagorsky, G., 2011. *CMA- the Management Accounting Magazine: How to manage projects.* Magazine Article. https://www.questia.com/magazine/1G1-19218893/how-to-manage-projects

Pitel, S . 2015. The research paradigm- methology,epistemology and ontology- explained in simple language. http://salmapatel.co.uk/academia/the-research-paradigm-methodology-epistemology-and-ontology-explained-in-simple-language/

Project Management Body of Knowlegde (PMBOK), 2012. *Labour, material and equipment utilization*. https://zoetalentsolutions.com/course/project-management-by-pmbok-2012/

Procopious, C. 2010. *Pedestraian access to site and access routes.* https://www.google.com/search?q=Papa+Prokopios+2010+construction+site+access+routes&spell=120

Tecca Home Builders. 2017. *Storage and delivery of construction material*.

Thomas, N. I.R. & Costa, D.B. 2017. Adoption of environmental practice on construction sites. Vol 17 (4). http://dx.dol.org/10.1590/s1678

Tipil, L. G.,Ojeba, O. P. & Ilyasu, S.. M., 2014. Evaluating the effect of communication in conatruction project delivery in Nigeria. http://springjournals.net/gjest/springjournals.netgjestarticlestipilietal

Rahmandad, H. and Hu, K. (2010). *Modelling the rework cycle: capturing multiple defects per task. System Dynamics Review, 26(4), 291-315.*

Ramasamy, D. 2017. *Safety issues, problems and recommendation to indian Construction Industry*. https://www.researchgate.net/publication/322384251_Safety_Issues_Problems_and_Recommendations_to_Indian_Construction_Industry

Rashid, I.A., Bession, H. & Bawezeer, F., 2007. *Factors affecting safety in large construction contractor in Egypt*. Proceedings 23rd Annual ARCOM conference, 3-5 September 2007. 661-670, University of Cairo.

Riddell, T. 2017. Top 5 issues facing the construction industry in 2017. https://esub.com/top-issues-facing-the-construction-industry-2017/

Risk management. 2018. Lighting on a construction site. www.sterlingsafetytraing.co.uk

Risku,T.A. & Karkkainen, M. 2004. *Material delivery problems in construction project: possible solutions*. Helsinki University of Technology.

Research Insight, 2014. *A review of static and dynamic approach*. 28(5), 102-110

Reclaiming Heath and safety standards (RHSS). 2009. *Instructing for updating health and safety*. https://www.usbr.gov/ssle/safety/RSHS-all.pdf

Rowe, G., Lenny, J. & Frewer, L.J., 2011. *A typology of public engagement mechanism science*. Science Technology Human Values, 30: 251. http://www.segupublications.com.

Ruwanpura, J. 2015. *Logistics management in the construction industry. Article,* https://www.researchgate.net/publication/265942527_LOGISTICS_MANAGEMENT_IN_THE_CONSTRUCTION_INDUSTRY

Sambasivan, M. & Soon, Y.W., 2007. *Courses and effect of delays in Malaysia construction Industry*. The Journal of project management, 25(5): 517-526. Tarbiat Moders University.

Shapira, A. & Ben-David, A. 2017. *Characteristics of equipments planning for multi-crane building construction sites.* www.mdpi.com/journal/buildings

Sakuria, Y., Mayhew, P. & White, M. 2008. *Theft and vandalism at residential building sites in Australia.* https://aic.gov.au/publications/tbp/tbp029

Salonen, A. 2016. *The ergonomics value stream.* https://zoomin.idt.mdh.se/course/PPU413/Presentations/Ergonomics%202018.pdf

Staff Training, 2016. *Disciplinary code and procedures. Displine in the workplace*.

Stewart, D. 2015. *New health and safety legislation to impact on construction industry*. https://www.engineeringnews.co.za/print-version/new-health-and-safety-legislation-to-impact-on-construction-industry-2015-01-22

Scott, W. Richard, Raymond E. Levitt and Ryan J. Orr, eds. (2011). *Global Projects: Institutional and Political Challenges* . Cambridge University Press, Cambridge, UK.

Smith, J., 2009. *Mega Project construction: The corps of engineers and Bechtel group in Saudi Arabia.* British University.

Sterman, J. (2000). Business Dynamics: Systems Thinking and Modelling for a Complex World, Boston: McGraw-Hill, pp. 982

Stanley, K., 2015. *Concrete problems, poor workmanship and improper construction technique*. https://www.linkedin.com/pulse/concrete-problems-poor-workmanship-improper-technique-kevin-stanley

Sezer, A.A. 2014. *Article of Contractor use of productivity and sustainability indicators for building refurbishment. The Journal of Built environment project and asset management. Vol.5(2)*

Sergeant, M., 2016. *What constitus a written instruction?*article in practical law construction blog.

Seeley, B.J. 2010. *Construction and demolition waste management in Turkey.*

Shanock, L.R. & Eisenberger, R., 2006. *When supervisors feel supported: Relationships with subordinates perceived supervisor support, perceived organizational support and performance.* Journal of Applied Psychology, 91(3): 689-695. http://www.dxdoi.org.

Sunjka, B.P. & Jacob, U. 2013. *Significant causes and effects of project delays in the Niger Delta region, Nigeria*. Proceedings of SAIIE25, Held 9-11 July, 2013: 1–14. Stellenbosch, SA.

Takim, R., 2009. *Book of Innovation, communication and engineering*. Islamic University of Malaysia.

Terry, H.Y., Thomas, S. & Martin, S., 2013. *Evaluating stakeholder satisfaction during public participation in major infrastructure and construction projects: A fuzzy approach.* Automation in construction, 29: 123-135 QUT faculties and Divisions.

Turkulainen, V. 2015. *Managing project stakeholder communication*. College of business, university college Dublin.

Uguchkwa, S. 2015 *Partipation of indigenous contractors in Nigerian public sector construction projects and their challenges in managing working capital*, Published by European Centre for Research Training and Development UK.

Ukessays. 2018. *Management of site staff and direct labour*. https://www.ukessays.com/essays/construction/management-of-site-staff-and-direct-labour-construction-essay.php

UsLegal. 2018. *Public safety and legal definition*. https://uslegal.com/
Vaidyanathan, S. 2018. What are the harmful affects of noise pollution. https://www.preservearticle.com/201101032328/harmful-affects-of-noise-pollution.html

Vaidyananthan, S. 2014, *What are the effects of noise pollution in a construction site.*

Varela-Margolles, A. 2018. Noise Compatible Planning. https://www.fhwa.dot.gov/ENVIRonment/noise/noise_compatible_planning/

Victoria, S., 2008. *Occupational Health and Safety article of guidance for house builders: What is adequate site supervision?* Queensland Government.

Von Bertalanffy, L. (1974). *Perspectives on General System Theory. Edited by Edgar Taschdjian. George Braziller, New York.*

Vondrackova, T., Vostova, V. & Nyvlt, V. 2017. *The human factors as a couses of failure in building structures.*https://www.researchgate.net/publication/311849433_The_human_factor_as_a_cause_of_failures_in_building_structures

Wekeling, B. 2017. *Defination of workplace health and safety*. https://bizfluent.com/about-7227639-definition-workplace-health-safety.html

Watten, M.O., 2001. *This Not Knowing Needn't to Bother Us: Artistic uses of incompetence*. The London Consortium, University of London.

Wayne, L. & Ferris, G., 2010. *Upward influence in organization: test of a model*. Cornell University. http://digitalcommons.ilr.cornell.edu/cahrswp.

Weber, M., 2017. *Dissecting characteristics nonparametrically*. University of Chicago.

World Wildlife Fund, 2000. *Stakeholder collaboration: Building Bridges for conversation, encouraging conversation strategies units' research and development.*

Workplace Denmark (WD). 2000. *Safety in building and construction industry* .https://workplacedenmark.dk/en/cookies.aspx

Wolter, K., 2016. The important of supervision on construction sites. www.wolterskluwe.com

Wong, M.H., 2014. *A contribution to set a legal framework biofertilisers: lack of legal framework.* Applied Microbiology and Biotechnology 98(15): 6599-6607.

Winch, G.M., 2010. *Managing construction project: an information processing approach. 1st edition* Blackwell Science.

Wikivesirty. 2018. *Modern methods of construction*. https://www.designingbuildings.co.uk/wiki/Modern_methods_of_construction

Yang, J., 2011. *Techniques for stakeholder engagement.* International Journal of project management, Hong Kong University 29(7): 900-910.

Zeb, A., Malik, S., Naum, S., Mohammad, O. & Amin, S., 2015. *Study on material management.* International Research Journal of Engineering and technology: Sri Ramakrishna Institute of technology 3(11) www.irjet.net.

Zenun, N.M. 2007. *The effects of teams co-location on project perfomence*. https://www.researchgate.net/publication/37680281_The_Effects_of_Teams'_Co-location_on_Project_Performance

APPENDIX 1: RESEARCH QUESTIONNAIRE

Appendix 1

Department of Construction Management and Quantity Surveying
Faculty of Engineering and Built Environment
Durban University of Technology
Steve Biko Campus

Tel: 031 373 2585
AyodejiA@dut.ac.za

04 September 2018

Dear Madam / Sir

Re: Resolution of management issues with Mega projects.

The questionnaire survey is part of a research project aimed at meeting the requirements for Master Built Environment (Construction Management) at the Durban University of Technology, carried out to:

Assess the causes of management issues of the mega projects;
Assess the impact of these challenges on the resolution of management issues with mega projects;
To evolve mitigation strategies relative to the improvement of management of mega projects.

Kindly complete the accompanying questionnaire and note that your anonymity is assured.

We would be grateful if you would endeavour to complete the questionnaire and return it by 28 October 2018 through this email: scelo@chsdevelopments.co.za

Or through facsimile to: (031 266 3631)
Att: Mr S Mhlongo

Should you have any queries please do not hesitate to contact Mr Scelo Mhlongo at 083 2284 900 or through e-mail:scelo@chsdevelopments.co.za

Thanking you in advance for your response.

____
S. Mhlongo
Mtech (Construction management) student

____
Dr. A.O Aiyetan, PhD (Construction Management)
Supervisor and Mtech Co-ordinator
Department of Construction Management and Quantity Surveying

QUESTIONNAIRE TYPE I

Section 1: DEMOGRAPHIC DATA

A *ORGANISATIONAL*

1. In which province do you work?

□ KwaZulu Natal □ Gauteng □ Western Cape □

2. Name of Project:

……………………………………………………………………..……

3. Name of organization:

…………………………………………………………………..………

4. Please indicate the actual number of years your organisation has been involved in construction…………………………………………………..

B *PERSONAL*

5. Please indicate your gender

□ Female □ Male

6. Please indicate your age:

□ Under 25 years' □ 41-50 years
□ 25 - 30 years □ Over 50 years
□ 31 - 40 years

7. Please indicate your highest formal qualification:

	Tick		*Tick*
Matric certificate		Honours Degree	
Diploma		Master's Degree	
Postgraduate Diploma		Doctoral Degree	
B Tech degree		Other (Please specify)	
Bachelor's Degree		Other (Please specify)	

8. Kindly indicate from below the category of CIDB grading your company belongs to:

	Tick
CIDB grade 8	
CIDB grade 9	

9. Please indicate your status in the organisation:

	Tick		*Tick*
Director/ Managing member / Principal		Buyer	
Senior executive / Manager		Supervisor / Foreman	
Site Agent / Clerk of Works		Trainee / Intern	
Other (Please specify)			

10. Kindly indicate your actual years of experience in the building construction industry

□ 6 - 10 years □ 21-25years
□ 11 - 15 years □ 26- 30 years
□ 16 - 20 years □ 31- 35 years

11. Kindly indicate from below the type of facility you have been involved in constructing.

	Tick		*Tick*
Residential houses		Hotel/Motel	
Sports field Construction			
Dam construction			
Civil Construction			
Industrial Firm park			

Other (state what function)	

12. Kindly indicate the number of floors the facility being constructed consists of:

	Tick
1 Floor	
2 Floors	
3 – 5 Floors	
6 Floors and above	

SECTION 2: MAIN QUESTIONNAIRE

1. PROJECT SCOPE DETAILS

1.1 Project Scope in Monetary Value

a) Initial cost b) Final cost	a)
	b)

2. PROJECT DURATION

2.1	Actual construction start date	
2.2	Final Completion Date	
2.3	Final Construction Period at Tender Award (in weeks)	

3(a). With respect to your perception rate the influence of management challenges to the delivery of project. Use a scale of 1 (minor) to 5 (major) below.

Minor……………………………………………………………………Major									
1		**2**		**3**		**4**		**5**	

3(b). On a scale of 1 (minor) to 5 (major), rate your understanding of these challenges encountered by management in managing mega project. (Please note the 'unsure' (U) and 'Does not' (DN) options). (This are challenges in general not specific to any project it a general understanding of the participants)

	Management issues	**U**	**DN**	**Minor……………………Major**				
				1	**2**	**3**	**4**	**5**
3.1	Stake holder management	U	DN	1	2	3	4	5
3.2	Plant Management	U	DN	1	2	3	4	5
3.3	Production management	U	DN	1	2	3	4	5
3.4	Labour management	U	DN	1	2	3	4	5
3.5	Material wastage	U	DN	1	2	3	4	5
3.6	Social facilitation management	U	DN	1	2	3	4	5
3.7	Health and safety management	U	DN	1	2	3	4	5
3.8	Logistic Planning	U	DN	1	2	3	4	5
3.9	Other (specify)							

4(a) Relation to your perception, rate the influence of challenges experienced during the implementation of the mega project with regards its delivery, on a scale of 1(minor) to 5(major). (This is project based, on the project where the participant was involved and it further deal with influence related to each factor)

Minor……………………………………………………………………...Major									
1		**2**		**3**		**4**	*****	**5**	

	Management issues	**Minor……………………Major**

		1	2	3	4	5
4.1.	Stake holder management related issues	1	2	3	4	5
4.2	Plant Management related issues	1	2	3	4	5
4.3	Production management related issues	1	2	3	4	5
4.4	Labour management related issues	1	2	3	4	5
4.5	Material wastage related issues	1	2	3	4	5
4.6	Social facilitation management related issues	1	2	3	4	5
4.7	Health and safety management related issues	1	2	3	4	5
4.8	Logistic Planning related issues	1	2	3	4	5

4(b) on a scale of 1 (minor) to 5 (major), rate the causes of challenges experienced during the implementation of the mega project. (Please note the 'unsure' (U) and 'Does not' (DN) options).

	Causes of challenges related to management issues	**U**	**DN**	**Minor……………………Major**				
				1	**2**	**3**	**4**	**5**
4.1	**Stake holder management related issues**							
4.1.1	Stake holder decisions	U	DN	1	2	3	4	5
4.1.2	Stake holder responsibility through project life cycle	U	DN	1	2	3	4	5
4.1.3	Stake holder dynamics	U	DN	1	2	3	4	5
4.1.4	Stake holder collaboration	U	DN	1	2	3	4	5
4.1.5	Techniques for stakeholder engagement	U	DN	1	2	3	4	5
4.1.6	Hiring competent project manager	U	DN	1	2	3	4	5
4.1.7	Transparent evaluation of alternatives solutions	U	DN	1	2	3	4	5
4.1.8	Ensuring effective communication among the stake holder.	U	DN	1	2	3	4	5
4.1.9	Common goals and objectives for project	U	DN	1	2	3	4	5
4.1.10	Other specific	U	DN	1	2	3	4	5
4.2	**Plant related issues**							
4.2.1	Plant maintenance	U	DN	1	2	3	4	5
4.2.2	Plant downtime	U	DN	1	2	3	4	5
4.2.3	Health and Safety	U	DN	1	2	3	4	5
4.2.4	Plant productivity	U	DN	1	2	3	4	5
4.2.5	Plant optimization	U	DN	1	2	3	4	5
4.2.6	Robotics and automation of plant	U	DN	1	2	3	4	5
4.2.7	Plant operators and competence	U	DN	1	2	3	4	5
4.3	**Labour and workers related issues**							
4.3.1	Unskilled site manpower	U	DN	1	2	3	4	5
4.3.2	Inadequate leadership by supervisor	U	DN	1	2	3	4	5
4.3.3	Poor communication between supervisor and workers	U	DN	1	2	3	4	5
4.3.4	Supervisor lack of training	U	DN	1	2	3	4	5
4.3.5	Failure to allocate work and tools by supervisor	U	DN	1	2	3	4	5
4.3.6	Failure to monitor team performance	U	DN	1	2	3	4	5
4.3.7	Workforce involvement	U	DN	1	2	3	4	5
4.3.8	Failure to apply disciplinary procedures	U	DN	1	2	3	4	5
4.3.9	Teamwork and team developments	U	DN	1	2	3	4	5
4.4	**Materials-related issues**							
4.4.1	Material shortage due to damage by mishandling	U	DN	1	2	3	4	5
4.4.2	Re-work due to poor workmanship	U	DN	1	2	3	4	5
4.4.3	Inadequate storage facilities on site	U	DN	1	2	3	4	5
4.4.4	Delay in material supply	U	DN	1	2	3	4	5

4.4.5	Inadequate supervision	U	DN	1	2	3	4	5
4.4.6	Poor site security	U	DN	1	2	3	4	5
4.4.7	Alteration of designs	U	DN	1	2	3	4	5
4.4.8	Over ordering of construction materials	U	DN	1	2	3	4	5
4.4.9	Theft and vandalism of material	U	DN	1	2	3	4	5
4.5	**Production-related issues**							
4.5.1	Lack of material on site	U	DN	1	2	3	4	5
4.5.2	Incomplete drawings	U	DN	1	2	3	4	5
4.5.3	Inspection delays	U	DN	1	2	3	4	5
4.5.4	Incompetent supervision of work	U	DN	1	2	3	4	5
4.5.5	Instruction time	U	DN	1	2	3	4	5
4.5.6	Lack of tools and equipment	U	DN	1	2	3	4	5
4.5.7	Poor communication amongst construction team	U	DN	1	2	3	4	5
4.5.8	Poor site conditions	U	DN	1	2	3	4	5
4.5.9	Improper construction methods	U	DN	1	2	3	4	5
4.6	**Social/Community- related issues**							
4.6.1	Lack of community buy-in	U	DN	1	2	3	4	5
4.6.2	Delay or Non-payment of Compensation	U	DN	1	2	3	4	5
4.6.3	Community unrest, Military & communal crises	U	DN	1	2	3	4	5
4.6.4	Lack of legal framework	U	DN	1	2	3	4	5
4.6.5	Location of the project	U	DN	1	2	3	4	5
4.6.6	Other (Specify)							
4.7	**Health and Safety related Issues**							
4.7.1	Health and Safety human factors	U	DN	1	2	3	4	5
4.7.2	Legislation	U	DN	1	2	3	4	5
4.7.3	Financial issues	U	DN	1	2	3	4	5
4.7.4	Safe working conditions	U	DN	1	2	3	4	5
4.7.5	Poor safety trainings	U	DN	1	2	3	4	5
4.7.6	Poor safety inductions and supervisions	U	DN	1	2	3	4	5
4.7.7	Ergonomics	U	DN	1	2	3	4	5
4.7.8	Lighting	U	DN	1	2	3	4	5
4.7.9	Other (Specify)							
4.8	**Logistics Planning related issues**							
4.8.1	Neighbourhood buildings	U	DN	1	2	3	4	5
4.8.2	Site access routes	U	DN	1	2	3	4	5
4.8.3	Delivery and storages	U	DN	1	2	3	4	5
4.8.4	Delivery times	U	DN	1	2	3	4	5
4.8.5	Public safety	U	DN	1	2	3	4	5
4.8.6	Parking spaces around sites	U	DN	1	2	3	4	5
4.8.7	Construction noise pollution	U	DN	1	2	3	4	5
4.8.8	Crane location	U	DN	1	2	3	4	5
4.8.9	Movements of vehicles	U	DN	1	2	3	4	5
4.8.10	Planning of works	U	DN	1	2	3	4	5
4.8.11	Schedule for plant, labour and materials	U	DN	1	2	3	4	5
4.8.12	Use of banksmen on site	U	DN	1	2	3	4	5

Factors		Impacts																													
		Cost					**Quality**					**Time**					**Production**					**Company image**					**Competitive advantage**				
5.1	Stakeholder Management	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
5.2	Plant Management	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
5.3	Production Management	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
5.4	Supervision of workers	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
5.5	Social Facilitation	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
5.6	Material wastage	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
5.7	Health and Safety	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
5.8	Logistic Management	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5

5**. On a scale of 1 (not influential) to 5(Very influential), rate how do these factors impact Cost, Quality, Time, Production, Company image and Competitive advantage of the mega project.**

6. **Do you have any comments in general regarding management issues in the mega project?**

………
………
………
………
………
……………………………………………………………………………………..

Please record your details below to facilitate contacting you, in the event that a query should arise.

Please note that the information provided in this questionnaire will be treated in the strictest confidence.

ORGANISATION

____

ADDRESS ____

____

____

____

CONTACT PERSON ____

PHONE ____

FAX ____

MOBILE ____

E-MAIL ____

Thank you for your contribution to the resolution of management issues with mega project.

Mr S Mhlongo

APPENDIX 2 : CONFERENCE PAPER ACCEPTENCE LETTER

APPENDIX 3: CONFERENCE PAPER

Resolution of Management Issues with Mega Project

Aiyetan, Ayodeji Olatunji[1] and Mhlongo Scelo

Department of Construction Management and QS.
Faculty of Engineering and the built Environment.
Durban University of Technology,
Durban
ayodejia@dut.ac.za and scelo@chsdevelopments.co.za

Abstract.

South Africa is a developing country and there are many construction projects that are underway. This study aims to contribute to the resolutions on the management of mega projects, since previous studies indicated that there are many failures in the construction of mega projects. The study was based in 3 provinces in South Africa which are KwaZulu-Natal, Gauteng and Western Cape. A mixed method research approach incorporating both qualitative and quantitative methods were used in the study to collect empirical data from stakeholders working on mega projects. The sample frame consist professionals such as the project managers, architects, quantity surveyors, foremen and site agents. The data were collected using a structured questionnaire and focused on individual interviews. A total of ninety-two questionnaire were analysed for this study. The study established that there are management issues that contribute to the success of the mega projects such as the lack of stakeholder engagement, poor plant management, and poor public participation. The paper recommends that in order for mega projects to be successful, stakeholder decisions must mitigate turnaround time on taking decisions for a project. Also, sound decisions must be taken for mega project success. It is recommended that regular plant schedule checking is done on a daily basis and proper plant checking must be done daily, prior to plant operation.

Keywords: Stakeholder · plant · production · supervision

1 Introduction

There is always a percentage of risk involved when erecting mega construction projects; however, there are many ways to improve the odds of escaping the negative consequences of such risks. Construction of mega projects is an essential aspect of development in cities, states and individual livelihoods. Substantial infrastructure projects are normally economic transformers, for example, the Dubai international airport is the world's most eventful, and responsible for 21% of Dubai's employment and 27% of its GDP [1].

The inability of the client and the project team to come to mutual agreements and understandings based on the comprehensive overview of the construction processes from inception to completion is a persistent reason for delays in delivery dates. Either party may be unaware of the environmental effects that may hinder the construction process. This view is supported by [2] who emphasize the problem of delays in the global phenomenon. The construction undertaking involves a plethora of tasks, requiring task management personnel to drive the construction team for effective production. It was estimated in the year 2010 that there were more than 1500 large construction projects worldwide at dissimilar stages of financing or construction, in areas such as oil, power, conveyance and engineering. Furthermore, the number, the intricacy and the scope of the projects have been increasing hurriedly over the past few decades [3].

Owing to this, several guides have been drawn up to help participants understand the management of mega projects. Articles and books give guidelines of how to manage the mega project without failure; an example would be 'Management of Mega Construction Projects (National Economic Developments office of Construction)' where the author identifies the importance of the strength, caliber and leadership of the project/ construction manager. Reports such as these will assist in increasing information and equipping participants for the successful implementation of many mega projects. The rapid rate of modernization and projected elevation of progress of the state's economy have created a colossal market for the construction business over the preceding decades. With the outline of a number of fiscal policies intended at increasing investment in fixed assets and to fast-track the infrastructure developments, an increase in extraordinary profile mega construction projects such as King Shaka International Airport have commenced in the preceding five years.

Mega construction projects are characterised by hefty investments, prodigious complexity, additional stakeholders and extensive influence. Despite these achievements of extensive influence, the construction business has been disparaged for producing inferior construction work, delays and budget overruns with truncated competence and value. Difficulties with dodging submission to the procurement system, untruthful contracts and unlawful sub-letting are some of the common challenges encountered in construction procurement. Regardless of a succession of government transformation in the construction trade, these adverse conditions persist. With this in mind, it is imperative to implement a rational and operative instrument to advance project management and governance of mega construction projects.

Intercontinental mega projects are probable to become progressively common in the engineering and construction trades. Participants at the Engineering Foundation Research session demarcated a mega-project as 'a high impact technically complex project which requires careful advanced planning, last three or more years, has significant impact on the public and industry, employs thousands of people and typically over billions of rand's'. The upsurge in the necessity for mega-projects are attributed to weakening and insufficiencies of present infrastructure, chiefly thoroughfares, conduits, water and sewage management plants; considerable infrastructure development required by third world nations to develop their economy; improved methods for the accrual and reduced bearing of perilous wastes on the environment, and the ongoing requisite for forceful private development and massive industrial ventures.

The very nature of these requirements infers that accomplishing them falls within the definition of a mega project. It is then indispensable that both advocates and implementers of mega-projects wholly understand the reasons involved in their preparation, implementation and overall management. [4] states that on one approximation, 65% of mega projects are botches. Project scoping and risk apportionment are fundamental to refining these consequences. Overall, the success rate of mega projects is less than the success rate of smaller projects.

2 Literature Review

This section discusses issues of management of mega projects. This is relative to the factors that influence the management aspects. Many mega projects face difficulties due to escalating management issues. Two main issues namely, stakeholder and plant management issues are discussed in this study.

2.1 Stakeholder management

This concerns the relationship between an organization and the interested groups or stakeholders. These relationships affect the individuals and their organizations, and could be a positive or negative influence on any successful project []. In the past years, stakeholder management has been advocated to be the main component of increasing the delivery of construction projects [5]. Previous research focuses on addressing the need for a practical guide to carry out stakeholder management duties in the construction industry. The following factors are possibly the main causes of poor stakeholder management: stakeholder management decisions, meeting responsibilities through the project life cycle, internal stakeholder collaboration in carrying out stakeholder management tasks, stakeholder dynamics and the use of available techniques for stakeholder engagement [6]. The long process of design and implementation of construction projects involve interaction, collaboration and negotiations among many project stakeholders, which involve but are not limited to the client, designers, contractors, local authorities and general project environment [7].

The relationships created by project stakeholders both directly and indirectly influence the construction project and have an impact on the overall successful completion of the project [8]. The deference participants involvement both directly and indirectly on the project are also considered categories since the project stakeholders management is vital to the success of the project. The other concerning factors affecting the stakeholder management process is the hiring of a project manager with high competency and transparent evaluation of alternative solutions. This project manager should also ensure effective communication between the project and its stakeholders, set common goals and objectives for the project, and explore the stakeholders' needs and expectations.

2.2 Impact of Stakeholder and Plant Management

Plant management refer to the management of construction plant and equipment on construction site. The construction of mega projects has exacerbated the rate of change and witnessed widespread development of mega civil engineering and construction projects. As a result, the demand on machines became increased and seen as an economical alternative to costly labour resources [9]. In the earlier days, the powering system of the machines were steam. This was clumsy and inefficient, but in the 1950's new modern diesel engine machines were introduced, having more potential for work [10].

Modern construction project managers must therefore pursue the effective utilization of their equipment, and thus ensuring survival of company [9].

According to [11], three factors affect plant management. These are plant maintenance, downtime and health/safety. In the construction of mega projects, many believe that the construction plant has different costs, which require deferent utilizations in order to make it efficient in the construction site [12]. Other factors that affect plant management, such as employing expert mechanics to increase the quality of the plant and having enough fuel to avoid plant down time [13]. Within the broader subject of construction management, other principle themes are identified namely, productivity, optimization, robotics and automation, machine control and operators and competence [14]. The impact of stakeholder's decisions and plant management on a project are relative to time, cost, productivity, quality, company's image and competitive advantage. These factors might have adverse impact if not well attended to.

3 Research Methodology

This study was conducted within three provinces in South Africa, namely, KwaZulu Natal, Gauteng and Western Cape. The sampling frame consist of Engineers (24) Site Agent (23) QS's (24) Foremen (14) Social facilitator (9) and Safety officer (4).

A non-probability sampling approach was employed, namely, selective method of sampling. The research instruments for this study were a questionnaire survey and a structured interview. These were administered through e-mail and personal contacts. Responses for the questionnaires were received through the same means. Overall, ninety-two (92) questionnaires representing 90% response rate achievement recorded. Descriptive statistical tool was employed for data analysis. All respondents have been involved in the management of a mega project.

Respondents between the ages of thirty and forty predominate in the sample investigated. Regarding the qualification of respondents, (20%) have bachelor's degrees, and predominate in the sample. Followed by National Diploma's and B-tech Degree (15.5%) each; Masters Degrees at (7.5%) and Honors (7%). Majority of respondents (40%) were found to have fifteen years' experience. Respondents have involved in the construction of mega projects such as hospitals, malls, sport fields and residential units. The strategical means for data analysis used were means scores. The Cronbach alpha (> .60) and factor analysis (> .70) test were conducted and are satisfactory.

3.1 Data presentation and analysis

This section presents the data obtained of the study and analysis.

Table 1. Stakeholder and plant management issues

Factor	**Unsure**	**Response (%)**						**Mean score**	**Standard Deviatio**	**Rank**
		DN	**Minor............................Major**							
			1	**2**	**3**	**4**	**5**			
Stakeholder related issues										
Stake holder decisions	0.0	0.0	1.3	20.0	43.8	35.0	0.0	3.13	0.77	1
Stake holder responsibility through project life cycle	0.0	0.0	1.3	12.5	62.5	23.8	0.0	3.09	0.64	2
Ensuring effective communication among the stake holder	0.0	0.0	0.0	17.5	56.3	26.3	0.0	3.09	0.66	2
Transparent evaluation of alternatives solutions	0.0	0.0	0.0	16.3	62.5	21.3	0.0	3.05	0.61	4
Stake holder collaboration	1.3	0.0	0.0	23.8	66.3	8.8	0.0	2.85	0.56	5
Techniques for stakeholder engagement	0.0	0.0	1.3	45.0	41.3	12.5	0.0	2.65	0.71	6
Stake holder dynamics	6.3	0.0	7.5	35.0	46.3	5.0	0.0	2.52	0.72	7
Common goals and objectives for project	1.3	0.0	6.3	51.3	37.5	3.8	0.0	2.39	0.67	8
Hiring competent project manager	3.8	2.5	41.3	38.8	12.5	1.3	0.0	1.72	0.75	9
Plant management issues										
Plant downtime	0.0	0.0	0.0	7.5	20.0	63.8	8.8	3.74	0.72	1
Plant maintenance	0.0	0.0	0.0	7.5	28.8	51.3	12.5	3.69	0.79	2
Health and Safety	0.0	1.3	5.0	22.5	58.8	12.5	0.0	2.80	0.72	3
Plant productivity	3.8	0.0	5.0	30.0	56.3	5.0	0.0	2.64	0.67	4

Robotics and automation of plant	1.3	2.5	10.0	32.5	48.8	5.0	0.0	2.51	0.75	5
Plant operators and competence	1.3	0.0	21.3	31.3	35.0	10.0	1.3	2.38	0.98	6
Plant optimization	25.0	0.0	2.5	45.0	26.3	1.3	0.0	2.35	0.58	7

The factor of that has the most significant influence under stakeholder management is: stake holder decision (MS = 3.13). The probable reason for the first factor are participants who take decision that will benefit themselves not the project. Decision that are not fair for all parties involved in the project.

The least significant factor in this category is hiring the competent project manager (Ms=1.72). This implies that mega project requires and demand the competent project manager for the project to be successful. The inexperienced project manager who lacks management skills can take wrong decisions, which can fail the project.

The factor that has the most significant influence under plant management related issues is plant down time (Ms= 3.74). Most of the time in mega project heavy machines are used which some of them are imported and there not maintained regularly. Poor plant management and planning of work as well can also have an impact.

The least significant factor in this category is plant optimization (Ms=2.35). The reason for this can be the lack of correct required plant on site. The failure to allocate plant on site can also have a negative impact on plant optimization.

Table 2: Impact of stakeholder and plant management issues on mega project delivery

Factor	Response (%)					Mean score	Rank
	Minor................................Major						
	1	2	3	4	5		
Cost							
Plant management	0.0	1.3	1.3	12.7	84.8	4.8	0.5
Stake holder management	0.0	0.0	13.8	31.3	55.0	4.4	0.7
Quality							
Stake holder management	0.0	3.8	6.3	16.3	73.8	4.6	0.8
Plant management	1.3	0.0	3.8	37.5	57.5	4.5	0.7
Time							
Stake holder management	0.0	0.0	1.3	5.0	93.8	4.93	0.31
Plant management	0.0	0.0	3.8	21.3	75.0	4.71	0.53
Production							
Stake holder management	0.0	1.3	1.3	5.0	92.5	4.8	0.5
Plant management	0.0	1.3	2.5	16.3	80.0	4.7	0.6
Company's image							
Plant management	1.3	3.8	23.8	50.0	21.3	3.8	0.8
Stake holder management	0.0	18.8	51.3	23.8	6.3	3.2	0.8
Competitive Advantage							
Plant management	1.3	26.3	32.5	27.5	12.5	3.2	1.02
Stake holder management	5.0	38.8	38.8	13.8	3.8	2.7	0.90

Table 2 presents the impact of stake holder and plant management issues on key performance parameters, which include: cost, quality, time, production, company's image and competitive advantage, these are discussed below:

Relative to cost

The most significant factor between stake holder and plant management that impact cost of the project is plant management (MS=4.8). Plant management in the mega project need to manage by a very experienced personal since it can have a great impact on cost and once the cash flow of the mega project are affected, the entire project delivery also get affected.
Stake holder management (MS=4.4) has less impact on cost compared to the plant management, this depends on the manner, experience and professionality of the stake holder.

Relative to quality

The most significant factor that impact the quality on the management of mega project is plant management (MS=4.6), faulty plant is likely to give wrong result. This is relative to the weighing of different materials for mixing, Also the adequacy of tools and plant to execute task neatly and more quickly. Therefore plant management have both positive and negative impact on the quality of production.
The least significant factor that influence plant management is stake holder management (MS=4.5). Comparing to plant management it has less influence on quality of the mega project however it most important factor that may affect quality if it not management properly.

Relative to time

On the table reveals the influence of management issues on time the factor that mostly affect time is plant management (MS=4.93). Plant that are in good condition, given regular maintenance are likely to be used for a considerable long time without breaking down. A hitch free performance of plant engenders high productivity and early delivery of the project. The contrary is the case, if plant are not regularly maintained.
Stake holder management (MS=4.71) has less influence compering to the plant management. The setup of the management team can have a positive or negative influence in time, therefore the way stake holder engaged each other can affect the project.

Relative to productivity

Plant management (MS=4.89). This corroborates the earlier analysis, stating that mega projects are driven by machines. This have great impact on production. While stake holder management (MS=4.7) has less impact than plant management. There is minor difference on the influences between plant and stake holder management. This shows that stake holder management is also very critical on production management.

Relative to company image

The most significant factor that influence company image the most is stake holder management (MS=3.86). Impact on company image. A good management will engender good operation and result. A bad management may also have negative impact or the operation of the company revealing the image of the company.
Plant management (MS=3.2) has the less influence company image compered to stake holder management. However the company that fails to manage plant may fail to manage mega project which may lead to project failure and company image can be negatively influenced.

Relative to competitive advantage

Stakeholder management (MS=3.24) has most influence in competitive advantage, there are knowledgeable and unknowledgeable clients in the construction industry, their contribution to the construction stages of a project could either make good of product or negatively affect. These contribution in either way having impact on the final product ultimately affect contractor's competitive advantage in both ways. A knowledgeable client will contribute positively in terms of idea on construction methods with positive impact on quality of production. While plant management (MS=2.7) has a less influence on the competitive advantage.

4 Conclusion

From the analysis of the data, it is found that stakeholder's decisions and stakeholder's responsibility through the life cycle of projects are those that mostly influence the delivery of mega projects, from the stakeholder's point of view. While, on plant management issues, plant down time and maintenance are the factors that most influence the productivity of plant. Stakeholder and plant management issues adversely impact time, cost productivity and quality in this decreasing order. Based on the conclusions reached from the data analysis, the following recommendations are made:
Stakeholders should endeavor to make quick and qualitative decisions that will enhance progression on project.
A plant maintenance schedule should be produced and strictly compliance to plant maintenance be enforced, in order to mitigate against plant down time.
These two major decisions will mitigate against delay, cost increases, ensure high productivity and quality of products.

Acknowledgments.

The authors herby acknowledge the financial contribution of Durban University of Technology relative to the conduct of this research.

5 References

1. Garamo, N., Matzenge, S. & Palite, R.: Mega Project: The Good, the Bad And Better. Article July 2013 McKensey Global Institute. http://www.mckensey.com, 2013.

2. Sambasivan, M. & Soon, Y.W.: Courses and Effect of Delays in Malaysia construction Industry. The Journal of project management, 25(5): 517-526. Tarbiat Moders University, 2007
3. Miller, R. & Lesserd, D.: Understanding and Management Risk in Large Engineering Projects. MIT Sloan School of management paper 4214-01 2
4. Charrett, D. & Loots, P. Challenges in achieving successful mega project. Melbourn TEC Chambers. (online). http://mtecc.com.au.), 2000.
5. Pampliega, S.: Stakeholder Management in the Construction Sector: Stakeholder management in construction project. CEU Business School, 2013.
6. Mowlus, J., Endogan, S. & Gunlat, P.: Stakeholder Management in Construction Projects: A Life Cycle Based Framework. Doctor of Philosophy in Construction of Heriot Watt University, 2014.
7. Winch, G.M.: Managing Construction Project: An Information Processing Approach. First Edition Blackwell Science, 2010.
8. Takim, R.: Book of Innovation, Communication and Engineering. Islamic University of Malaysia, 2009.
9. Hendrickson, C.: Intelligent Construction Plant Management. The Plant Management Research Group, The Built Environment Research Units, University of Wolverhampton, 2000.
10. Edward, D.J., Aloke, D. & Li, H.: Intelligent Construction Plant Information Management.17th Annual ARCOM Conference, University of Salford. Vol.1, 169-77. 5-7 September, 2001.
11. Amarald Group Publisher: Construction Plant and Equipment Management. Lounghbor ough University. Journal of Engineering, Design and Technology 7, 2009.
12. Aadal, H., Rad, K. G., Fard, A. B., Sabet, P.G.P. & Morshedi, R.: Impact of Plant and Equipment In Construction Industry. Maxwell Science Publication. Research Journal of Applied Sciences, Engineering and Technology 7(11): 2371-2375 2014.
13. Bahru, J. & Malaysia, T.: Major Emergency assessor. University Manual of Occupational Safety and Health. University Teknologi Malaysia, 2014
14. Edward, D.J. & Holt, H.G. Construction workers health and safety knowledge: Initial observation on some test –result data. Journal of engineering, design and technology. Vol.6, 1. Queensland University, 2008.