**UNIVERSITY OF KWAZULU-NATAL**

# Challenges Facing the Delivery of Mega Projects in Transnet Capital Projects

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In fulfilment of requirements for the degree of

Doctor of Philosophy

School of Information Technology and Management

Supervisor: Dr Vannie Naidoo

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## ABSTRACT

**"Challenges facing the delivery of mega-projects in Transnet Capital Projects"**

This study was undertaken to critically identify and analyse the challenges facing mega-project delivery at Transnet Capital Projects (TCP), a project execution wing of Transnet State-Owned Enterprise (SOE). Transnet is the custodian and operator of eight commercial ports, 20 500 kilometres of railway and 3800 kilometres of pipeline network in South Africa. The Department of Public Enterprises regards Transnet as an integral SOE upon which the country is heavily dependent on for economic growth, job creation and socio-economic transformation. In fulfilling its mandate, Transnet continually reviews its strategies to increase operational efficiencies, produce infrastructure ahead of demand, and reduce the costs of doing business. As a specialist project wing, TCP has delivered several mega-projects for the port, rail and pipelines divisions of Transnet, however evidence indicates that almost 55% of railway projects fail and that the New Multi-Product Pipeline (NMPP) project cost has almost doubled from its original estimate of R11.1 billion to R23.4 Billion. Currently TCP is executing several mega-infrastructure projects arising from Transnet's R300 Billion Market Demand Strategy (MDS). Future mega-projects are anticipated to follow from Transnet's 30-year long-term framework plan (LTFP). This study uses PMI's (2013) '10 Knowledge Areas of Project Management' as a model to critically identify and analyse the challenges facing the delivery of mega-projects in TCP. A simple convenience sample and quantitative data collected from 191 respondents in TCP project management teams provided an extensive data set for analysis. Statistical Package for Social Scientist (SPSS) was applied to analyse 122 constructs and through principal component analysis determine the main contributing challenges. Inferential statistical calculations were processed to determine correlation of 21 hypotheses. The findings indicate that while TCP has world-class project lifecycle processes and selected tools, there are challenges in upfront planning of mega-projects, inefficient scope and cost control, contract management challenges, inadequate personnel experience and skill, an overwhelmingly large number of stakeholders to manage and weak risk management. This study contributes new data on mega-project challenges, recommends new mega-project management practices, processes, and strategies to address these challenges. A new model to refocus mega-project execution for successful outcomes is presented. Transnet, project practitioners, researchers, stakeholders; public and private sector; and the African continent will benefit from the learnings of mega-project delivery at TCP.

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| | |
|---|---|
| APM | Association of Project Managers |
| AsgiSA | The Accelerated Shared Growth Initiative for South Africa |
| BEE | Black economic empowerment |
| CEAC | Cost estimate at completion |
| CESA | Consulting Engineers of South Africa |
| DB | Design-build |
| DOL | Department of Labour |
| DPE | Department of Public Enterprises |
| DTI | Department of Trade and Industry |
| EE | Employment Equity |
| EI | Emotional intelligence |
| EPCM | Engineering Procurement and Construction Management |
| EVM | Earned value management |
| FDM | Freight Demand Model |
| FEL | Front End Loading |
| HR | Human Resources Human Resources |
| IPMA | International Project Management Association |
| IT | Information Technology |
| JIPSA | Joint Initiative on Projects Skills Acquisition |
| KMO | Kaiser-Meyer-Olkin |
| LTFP | Long-Term Framework Plan |
| MDS | Market Demand Strategy |
| NEC | New Engineering Contract |
| NERSA | National Energy Regulator of South Africa |
| NMPP | New Multi-Product Pipeline |
| ORS | Owner Requirements Specification |
| PM | Project Manager |
| PMBOK | Project Management Body of Knowledge |
| PMI | Project Management Institute |
| PP | Project performance |
| PwC | Price Waterhouse Coopers |
| RPM | Rethinking Project Management |

| | |
|---|---|
| SA | South Africa |
| SOE | State-Owned Enterprise |
| SPSS | Statistical Package for Social Sciences |
| TBM | Tunnel boring machine |
| TCP | Transnet Capital Projects |
| TEAC | Time estimate at completion |
| TFR | Transnet Freight Rail |
| TNPA | Transnet National Ports Authority |
| TPL | Transnet Pipe Lines |
| TPT | Transnet Port Terminals |
| TQM | Total Quality Management |
| TRE | Transnet Rail Engineering |
| TTM | Transnet Transportation Model |
| UAE | United Arab Emirates |
| UKZN | University of Kwazulu-Natal |
| UNISA | University of South Africa |
| USA | United States of America |
| USD | United States Dollar |
| WBS | Work breakdown structures |

# CHAPTER 1

# INTRODUCTION TO THE STUDY

Major infrastructure projects play a key role in economic growth, job creation and community sustainability; hence proponents in both the public and private sector continue to push boundaries to satisfy socio-economic demands. Growth, development and success in society is generally measured in the quality of life which in modern times is usually associated with large-scale infrastructure such as manufacturing industries, efficient transportation, energy supply; high quality health services and education (McKinsey, 2012:5; Muller & Jugdev, 2012:762; PwC, 2012:3). To bridge the gaps in global infrastructure requirements, McKinsey (2016:1) reports that the world would require to invest almost $3.3 trillion annually to meet the annual growth forecasts up to the year 2030.

However, in recent times, the delivery agents of major infrastructure projects have come under severe criticism and scrutiny for substantial cost overruns, schedule delays and poor delivery (Cantarelli, Van Vee, Molin & Flyvberg, 2012:90; Rolstadas, Tommeln, Schiefloe & Ballad, 2014:639). In a study of 318 mega industrial projects, Merrow (2012:48) indicates that 65% of these projects failed and moreover suffered from long-term problems in operations. According to Xaba (2011:10), 55% of Transnet Freight Rail projects have failed with significant negative impacts on infrastructure capacity and business profitability.

While tools, techniques, processes and research continue to evolve to continuously improve the successful delivery of projects, and despite the best practices, project managers appear to be overwhelmed with challenges in delivering mega-projects and usually finish the race unsuccessfully (APM, 2016:126). According to Kerzner (2016:2), the project management approach is a relatively modern field that requires a new approach to organisational restructuring as well as the adaptation of special management techniques to deliver projects on time and on budget with the right quality.

## 1.1 BACKGROUND OF THE STUDY

The South African SOE, Transnet, is the backbone of South Africa's rail, port and pipeline transport network (Transnet, 2014:6). Transnet consists of five main operating divisions namely Transnet National Ports Authority (TNPA), Transnet Port Terminals (TPT), Transnet Freight Rail (TFR), Transnet Rail Engineering (TRE), and Transnet Pipelines (TPL). TNPA manages and administers the eight commercial ports in South Africa on behalf

of the state, and it is also the provider of port infrastructure. TFR is the owner of 20,500 km of railway line of which 1,500km is for heavy ore exports including coal and iron ore. TPT owns and operates 16 terminals for cargo handling at the ports. TPL transports the major portion of South Africa's petroleum via 3,800 km of pipelines. TRE's primary business is the refurbishment and maintenance of TFR rolling stock.

TCP is a specialist wing of the Transnet Corporate office which is mandated to deliver infrastructure projects on behalf of Transnet's Divisions (Transnet, 2015:21). TCP plays a critical role in ensuring that Transnet achieves its capital infrastructure strategy through the investment and delivery of infrastructure in the port, rail and pipelines business sectors. In its latest profile of projects, TCP indicates that it has ten mega-projects under execution: a new manganese export terminal; new railway lines from Kimberly to Ngqura; new deep-water quay walls at the Durban Container Terminal; a new Waterberg railway line; new quay walls at Maydon Wharf; a new tippler project in Saldanha; and the new multi-purpose product pipeline from Durban to Johannesburg (Transnet, 2015:73).

Transnet's R300bn MDS, adopted by the Transnet Board in 2014, involves the procurement of new rolling stock, expansion of ports and railways and upgrades to the petrochemical pipeline (Transnet, 2016:9). Transnet indicates that the aim of the MDS is to lower costs of transportation in South Africa, provide infrastructure capacity ahead of market demand, create additional jobs and develop critical skills in the transportation sector. Transnet (2016:54) anticipates in its LTFP to spend R900bn in its 30-year capital infrastructure plan (Transnet, 2016:54). Approximately R110bn of the MDS budget has been allocated to TCP for the execution of port, rail and pipeline infrastructure (Transnet, 2015:21).

Transnet further outlines its intention to extend its business beyond the borders of South Africa and into the African region. With the discovery of new oil and gas reserves in the African region (PwC, 2014: 10), new capacity is required for refinery, storage and pipeline infrastructure. Opportunities are being identified to operate depots, terminals and pipelines through mega-projects. Transnet intends to become the leading logistics service provider in sub-Saharan Africa (Transnet, 2016:28). South Africa is viewed by Transnet as a potential gateway to the sub-Saharan region, and through its ports, railway and pipeline infrastructure, Transnet plans to enhance regional integration thus stimulating economic growth and creating much-needed job opportunities.

It is widely accepted that infrastructure is a key driver to stimulate economic growth on the one hand and to satisfy the needs of a growing nation (McKinsey, 2017:14). In the case of South Africa, it is experiencing both needs and stimulus at the same time. South Africa has experienced increasingly higher economic growth rates since the emergence of its democracy in 1994 (Development Bank of South Africa (DBSA), 2012:6). Sanctions have fallen away, and new global markets have emerged to establish and increase trade with South Africa. As a result of the growth, SOEs are required to respond strategically to the demands for electricity capacity, larger deep-water ports, increased rail infrastructure and the demands of increasing infrastructure for the transportation of oil, gas and petroleum (Department of Public Enterprises:[DPE], 2016:131).

Transnet is currently executing projects in accordance to its robust LTFP (Transnet, 2014:10). The LTFP broadly incorporates the national infrastructure requirements that cater for infrastructure backlogs, future capacity requirements, and new opportunities for broader economic participation in the new democratic South African economy (Transnet, 2014:11; DPE, 2016:132). The South African Government has welcomed Transnet's long-term infrastructure initiatives, and it is providing focused support for the LTIF and MDS programmes through the newly created Presidential Infrastructure Coordinating Committee (PICC) (DBSA, 2012:2). As pointed out by the DBSA, these initiatives by Transnet will create much-needed employment, opportunities for economic transformation and subsequently boost the national economy.

Lately, Transnet's NMPP mega-project has been severely criticised for its schedule delays and substantial cost overruns (Le Guern, 2013:n.p). Small indicates that the NMPP Project is now estimated to be completed at a total cost of R23.4bn, over twice the initial 2008 estimate of R11.1bn. Transnet Pipelines receives its revenue via a tariff system determined annually by the National Energy Regulator of South Africa (NERSA) for the pipeline services it renders (NERSA, 2014:195). In addition to operating costs, the cost of infrastructure plays a fundamental role in determining tariffs; therefore, increasing infrastructure costs is frowned upon by all sectors of the economy since increasing tariffs contributes to increasing national inflation and reduces global competitiveness (Merrow, 2012:20).

## 1.2 PROBLEM STATEMENT OF THE STUDY

Literature points to a high failure rate of projects in Transnet. If Transnet continues to deliver projects that have a high rate of failure, the country stands to lose billions of rand in infrastructure investment. The higher costs of infrastructure will eventually increase the cost of logistics in South Africa with increasing inflation and ultimately reduce the attractiveness of investing in this country thus working against South Africa's growth and development plan. There appear to be no 'cutting edge' techniques and processes applied to the delivery of mega-projects, and this needs to be investigated further. The need to study the phenomenon at Transnet is imperative in an attempt to reduce project failure by conducting research in this critical area of management.

The driving force behind Transnet's ability to remain competitive is to efficiently deliver infrastructure capacity ahead of demand (Transnet, 2014:12). According to the Development Bank of South Africa in its *2012 State of Economic Infrastructure Report* supports this notion of a sense of urgency in the delivery of mega-projects in ports, rail and pipelines and reaffirms that the country's 'growth stimulus and prosperity' demands increased logistics corridors, transportation capacity and lower costs of business. (2012:42). An investigation is required into the factors behind the poor success rate of Transnet's projects. In an attempt to improve project success through research-based solutions to the problem, it is imperative to investigate the challenges that project teams are facing in the delivery of high-value projects.

## 1.3 RESEARCH OBJECTIVES

The principal goal of this research is to carry out a theoretical study to establish the challenges facing the delivery of mega-projects in TCP. To realise this study goal, the following objectives must be fulfilled:

- To understand the integration processes of projects.
- To determine whether the scope of projects is clear, updated and managed.
- To ascertain projects are completed on time.
- To ascertain the reasons for cost overruns.
- To understand the degree to which projects achieve their quality requirements.
- To ascertain if projects have adequate human resources and skills.

- To determine if communications are disseminated timeously and feedback managed at the various levels of the project.
- To determine if risks are continually identified, reviewed and managed.
- To ascertain if procurement processes are affecting the delivery of projects.
- To understand the impacts of stakeholder management in mega-projects.

## 1.4 RESEARCH QUESTIONS

The primary research question for this study is: "What are the critical challenges affecting the delivery of mega-projects is TCP?" To systematically unpack and clearly understand mega-project delivery at TCP, empirical data from TCP project personnel were analysed to provide answers to the following sub-questions:

- How are the project processes integrated?
- To what extent is the scope of projects clearly defined, managed and updated?
- To what extent are projects completed on time?
- Why are there cost overruns on projects?
- How are projects achieving their quality requirements?
- How are human resources allocated to projects?
- How are communications disseminated at the various levels of the project?
- To what degree are project risks continually identified and managed?
- How are procurement processes affecting the project delivery?
- To what extent is stakeholder management impacting on mega-projects?

## 1.5 RESEARCH HYPOTHESES

The following 21 hypotheses were tested to establish any significant correlations between the various constructs:

$H_{01}$: There is no statistically significant difference in the mean ranks of the dimensions among the age groups.
$H_{A1}$: There is a statistically significant difference in the mean ranks of the dimensions among the age groups.

$H_{02}$: There is no statistically significant difference in the mean ranks of the dimensions between male and female.

$H_{A2}$: There is a statistically significant difference in the mean ranks of the dimensions between male and female.

$H_{03}$: There is no statistically significant difference in the mean ranks of the dimensions between race groups.

$H_{A3}$: There is a statistically significant difference in the mean ranks of the dimensions between race groups.

$H_{04}$: There is no statistically significant difference in the mean ranks of the dimensions among the marital status groups.

$H_{A4}$: There is a statistically significant difference in the mean ranks of the dimensions among the marital status groups.

$H_{05}$: There is no statistically significant difference in the mean ranks of the dimensions among participates level of education.

$H_{A5}$: There is a statistically significant difference in the mean ranks of the dimensions among participates level of education.

$H_{06}$: There is no statistically significant difference in the mean ranks of the dimensions among participates nationality.

$H_{A6}$: There is a statistically significant difference in the mean ranks of the dimensions among participates nationality.

$H_{07}$: There is no statistically significant difference in the mean ranks of the dimensions among participates years of experience.

$H_{A7}$: There is a statistically significant difference in the mean ranks of the dimensions among participates years of experience.

$H_{08}$: There is no relationship between the development of realistic schedules and mega-project completion on time

$H_{A8}$: There is a relationship between the development of realistic schedules and mega-project completion on time

$H_{09}$: There is no relationship between clearly defined mega-project scope and the necessity to involve stakeH0lders in the initiation phase

$H_{A9}$: There is a relationship between clearly defined mega-project scope and the necessity to involve stakeholders in the initiation phase

$H_{010}$: There is no relationship between effective change-control processes and mega-projects completion on time.

$H_{A10}$: There is a relationship between effective change-control processes and mega-projects completion on time.

$H_{011}$: There is no relationship between major scope changes by the asset owner and redesigns leading to schedule slippages

$H_{A11}$: There is a relationship between major scope changes by the asset owner and redesigns leading to schedule slippages

$H_{012}$: There is no relationship between insufficient engineering is done for the business-case and underestimated project costs

$H_{A12}$: There is a relationship between insufficient engineering is done for the business-case and underestimated project costs

$H_{013}$: There is no relationship between inadequate experienced personnel and the development of detailed quality plans.

$H_{A13}$: There is a relationship between inadequate experienced personnel and the development of detailed quality plans.

$H_{014}$: There is no relationship between correct skill sets and the availability skills in the market at the time of project execution

$H_{A14}$: There is a relationship between correct skill sets and availability skills in the market at the time of project execution

$H_{015}$: There is no relationship between correct skill sets and mega-project completion on time

$H_{A15}$: There is a relationship between correct skill sets and mega-project completion on time

$H_{016}$: There is no relationship between inadequate communications between contracting teams and easy resolution of disputes

$H_{A16}$: There is a relationship between inadequate communications between contracting teams and easy resolution of disputes

$H_{017}$: There is no relationship between the availability of risk skill sets and the capability to manage risks

$H_{A17}$: There is a relationship between the availability of risk skill sets and the capability to manage risks

$H_{018}$: There is no relationship between the complexity of mega-projects and the difficulty to manage all risks in mega-projects

$H_{A18}$: There is a relationship between the complexity of mega-projects and the difficulty to manage all risks in mega-projects

$H_{019}$: There is no relationship between rewarding good contractor performance and mega-project completion on time

$H_{A19}$: There is a relationship between rewarding good contractor performance and mega-project completion on time

$H_{020}$: There is no relationship between contractors having the right teams to manage construction work and mega-projects completion on time

$H_{A20}$: There is a relationship between contractors having the right teams to manage construction work and mega-projects completion on time

$H_{021}$: There is no relationship between inadequate experienced personnel and the underestimation of project costs at the business-case stage

$H_{A21}$: There is a relationship between inadequate experienced personnel and the underestimation of project costs at the business-case stage

## 1.6 SIGNIFICANCE OF THE STUDY

The study sought to understand the challenges facing mega-projects in TCP. Organisations need to continually assess their environment and craft strategies (Hough, 2008: 28) for continual improvement. The literature on mega-projects from an African scenario perspective is limited, and our challenges are also unique. This study, therefore, aims to relate to some of the challenges facing mega-projects in the African continent.

The study contributes project management data and makes recommendations for consideration in the successful delivery of projects in TCP. A new model to refocus the delivery of mega-project management is also considered in this study. Project researchers, practitioners and stakeholders will benefit from the learning of project delivery at Transnet. The study contributes to knowledge on project management in the public sector and contributes new strategies and innovations for continuous improvements. Finally, this study contributes to the body of knowledge for continuous improvements in delivering mega-projects in the African continent and the international platform at large.

## 1.7 RESEARCH DESIGN AND METHODOLOGY

This study adopted a quantitative research approach due to the complexity of the research problem and leaned towards a positivist paradigm using a survey-based research design (Creswell, 2009:4; Sekaran & Bougie, 2013:102). Using a cross-sectional survey sample, the study adopts an interpretive paradigm using scientific methods for accuracy and diligence to demonstrate rigour and replicability (Sekaran & Bougie, 2013:102; Zang & Fan,

2013:195). Information, gaps and weaknesses from an extensive literature review were used to develop the study instrument. The study instrument, a Likert-scale type questionnaire, was used to collect quantitative primary field data from TCP project personnel to provide answers to the research questions. A simple convenience sample of 324 participants consisting of all project directors, senior project managers, project managers, and project support staff was used for this study. The instrument was administered via an electronic platform 'Survey Monkey' to reach participants in the various geographically located offices.

Field data were analysed using a statistical tool SPSS for all multiple-choice questions. The Cronbach's alpha test showed that the data was reliable for further analysis.

For the qualitative tests, principal component analysis was undertaken to determine the most significant factors contributing to TCP's mega-project execution challenges. Inferential statistics using non-parametric tests were performed to determine any significant relationships among selected constructs.

The results of the quantitative data analysis were further evaluated and assessed against comments provided by respondents in the open-ended questions to compare the findings. The findings provided answers to the research questions.

## 1.8 THEORETICAL FRAMEWORK

The study undertook extensive literature to assess and evaluate key concepts, dimensions and constructs on mega-projects from both a local and international outlook. The Project Management Institute's (PMI, 2013:58) ten knowledge areas of project management which form the theoretical foundation of this study were systematically unpacked and reviewed. These ten dimensions are integration, scope, time, cost, quality, human resources, communications, risks, procurement and stakeholder management (PMI, 2013:59). The ten dimensions supported by 125 constructs prepared by the researcher for use in the research instrument were used to comprehensively cover key areas and gaps arising from the literature review.

The study was designed with the intention of determining the TCP project teams' perceptions on the challenges of delivering mega-projects. TCP's project personnel took the time to support this study and to provide meaningful insights into a vast sum of challenges.

## 1.9 BOUNDARIES AND LIMITATION OF THIS STUDY

This study focuses on Transnet's mega-projects comprising of infrastructure provision with a value larger than R300m for ports, rail and the pipeline sectors. The study is ring-fenced to mega-projects undertaken by TCP in an attempt to obtain an understanding of the challenges TCP faces in the delivery of its mega-projects. At the time of conducting the study survey, there were some networks problems in the organisation which proved to be challenging to respondents hence affecting respondents in completing the questionnaires online.

## 1.10 STRUCTURE OF THE THESIS

### Chapter 1: Introduction and Background to the Study

This chapter provides an overview of the study by presenting the background to the research, the problem statement, the study's objectives and the research questions. The study approach is presented, statistical tools and study hypotheses revealed, and the structure of the thesis is outlined.

### Chapter 2: Literature Review

This chapter is an introduction to project management and contextualises Transnet's role in the infrastructure domain of project execution.

### Chapter 3: Literature Review

The theoretical framework consisting the ten project management dimensions of the PMI (2013:18), upon which this study is based, is introduced in this chapter. A comprehensive body of literature about these project management dimensions is critically reviewed and assessed to reveal weaknesses and gaps in research on mega-projects. The dimensions are further examined to determine the applicability of suitable data that could be utilised to address the challenges in TCP.

### Chapter 4: Research Methodology

This chapter describes the methodology adopted to conduct the research study. It describes the sampling technique, research instrument and data collection methods. The various tests

conducted in the statistical analysis are presented and explained. This chapter provides the blueprint of how the study was undertaken.

**Chapter 5: Presentation and Interpretation of Results**

In this chapter, the analyses and interpretation of the results are presented in tables, pie-diagrams, and graphs to present the study's findings.

**Chapter 6: Findings and Discussions**

This chapter summarises and discusses the study's findings. The results are benchmarked and compared to the body of literature. New data on mega-project challenges in TCP are presented and recommendations for new mega-project management practices, processes, and strategies to address these challenges are made. A new model to refocus the delivery of mega-project management is also presented in this chapter.

**Chapter 7: Conclusion and Recommendations**

This chapter draws on the limitations of the study, presents suggestions for future research on mega-projects and concludes the study.

## 1.11 CHAPTER SUMMARY

To maintain sustainable operations and remain competitive, Transnet's mega-projects must be efficiently executed. The national logistics platforms and corridors depend on Transnet to timeously and effectively provide the necessary transportation infrastructure to stimulate economic growth and lower the cost of doing business. The results of this study will contribute a comprehensive outlook on refining the project management practices and processes adopted by Transnet's TCP wing and in doing so reduce the failure rate of complex mega-projects. This study goes further to explore the challenges facing project practitioners, factors contributing to high rates of project failure in TCP and, in response, to suggest guidelines to realise greater success in project delivery.

This chapter introduced the study by presenting the background and motivation for the study, the problem statement, the study's objectives, the research questions and hypotheses and the significance of the study. It concludes by outlining the structure of the thesis. In Chapter 2, a literature review is undertaken and the notion of mega-projects is contextualised.

# CHAPTER 2:
# LITERATURE REVIEW: MEGA PROJECTS

## 2.1 INTRODUCTION

In this chapter, the literature review examines mega-projects in broad themes related to the study. Mega-projects at a global and local South African level are introduced. Transnet's long-term planning framework and strategy are unveiled, and their relation to mega-projects is understood. Socio-economic factors interdependent on mega-projects in a South African context are introduced in this chapter.

As a thematic area, infrastructure development at a global level funnelling down to a South African context is introduced to describe the mega-project phenomenon. The definition of mega-projects is examined, and typical mega-projects are described. An international perspective on global development trends and a brief global outlook on economic growth in developing nations are discussed and referenced to mega-projects. Transnet's 30-year long-term framework is examined, and its infrastructure plans for expanding into the African continent are introduced.

Following an overview of Transnet's MDS, the chapter progresses to introduce Transnet's Freight Demand Model (FDM) and the purpose of Transnet's infrastructure capacity analysis. The translation of strategy into portfolios, programmes and projects is discussed and the concept of project lifecycle processes are explored as a theme on project processes.

Mega-projects do not exist in isolation but they are closely integrated and aligned to socio-economic requirements. Project integration with socio-economic factors as a thematic area is explicated to discuss post-apartheid factors in South Africa including transformation, black economic empowerment (BEE), job creation and skills development in an effort to determine their influence on mega-projects.

Finally, a reflection on mega-projects successes and challenges is presented as a theme in this chapter. The evolution of examining projects successes is introduced for further elaboration later in the study. An in-depth investigation and assessment is undertaken of the critical factors challenging mega-projects and their impacts.

## 2.2 MEGA-PROJECTS IN CONTEXT

In the literature, there are several descriptions of mega-projects (Fiori & Kovaka, 2005:6). Locatelli, Littau, Brookes and Mancini (2014:625) categorise mega-projects as having "extreme complexity in both technical and human terms and by far having a long record of poor delivery". Mega-projects, as described by Flyvberg (2009:344), are initiatives that produce expensively large physical infrastructure, and are constantly under the watchful eye of the public. Merrow (2011:15) prefers to describe mega-projects in terms of the value of the investment, generally greater than one billion dollars (US) in project value. Oliomogbe and Smith (2012:617) appear to support the monetary description of mega-projects, and their estimate in that mega-projects usually have a value of greater GBP150m (British). Fiori and Kovaka (2005:7) prefer to describe mega-projects using five parameters namely "magnified cost, extreme complexity, increased risk, lofty ideals and high visibility". On the other hand, McKinsey (2014:28) brought in the dimension of size, time and systems in their description of mega-projects as being "large and often long-lived endeavours that are managed in a complex set of systems and integrated with loose subsystems with subsequent ineffective delivery in terms of performance and schedule". In Transnet's Project Lifecycle Processes (PLP) (Transnet, 2014:15), mega-projects are categorised as projects with high levels of complexity and integration, demanding hugely resourced teams and a cost estimate greater than ZAR300m. While there is no agreement among scholars on a precise definition of mega-projects, Transnet's grouping sufficiently encompasses the salient features of mega-projects and is satisfactory for this study.

## 2.3 TYPICAL MEGA-PROJECTS

Merrow (2011:11) states that in the first ten years of the 21st century, the world has seen more process industry mega-projects than ever before due to the current demands for energy, chemicals and various other products. These mega-projects consist of large and complex, nuclear power plants, oil and gas plants, mineral plants. Other mega-projects consist mainly of roads and tunnels, railways, pipelines, aerospace, large sporting events, hydroelectric facilities, and marine projects (Priemus, Flyvberg & van Wee, 2016:3). In its Infrastructure Projects Update (Transnet, 2010:22) delivered to the Consulting Engineers of South Africa (CESA, 2013:6), Transnet indicated that it had completed the following mega-projects: Deepening and Widening of the Durban Harbour Entrance Channel; Cape Town Container Terminal Expansion Project; Durban Container Terminal Reengineering; Durban Point Car

Terminal; New Bulk Liquid Berth at Island View 5; New Bunker Berth, Richards Bay Dry-Bulk Terminal; Coal Line Upgrade; New Port of Ngqura; and Train Locomotive Renewal. Transnet indicated that it had spent a total of R72 Billion from 2005 to 2010 (CESA, 2013:7). In its sustainability report, Transnet indicated that its strategic list of new mega-projects consists mainly of long railway lines and tunnelling, port expansion and marine works, new cargo handling terminals in ports, equipment engineering for trains, long petroleum and oil pipeline, buildings and bridges (Transnet, 2016:33). Transnet's mega-projects are typically infrastructural projects and can be equated to other international mega-projects of this type.

In an international global review by McKinsey (2016:31), there are indications that these mega-infrastructure projects are strategic investments and are increasing in complexity. They are expected to rapidly increase over the next few decades to include expansion of cities, water supplies, sanitation and mega-industries in developing nations. ECSA (2015:6) reports that the types of mega-project are vast however they are broadly categorised as infrastructure, transportation, built environment, industrial and energy. The complexity and risk profile varies with each type of mega-project hence it is important to appreciate the context in which these projects are executed when comparing the mechanisms of delivery

## 2.4 GLOBAL OUTLOOK ON INFRASTRUCTURE DEVELOPMENT

Overall global development continues to increase at a steady pace even as markets shift with areas of production and consumption (World Bank, 2015:10). Adding to this notion PwC (2015:87) further indicates that the key drivers for the mega-infrastructure growth boom are the consequence of the migration of populations to major cities in search of employment and a better quality of life. The high demand for the provision of mega-infrastructure requirements in buildings, services and ports is being driven by the high economic growth rates in the East Asian nations of China and India and developing countries in Africa and South America (McKinsey, 2016:4). This trend in growth and infrastructure demand is forecast to continue into the next two decades hence sustaining the need for mega-infrastructure projects in ports, rail and cities (PwC, 2014: 90)

According to the United Nations (2016:38) the world economy is expected to grow at 2,9% and 3,2% in 2017 and 2018 respectively; however, the growth rate in developing countries is expected to be much higher in the order of 4,8% over the same period:

- West African growth is expected to peak at the 5% mark, and East African expectations are in the order of 6,6%, while southern Africa is slightly lower and forecast to be in the order of 3,3%.

- The UN figures for east and south Asia have fallen to about 5,6% as a result of the lower growth rate in China.

McKinsey (2017:87) supports the view of much higher growth in the developing countries when compared to the western counterparts. Adding to this trend, PwC (2014: 97) reports that Kenya has boosted its mega-infrastructure development projects by investing some $60 billion worth of mega-projects in East Africa. Mega-projects in the Kenyan basket of developments include a 600 kilometre railway line, 1,500 kilometres of pipelines and ports. The Lamu Port Southern Sudan Ethiopia Transport Corridor Project is driving investment because of the discovery of oil in Uganda and Kenya. McKinsey is also aligned to the notion of mega-investment in the African continent and reaffirms that mega-infrastructure investments will trend for the next few decades although appropriate implementation mechanisms and execution plans are required (McKinsey, 2017:90). However, Jakobsen (2012:486) warns that mega-engineering outfits will be confronted with turbulent economic climates, social and environmental activism and although developing nations will embrace multinational enterprises, the key success factors will be to address political and regulatory risks

Global indications are that there are extensive infrastructure project opportunities forecasted for developing nations and the African continent. In order to support the strengthening of economies, efficient delivery mechanisms will be paramount in project execution to ensure successful outcomes and the realisation of business investments

## 2.5 TRANSNET'S LONG-TERM FRAMEWORK PLAN (LTFP)

Transnet's LTFP is a framework tool developed by Transnet's Group Planning Division to guide the long-term infrastructure planning of ports, railways, terminals, and pipelines (Transnet, 2016:35). In its 30-year look ahead, Transnet provides a broad planning overview regarding the development of its eight ports, 20,500 kilometres of railway networks, and 3800 kilometres of petrochemical pipeline. Further long-term planning details are also provided on the expansion programmes for its Port Terminals handling containers, motor vehicles, dry-bulk and general cargo. The LTFP is updated and published annually as a

guiding tool to facilitate internal and external public stakeholder integration. Transnet (2016:36) provides evidence that mega-project initiatives are derivatives of robust, integrated planning processes but cautions that risk profile benefits will only be realised to effective execution of infrastructure development and efficient operations.

### 2.5.1 Transnet's Freight Demand Model

The thirty-year Transnet Transportation Model (TTM) takes an unconstrained view of cargo growth demands using various modelling tools (Transnet, 2016:43). The TTM provides a basis for determining Transnet's infrastructure requirements without the constraints of capital affordability, business profitability or any other business constraint. Figure 2.1 illustrates the processes undertaken by Transnet in the development of its TTM. The fundamental basis of the LTFP is to identify infrastructure capacity requirements ahead of demand. Transnet expects its freight demand to increase from 828 million tonnes per annum (tpa) to 1,525 tpa. Thirty-year forecast volumes are down to 125% compared to the 2015 data of 159% as a result of world trade dynamics and slower growth in South Africa. Transnet expects capacity infrastructure capacity demand to be shifted later than anticipated in 2015 thus indicating that the timing of infrastructure development is fluid and dependent on market conditions hence the agility of projects is a key success factor.

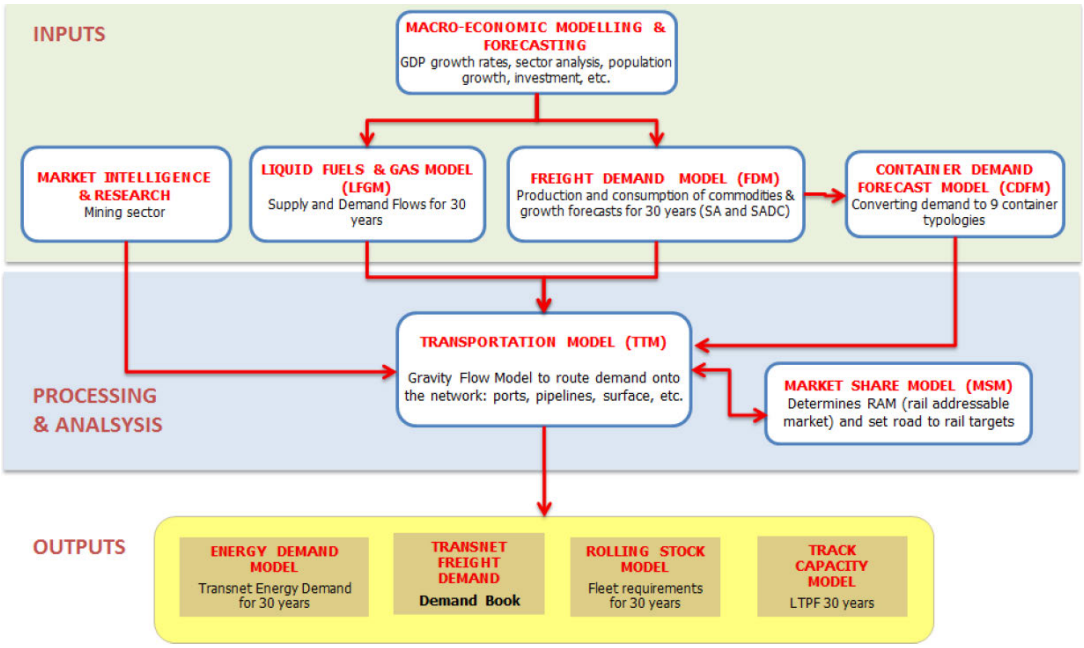


Figure 1.1: Transnet transportation model

Source: (Transnet 2016:43)

### 2.5.2 Transnet's 'Africa Plan'

A special feature of the LTFP is an integrated Africa Plan that links South Africa to the rest of the African Continent (Transnet, 2016). Transnet views national development and development into the African continent as a key strategic objective that is supported by the Transnet Shareholder Compact (National Treasury, 2016:15). With the discovery of new oil and gas reserves in the African region (PwC, 2014:67), new capacity is required for refinery, storage and pipeline infrastructure. Opportunities are being identified to operate depots, terminals and pipelines through mega-projects. Transnet intends to become the leading logistics service provider in sub-Saharan Africa (Transnet, 2016:43). South Africa is viewed by Transnet as a potential gateway to the sub-Saharan region and, through its ports, railway and pipeline infrastructure, Transnet plans to enhance regional integration thus stimulating economic growth and creating much-needed job opportunities. In its regional FDM, Transnet has taken a 30-year look ahead at the economies of 17 sub-Saharan countries in aligning its strategic goal of providing transportation linkages via the port and rail networks. Hence Transnet views the African continent as having untapped potential for several new mega-project-related logistics systems.

## 2.6 TRANSLATING THE LTFP INTO STRATEGY, PORTFOLIOS, PROGRAMS AND PROJECTS

### 2.6.1 Transnet Market Demand Strategy

Transnet's MDS takes a seven- to ten-year corporate view to determine its strategic plan (Transnet, 2016:101) which incorporates operational and budget requirements. The current MDS infrastructure capital plan is estimated at R312 billion over a ten-year rolling period (Transnet, 2014:38). In supporting government's drive for economic growth through infrastructure investment (National Treasury, 2016:19), Transnet intends to achieve 12% revenue growth, create 494 991 jobs and spend R9,03 million on training, skills development and bursaries by the year 2021 (DBSA, 2014:14). Figure 1.2 provides an overview of Transnet's 7-year rolling capital investment plan up to financial year 2022/2023.

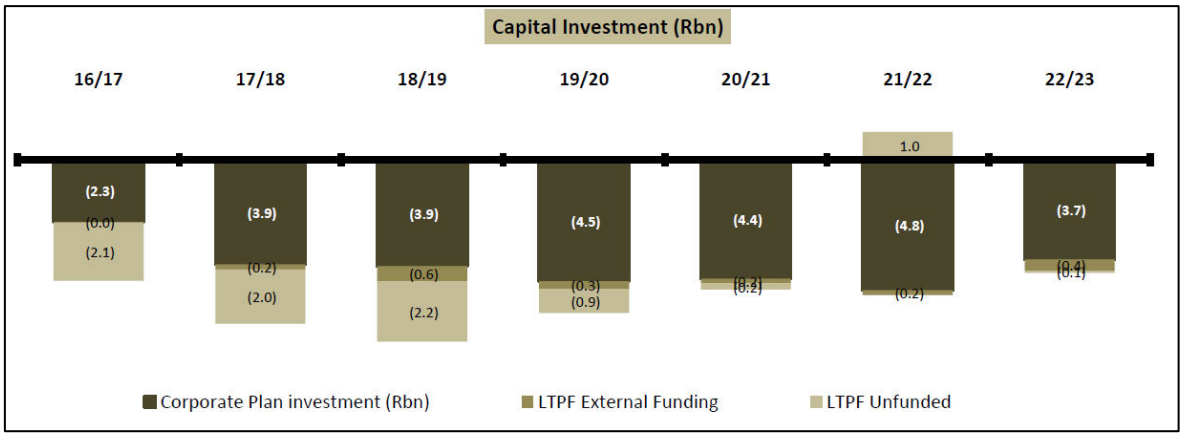


Figure 1.2: Transnet 7-year MDS Investment Plan

Source: (Transnet. 2016:503)

### 2.6.2 Portfolios, Programmes and Projects

2.6.2.1 Portfolio management

According to Unger, Kock, Gumender and Aubry (2012:608) and Teller, Unger, Kock and Gumender (2012:596), a portfolio is an assembly of programmes with the sole purpose of assisting the organisation with the selection of projects and the provision of the necessary support for the project in order for the project to fulfil the desired goals of the organisation. PwC (2014:17) describes portfolio management as a process that ensures that the capital programmes are in alignment with the strategy of the organisation. PwC illustrates a four-stage process for the management of portfolios which include

- Translation of strategy,
- Portfolio planning,
- Portfolio management,
- Strategy and portfolio revaluation.

2.6.2.2 Programme management

Programmes are an assembly of interrelated projects that align the business strategy requirements and the outputs that a project is required to deliver (Teller et al., 2012:598). This approach is aligned to PMI (2013:9) which defines a programme as a collection of similar projects that are required to produce a common purpose. PMI further illustrates that the application of developed processes and tools will achieve the benefits that the organisation desires. Transnet indicates that it has arranged it programmes to align with commodities and transport corridors (Transnet, 2016:28). The programmes include the

container programme, coal programme, iron-ore programme, and the manganese programme. The aims of these programmes are to provide capacity ahead of demand, increase efficiencies from 'Pit to Port', lower the cost of operations, create jobs and transform the business.

#### 2.6.2.3 Project management

PMI (2013:3) describes a project as a "temporary endeavour that produces a unique product with a definite start and completion date". Project management is further described by PMI as a set of processes that are applied in practice to achieve the desired project outcome. These processes consist of planning, executing and controlling activities. The generally-accepted emphasis on the application of processes and techniques has been criticised as being insufficient and inadequate for successful project execution and lacking in essential soft ingredients including innovations, value-add, collaboration. A new wave of enquiry in project management, called Rethinking Project Management (RPM) is probing the value of soft ingredients and their impact (Svejvig & Grex, 2016:824). The argument in RPM is that cost containment, quality assurance and schedule can be flexible cornerstones giving rise to a new debate on the matter of governance, business investment and responsiveness to under-developed matters such as stakeholder involvement, sustainable environment and team competency development.

In an earlier examination of maturity among portfolio, programme and project management Sargeant (2010:136) and Skulmoski (2001:11) reported that maturity and competency are equally important when integrating portfolios, programmes and project management for successful attainment of the organisation's strategic goals. Young, Young and Zapata (2014:215) in a study of portfolio, programme and project management in the Australian public sector office reports that the link and alignment between the strategy and the programme office was weak.

Literature highlights that the levels of maturity and understanding between portfolio, programmes and projects are still a highly sensitive matter when measured against clear roles, responsibilities, planning, capacity, experience and ultimate success. As suggested by Svejvig and Grex (2016:824), the field of project management provides ample opportunities for growth and development which will ultimately lead to improved project success; however, new frontiers in examining and approaching project execution need to be examined.

## 2.7 PROJECT LIFECYCLE PROCESSES

A project journeys through a series of phases or stages which constitutes the project life cycle (Aaltonen & Kujala, 2010: 382). According to PMI (2013:38), the project lifecycle defines the phases linking the beginning and the end of the project. Many organisations have developed their own set of project lifecycle phases to suit their individual requirements for project execution (Transnet, 2016:505). Supporting this argument, PMI (2013:39) advises that there is no single agreed method for determining the ideal lifecycle processes and that the project manager or the organisation should determine the project phases, tools, and processes that best suit the project.

Girmscheid and Brockman (2008:22) propose a three-phase lifecycle for mega-projects which may take up to twenty years to complete depending on the complexity of the project as shown in Table 2.1. The lifecycle commences with the development of concepts, proceeds to the procurement of a contractor and closes with the construction completion. A key feature of the third stage is the management of stakeholders. Girmscheid and Brockman (2008:23) state that the final stage of implementation is generally extremely complex, with high levels of task complexity, cultural and social complexity and social complexity. In this phase, the design is finalised and constructed.

Table 2.1: Three-phase project lifecycle

| **Phase** | **Deliverable** |
|---|---|
| Conception | Concept designs completed |
| Negotiation | Procurement and contract price agreement |
| Implementation | Management of stakeholders. Construction completed |

Source: (Adapted from Girmscheid & Brockman 2008:22)

PMI (2013:42) illustrates a four-phase project lifecycle as outlined in Table 2.2. According to PMI, the control of each of the phases is achieved through the processes of initiation and the development of clear deliverables. The completion of each phase is formally closed but does not include the task of authorising the commencement of the next phase.

Table 2.2: PMI's four-phase approach to the project lifecycle

| Phase | Deliverable |
|---|---|
| Start Phase | Project Charter |
| Organise and Prepare Phase | Project Management Plan |
| Execute | Accepted Deliverables |
| Close-out | Archive Project Documents |

Source: (Adapted from PMI 2013:42)

In the case of Kerzner (2013:49), a broader five-phase approach is advocated for the project lifecycle as shown in Table 2.3. Kerzner commences the concept phase and delves deeper into planning phase in stage 2. A rigorous process to test the investment is undertaken after planning whence approval is granted to proceed and complete construction. The final phase consisting of commissioning the project and handover to operations.

Table 2.3: Kerzner's five-phase approach to the project lifecycle

| Phase | Deliverable |
|---|---|
| Conceptual phase | Concept developed |
| Planning Phase | Project planning completed |
| Testing Phase | Accepted performance |
| Execution Phase | Construction completed |
| Closure | Project commissioned and handover |

Source: (Adapted from Kerzner, 2013:39)

Transnet (2016:505) indicates that it uses a five-phase approach as indicated in Table 2.4. Transnet expands the cycle further to include that each of the Front-End Loading phases commences with formally-approved funding and ends with a formal review ("gate review"). Subsequent phases are only executed if the previous phase closes with an approved gate review. In the concept phases, various project options that are aligned with Transnet's strategy are developed. In the prefeasibility phase, a single 'go-forward' option is selected for the feasibility phase, should the commercial viability tested at the end of the prefeasibility phase meet Transnet's requirements. In the feasibility phase, a single go- forward option is developed up to 70% engineering. The detailed design phase completes the design, procures a construction contractor, completes all construction work and commissions the project. The close-out phase consists of contract closure, financial closure and ends with documentation of 'lessons learnt' (Transnet, 2014:45).

Table 2.4: Transnet five-phase approach to project lifecycle

| Phase | Deliverable |
|---|---|
| Concept phase (FEL1) | Concepts developed |
| Prefeasibility Phase (FEL2) | Selection of option for detailed design |
| Feasibility Phase (FEL3) | Detail design up to 70% engineering |
| Execution Phase (FEL4) | Detail design completed. Construction completed |
| Closure | Project commissioned and handover |

Source: (Adapted from Transnet, 2014:45)

The principle of a PLP as alluded among scholars reinforces the need for a structured approach for the implementation of mega-projects. Each phase of the lifecycle processes ensures that the project progresses from concept development until detailed designs are obtained, and construction is completed. Transnet's PLPs are indicative of a robust approach to mega-project implementation; however, there are still challenges, as indicated by literature, in the high rates of project failure.

## 2.8 DEMOCRATIC SOUTH AFRICA

Since democracy in South Africa unfolded in 1994, South African businesses have been urged to include the economic participation of previously disadvantaged individuals and businesses in a bid to close the gaps for those that have been excluded or denied access (DTI, 2011:20). In 2003, legislation was passed in South Africa to enact the Code of Good Practice on BEE, and this applied to the following entities:

- All public entities including Transnet;
- Any public entity that undertakes business with any organ of state;
- Any enterprise that undertakes business with any organ of state or public entity; and
- Any other enterprise that undertakes any business subject to B-BBEE measurements.

As a state-owned entity, Transnet has been extensively contributing in supporting economic participation and transformation as published in its annual reports (Transnet, 2015:14). However, it is important to assess if the transformation initiatives are making any impact in the delivery of mega-projects.

### 2.8.1 Transformation

In 1996, South Africa launched the Growth, Employment and Redistribution initiative as a response to low economic growth, high unemployment, and imbalances in financial prosperity that existed as consequence of the previous Apartheid Government (Hamann, Khagram & Rohan, 2008:25). The 1996 Green Paper on employment equity provided guidance to organisations to address the imbalances in the ratios of the various racial groups in the workplace (DTI, 2007:9). The Accelerated Shared Growth Initiative for South Africa (AsgiSA) was launched by the South African government in 2006 as a major initiative to grow the economy and subsequently improve the quality of life for all South Africans (DTI, 2011:7). SOEs such as Transnet play a crucial role in adopting and achieving national initiatives.

### 2.8.2 Broad-Based Black Economic Empowerment

B-BBEE (commonly known as BEE) was launched as a sustainable strategy to promote the inclusiveness of Blacks in the economy of South Africa following the promulgation of the Employment Equity Act (Kruger, 2010:75). The BEE code was launched as a policy in 2003 by the Department of Trade and Industry (DTI, 2016:8). The purpose of BEE is to provide equal opportunities for all South African and encourage support for the previously disadvantaged race groups. The code covers seven key areas including ownership, executive management, preferential procurement, enterprise development, skills development, employment equity and socio-economic development. Mbeki (2009:80) reports that BEE is working very successfully at a micro-level in South Africa. The finding is that BEE has had a positive impact on the competitiveness and profitability of companies. However, it would be noteworthy to assess whether BEE is performing successfully in Transnet high impact and high-value mega-projects.

### 2.8.3 Infrastructure Demand for Skills

A parallel programme, the Joint Initiative for Priority Skills (JIPSA) was also launched by the Department of Labour (DOL) in 2006 to address the skills shortages and facilitate the development of skills (DOL, 2016:3). According to Bond, Steyn and Rotelli (2013:1006), the inferior education of Blacks was worse than that of Coloureds and Indians in apartheid South Africa. According to JIPSA (2016:11), engineering skills, project management skills, architecture, and geotechnical skills continue to be listed in the top critical skills in South

Africa. De Boer (2010:15) found that the high levels of dissatisfaction with working and living conditions led to high level of potential emigration and ineffective retention strategies exist in the country. He also found that as long as there are demands for professionals in western countries, the 'brain drain' from South Africa will continue to exist.

Kovacevic (2007:6) states that the vast infrastructure investments required in South Africa require the services of skilled and qualified engineers, but because the country is not able to supply the demand for the required professionals, delivery outputs are inefficient. Kruger (2011:207) adds that the shortage of skills in South Africa contributes to negative growth in the economic development of South Africa. Transnet (2017:34) reports that its human capital strategy responds to the skills shortage experienced in the economy and the company is addressing the grave situation through the following initiatives: strategic workforce planning, feeder training pipelines, Transnet Academy and the School of Engineering.

Literature shows that there is a shortage of skills in Transnet and in the country as a whole. However there appears to be a gap in the literature on the existence of any skill shortages in Transnet's mega-projects, and if this is the case what consequences are there for mega-project delivery?

## 2.9 FRAMING MEGA-PROJECTS IN THE SOCIO-ECONOMIC CONTEXT

Mega-projects play an important role in social development since they contribute significantly to economic growth and communities (Nijaki & Worrel, 2012:141). This notion is supported by Lee and Chan (2008:526) where they suggest that mega-projects, when viewed in a global context, have the primary goal of promoting economic growth, balancing social inequalities, and existing in harmony with the natural environment. However, the planned benefits of mega-projects in the execution stage may receive a contradictory response as a result of protests in the political, economic and social environment (Kruger, 2011:207). Kruger illustrates that by using a holistic approach considering both tangible and intangible tools and processes, mega-projects can meet the requirements of both the projects and stakeholder requirements. The integration of the socio-economic environment and local culture needs to be evaluated and managed to achieve all aspects of the sustainable mega-infrastructure development (Mitchell, Clarke & Baxter, 2008:464).

Fauconnier and Mathur-Helm (2008:6) caution that in the application of the fundamental principle of infrastructure development projects, various factors and the impacts of their

interactions must be clarified and thoroughly understood to achieve success. In general, mega-project success relies on the perfect balance of multidisciplinary knowledge and adequate stakeholder integration of the significant aspects from project initiation until commissioning and close-out (Ashby & Burgoyne, 2009:519). According to Mahmoud & Selman (2011:336), the holistic perspective of investment costs, quality, user requirements, sustainability and risks could be the key factor in addressing socio-economic, environmental and cultural concerns to achieve the expected outcome of a sustainable mega-project.

Flyvberg (2009: 344) reinforces the notion that mega-infrastructure projects have huge impacts on communities and the environment; hence, they attract much attention from the public. He raises a concern that special care and due diligence must be exercised in the consultation processes with communities to ensure that there are no misrepresentations or over-optimism since mega-projects are known for their poor performance against schedules and budgets.

Literature provides sufficient evidence that stakeholders and communities play a crucial role in supporting mega-project execution. Scholars caution that careful attention must be paid to the identification, role and impact of stakeholders in the execution of mega-projects in Transnet else challenges may arise. However, literature appears to be silent on the quantum of stakeholders that mega-projects are expecting and the related strategies and processes that may be required to deliver the project successfully.

### 2.9.1 Integration of National Departments

The active involvement of national government, local government and advisory services is a critical requirement for project support, approval and engagement with local business and local communities in supporting the goal of project approval and efficient execution (McKinsey, 2012:15). However, McAdam, Walker and Hazlett (2011:303) found that structured integration at the strategic, policy setting and operation levels with the local authorities often lacks cohesion. Public involvement is also required in the early planning process of mega-projects for alignment with social, environmental and economic development (Shan & Yai, 2011:158). An integrated area-based development plan should provide support policy approval across all diverse sectors including government, business, trade and local communities (Satterthwaite, 2013:15). Since Transnet contributes to national initiatives, its alignment in supporting economic development is vital and needs to be explored further in the context of mega-project delivery.

### 2.9.2 Social Integration

Longoni and Cagliano (2015: 216) maintain that adopting a holistic approach with clear goals and desires that are embraced by all parties in society will keep mega-projects on a firm path since the main aim of the mega-project is to improve the quality of life for all, maintain economic growth and support a sustainable environment. Shah and Baporika (2010:31) recommend the development of a socio-cultural framework plan for mega-projects which must facilitate genuine stakeholder participation, planning, solving and institutional building activities to ensure sustainable long-term inclusive participation. Fellows and Lui (2013:415) highlight that in the construction phase of a project, there are a number of factors that may affect the development of project culture. Roehrich, Grosvold and Hoejmose (2014:695) build on this discussion and suggest that a sustainable project culture can be developed by an amalgamation of the culture of various stakeholders in a typical mega-construction project. Hence, they recommend that the construction industry is in the best position placed to manage culture at the mega-project construction phase. Due to its project-based nature, Zuo, Zillante and Coffey (2009: 23) support the view that the construction industry needs to manage culture at the project level.

### 2.9.3 External Authorisations

Other challenges faced by those planning mega-projects include high levels of uncertainty, minimising impacts on neighbourhoods and the environment, laws and regulations that empower community groups to contest project information and methodologies, all while the project team attempts to solve a complex problem (Flyvberg, 2009:345). He goes further to comment that the collective benefits that are often the underlying logic of a mega-project are reduced to an individualised form of public benefit. As a response to integration and external stakeholder ‘buy-in’, Transnet annually publishes its LTFP as a public document. Transnet reports that the LTFP is an integrated plan that is developed using a bottom-up and top-down approach involving national government, local authorities, business and local communities (Transnet, 2016:34). Transnet LTFP appears to be comprehensive and aligns well with practices recommended in literature; however, there is a gap in the literature on external factors impacting positively or negatively on the delivery of mega-projects.

## 2.10 A REFLECTION ON PROJECT SUCCESS FACTORS AND CHALLENGES

Joslin and Muller (2016:364) believe that project success is determined by criteria and standards that must be achieved by the project manager for a set of desirable outcomes. While Nguyen, Ogunlana and Lan (2004:408) support this notion, they add that stakeholder satisfaction must also be achieved. According to Saqib, Farooqui and Lodi (2008:146), project success varies from one project to another and the definition of success depends on a variety of factors including project size, scope, design complexity, technology and the participants, while Al-Tmeemy, Abdul-Rahman and Harun (2011:343) believe that overall project success is achieved when the technical performance criteria are achieved.

Han, Yusof, Ismail and Aun (2012:94) agree that the description of project success is difficult to frame but reiterate that project success is dependent on budget, schedule and quality – the 'iron triangle' of project management. Dalcher (2012:644) maintains that success needs to be expanded from a view of planning and controlling to include views of clients, contractors and stakeholders which are generally neglected. Pakseresht and Asgari (2012:387) support the view of stakeholder importance and add that that the idea of project success is an elusive area that is complicated and highly dependent on the views of internal and external stakeholders.

### 2.10.1 Evolution in Project Success Criteria

According to Muller and Jugdev (2012:757), research into the understanding of project success accelerated in the 1980s with the first comprehensive set of works by Pinto and Slevin (1989:33). In their research paper, they identify three periods that clearly define the evolution of examination of projects:

- **Period 1 (1960 – 1980)**

During this time project management focused on driving the "iron triangle of cost, time and quality". Belassi and Tukel (1996:141) indicate further that the first studies on critical success factors undertaken by Rubin and Selig (1967:131) found that project success was chiefly dependent on technical performance.

- **Period 2 (1980 to 1990)**

In period 2, Muller and Jugdev (2012:760) relate that project management success criteria expanded to include broader frameworks consisting of organisation strategy, financing

mechanisms, definition of the project, schedules, human resource qualities and attitudes, communications and external factors. During this period, Morris and Hough (1987:156) illustrate that success criteria were aligned to the political environment, business strategy, objectives of the project and contracting factors.

- **Period 3 (1990 – 2000)**

Muller and Jugdev (2012:760) indicate that during this period, frameworks expanded and evolved to bring greater emphasis to considerations of the external environment. During this period, major studies by Pinto and Prescott (1990:1281) elaborate that the project lifecycle stage dictates the execution strategy and that planning factors including client alignment, stakeholder engagement and sustainable environment play a critical role in project success

In this current era, focus is moving towards understanding and influence project personnel attributes including skills, experience, and behaviour for project success. Apart from the traditional factors of strategy, project process and external environment, APM (2016:10) highlights that the competency of project professionals and the capability of the project team are highly critical success factors. Hodgson and Cicmil (2016:744) provide information on the 'Making Projects Critical' movement which is focusing its energy on prioritising issues such as ethics, equality, morality in projects, creating awareness of the influences of political matters underpinning projects.

Table 3.5 provides an overview of project success factors echoed by various scholars and the APM (2014:3) project institution over the past few decades. It is evident in this comparison that many factors need to be considered and managed to achieve project success including tools, processes, skills and behaviours. However, in recent times, Wells (2012:43) indicates that aligned project personnel attributes such as skills, behaviours and attitudes are becoming highly critical success factors.

Table 2.5: Viewpoints on project success factors

| Pinto and Slevin (1989) | Chan et al (2004) | Dalcher (2012) | APM (2014) |
|---|---|---|---|
| Executive management support | Project type, size and complexity | Technical performance | Capable sponsor |
| Client management | Procurement methods | Financial performance | Engaged users |
| Technical definition | Planning and control efforts | Degree budgets are achieved | Project commitment to success |
| Client acceptance | Contractor and sub-contractor capability | Degree Technical specifications are achieved | Funding secured |
| Monitor, control, feedback | Client involvement | Degree Schedule are achieved | Proven methods and tools |
| Communications | Project leadership | Contractor performance and benefits | Appropriate standards |
| Politics management | Team's skills and experience | Shared positive attitude | Integrated supply chain |
| Environmental support | Team conflict | Workable project and definition | Effective governance |
| | Physical environment | Well qualified resources | Competent professionals |
| | Social environment | Clear communications | Capable teams |
| | Industrial action | Tolerance of error | Supportive organisations |
| | Technology | | |

Source: (Adapted from Pinto and Slevin, 1989:33; Chan et al, 2004:154; Dalcher, 2012:644; APM, 2014:3)

Literature reveals that the definition and description of project successes is still open-ended, varies among scholars, appears to be specific to project types and is dependent on stakeholder perceptions. Hence the measurement of success or its converse may be as open-ended as its definition and highly dependent on an independently selected frame of reference.

### 2.10.2 Project Failure and Challenges

Early studies on undertaken by Avots (1969) cited in Belassi and Tukel (1996:141) revealed that project failure was related to several factors such as top management being unsupportive, failures by the project manager and termination of contracts. Takim and Adnan (2008:82) relate that projects fail during various phases of the project lifecycle, but the most expensive failures occur as a result of poor management of the construction contractor. In his study of industrial mega-projects, Merrow (2011: 2) reveals the top seven reasons for project failure are investment imbalances, compressed schedules, insufficient upfront detailed planning, insufficient funding for upfront planning, cost cutting, passing risks onto contractors and dismissal or loss of key project personnel.

According to Ika and Hodgeson (2014:1182), project failure occurs when planned schedules, costs, scope and quality required are not met. While Parvaneh and El-Saegh (2016:39) agree with this view of deliverables not meeting the 'iron triangle of time, cost and quality' can be regarded as a failure, they indicate that there is no agreed set of standards that can be used to measure or describe project successes or failures. The Standish Group's (2014:8) CHAOS report reveals that the rate of IT project failures is increasing and that the top three failures can be attributed to user involvement, executive support and clear statement of requirements. Bayilet and Teklu (2016:562) further state that other factors for failure include lack of proper planning, unrealistic expectations and incompetent staff.

In summary, the definition and description of project failure vary among scholars and institutions and appears to revolve around project types, planning and execution processes, executive management support and selective performance targets measures that need to be met.

## 2.11 CHAPTER SUMMARY

Chapter 2 literature review appraised various thematic areas associated with the research questions. The literature review broadly set the context by recognising various theories, practices and project features that are connected with the research problem.

It is apparent from the literature review that mega-projects are essential investments to support economic growth, community services and improvement in the quality of life. There are various definitions of mega-projects and no agreement among on scholars on an accepted

definition. It is evident that mega-projects are complex, draw on billions of rands in investment, and usually they do not meet planned expectations.

Transnet's long-term infrastructure planning, strategy and PLP are integrated and aligned to provide a solid platform for the realisation of its corporate growth and is supportive of socio-economic requirements. It is recognised that a result of positive and negative economic cycles, Transnet has the ability to adjust its mega-projects programmes to maximise its investments propositions.

The literature review provided an analysis of post-apartheid factors in South Africa including transformation, BEE, job creation and skills development in order to assess their impacts on mega-projects. It is evident that BEE has been successful at a micro-level and is supportive of legislative requirements. However, the critical shortage of project-related skills has an impact on the efficient delivery of outputs because the country is unable to meet demand.

The chapter ended with an evaluation of the literature on the successes and challenges associated with the consequences of projects delivery. The outcomes of the gaps, weaknesses and agreed factors influencing project challenges were assimilated as inputs to further develop the research instrument for the collection of quantitative data for this study. The literature review is further expanded and refined in Chapter 3 using a theoretical model.

# CHAPTER 3:

# OVERVIEW OF THE THEORETICAL MODEL UNDERPINNING THE STUDY

## 3.1 INTRODUCTION

This chapter introduces the theoretical model that was adopted to anchor this research study. The ten dimensions of the theoretical model are unravelled and aligned to the literature pertaining to the research objectives of this study. Each of the mega-project management dimensions is introduced and unpacked to offer contemporary thinking and a critical review of the strengths, gaps and weaknesses related to each dimension.

Project management fraternities and their project frameworks are introduced in this chapter. A summary of the key project management dimensions of each project fraternity is provided and the selection of the PMI (2013:61) framework and its applicability for this study is clarified.

Under the dimension of project initiation and integration, the role that stakeholders play in determining the project scope and deliverables are examined. Further detail is provided in identifying who the internal and external stakeholders are and the best practices of integration in the lifecycle phases are discussed. The business investment view of mega-projects and its relevance to the project for maximising investments requirements are linked for gap analysis.

The scope and management of mega-project scope is appraised and evaluated. The role of the owner in defining the project scope and the impacts of scope changes during project execution is reviewed. Responses to rapid technology advancements during the life of the mega-project while attempting to mitigate negative impacts are presented in this section of the literature review. In understanding the schedule impacts of mega-projects, the sub-elements of tools and techniques are presented and the processes for accelerating schedules are evaluated. The critical area of skills requirements for developing and managing project schedules is outlined.

The fourth dimension of the theoretical framework is cost management. Under this dimension, a detailed analysis is undertaken on the project's estimated costs, levels of error in cost estimates, cost-control management and the impact of changes to estimated costs.

Quality management and resourcing for mega-projects appraisal considers the constructs of organisational maturity, quality package plans, and skills requirements.

A comprehensive review on human resourcing, skills requirements and teamwork is undertaken. Project team structures and skill sets are assessed against the impacts of project performance and execution. Transnet's response to skills development and the mitigation of supplementing necessary skills for mega-projects are presented. The value of experience for mega-projects is explored, as well as soft issues of collaboration and trust.

The importance of communications in project team performance and the importance of being in possession of a communication plan for internal and external communications are investigated and appraised. Further considerations on enhancing stakeholder relationships are presented. Risk management tools and techniques are evaluated, and further considerations on the levels of risk monitoring and planning are presented.

## 3.2 THEORETICAL FRAMEWORK

### 3.2.1 Project Management Institute (PMI)

Project management practices, technical knowledge and the application of skills in project management have been developing over recent decades from a variety of sources including individual scholars and professional bodies (PMI, 2013:483). As explained by the PMI based in USA, the collection of project management knowledge has been compiled to present a project management standard called the Project Management Book of Knowledge (also commonly referred to as "PMBOK"). The original version of the PMBOK was published in 1996 and the latest updated publication was released in 2013. The 10 knowledge areas of the PMBOK are Integration Management, Scope Management, Schedule Management, Cost Management, Quality Management, Human Resources Management, Communications Management, Risk Management, Procurement Management and Stakeholder Management.

### 3.2.2 Association of Project Managers (APM)

The APM based in the UK is a chartered body for project professionals (APM, 2016:15). The APM Body of Knowledge publication provides a methodology for the management of projects which forms the basis for APM's accreditation, qualifications, publications and research. APM's Projects in Controlled Environment (PRINCE2) is a standard that is extensively used in the UK.

### 3.2.3 International Project Management Association (IPMA)

The IPMA was founded in 1965 (IPMA, 2014:n.p). IPMA has 66-member associations around the world with its main aim of leading development as well as promotion of the project manager. The IPMA Competence Baseline (IPMA ICB) provides for talent development and four levels of competence certification, namely:

- Certified Project Management Associate
- Certified Project Manager
- Certified Senior Project Manager
- Certified Project Director

### 3.2.4 Theoretical model for this study

Currently, there is no single association or accreditation that is specified among scholars for the execution of projects, and it therefore depends on the project management practitioner or project execution organisation on the choice of project management association and accreditation deemed relevant.

The theoretical framework used in this research is based on the '10 Knowledge Areas' framework of the PMI for the following reasons:

- Based on the literature review and the research problem, PMI's '10 knowledge area was best suited to evaluate the challenges in TCP.
- PMI consolidates the knowledge areas contained in the APM framework.
- PMI accommodates the competency factors of IPMA.
- TCP personnel have been trained using PMI's PMBOK (PMI-SA, 2013:n.p).
- TCP personnel are accredited PMI practitioners (PMI-SA, 2013:n.p).

## 3.3 INITIATION AND INTEGRATION IN MEGA-PROJECTS

The initiation and integration process in mega-processes is primarily associated with the commencement of the project following necessary approvals, engaging the relevant stakeholders for requirements and developing the project plan (PMI, 2013:54).

### 3.3.1 The Role of Stakeholders in Project Integration

Stakeholders play a key role in the early stages of a project where usually many viewpoints and any ambiguity must be clarified (Culmsee & Awati, 2012:528). It is critical that stakeholders are identified and consulted at the earliest stage and that stakeholders are taken along in the journey of the projects. This view is supported by Windapo and Goulding (2013:424) who further emphasise that stakeholders should be determined at the commencement of the mega-project. They emphasise that stakeholder requirements when converted to expectations should be tracked throughout the project lifecycle to ensure that common goals, consistency and buy-in are maintained. Poor integration of teams and stakeholders in the early stages of the projects can lead to problems in planning and incomplete definition of the scope (Ibrahim, Costello & Wilkinson, 2015:300), which eventually find its way with adversarial effects to the construction stage leading to disastrous project outcomes (Ahsan & Ahmad, 2016:50).

### 3.3.2 Stakeholder Identification in mega-projects

PMI (2013:563) describes stakeholders as all parties both internal and external to the organisation that have an interest in the project and its execution. Internal stakeholders include the project owner, operations personnel and the project organisation's management, while external stakeholders exist outside of the project organisation which include authorising authorities, local communities and the environmental fraternities. Windapo and Goulding, (2013:424) expand this concept by asserting that value is created by engaging all stakeholders and identifying their requirements as early as possible in the project and eventually leads to successful execution and acceptance of the end product Following on Sallinen, Ruuska and Ahola (2013:51) articulates that the extent and levels of consultation will vary in the various phases of the project; therefore, it is necessary to develop an effective strategy that adequately engages stakeholders. Lastly, Culmsee and Awati (2012:528) propose that a common platform for open dialogue should be developed by the project team as a requirement to achieve common understanding and for the elimination of political as well as any other constraints.

While literature support the notion that mega-projects are massive interventions, and assists with processes for describing and engaging stakeholders, there appears to be a gap that addressed the quantum of stakeholders and measures the project team's ability to effectively manage stakeholders.

### 3.3.3 Mega-Project Team Integration

Team integration, according to Lahdenpera (2012:57), is an important strategy to promote a collaborative and positive working team which will deliver increased performance as duly required in complex projects. Baiden and Price (2011:129) build on this concept by explaining that there is a variety of organisation structures, cultures, individuals and work-practices that influence the performance of project execution. However, they caution that the expert personnel requirements and skill sets must be deployed for successful large project rollout and individuals must 'sing the same tune' as an integrated team.

Rowlinson and Cheung (2015:15) extend the concept of team integration to include the contracting and sub-contracting parties adding that contracting principles involving joint ventures, alliances, partnerships must be considered in contracting strategies. Apooja, Herrala, Pekuri and Haappasalo (2013:695) expand the notion of extending the project team to include contractors and conclude that the collective energy of all parties in an extended integrated team will produce performance that cannot be realised with traditional contracting strategies. They also added a further two significant indicators: team leadership and team charter. In addition, Lahdenpera (2012:57) asserts that a 'no blame' culture ensures that relationships are equal, and that joint problem-solving can increase performance and working in a spirit of trust.

Ibrahim et al. (2015:300) found that there are five top indicators that are highly significant for high performance integrated teams: single team focus on objectives and goals, free-flow of information, commitment from top management, respect and trust and initiatives are encouraged. Four key elements for a framework of influencing integration (Ibrahim et al., 2015:305) include, team formation, contractual models, the teamwork principle; and operational monitoring. They conclude that team meetings that are regular and team-building initiatives also enhance and strengthen relationships.

### 3.3.4 The Business Investment and Project Dependency

Olsen, Frydenberg, Jakobsen and Jessen (2010:257) highlight a cautionary measure that that the project team should have a clear understanding of the business-case and business environment as much as the understanding of the investor. Mega-projects are synonymous with long durations for the delivery of the end product, and during this lengthy period, the project may encounter a single or several positive or negative economic cycles (Merrow,

2011:90). However, a clear understanding of the business need enables the project team to steer the mega-project's deliverables in a manner that is adaptive to the changing commercial environment while still meeting the investment requirements (Guo, Li, Li & Zhang, 2016:866). Following on, Atmo and Duffield (2014:335) assert that the outcomes of a project can be improved if the project team finds a link between the commercial arrangements and the technical solution, eventually leading to a favourable business solution. However, Guo et al. (2016:867) indicate that the transaction costs can be minimised if the owner reduces many uncertainties in the project which include project team being familiar with the business environment and having solid experience in projects of a similar nature

Highlighting the huge investment value of mega-projects and the scrutiny that investors evaluate project compatibility with the strategy of a company, Olsen et al. (2010:257) caution that any potential suboptimal commercial delivery:

- May negatively affect project funding;
- May require that the owner of the mega-project inject additional funding;
- May negatively impact on the profitability and the investment value that the mega-projects finally delivers to the owner;
- The end customer including the public could be the party who pays the price for poor project delivery and poor investment decisions.

While literature provides substantial information on the value of the business-case and the project team alignment, it is vague as to the extent to which mega-projects teams understand the business-case and actions taken to indeed manoeuvre the project to meet the investment objectives.

### 3.3.5 Incorporating the Legal Environment

Sallinen, Ruuska and Ahola (2013:51) explain that government authorities as a major stakeholder will have heavy influence on projects as it bases its influence on laws and regulations that require to be adhered. They further highlight that government as a stakeholder has many responsibilities thus promoting a project on socio-economic advantages alone is insufficient basis for project approval since morality issues may be at stake requiring long timelines to support approvals. Guo et al. (2016: 866) contend that the challenges of the owner's team to adequately address legislative requirements and give

authorities the necessary back up assurance it requires, may lead to obstacles in enabling and advancing projects.

### 3.3.6 Section Summary

Following the line of reasoning on the importance of the role of stakeholders in mega-projects, there is an absence of firm evidence that stakeholder management are meeting best practise or challenges are being encountered. Hence it would be valuable to evaluate through the eyes of TCP any challenges or successes on mega-projects in the South African context. The arguments of scholars point to teams being mobilised on a project with specific roles however they may not all be striving to a common project goal. It is clear from literature that if left untreated, project team misalignment and 'soft behaviour' issues can be major challenges in mega-project execution. It is not conclusive from scholars as to the extent that project teams fully understand the project's investment impacts and whether the projects execution strategies are aligned to desired successful outcomes.

## 3.4 SCOPE DEVELOPMENT AND MANAGEMENT

The scope of a project describes the various pieces of work that must be undertaken to produce the product or service (PMBOK, 2013:571). Scope development in a mega-project, according to Merrow (2011:177), is the most important task in a mega-project. Project scope that is clearly defined, updated and managed has the benefit of efficient project execution delivery and reduces costly changes in mega-projects (Ibrahim et al., 2015:310).

### 3.4.1 Scope Definition

Several key stakeholders are consulted and involved in developing the mega-projects scope but the project team places a heavier weighting on developing the mega-project's scope based on the owner's requirements (Cheng 2014:851). The project owner remains the authorised party that approves the scope and project initiation and the owner remains the party that approves any other scope changes during the life of the execution phases. The development of the scope must comprehensive even to the smallest detail; thus, Merrow (2012:39) devotes the entire FEL2 phase of a mega-project to scope preparation and assessment before closing the FEL2 phase with the execution strategy, schedule and detailed design planning. Ibrahim et al. 2015:310) contribute further insight on scope definition stating that it is completed at a stage when preliminary designs have been completed, all

risks in the project have been evaluated, an execution plan for the project has been adopted and approved, and all critical decisions for the project have been accepted.

### 3.4.2 Managing and Maintaining Mega-Project Scope

Changes in mega-projects are generally associated with scope changes of the works, material changes in quantities during the construction phase, and changes in the unit rates utilised in the bill of quantities (Alnuaimi, Taha, Mohsin and Al-Harthi, 2009:615). According to Larson and Grey (2017:483), as the scope becomes clearer "the cost estimation processes become finite and the range of the cost estimates become tighter".

Sharma and Lutchman (2006:161), in their investigation of "scope definition of expanding operating projects", found that poorly defined scope and scope changes during execution of upgrading projects result in significant budget overruns, delayed schedules, poor worker morale, and increased conflict among the owner's team, managing consultants and the construction team.

In an assessment of state housing construction projects in Ghana, Amoatey, Ameyaw, Adaku and Famiyeh (2015:208) sought to establish the chief causes of delays and its effects on project delivery. This study reveals that apart from bureaucracy delaying payments to the contractor, the major cause of project delays are scope changes made during the project. As a result of these delays and changes, the housing projects suffered schedule overruns, cost-overruns, and litigation. The end result was that the contractors ran into financial crisis and abandoned site.

### 3.4.3 Role of the Owner in Scope Changes

Merrow (2012:39) examined the key requirements for developing adequate scope definition upfront in order to improve project execution and interfacing and found that the essential requirement included additional time for upfront planning, owner's focus on key requirements for the project and 'not nice to haves', as well as equipment and material planning.In analysing four public construction case studies in Oman, Alnuaimi et al. (2009:616) found that that the owner's additional requirements to the works and design modifications were the most important reasons for changes in construction projects. As the result of these problems the authors further highlighted reported there were delays in schedules, overruns in costs and disputes.

### 3.4.4 The Impacts of Technology Changes in Long Project Duration and Scope Management

Walker and Steinfort (2013:182) state that projects often display a complex environment with chaos and paradoxes. They assert that understanding the impact of technological requirements and planning at a macro-level can improve understanding and responses. Arthur and Kennedy (2014:23) emphasise the use of appropriate technology that should be adopted for mega-projects given the long operational lifespan of mega-infrastructure. However, according to Yeow and Edler (2012:472), the lengthy timelines of projects can render software obsolete in its journey from the design phase through to construction and final commissioning.

### 3.4.5 Section Summary

Literature indicates that there are many factors leading to scope changes and that these factors are triggered by circumstances contiguous to the project. There is no single factor agreed among scholars as the most significant factor contributing to scope changes however it is evident that the role of the owner's team in instigating changes may be the key area to probe further using empirical evidence. Having established that mega-projects have long durations, it would be prudent to test if technological changes are affecting the delivery of mega-projects in TCP.

## 3.5 SCHEDULING

Project schedules consist of a series of dates that indicate the start and completion dates of the activities that are required to fulfil the project requirements (Graham & Englund, 2011: 87). The project schedule also contains information on the duration of various project activities, presents the sequence of activities and any interdependencies between activities (Hazini, Dehghan & Ruwanpura, 2013:382).

### 3.5.1 The Process of Schedule Development

The process of scheduling commences with the identifying and defining the various activities that are required to deliver the business solution (Berg & Karlsen, 2014:449). Project team specialists on work, package, discipline and leads are usually involved in confirming the activities and the duration of time that would be required to complete the activities (Tilos, 2012:6). Generally, reliance is placed on past project performance to

determine the duration of the various activities but unreliable forecasting of activity durations and the absence of reliable forecasting statistics may lead to risky project schedules and challenges in managing schedule slippages (Sawyer, 2012:13). Building on this concept of past performance as an input for schedule development, a critical area to assess would be the experience levels of TCP Scheduler's.

### 3.5.2 Tools and Techniques for Schedule Development

There are two common and widely accepted formulae that are produced by the PMI (2013:149) namely the 'time estimate at completion' (TEAC) and the 'cost estimate at completion' (CEAC).' The 'Earned value management' (EVM) is also a common technique that is used for controlling schedule delays and cost overruns and EVM supports the control functions for 'monitoring, analysing and forecasting' schedule completion and project cost (Narbaev & De Marco, 2013:10).

Norouzi (2015:1) comments that common techniques are limited in their capability to estimate completion time and suggests the use of probability distribution techniques for complex schedule networks that can cause complications and make assessments difficult. Hence, he identifies the need for the "fuzzy approach" to be expanded and intensified for improved results.

Narbaev and De Marco (2013:11) caution that the simple CEAC method has three limitations. They illustrate that a new regression-based non-linear 'CEAC methodology' can be used to improve early forecasting of the final cost of completion. This method is integrated into the growth model with the earned-schedule for improved accuracy. Furthermore, they highlight that this method relies heavily on the availability of accurate schedule information as well as cost information to be produced at all levels of the project team. Norouzi (2015:1) indicates that "unless reliable and timely reporting is established", schedules will only produce "false forecast of costs and schedules". The author recommends for future research, that factors such as "sequential relationships, schedule-changes, fast tracking and dynamic-scheduling" are incorporated into the schedule analysis for predicting project completion.

### 3.5.3 Accelerating Schedules

Marks and Ellis (2013:79) explain that it is quite common on time-sensitive projects to for the project team compress schedules by accelerating and overlapping activities to arrive at

an earlier project completion date. However, acceleration generally means more costs are added to an activity while overlapping tasks can cause additional schedule risks to activities that are usually undertaken in sequence. Considerations must be given to time and cost trade-off to determine if the benefits of schedule compression are worthwhile. Thus, Haznini et al. (2014:340) found that the appropriate tactics for schedule compression are challenging especially if such strategies are subjective, leading to further rework, schedule slippage and cost overruns which lead to a loss situation on the project.

In an attempt to find an optimum solution for schedule compression, Narbaev and De Marco (2013:11) recommend the use of "genetic algorithms" for resolving the time-cost trade-off since genetic algorithms have the capability of running complex problems in a shorter time and optimising the "time-cost solution".

### 3.5.4 Skill Requirements for Scheduling

According to Varajao, Dominguez, Ribeiro and Paiva. (2014:586), construction type projects have been criticised quite commonly for delays, deviations from budget, quality and production issues; thus, careful management of critical aspects is required for a project to be successful. Project planning and well-defined objectives are the top ranking criteria for both IT and Construction projects. The efficiency of the project manager was ranked 3rd and involvement of the team took 4th place. They concluded that project managers must allocate the resources that are necessary in the planning phase as project success is dependent on this key requirement. The project manager's efficiency also ranked at the top of the critical aspects of success.

According to Marks and Ellis (2013:79), it is essential that the schedule of major projects is not over-optimistic and that they have a suitable budget to match an appropriate project timeline. Furthermore, all major projects should have an appropriate funding contingency that caters for unforeseen events; otherwise it becomes difficult and time-consuming for the owner to solicit funding from government authorities, leading to further delays in completing the project.

Norouzi, Heydari, Noori and Bagherpour (2015:1) consider uncertainty as a "property of a system which is an indicative defect in human knowledge towards a system and its state of progression". According to Norouzi et al. (2015:2), projects are implemented in an environment that is uncertain; thus, ambiguity is a major feature in a project environment.

Common techniques do not have the capability of estimating the completion time for a project that is executed for the first time. He further explains that the use of probability distribution techniques for large, complex networks can complicate and make assessments difficult; hence the need for the fuzzy approach to be expanded and intensified for improved results.

### 3.5.5 Causes of Mega-Project Delays

Delay is defined as the time overrun beyond the agreed completion date as stated in the contract agreed by the contracting parties for the delivery of a project (Marks & Ellis, 2013:349).

In the state development of large housing projects in Ghana, Amoatey et al. (2015:198) indicate that significant delays in the project completion date were primarily related to the delayed approval of the commencing the project and scope changes. Further delays occurred during construction when contractors were not paid on time due to delegated authorities in government not approving payments as per the planned timeline.

In the case of major agricultural infrastructure in Guyana, Mark and Ellis (2013:79) identified eight main causes of delays: access to site, weather delays, schedule being too optimistic, unforeseen ground conditions, too many change-orders, poor and incomplete site investigations prior to the bidding process, slow decisions by client, and shortages in skilled labour.

In the case of IPA's 318 mega-projects consisting mainly industrial off-shore and onshore processing plants, Merrow (2011: 40) alludes to poor engineering and poor quality control as the chief contributors to project schedule slippages. He explains that that slow engineering work mobilisation drives "late and out of order equipment and engineered bulk materials". Andersen, Samset and Welde (2013:171) argue that the complexity of mega-projects often leads to schedule overruns. Ibrahim et al. (2015:300) adds that poor team integration of stakeholders in the early stages of the project leads to incomplete project schedules in the construction phase as a result of changing needs by the contractor.

### 3.5.6 Section Summary on Project Schedule

Scholars point out that tools and techniques, past project schedule data and the skill set of schedulers play an important role in the production of schedules. In reviewing the causes of

schedule delays, it appears that there are many reasons and combinations thereof that contribute to project delays. There is no agreement among scholars on the causes of delays. The delays appear to be broadly related to project type, complexity, incomplete definition, owner and approval issues, poor engineering, as well as project management issues. Scholars in an attempt to characterise fast-track projects provide some useful guidance and caution on accelerating schedules. However, literature lacks empirical evidence on the relationship of producing realistic schedules and project completion. TCP study provides an ideal test case to probe further if there is a relationship between the production of realistic schedules and mega-project completion on time. Noting the DOL (2016:3) report on skills shortages in South Africa, the skill level of schedulers must be probed further to assess if this a challenge on TCPs' mega-projects.

## 3.6 COST MANAGEMENT ON MEGA-PROJECTS

The traditional iron triangle of scope, time, cost and quality are the primary determinants of deliverables objectives in a project (Burke, 2013:34). Cost is one of the critical criteria to measure the success of a project (Memon, Rahman, Abdullah & Ade Asmi Abdu Aziz 2014:30 ), while Lad and Beck (2009:18) concluded that success of capital projects should be judged on performance, operational reliability and maintenance. It is generally accepted that at the approval phase of a project is a critical point that determines whether the project proceeds or not. Projects that are approved at this stage usually go ahead to be executed but the survival of such projects could be based on the false premise of an unrealistically low price being the tangible factor thus corrupting the decision processes (Anderson et al., 2016:179; Flyvberg, 2009:350). On the contrary, Keil, Mathiassen and Zheng (2006:160) argue that decision-makers will continue to support funding projects if they believe that there are long-term benefits in keeping the project going. They further expand this notion to incorporate the factors that determine continuation to include the size and scope of the project, economic benefits and quantum of costs required to conclude completion.

### 3.6.1 Cost Control

Muller and Jugdev (2012:757), places an emphasis on project teams utilising the appropriate methodology aligned to governance requirements within the organisation for cost control and change management requirements. This view is supported by PMI (2013:217) that tools and techniques are essential requirement of the project team to produce cost estimates. Sai and Nallam (2016:433) conclude that well-defined work breakdown structures (WBS) are a

'backbone' for good estimating of costs. They go on to comment that the WBS itself is insufficient and that skilled teams with good historical knowledge are a key requirement to building reliable estimates using the WBS approach as well as monitoring costs escalations during the project implementation phase.

### 3.6.2 Level of Error in Cost Estimates

According to Andersen et al. (2016:170) the estimating of project costs is undertaking at the various phases in the lifecycle of a projects. In the early stages of concept design, the estimates are crude due to lower levels of detail hence the range of the cost estimate has a wider band of confidence. Zhang and Fan (2013:195) support the notion that the reliability of estimating improves when a greater level of technical detail becomes available in the latter phases detail design phase of the project. However, Zayed and Liu (2016:170) observe that costs estimates of mega-construction projects are well known for their uncertainty in the preparation of cost estimates in the bidding phase due to limitations of available information at the time of compiling and submitting cost estimates.

The causes of cost-overruns include imperfect forecasting technique, insufficient data, changes to scope and rework, lacking skills, planning competencies (Morris & Hough, 1987:139) while Flyvbjerg (2009:360) introduces the concept of "honest mistakes" for which decision-makers cannot be held accountable in addition to technical details alone being the reasons for the extent of overruns.

### 3.6.3 Dynamic Costs Updating

According to Zhang and Fan (2013:196), there will be differences between the planned cost estimate and the forecasted costs as additional details and compensation data becomes available as the project progress. Therefore they emphasise that the project cost estimate must be updated immediately to provide the latest estimate of the cost plan for the effective management of the projects costs.

Dey, Kinch and Ogunlana (2007: 297) expand the discussion on cost control to risks related to changes and unforeseen activities which are a certainty on large projects. They caution that the project team actively respond to such incidents for keeping costs within budgets especially when additional project funding may be at stake. Dey et al. (2007:300) further comment that the appropriate levels of resources for cost-control purposes may be at risk if

the outset the project identified budget limitations to deliver the project and restricted resource requirements.

Cheng (2014:850) asserts that mismanaging of budgets can be problematic for project cost management in situations where misaligned allocation budgets are apportioned, costs are expended too early in a project or budgets are misused for activities that are not within the project scope (Wallace, Keil & Rai, 2004: 308).

### 3.6.4 Overruns on Cost Estimates

As a project progress through its various phases, the project will often experience a dramatic increase in total cost as result of the massive underestimation of costs and schedule requirements in the early stages of a project. (Andersen et al., 2016:171). At this early stage of the project, the project cost is based on limited low levels of engineering and very little effort is put into the 'unknown risk' and contingency plans. Rosenfelt (2014:1943), reports that too many changes in requirements of the project and changes to the project definition are the key 'root causes' of cost-overruns in projects.

More than half of Malaysian construction projects had cost-overruns according to Shehu, Endut Akintoye and Holt (2014:1471) who further conclude that the open-tender method experienced 60% overruns, negotiated tender had 52% and a selective tendering method had 48% overruns. They highlight that the 'design and build' project execution method experienced the least overrun on cost.

Mega-projects according to Andersen et al. (2016:173) had overruns of 500% relative to the final execution phase. Hough (2008:189) reports that cost-overruns on more than 440 projects experienced cost-overruns in the region of 20 to 40% as well as major schedule slippages. In their study of over 2000 projects, Flyvberg and Budzier (2011:601) found that projects had overruns as high as 200% thus reducing the average to 27% cost overrun. In the transportation sector, Odeck (2014:68) found that projects experienced cost-overruns in the order of 8% and that there was an underestimation in all phases of projects. Hollmann, Bali, Germain and Kai-man (2014:156) found that projects had an overrun of between 1.24 and 1.79 when comparing the actual costs to the base costs.

### 3.6.5 Resources and Skills

The DOL (2016:3) critical skills report reveals skills shortages in project management, engineering, architecture and geology. Transnet acknowledges in its 2015 Sustainability report (Transnet, 2015:28) that there is a shortage of selected critical skills to execute its infrastructure plan. Transnet claims to have plans in place to address the issue of critical skills in via its resources development pipeline. Unfortunately, the pool of critical skills appears to be generic to various broadly-segmented functions and does not specify cost personnel. There is insufficient information available to determine whether project cost-control development is included in Transnet's development pipeline. Winch and Leiringer (2016:271) conclude that for mega-projects the remedy to control cost escalations was to "build efficient teams with good knowledge, optimise the utilisation of resources, and prioritise project activities".

### 3.6.6 Section Summary

Projects that are in control use rigorous cost estimations processes and the appropriate level of competent resources to effectively manage project costs else the project can run out of control with disastrous results. Literature presents a debate on tools and techniques for enhancing project cost control but the abundance of available data reveals that there have been massive cost overruns on a large number of projects. Projects and their reasons for cost overruns appear to be unique hence scholars will continue to investigate relevant phenomena in an attempt to curb the anticipated challenge of runaway mega-project costs.

## 3.7 QUALITY MANAGEMENT

Xiaofen (2013:423), in an investigation done on 'quality management maturity' of enterprises in Shanghai, found that most organisations would need to enhance their quality management systems substantially to remain competitive as well as maintain sustainable operations and growth. According to Burstrom and Wilson (2014:493), project teams are fragmented and it is not clear whom is responsible for to control project quality ultimately resulting in a loss of trust in the project delivery team. Failure to meet quality requirements may lead the owners and stakeholders not accepting the projects products or end results (Leite, Santoro, Cappelli; Batista & Santos, 2016:566).

### 3.7.1 Managing Quality

PMI (2013:228) indicates that all quality plans for various project activities must be known upfront at the commencement of a project which broadly include packages for design, procurement, bid evaluation, construction management commissioning and project close-out. Xiaofen (2013:423) reveals that there are gaps in the responsibilities of parties required to manage quality and there are further gaps in the integrity of quality management in enterprises. Leite et al. (2016:566) support the view that business units and project teams are fragmented and it is not clear whom is responsible to control quality. Xiaofen (2013:425) concludes that parties responsible for quality management displayed 'weak soft skills' including knowledge of quality systems and its applications through processes and systems.

Leopoulous and Chatzistelios (2014:216) explain that an absence of a quality packages may result in a dimension not having a frame of reference to measure quality and consequently resources may be overlook quality requirements. Muller, Spang and Ozcan (2009:70) highlight that failure to meet quality requirements may lead the owners and stakeholders not to accept the projects products or end result and could lead to a project disaster if major efforts are required to rectify quality requirements. An ultimate result is a loss of trust in the project delivery team.

### 3.7.2 Resourcing for Quality Control

Steger and Dirk (2010:131) state that the client wants the best quality at the lowest cost within a specified deadline however the client contractors and project teams are also constantly pushing the boundaries for their own self-interest with minimal resources while attempting to keep stakeholders satisfied. Henderson and McAdam (2006:364) relate that for agility and success in a tough market environment, organisations must have the skills and experience to exploit opportunities. In a study of road construction projects, Mahamid (2011: 616) reveals that the poor resource management and insufficient inspectors were the most sever factors contributing to road quality construction challenges in Palestine.

According to Xiaofen (2013:418), mega efforts are required by enterprises to achieve excellence in quality management. Investing in 'soft skill strength' development will redefine the benefits in quality management. Muller, Spang and Ozcan (2009:70) supports the notion that projects that are in control use an appropriate level of resources and skills coupled to the required governance to effectively keep projects under control.

### 3.7.3 Section Summary

The quality management dimension appears to rest on a shaky foundation with revelations of gaps in processes, skills and committed continued improvements. A possible explanation for this situation may be that quality management has varying intent for industries and that over time; quality practices have become deep-rooted in standard operating processes rather than keeping up with best practices required for mega-project delivery.

## 3.8 HUMAN RESOURCES

International studies conducted recently focus heavily on the project manager and its role as a leader (Ibrahim et al., 2015:313). As the leadership role places a heavy weighting on soft skills, there is growing evidence that correlate strong soft skills to improved project delivery in complex projects (McEvoy, Braby & Munck, 2016:541).

### 3.8.1 Project Teams

According to PMI (2013:37), project teams are specifically created to undertake the execution of a project which usually is a temporary endeavour as projects usually have specific start and finish dates. PMI indicates that it is very seldom that a project team outlives the project, which simply put, is an indication that the team that started with the project will undergo changes in the individuals that make up the project team. Graham and Englund (2008:110) indicate that core teams are set up consisting of dedicated experienced specialist individuals from the various work package disciplines. These discipline specialists direct the work of other team members and they are empowered to provide the necessary guidance and expert advice to channel the project to achieve goals. While other team members may ‘come and go’, Merrow (2011:180) advises that the core project team should remain stable and grounded to the project to in order to ensure project success else project management problems will continue to manifest itself. Berg and Karlsen (2014:451) reveal that members of the project team often work under tremendous pressure, conflict, sometimes unclear roles and a grey line between line manager and owner. This situation causes burnout, conflict and high turnover in team members.

### 3.8.2 Skill Sets

IPMA (2006:9) describes competence as ‘a collection of knowledge, personal attitudes, skills and the relevant experience’ required to successfully carrying out a function. These

competencies operate at three levels namely technical level, behavioural level and at the contextual level. While Langer, Slaughter and Mukhopadhyay (2008:24), in a study conducted in the IT sector assessing the impact of project managers skills, found that in high complexity projects having large teams, project execution can be improved when team members and leaders both demonstrate high-level in both 'hard' skills (technical, general) and 'soft' skills (tacit, non-technical). The study also found that soft skills has a significant impact on client satisfaction as well as moderating the 'negative impacts of project complexity' as a result of improved coordination within the project. Langer et al. (2008:24) further revealed that soft skills did not necessarily improve cost performance but that hard skills showed significant improvement in cost drivers.

In a study involving 112 project managers in complex construction projects in China, Zang and Fan (2013:205) argue that there is a strong correlation between a project manager's emotional intelligence (EI) and project performance. The study indicated that the supportive EI factors include, organisational awareness, empathy, cultural understanding, self-control and self-confidence. Zang and Fan (2013:207) recommend that project managers with 'high cultural understanding and adaptability' be deployed to international projects while project managers with 'good organizational awareness' be retained for domestic projects. Another recommendation was that cost-plus contracts be allocated to project managers with high levels of empathy and project managers with high levels of inspirational leaders be allocated to unit price contracts.

### 3.8.3 Impacts of Skills on Performance

Human resource risks are regularly cited as a key reason for project failures (Han & Huang, 2007:46). These risks arise as a result of insufficient team of skilled personnel available to deliver the project requirements (Keil, Matthiassen & Zheng., 2006:156); poor estimation of man-hour requirements with a result overtime on staff (Kim & Park 2006:412); high staff turnover rate with a resulting loss of intellectual knowledge and learning time hence project delays; and the reliance on a selected person or a few selected people which puts the project at risk if the individuals are demobilised or leave the project (Schmigt, Lyytinen, Keil & Cule, 2001: 26).

Wallace, Keil and Rai (2004: 302) support the view that the weakness in developing an appropriate team size with the relevant skills can result in issues such as unbalanced workload on disciplines, insufficient time for training and continuous professional

development and failure to provide team motivation which subsequently results in poor team performance.

### 3.8.4 Experience Levels for Mega-Projects

IPMA (2006:6) describes competence as "a collection of knowledge, personal attitudes, skills and the relevant experience required to successfully carry out a function". These competencies operate at three levels namely technical, behavioural and contextual levels. Competence is compromised when either one or a combination of knowledge, attitude or experience is limited. Shahtaheri, Haas and Salimi (2017:40) further argues that in an organisation's commitment to delivering successful complex large projects, experienced and competent personnel must be mobilised to ensure desired investment outcomes. Tavana, Abtahi and Khalili-Damghani (2014:1830) go on to further illustrate that the public sector struggles to find a balance between measuring and managing intellectual capital, where intellectual capital is a sum of experience, knowledge, information, intellectual property and other intellectual resources.

### 3.8.5 Supplementing Internal Organisational Skill Sets

Engineering Procurement and Construction Management (EPCM) contractors are large external contracting parties located internationally and more recently in South Africa that focus on mega-project execution on behalf of project owners (Hatch Mott MacDonald and Fluor, 2016: n.p). EPCMs have access to both local and international resources in assembling a project team that is best suited in executing mega-projects. As part of the bidding process for EPCM appointments, a major requirement for bid evaluation is the submission made by EPCMs of CVs containing the competency and experience levels of personnel that will be mobilised for execution of the project under consideration. Nersheim and Smith (2015: 255) indicate that project execution, being a temporary task with a "high degree of uniqueness" implies that the local parties should consider a hybrid of local skills intertwined with external short-term contracts. However, Ibrahim and Wilkinson (2015: 313) caution that any ambiguity about the authority in the project team may lead to power struggles, trust issues and poor levels of collaboration.

### 3.8.6 Transnet's Response to Skills Development

Transnet presents in its 2015 Sustainability Report that there is a shortage of selected critical skills (Transnet, 2015:28). Transnet indicates that it has plans in place to address the issue

of critical skills in its resources development pipeline. Unfortunately, the pool of critical skills appears to be generic to various, broadly-segmented functions and does not specify the functional area of concern There is insufficient information available to determine exactly which functional are within the project management division is facing a skills problem.

#### 3.8.6.1 Transnet management's approach to employment equity

Transnet's most material issue with respect to transformation is increasing representation of black employees, female employees and people with disabilities (Transnet, 2015:44). The main outcome that Transnet aims to achieve is the appointment of skilled, technical, professional and managerial posts that reflects the country's racial, gender and disability profile. Transnet's Employment Equity (EE) Policy is aligned to the Employment Equity Act (55 of 1998) and confirms the company's commitment to the elimination of unfair discrimination and the implementation of affirmative action measures to achieve a workforce that represents the national, economically-active population of South Africa across the occupation levels. Transnet asserts that it adheres to the Promotion of Equality and Prevention of Unfair Discrimination Act (4 of 2000), the Labour Relations Act (65 of 1995) and the Skills Development Act (97 of 1998). There is ongoing revision of the EE Policy to include a preference for designated groups.

#### 3.8.6.2 Skills development in Transnet

Transnet responds to the broader skills development challenges of the country by ensuring training plans are responsive to the critical skills requirements (specifically engineering skills and artisans) of the economy (Transnet, 2015:16). Transnet indicates that annual training plans are drafted in consultation with recognised trade unions of operating divisions and corporate centre structures in line with the requirements of the Skills Development Act (97 of 1998). These are submitted to the Transport Education Training Authority for approval and monitoring in order to process training grants.

Transnet's human capital strategy (Transnet, 2015:17) is responding to the skills shortage experienced in the economy and the company through the following initiatives:

**a. Strategic workforce planning:**

"Strategic workforce planning is undertaken to continually analyse business needs, skills requirement and gaps. To ensure accurate identification of the right skills to be developed, a

stringent engagement process is embarked upon involving line managers. This is enhanced by collating information from employee development plans. Strategic workforce planning involves skills clustering, demand simulation, simulation, supply simulation gap analysis, initiatives and anchoring."

"Feeder training pipelines have been established for critical skills categories including: artisans, technicians, engineers, and sector-specific and protection officers. The Youth Development strategy is aligned to the feeder pipelines. The feeder pipelines also provide the focus for student financial assistance, internships, leaderships, apprenticeships, sponsorships, career guidance, various graduate programmes, coaching and mentorships."

**b. The Transnet Academy:**

- "The School of Rail focuses on sector-specific training including train driving, yard operations, train control operations and track operations. Refresher and relicensing training takes place regularly to ensure compliance with current regulatory requirements.
- The School of Engineering delivers apprenticeship programmes in 27 trades.
- The Maritime School of Excellence focuses on sector-specific training in the ports and marine disciplines such as pilot, tug masters, marine engineering, dredge masters, skippers and master operations.
- The School of Pipelines trains artisans in the pipeline environment.
- The School of Security delivers the protection officers skills programme to unemployed youth.
- The School of Leadership focuses on supervisory, managerial and leadership training in the Operating Divisions, spanning from entry to executive levels."

### 3.8.7 Section Summary

The arguments presented by scholars reveal the need for the relevant skillsets and competencies to be available to undertake the execution of projects. However, the arguments are inconclusive that the current state of skill shortages are negatively affecting the delivery of mega-projects in South Africa and TCP, in particular. Scholars reveal that indeed international mega-projects suffer setbacks when personnel ccompetence is compromised through limitations in either one or a combination of knowledge, attitude or experience.

Literature further reveals that EPCM teams with international exposure and experience in are mega-projects are available to support the resources shortages in owner project teams.

## 3.9 COMMUNICATIONS

According to Zick and Anderson (2014:788), the goal and purpose of communications is to send clear and unambiguous information to its recipients. In a study of dialogue, Chiocchio, Grenier, O'Neill, Savaria and Williams (2012:35) found that there was a high rate of messages exchanged between high performing project teams and stakeholders. They assert that listening skills, effective questioning and providing feedback constitute the most important competencies in communicating effectively. However, Zick and Anderson (2014:789) found that 80% of project managers focus heavily on communication as pure transmission instead deeper consideration of 'constitutive' content of communication Hossain, (2009:25) asserts that the most important strength of the project manager is the ability to obtain buy-in through influence, negotiation and persuasion thus impacting the progress of tasks towards completion under the prevailing set of conditions. The author expounds further that a positive relationship between 'positive meaning and leadership' encourages members to own the project's vision and increases the effectiveness of working towards attaining the project's goals.

### 3.9.1 Impacts of Communication in Projects

Katz (1982:88) found that the poor communication had a negative impact on team performance and stakeholder management. Pinto (1990:209) indicates that high performing teams cooperate better than low performing teams whether communication takes place via formal or informal channels. Henderson (2008:58) further iterates that there is a relationship between contracting parties and communications. Project managers that possess a strength in information-sharing among team members indirectly increased the performance of the team. Taylor and Cooren (1997:435) recommend that communication be used as a tool to create, refocus and assist the project with changes as it progresses in its journey to completion.

### 3.9.2 Responsibility to develop a Communications Plan

Chiocchio et al. (2012:25) posits that the latent complexity coupled with high stakes in time-sensitive mega-projects requires an appropriately-detailed communications plan that

responds effectively to the project management demands of mega-projects. Brill, Bishop and Walker (2006:120) supports the view that projects require detailed communications plans for the extensive stakeholder management required in mega-projects. He further states that it is the duty of project managers that have the relevant competencies to develop a detailed communications plans. Steger and Dirk (2010:131) go further to state that project managers are expected to be strategists and tacticians between the planning of communications and the actual interaction with stakeholders.

Smulowits and Ziek (2012:28) found that there were many available tools and strategies for communications but successful teams were selective in the tools and strategies used for communications and ultimate project success (Henderson & Stackman, 2010:50).

### 3.9.3 Communications beyond the Internal Team

Brill et al. (2006:129) assert that project managers need to be competent and effective in communicating with the owner, project team, and stakeholders. According to Soderlund (2011:160), inadequate communications between stakeholders is detrimental and leads to project failure. Chiocchio et al. (2012:36) found that a high number of messages exchanged between the owner teams and the contracting teams provides evidence of maturity in the relationship which ultimately leads to project success.

Parker, Kunde and Zeppetella (2017:149) maintain that stakeholder relationships can be improved by using communication skills, commitment and reliable behaviour. Smulowits and Ziek (2012:28) explain that common goals and milestones can be easily achieved in a trusting communication and sincerity which are important building blocks for maintaining well-functioning relations in business. They further assert that good relationships build trust in stakeholders and trust is reciprocal. In reciprocating this view, Chiocchio et al. (2012:36) warns that strong relationships can easily be lost when major challenges occur in projects and communications fall apart.

### 3.9.4 Section Summary

Scholars place emphasis on selected relevant benefits and issues associated with communications in project execution. One of the critical communications platforms in project management is the project progress meetings. At the progress meetings, important project performance measures such as scope, cost and schedule management are communicated, deliberated and necessary further actions are determined. There appears to

be gaps in literature on the effectiveness of project meetings as well as the performance of stakeholder meetings. These gaps may hold potentially creative solutions to enhancing communications with stakeholders by measuring and managing project performance for successful outcomes.

## 3.10 RISK MANAGEMENT

Complex mega-projects by their nature are accompanied by many unknown risks (Piperca & Floricel, 2012:248). The authors comment further that while some risks are predictable, others are difficult, but risks, in general, tend to be underestimated by project managers. Thuyet, Ogunlana and Dey (2007:175) expound further by stating that some of the project risks are beyond project control, for example, bureaucracy and lengthy approval processes. On the other hand, Didraga (2013:89) accepts that there are major controllable risks on projects that can be mitigated including risks arising from poor designs, incompetent teams and late approvals from the owner. Piperca and Floricel (2012:251) support this view and argue that teams need to build the capacity to respond to these risks should they materialise in an event.

### 3.10.1 Risk Management Planning

According to PMI (2013:321), risk management planning is undertaken in the early phases of the project. This risk management plan incorporates the development of project risk plans, identification of risks, undertaking risk analysis on qualitative and quantitative risks and development risk response plan. Huang and Hans (2008:177) follow a similar approach when they highlight that risks need to be quantified, and that their impact on performance of the project must be evaluated together with the development of strategies of control. Moreover, the view of Hubbard (2009:148) is that "risk management is the identification, assessment and prioritisation of risks followed by effective and efficient resource application to maximise the realisation of opportunities and reduce, control and monitor the likelihood and /or impact of events".

### 3.10.2 Project Risk Approaches

Didraga (2013:89) states that there are numerous project risk management approaches in literature. De Bakker et al. (2009:499) argue that the management approach focuses on identifying specific events and situations in projects that have a bearing on the original plan and developing measures for keeping the current projects on track. The contingency approach to risk management in projects consider its success to be reliant on the extent to which the project is capable of dealing with uncertainties in the project environment (Jun, Quizhen & Qingguo, 2011:931). However, Hans and Huang (2007:47) advocate that, according to the evaluation approach, having knowledge of the risk means that they can and will be managed. The evaluation approach focuses on finding project risk factors as opposed to determining how to manage risks.

### 3.10.3 Tools and Processes for Risk Management

Risk management processes are iterative and are undertaken throughout the lifecycle of the project (Brandas, Didraga & Bibu, 2012:149). This process involves risk identifications, assessment and response planning. Ramos and Mota (2014:350) found that a large number of organisations have invested huge amounts of funding in risk management tools and systems but failures due to risk manifestations continue to occur. This view is supported by Javani and Rwelamita (2016:389) who maintain that risk management is a crucial cornerstone for project success. However, while adopting the best risk management processes and tools, project managers continue to be challenged by failures in managing risks.

### 3.10.4 Risk Identification

The risk identification process consists of identifying and documenting potential project risk events throughout the lifecycle of the project since new risks might become evident as the project progresses (Richardson, 2010:134). Susser (2012:45) further points out that the identification process of project risks entails continuous and repetitive effort in the identifications, measurement and documentation of mega-project risks. However, identifying risks related to the implementation of mega-projects can become significantly challenging for project managers as there are various ways to describe and categorise them (Baccarini, Salm & Love, 2004:290).

In order to manage project risks, Kwak and Stroddard (2004:917) recommend the implementation formal risk management processes. In addition, Richardson (2010:135) highlights that this process needs to be proactive throughout the project lifecycle in order to remain effective.

### 3.10.5 Risk Assessment

According to Susser (2012:46), a qualitative or quantitative approach can be used during the risk assessment process and the process must fulfil the requirements of establishing time-frames, likelihood and impact of each risk. However, Besner and Hobbs (2006:38) suggest that quantitative risk analysis is not considered useful since risk in mega-projects are not based on probabilistic analysis whereas qualitative analysis introduces an impact matrix analysis which is useful for ranking identified risks using a predetermined scale. Richardson (2010:135) further articulates that additional tools and techniques can be used during quantification analysis namely: decision tree analysis, modelling and simulation, sensitivity analysis. Schwalbe (2011:29) claims that the application of knowledge and skills to the risk tools are one of the most critical requirements for risk management in mega-projects. However Fuller, Valacich and George (2008:176) maintain that projects are bound to fail if the correct set of knowledge is applied to the incorrect phase of the project. The authors advocate that practical issues facing the project team are the inconsistencies in the approach to risk identification and mitigations.

### 3.10.6 Risk Response Planning and Monitoring

Susser (2012:45) advocates that responding to risk helps project managers to develop procedures and processes to migrate the defined risks to allow them to keep track of such risks occurring in the project and to implement risk response plans. According to PMI (2013:311), response planning involves developing responses to known risks, thus enhancing opportunities and reducing threats to project objectives.

According to Richardson (2010:139) risk monitoring involves ongoing management activities for project risks whereby identified risks on the risk plan can be managed easily. Richardson however warns that new risks during the project lifecycle have to be processed and that activities related to the monitoring and control process often results in plan changes and updates but if conducted properly, this process will improve the likelihood of project success. Taylor, Artman and Woelfer (2008:20) highlight that it is difficult to anticipate

certain threats especially if the size and impact cannot be accurately estimated. They caution further that it is particularly challenging in terms of the response action if the project team has not undertaken a full risk assessment at the beginning of the project and there have been no updates were made to the risk plan.

### 3.10.7 Section Summary

Literature presents numerous views on risk management processes and uncertainties which if ineffectively managed can lead to project disaster and failure. However, there appears to be scholars not to have extensively addressed the following critical risk management factors:

- quantum of risks facing mega-projects;
- the ability of project teams to manage all risks;
- the association mega-project complexity and related risk profiles;
- the adequacy of risk models for utilisation on mega-projects.

## 3.11 CONTRACTS AND PROCUREMENT PROCESSES

Hansen, Zhang and Ahmed-Kristensen (2013:154) explains that project management in the current era is characterised by a group of dedicated people in a temporary arrangement committed to the delivery of very large projects usually within tight timelines however processes and timelines can be jeopardised with contractual matters. Dada (2012:74) further explains that the construction industry plays a key role in infrastructure development but contractors are often faced with "a maze of procurement paths". Dada raises a concern that "complex procurement is one where the specification is complex or difficult to describe to bidders" yet contractors are expected to price and execute the works.

Bogus, Migliaccio and Jin. (2013: 198) indicate that there are several factors influencing the performance of a contract, the most influential of which is the procurement processes. Multi-parties in large complex mega-projects demand more from all dimensions or else the impacts will be felt on the project's delivery. Kamminga (2014:127) illustrates that within the complexity of large projects, there may be many issues arising from the temptation of "opportunistic behaviour" by contractors.

### 3.11.1 Public Sector Procurement

Yeow and Edler (2012:487) indicate that traditional buying in the public sector is very different from the complexity and demands for large project procurement. Procurement

involves complex processes which are complicated even further as it must comply with multiple policies and objectives (Lavikka, Smeds & Jaatinen, 2015:207). Furthermore, procurement in the public sector is driven by budgets and legislative requirements and procedures that are stringent and involve a hierarchy of levels of approval (Yeow & Edler, 2012:490).

However, Gosling, Naim and Towill (2009:102) articulate that project management techniques for procurement management in the public sector is not new as many large projects have been undertaken in the past; an example of this is procurement in the defence force. The author expounds further that large projects funded by public departments require unique processes that are driven by distinctive methodologies and techniques.

### 3.11.2 Transnet's Broad-Based Black Economic Empowerment Policy (B-BBEE)

Transnet (2017:83) indicates that it has a broad-based black empowerment policy and its strategy is to ensure that a uniform message is understood throughout the company and consistency in the application of B-BBEE Act (5 of 2003). Under the policy, preferential procurement is advocated whereby bids (tenders) are not only awarded on technical specifications and price but also on a prescribed point of system where preference is given to historically disadvantaged individuals. Transnet reports that it aims to increase representation of the representation of the following groups: African (as per the DTI Code of Practice definition), females and people with disabilities.

### 3.11.3 Procurement Time-Frames

According to Held (2010:369), delays in procurement disrupt the entire project schedule and sets mega-projects up for cost risks with the result that project management is forced to compress schedules to still make the end date. Bogus et al. (2013:182) in their study of building, industrial and transportation projects indicate that whichever contracting method is used to deliver projects, the procurement of design services and construction can be a lengthy process especially for public entities.

In complex mega-projects where the business-case investments require specific thresholds, the entire supply chain and its networks are required to be efficiently coordinated and managed to minimise project timelines (Mello & Strandhagen, 2011:261). According to Bogus et al. (2013: 182) there are various methods of procuring services for project delivery but in the traditional execution of projects, the phases of design and construction are two

separate processes. PMBOK (2013:370) suggests that procurement should be a strategy at the organisational level and that procurement should be executed using project management techniques to deliver efficiencies.

### 3.11.4 Transnet Contracts

Transnet indicates the use of the New Engineering Contract 3 (NEC3) suite of contracts for contracting with suppliers and contractors (Transnet RFP, 2016:1). The NEC3 suite of contracts consists of various contract specifically designed for specialist contracting requirements (NEC 2016, n.p). Within the NEC3 contract, there are various options that are available to specifically address compensation for the services provided; that is, lump-sum, activity-based or time-based. In reviewing the NEC guidelines, it is clear that one of the fundamental principles of NEC3 is a win-win, fair approach to contracting. Clause 10.1 states that "mutual trust and respect" is needed between contracting parties.

Apart from the contract as a legal binding document, the interpretation and execution of the contract can be critical to project delivery while the relationship in large projects can add further complexity (Kamminga, 2014:125). Moreover, Redon (2013:182) asserts that unreasonably demanding contracting managers can be contributors to overruns on costs and schedules He expands this notion to explain that contracts as drivers of governance, technical requirements and delivery of goods and services are limited, may not support cooperation among parties and may lead to conflict.

### 3.11.5 Owner's Bid Specifications

Urschitz (2014:675) explains that the owner wants the construction completed as quickly as possible with the lowest risk after funding is approved and that the key to success is that the owner's team must develop clear justifiable procurement process. Bogus et al. (2013:186) further elaborate that significant effort is required upfront by the owner in defining its vision and its requirements for contractors to prepare a strong bid.

Generally, owner's requirements may be sparse in their definition thus challenging the contractor's execution plan and proposal (Pilbeam et al., 2012:358). The result is that the contractor submits a proposal that presents risk and uncertainty while cost overruns may be minimised if sufficient design and cost estimates are done before the construction processes commence. (Bogus et al., 2013:186).

In organisations where large complex assets are acquired, there is much emphasis placed on specifications in the contract by the client to ensure that a contractor can manage construction and delivery of the asset (Pilbeam et al. 2012:358). Expanding on this view of client specifications, Arthur and Kennedy (2014:27) advocate that the specification usually focuses on capacity and capability, but little emphasis is placed on assuring that the assets will perform within quantifiable confidence levels to meet the expectations of the end user (operator) during the life of the asset. The authors conclude that there is a conflict within the organisation, i.e. the project team procuring and delivering the asset, and the end user.

### 3.11.6 Approaches to Contractor Selection

Clients have many choices on the method of procurement but decisions are made based on various factors which may include time, risk, costs, quality and legal requirements (Dada 2012:69). He indicates that the fastest-growing procurement strategy is the design and build (DB) method. Bogus et al. (2013:209) is aligned to this view and indicate that the procurement of DB contractor could be the key to the success of a project. They found that projects with longer procurement duration there were smaller growths in schedule, primarily as a result of a two-stage approach to procurement. The two-stage approach involved the prequalification of bidders in stage 1 and the interrogation of the selected bid in stage 2 prior to award.

Urschitz (2014:677) explains that in the case of a mega tunnel project, the agreed procurement strategy adopted was for the owner to procure the tunnel boring machine (TBM) as an early, long-lead item to reduce the overall project duration. In this case, Urschitz expounds that the procuring of the construction contractor was for labour only since this method of procurement is typically used by clients who want to reduce the risk of tender bids that are over-optimistic and to reduce construction risk. A further requirement of the procurement strategy was to involve the contractor upfront in the selection of the TBM as an approach to agreeing on operations, breakdown and repairs of the TBM and to reduce any potential conflict in the construction stage.

### 3.11.7 Managing Contractors

The procurement and contracting approach based on a client and contractor (2 party system) with a contract awarded at the lowest price can be an obstacle to effective integration (Apooja et al., 2013:701), thus limiting a cooperative and collaborative approach to efficient

delivery of mega-projects (Ibrahim et al., 2015:310). Therefore, the management of contractor's teams plays a key role in achieving the projects schedule performance (Apooja et al., 2013:715). Expanding on this concept, Heidemann and Gehbauer (2011:19) expound that a sound relationship between the client and contractor teams is a winning formula for project success. Clause 10.1 of the NEC3 contract (NEC3, 2016: np) supports this approach and emphasises that the essence of the NEC3 is that the parties engage in a spirit of "mutual trust and cooperation" (NEC3, 2016: n.p). The NEC3 contract advocates that it aims to resolve disputes and to resolve opposition to cooperation.

Davis and Love (2011:444) explain that the sharing of knowledge and problem-solving can be enhanced with the co-location of project teams by improving social integration, networking and information-sharing thus reducing the costs of additional coordination. Muller, Spang and Ozion (2009:82) maintain that there are several factors influencing the performance of a contract, and maintain that the owner requirements on completion, delay damages and an incentive scheme for completing early also impact project schedules.

### 3.11.8 Client-Contractor Conflicts

Client issues are seen to play a significant role in delays in mega-construction projects in the UAE (Motaleb & Kishk, 2010:1150). Amoatey, Ameyaw, Adaka and Famiyeh. (2015:198) observed that client and contractor conflict coupled with frequent price changes are common factors in project delivery delays in developing countries. Some of the critical delays in major construction projects involve waiting for the client representatives to approve variations while the contractor incurs large standing-costs. Heidemann and Gehbauer (2011:19) add that conflict can linked to poor management of scope changes in projects and is one of '20 causes of non-excusable' delays in construction.

Dossick and Neff (2011:83) focus on the 'soft' issues revealed that collaborative working and joint problem-solving can be hindered by organisational and cultural boundaries. Zuo et al. (2014:805) found that culture plays a crucial role in achieving harmony among project teams with a resultant improvement in schedule and overall project performance. They add that when working on mega-projects, project managers need to understand the differences in organisational culture and the approach to decision-making among the project teams in an attempt to minimise potential friction and enhance outputs.

### 3.11.9 Section Summary

The latest thinking of scholars is that a collaborative and cooperative approach in contract arrangements can be beneficial to project success. Scholars also caution that conflict between contracting parties can be a stumbling block project success, although modern contract agreements have been enhanced to address matters such as mutual trust, fairness and sound relationships. There appears to be issues in mega-projects that have not received the relevant attention in in the limited literature of procurement and contract management. Some of the unattended issues include: impacts of long procurement processes, BEE transformation in mega-projects, and contract administration in complex mega-projects.

## 3.12 STAKEHOLDER MANAGEMENT

According to PMBOK (2013:23), stakeholders can be defined as "a person or organisations such as customers, sponsors, the performing organisation or the public, who are actively involved in the project, or whose interest may be positively or negatively affected by the performance or completion of the project". Stakeholders can be divided into two main groups consisting of internal and external stakeholders (Aaltonen, Kujala & Oijala, 2008:514). Cova and Salle (2005:357) define internal and external stakeholders as:

- **Internal stakeholders**: This group of stakeholders consists of formally-appointed members of the project team or coalition-team responsible for execution of the project. They may also be referred to as primary stakeholders

- **External stakeholders:** This group of stakeholders are non-business stakeholders that may be affected by the project. They are not formally-appointed members of the project.

### 3.12.1 Understanding the Requirements of External Stakeholders

In the early project stages, it is difficult to understand the viewpoints and requirements of all stakeholders as scope definition and detail is at a conceptual level. (Culmsee & Awati, 2012:528). These levels of stakeholder responsibility and authority can vary or change during the various lifecycle stages of a project (Eskerod & Huemann, 2013:37). While the project team works its way through the various phases of the project, the team needs to build trust, strengthen communication and demonstrate integrity with stakeholders (Loi, 2016:148). Identifying and involving stakeholders at the early stages will enhance the

definition of the project scope and provide completeness of the project deliverables (Minoja, 2012: 67).

Mega-projects attract a lot of attention from media and interest from the public especially in the project construction phase (Xie, Yang, Hu & Chan, 2014:226). Misunderstanding the requirements of stakeholders can lead to dire consequences which include major execution changes and even abandonment of major projects (Windapo & Goulding, 2013:430). The importance of government departments in enabling projects and supporting mega-project development is highlighted by Aarseth, Rolstadas and Andersen (2013:121). They advocate that the obligation of government is to promote economic development while still maintaining its legal obligations and protecting society in order to achieve the milestones in the project and achieve common stakeholder goals.

### 3.12.2 Managing and Measuring Stakeholder Expectations

Doloi (2012:531) asserts that in major infrastructure development, society plays a major role in defining sustainability for long-term integrated development. (Loi, 2016:14) explains that society and communities measure the benefits of developments in terms of various aspects including job creation, economic growth, and balance in the environment therefore it is important for mega-projects to measure these benefits and disseminate this information constantly to communities. According to PMBOK (2013:36), the project communications management plan should involve five stages, namely: "Identify stakeholders, plan communication with stakeholders, distribute information, manage stakeholders' expectations and report performance".

Project managers should take into account stakeholders' needs and requirements in order to achieve success in the project.

Longoni and Cagliano (2015:220) advocate that the transformation process for implementing sustainable development project is linked to adequate support being provided. The development plan is a major key to enhancing management capacity for encouraging community participation and developing infrastructure projects (Walley 2013: 499). The system needs to combine area-based conditions and appropriate knowledge and technology for doing various tasks and has to be strengthened. Satterthwaite (2013: 59) states that local authorities and public organisations play a vital role in facilitating sustainable development processes to directly intervene in making a plan with a variety of functions. Eskerod and

Huemann 2013:40) caution that mega-project development requires appropriate strategies, that is aligned to respond to any call for help among competing pressures for economic development, environmental protection, a more equitable society. (Lee & Chan, 2009:526) respond that the integration of environmental aspects, skill and expertise of stakeholders, a pragmatic approach to self-governance and the role of community management are instruments that help achieve success in mega-project development. Doloi (2012:532) recommends the social network analysis as a tool to measure stakeholder management and performance. This methodology uses the two-step approach:

1. Identifies all stakeholders according to their roles in the project and their relationships in the project.

2. Measures the impact of stakeholders and their levels of satisfaction.

### 3.12.3 The Impacts of Project Culture on Stakeholders

According to Zuo, Zillant and Xia (2014:803), project culture is defined as the shared value, basic assumptions and beliefs that the participants involved in a project hold that determine the way they process the project and the relationship with each other in the project environment. Love, Edwards, Ozorhon, Arditi, Dikmen and Birgonul (2008:365) further articulate that national and inter-cultural differences influence various aspects of construction projects such as stakeholder management, communication and risk management. Love and Irani (2011:197) found that project culture plays an important role in the management practices in the construction industry and that culture is a catalyst for affectively developing, implementing and maintaining quality management in an organisation. Ankrah, Proverbs and Debrah (2009:35) add that the project culture is affected by a number of factors such as project scale, level of complexity and priority assigned to cost, health and safety. Adding to the complexity of this issue they assert that there are polarised inter-professional culture perspectives of construction project participants.

Heeroma, Melissen and Strierand (2012:272) assert that it is the project manager's responsibility to shape the project culture by merging cultures of various organisations and professions to facilitate knowledge transfer. This view is also supported by Suhonen and Passivaara (2011:11) who state that project culture plays a critical role in developing human capital such as occupational health and interaction between project participants. Xie et al. (2014:823), project culture plays a vital role in achieving harmonious relationships among

project participants and hence leads to satisfactory project outcomes. Therefore, as related by Xia, it is imperative to develop and nurture a project culture that will foster collaborative relationships among participating parties and improve project performance.

### 3.12.4 Stakeholder Management in Transnet

Transnet's stakeholder engagement policy, adopted by the Transnet's Board in November (Transnet, 2014:24) defines stakeholders as a person or group of people who are directly or indirectly affected by Transnet, including those who may have interests in Transnet's business activities and or the ability to influence Transnet's business outcome, either positively or negatively. Transnet's explains that stakeholder engagement forms an integral part of Transnet's value creation. Transnet's asserts that its most material stakeholders are shareholders (Ministry of Public Enterprises), customers, employees, investors, suppliers, organised-labour, communities, regulators, national government, provincial government, local government, non-governmental organisations, media, academia and scientific institutions and international bodies.

Transnet's engagement with its stakeholders is an integral part of the daily execution of its business activities and implementation of the MDS (Transnet, 2016:101). Issues, expectations and concerns from stakeholders are tracked to identify their most salient issues arising from business engagements, providing TCP the relevant platform from which to respond. Transnet identifies, maps and prioritises its substantial stakeholders based on:

- The effect each stakeholder has on Transnet's ability to successfully implement strategies and achieve its objectives.
- The effect and impacts of Transnet's activities, services and products on stakeholders.
- According to Transnet (2015:21), Transnet's stakeholder engagement policy and process control framework allows for systematic annual identification, annual planning, engagement-monitoring and regular reporting on engagements with stakeholders. Transnet's stakeholder management plan consists of:
    - Appointment of stakeholder relationship owners per material stakeholder group;
    - Development of an annual stakeholder engagement plan for each material stakeholder group;

- Recording salient issues from engagements; and reporting on material issues arising from engagements.

- During 2015, a stakeholder engagement database was developed to capture information on material stakeholders, engagements and responses.

### 3.12.5 Section Summary

Scholars provide valuable views on the critical role that stakeholders play in the project delivery processes. There appears to be however several gaps that practically affect mega-project delivery and may be challenges affecting performance. These gaps revolve around the following aspects:

- Adequacy of resources for stakeholder management
- Impact of community stoppages and costs on mega-projects
- Community job creation performance

## 3.13 CHAPTER SUMMARY

A detailed review and evaluation of all the project management dimensions pertaining to the research questions were undertaken in this chapter. Related literature, practices and gaps were explored, analysed, documented and reported to explain the phenomenon related to the research problem and objectives.

Most scholastic literature was found to originate from developed western nations although over the past decade there is increasing new literature and data emanating from developing nations in the Far and Middle East. Literature originating from the African continent and the locally in South Africa projects is extremely sparse and rarely related to mega-projects. The evaluations, synthesis and gaps in literature were eventually utilised to develop the research instrument for undertaking the quantitative data collection for this study focusing on understanding the challenges facing the delivery of mega-projects in Transnet Capital.

Arising from the literature review, it is evident that the initiations and integration processes in mega-projects is an important first step in getting the project started. In doing so, user and stakeholder requirements are critical data for the project team to understand the project delivery expectations and for the project team to produce an appropriate plan for achieving the objectives of the mega-project. However, the literature review indicates that is a

challenge to identify all stakeholders and further understand their needs and expectations. It is a further challenge to anchor the owner's requirements for the mega-projects.

Scope development and definition is an ongoing process that is refined thorough the projects lifecycles stages. The owner's role in defining the mega-project scope is a key factor for a refined scope definition. Incomplete scope definition or changes to a mega-project's scope often leads to disastrous cost and schedule results. The rapid advance of technologies applied in mega-projects is a challenge to maintain a steady scope. Mega-projects have a negative track record of not meeting planned schedule requirements with negative impacts on mega-project costs. The pressure on project teams to accelerate schedules beyond realistic timelines to meet business investment requirements often meets with results that are contrary to the initial notion of acceleration. Mega-projects require skilled and experience schedulers to fulfil the role profile within the project's execution team.

There is strong evidence in the literature review of international mega-projects that there is a high probability that mega-projects will incur cost overruns. Even with the best tools, techniques and processes, mega-projects continue to be challenged to preserve planned costs. A recurring feature of breaching planned investment cost appears to be related to changes in the execution of mega-projects and the skills of cost controllers appointed to mega-projects is questionable.

A detailed evaluation of skills, experience and team dynamics of mega-project personnel was presented and benchmarked against the IMPA ICB3 framework for competency. It is evident that the availability of resources is a challenge in the local and international industries. Furthermore, negative team dynamics among the owner's team, EPCM team and the construction contractor's teams can lead to detrimental impacts on the delivery of mega-projects. Many organisations face challenges in their levels of maturity in quality management. The efforts towards quality management tools, processes and personnel development appears to be limited hence displaying several gaps in the execution of projects.

Communicating planning and the timeous dissemination of information plays an important role in time-sensitive mega-projects. Literature reveals that poor communication can produce negative impacts on the efficiencies of project delivery. In the management of project risks, it is evident that tools and processes are insufficient alone to produce proactive mitigation of risks and literature points to the gaps in approaching risk management as a key element to be addressed.

Procurement timelines in public entities can be challenging in reducing project schedules. Further challenges in contract management can lead to conflict between contracting parties with a consequent impact on project delays. Literature indicates that a collaborative approach focusing on soft skill skills such as attitudes and behaviours may be the key attributes for successful project execution. Literature further indicates that stakeholder management is a beneficial space to intensify project efforts in order to deliver project expectations. Transnet is aligned to this philosophy of actively engaging internal and external stakeholders to maximise its benefits in delivering mega-projects. The next chapter discusses the research methodology used in the study.

# CHAPTER 4:
# RESEARCH METHODOLOGY

## 4.1 INTRODUCTION

The preceding chapters dealt with the introduction to the research, an overview of the global and South African mega-project industry and a comprehensive literature review underpinning the theory of the study. This chapter focuses and reports on the research paradigm, strategy and design of the research study. It outlines the methodology and provides a description of the techniques adopted in the design of the research. The target population is described and the sampling technique is illustrated. The design of the research instrument is elaborated for the quantitative data collection. Additionally, the procedures for the statistical data analysis are described and expounded. The chapter goes further to explain the concepts of reliability and validity and the approach adopted to embed these into the study. The issue of bias is explained and the further discussion is provided on eliminating bias in this study. The chapter concludes with a review of good ethical practices that have been incorporated in conducting the study.

## 4.2 RESEARCH QUESTION AND HYPOTHESES

The main research question for this study is: "What are the critical challenges affecting the delivery of mega-projects is TCP?" To systematically unpack and clearly understand the challenges facing mega-project delivery at TCP, empirical data were analysed to provide explanations to the following sub-questions:

- How are the projects processes integrated?
- To what extent is the scope of projects clearly defined, managed and updated?
- To what extent are projects completed on time?
- Why are there cost overruns on projects?
- How are projects achieving their quality requirements?
- How are human resources allocated to projects?
- How are communications disseminated at the various levels of the project?
- To what degree are project risks continually identified and managed?
- How are procurement processes affecting the project delivery?
- To what extent is stakeholder management impacting on mega-projects?

The following 21 hypotheses were tested to establish any significant correlations between the various constructs:

$H_{01}$: There is no statistically significant difference in the mean ranks of the dimensions among the age groups.
$H_{A1}$: There is a statistically significant difference in the mean ranks of the dimensions among the age groups.
$H_{02}$: There is no statistically significant difference in the mean ranks of the dimensions between male and female.
$H_{A2}$: There is a statistically significant difference in the mean ranks of the dimensions between male and female.
$H_{03}$: There is no statistically significant difference in the mean ranks of the dimensions between race groups.
$H_{A3}$: There is a statistically significant difference in the mean ranks of the dimensions between race groups.
$H_{04}$: There is no statistically significant difference in the mean ranks of the dimensions among the marital status groups.
$H_{A4}$: There is a statistically significant difference in the mean ranks of the dimensions among the marital status groups.
$H_{05}$: There is no statistically significant difference in the mean ranks of the dimensions among participates level of education.
$H_{A5}$: There is a statistically significant difference in the mean ranks of the dimensions among participates level of education.
$H_{06}$: There is no statistically significant difference in the mean ranks of the dimensions among participates nationality.
$H_{A6}$: There is a statistically significant difference in the mean ranks of the dimensions among participates nationality.
$H_{07}$: There is no statistically significant difference in the mean ranks of the dimensions among participates years of experience.
$H_{A7}$: There is a statistically significant difference in the mean ranks of the dimensions among participates years of experience.
$H_{08}$: There is no relationship between the development of realistic schedules and mega-project completion on time

$H_{A8}$: There is a relationship between the development of realistic schedules and mega-project completion on time

$H_{09}$: There is no relationship between clearly defined mega-project scope and the necessity to involve stakeH0lders in the initiation phase

$H_{A9}$: There is a relationship between clearly defined mega-project scope and the necessity to involve stakeH0lders in the initiation phase

$H_{010}$: There is no relationship between effective change-control processes and mega-projects completion on time.

$H_{A10}$: There is a relationship between effective change-control processes and mega-projects completion on time.

$H_{011}$: There is no relationship between major scope changes by the asset owner and redesigns leading to schedule slippages

$H_{A11}$: There is a relationship between major scope changes by the asset owner and redesigns leading to schedule slippages

$H_{012}$: There is no relationship between insufficient engineering is done for the business-case and underestimated project costs

$H_{A12}$: There is a relationship between insufficient engineering is done for the business-case and underestimated project costs

$H_{013}$: There is no relationship between inadequate experienced personnel and the development of detailed quality plans.

$H_{A13}$: There is a relationship between inadequate experienced personnel and the development of detailed quality plans.

$H_{014}$: There is no relationship between correct skill sets and the availability skills in the market at the time of project execution

$H_{A14}$: There is a relationship between correct skill sets and availability skills in the market at the time of project execution

$H_{015}$: There is no relationship between correct skill sets and mega-project completion on time

$H_{A15}$: There is a relationship between correct skill sets and mega-project completion on time

$H_{016}$: There is no relationship between inadequate communications between contracting teams and easy resolution of disputes

$H_{A16}$: There is a relationship between inadequate communications between contracting teams and easy resolution of disputes

$H_{017}$: There is no relationship between the availability of risk skill sets and the capability to manage risks

$H_{A17}$: There is a relationship between the availability of risk skill sets and the capability to manage risks

$H_{018}$: There is no relationship between the complexity of mega-projects and the difficulty to manage all risks in mega-projects

$H_{A18}$: There is a relationship between the complexity of mega-projects and the difficulty to manage all risks in mega-projects

$H_{019}$: There is no relationship between rewarding good contractor performance and mega-project completion on time

$H_{A19}$: There is a relationship between rewarding good contractor performance and mega-project completion on time

$H_{020}$: There is no relationship between contractors having the right teams to manage construction work and mega-projects completion on time

$H_{A20}$: There is a relationship between contractors having the right teams to manage construction work and mega-projects completion on time

$H_{021}$: There is no relationship between inadequate experienced personnel and the underestimation of project costs at the business-case stage

$H_{A21}$: There is a relationship between inadequate experienced personnel and the underestimation of project costs at the business-case stage

## 4.3 RESEARCH PARADIGM

Hofstee (2010:120) explains that research study design relates to the techniques applied in the study to address the research problem. Some of the techniques include survey- based studies, literature reviews, case studies, comparative studies and appraisal research (Creswell, 2009:4; Sekaran & Bougie, 2013:102). Hofstee (2010:120) states that in research design, it is critical to understand research paradigms available to the researcher. He goes on to add that there are many perspectives on research enquiry but the two major perspectives are the positivist paradigm and the phenomenology paradigm. To determine the relevant research approach for this study, the traditional positivist and phenomenology perspectives are outlined, compared and assessed to provide clear guidance.

According to social scientists of a positivist view, the existence of the social world is external and it can be measured using a scientific approach (Wahyuni, 2012: 69). The authors further elaborate that the social scientist remains objective and through rigorous testing and

observations, theory can be deduced to explain casual relationships between variables using well-defined methods of survey, experimental and quasi-experimental.

In the phenomenological approach, reality is 'socially constructed' as opposed to being determined objectively (Blumberg, Cooper & Schindler, 2014: 89). The researcher in this paradigm is seeking an understanding as to why and how matters are happening by the collection of data from social engagements and exchanges in the natural environment using a realistic set of methods such as observations, interviews, case studies (Wahyuni, 2012: 69). Quite often, phenomenology is often referred to as various other terms such as interpretivism, constructivism, qualitative enquiry or naturalistic enquiry.

## 4.4 RESEARCH METHODOLOGY

According to Wahyuni (2012: 72), research methodology is about the use of the model to undertake research in a particular paradigm in order to determine how the research problem can be solved. Collin and Hussey (2009:3) further define the methodology as a process of enquiry, knowledge development and the use of appropriate methods to collect and rigorously analyse the research data.

Philosophical elements of knowledge fall broadly into two categories namely Ontological and Epistemological paradigms which the researcher may choose to optimally conduct a social research study (Lewis and Thornhill, (2009: 119); Wahyuni,(2012:72).

According to Saunders (2009: 119) scholars describe ontology as the way reality is perceived and about 'what things are'. This reality is often professed as dependent on communal actors and therefore subjective in its theory.

Philosophy scholars describe epistemology as a branch of philosophy that is focused on the nature of thing and the methods of figuring the truth (Wahyuni, 2012:69; Saunders, 2009:102). Epistemology is constituted of two Greek words 'episteme' and 'logos'. 'Episteme' is means science or knowledge while 'logos' is about theory, knowledge and information. In essence, epistemology is study of understanding the criteria of what does or does not constitute 'scientific knowledge' (Johnson & Duberley, 2013:3).

In the adaptation of a research method that adopts and contextualises a paradigm for conducting the social study, Wahyuni (2012, 72) indicates that the researcher anchors the study in a paradigm demanded by the study. Creswell (2013, 209) further reinforces that the

researcher perceives the problem as a view of the world and that the standpoint taken by the researcher characterises the assumptions and fundamental beliefs of the matter surrounding the research problem.

Table 4.1: Comparison of quantitative and qualitative research methods

| **Quantitative method** | **Qualitative method** |
|---|---|
| Positivism | Phenomenalism / Interpretivism |
| Single reality | Multiple realities |
| Quantitative | Qualitative |
| Deductive reasoning | Inductive reasoning |
| Focus is narrow and concise | Focus is broad and complex |
| Tests theory | Develops theory |
| Statistical analysis | Narrative analysis |

Source: (Adapted from Blumberg, Cooper & Schindler, 2014)

### 4.4.1 Approach taken in this Study

As stated by Sekaran and Bougie (2013:187), the design of the research is, in essence, the roadmap the researcher uses to gather information, process responses and evaluate processed data which ultimately leads to an explanation of the problem at hand. In this study, the researcher has adopted a quantitative research approach. The challenges facing the delivery of mega-projects in TCP has not been previously studied and this study was aimed at scientifically observing, unpacking and interpreting the feedback obtained from TCP in order to establish the challenges facing Transnet in the delivery of mega-projects.

This study is anchored on a positivist paradigm leaning towards an epistemological philosophy. The study has a social science connotation and uses the lens of natural science which is supported by positivism (Wayhuni, 2012:71). The philosophy of epistemology supports the ability to generate, understand and use knowledge in a method that is reasoned to be legitimate and satisfactory (Wahyuni, 2012:71). This study requires the production of legitimate and satisfactory knowledge that can be measured objectively while producing accuracy and precision through the use scientific methods.

Take a positivist view, this study intends to accomplish, through an independent investigation, explanations that demonstrate causality and achieves generalisation (Easterby-Smith, Thorpe and Jackson, 2014: 24). As indicated by Wahyuni (2012, 71), the project teams of TCP will be given an opportunity to present social occurrences as they relate to the execution of mega-projects. An empirical assessment of TCP responses will be undertaken

to determine the challenges that exist in TCP's mega-project's execution therefore growing the knowledge in this field of mega-projects. This study will establish analytical accuracy, rigor, replicability, testability and purposiveness (Sekaran and Bougie, 2013:186)

In summary, the preference to adopt an epistemology philosophical paradigm for this study, is most appropriate choice as this study is motivated by a wish to expand the limits of information and knowledge to organisations, practitioners, academia, the African continent and socio-economic sector at large.

## 4.5 STUDY SETTING

The research site for this study is TCP which is a division of Transnet SOE. The population of this study consists of 324 employees at TCP. The population is randomly located at seven geographically located offices in the Republic of South Africa namely Johannesburg, Richards Bay, Durban, East London, Port Elizabeth, Cape Town and Saldanha. The survey was undertaken at TCP's place of work. The employees at TCP are a specialised unit that are in employ for the development and execution of infrastructure projects in the port, rail and pipeline disciplines. TCP has several departments consisting of project management, project controls, engineering, finance, human resources and facilities management. Selected departments such as finance, human resources and facilities management do not play an active role in the direct execution of projects.

## 4.6 POPULATION AND SAMPLES

In this study, the target population consisted of project personnel undertaking mega-project in TCP. The target population of interest for this study consisted of 324 personnel who are responsible and accountable for the delivery of projects, namely:

- Executive management (Project Directors)
- Senior management (Principal project managers, Senior project managers)
- Middle management (project managers)
- Engineers
- Project Support personnel (Project Control Managers, Cost Engineers, Quantity Surveyors, Planners, Quality Managers, Environment Managers, Procurement Manager, Contract Managers)

## 4.7 SAMPLING

Blumberg, Cooper and Schindler (2014: 174) describes sampling as a method of selecting a suitable representation of a part of the population that adequately represents the characteristics of the entire population. This view is supported by Cavana, Delahaye and Sekaran (2011: 253) whom describes a sample as a suitable number of elements selected from a population and by analysing the sample and understanding its characteristics, it is acceptable to generalise the sample's characteristics to all elements of the population. Selection of a sample depends on a various practical and theoretical matters such as time, budget and geographical location while keeping in mind the purpose and objective of the of the study (Hair et al., 2011: 167). The benefits of sampling include reduced costs of investigating each element of a large population, reduced fatigue and fewer errors in data especially in large populations.

Traditional sampling techniques can be categorised into two major methods namely probability and non-probability sampling (Edmonds & Kennedy, 2013: 17). Each of these sampling techniques have different strategies dependent on the extent to which generalisation is desired, time that is available for the study, as well as any resource constraints.

### 4.7.1 Probability sampling

In probability sampling, each element of the sample frame has an equal chance of being included in the sample (Hair et al., 2011:168). The authors emphasise that in drawing a sample based on a random procedure, each element has a chance of being selected in the sample (also referred to as a non-zero probability) and this chance can be accurately determined hence reducing selection bias.

There are several probability sampling techniques as indicated by Blumberg et al. (2014:171) which include simple random sampling, systematic sampling, stratified random sampling and cluster sampling.

The simple random sampling involves an unsystematic random selection of elements from the target population with an equal probability of being selected. In this technique offers most generalisations and overcomes selection bias.

In systematic sampling elements, selected form the sampling frame using ordered criteria. The first element is randomly selected thereafter every nth element in the frame as per ordered criteria is selected

Stratified random sampling involves the process of initial segregation of the target population thereafter follows with random selection of the elements from each stratum

In cluster sampling, the target population consists of heterogeneous groups referred to as clusters. Geographical area is a common type of cluster sample however this technique exposes itself to increased bias. Considering all probability sampling designs, the cluster sample has the least generalizability.

### 4.7.2 Non-probability sampling

Cavana et al. (2011: 262) relate that in non-probability sampling not every element in the target population has a chance of being selected into the sample and the discretion of the researcher determines whether the element is selected or not. Therefore, the findings derived from the sample cannot be generalised to the population. The benefits on convenience sampling include efficient and rapid collection of information. Non-probability sampling is can be categorised into two broad categories namely convenience sampling and purposive sampling:

Convenience sampling involves the process of selection element that is usually readily available for the study and can provide the required information. This sampling technique is often applied in the exploratory stage of research projects.

In Purposive sampling, elements are selected at the discretion of the researcher for a specific requirement in the study. This method of selection is frequently implemented in qualitative study designs.

### 4.7.3 Sampling strategy of this study

For this study, the TCP population was stratified into project management, engineering and project support personal as these are study elements are directly involved in the planning, execution and delivery of mega-projects in TCP. A total of 324 persons in project management, engineering and project support made up the target population for this study. With the availability of internet technology and ‘Survey Monkey’, it was possible to reach out to the entire population of project management elements. A census sample consisting of

the entire target population of 324 people was used for this study (Blumberg et al., 2014: 185).

4.7.3.1 Sample size

Krejcie and Morgan (1970: 607) produced a guideline set of rules for determining the sample size. According to TCP, a total of 324 persons are directly responsible for the execution of mega-projects. As per requirements of Sekaran and Bougie (2010:295) and Krejcier and Morgan's (1970:607) table for calculating sample size, a minimum sample of 174 respondents will be required for a target population of 324 project personnel in order to achieve a confidence level of 95% and 5% error. In this study a total of 191 personnel responded to the questionnaire. This was a 58% response rate. This excellence in response rate could be attributed to personnel believing in making a difference and wanting to improve their efficiencies in mega projects. They responded to the questionnaire because they valued the feedback that will come from the results of the study that could assist them in their job performance and efficiencies in mega projects.

## 4.8 RESEARCH INSTRUMENT

An appropriate instrument is required to provide empirical evidence and uncover the reality surrounding the challenges in mega-project delivery, hence the following section discusses the research instrument that was used for this study.

Following from the research approach of a positivist, epistemology philosophical paradigm, a questionnaire-type research instrument was designed to collect quantitative data (primary data) for further processing and analysis (Fabrigar & Wood, 2013:8; Salkind & Rasmussen, 2013:2). A five-point Likert-scale measurement instrument with ordinal scales was designed based on an extensive literature review from various scholars.

A questionnaire is a written set of pre-formulated questions that is utilised to collect data based on the researcher's requirements and variables that will be measured (Blumberg et al., 2014: 354). Hair et al. (2011:198) supports this notion and adds that the questionnaire is a scientifically designed instrument for measuring the phenomena being researched by ensuring data accuracy, and the instrument consists of closed ended statements allowing selection of choice as well as opened ended questions allowing respondents to answer as they may choose.

The design of the instrument for this study was influenced by the theoretical framework anchoring this study. The ten dimensions of PMI's (2013:42) knowledge areas was customised to suite the concepts of the extensive literature review for this study. In Chapter 3, the ten dimensions were extensively discussed, critically reviewed for strengths, gaps and weaknesses. The literature review allowed the researcher to carefully develop statements for the questionnaire that supported the purpose of this study. To solicit meaningful results, the statements for the questionnaire were logically arranged to support the ten knowledge areas of the theoretical framework. Care was taken to ensure that statements reflected project management meta-language and that the statement content was clear. The study instrument consisted of both closed statement and open-ended question to solicit responses from TCP project teams.

### 4.8.1 Description of the Research Instrument

The research instrument was systematically and carefully designed to address the research objectives, questions and hypotheses with the guidance of several scholars and project management authorities. Some of the key sources of literature that influenced the development of the questionnaire include the following: Merrow (2011). PMI (2013), APM (2014) Abimbola and Golding (2013), Transnet (2015), Duffield (2014), IPMA ICB (2006), Zick and Anderson (2014), Bogus et al. (2013), Kikwasi (2012), Doloi (2012).

A Likert 5-point 'ordinal scale' was the preferred design to solicit responses to various statements because of its flexibility to structure data and execute various statistical analysis in the study (Fabrigar & Wood, 2013: 8).

The research instrument questionnaire was divided into twelve sections as follows:

Section A: Demographic

Section B: Integration processes in mega-projects

Section C: Scope of mega-projects

Section D: mega-projects' schedule

Section E: Managing costs on mega-projects

Section F Quality Management in Mega-Projects

Section G: HR and skills on Mega-Projects

Section H: Communications in Mega-Projects

Section I: Managing risks in mega-projects

Section J: Procurement in Mega-Projects

Section K: Managing Stakeholders in Mega-Projects

Section L: Open-ended questions

Section A was developed and included in the questionnaire to determine the demographic profile of the respondents in terms of age, gender, race, marital status, highest formal qualifications, citizenship, and years of employment at TCP. The intention of soliciting demographic information was to provide relevant data to support analysis of project challenge factors such as competency, mobility of personnel, international and local experience factors and social transformation in mega-projects

Sections B to K comprised of statements under the umbrella of the 10 knowledge areas of project management. TCP participants were required to provide their opinion on the statements by selecting one of the ratings on a scale of 1 to 5. The ratings were designed as follows: 1= strongly disagree; 2 = disagree; 3 = neutral; 4 = agree; 5 = strongly agree.

Section L consisting of open-ended questions. These questions intended to provide an opportunity to respondents to provide their views on several challenges and issues derived from the literature review. These questions were included at the end of the questionnaire and were solicited to source valuable information to enrich the study on project challenges and not intended for any quantitative analysis.

### 4.8.2 Justification for the Research Instrument

The Likert-scale-type instrument is a common tool that has been used for collecting data for quantitative research in a social science management studies, thus the researcher was encouraged to use this instrument for this study. Further reasons that supported the choice of this instrument include:

- The instrument is quick and easy for participants to use
- Ability to easily administer to large sample sizes required by quantitative research

- Ability to reach participants in various offices nationally
- Cost effective method to solicit data from TCP participants using electronic platforms
- Both dependent and independent variables contained in the questionnaire allows significant variations that can be determined using this instrument

## 4.9 PRE-TEST AND PILOT STUDY

According to Drost (2012:11), pilot testing (also termed 'non-collaborative' pretesting) is aimed at reducing bias and ensuring that respondents have a sound understanding of the questions. Hair, Money, Samouel and Page (2011:267) assert that no questionnaire should be administered before the researcher has evaluated the likely accuracy and constancy of the responses, by pretesting the questionnaire using a small sample of the respondents with characteristics similar to those of the target population. Blumberg et al. (2014:381) outline several types of pretesting that can be carried out for various purposes such as checking face validity or content validity.

The purpose of pretesting in this study was to understand any shortcomings of the questionnaire and adjust the questionnaire if required for efficiency improvements. Pretesting was required to determine if the respondents would clearly understand the content of the statements and questions; gauge the level of interest and to determine the estimated time to complete the questionnaire.

For this study, a convenience sample of 10 practising project management individuals was solicited to participate in the pilot study initiative. The feedback from the respondents in the pre-test was very positive with respondents indicating that the questions were indeed very relevant to the study and that they felt engaged throughout the completion of the questionnaire. The instrument was tested for internal consistency by analysing the Cronbach's alpha coefficient, which confirmed that the instrument alpha reliability of 0,895 was within the accepted range of 0, 7 and 1.0 as recommended by scholars (Blumberg et al., 2014: 381). The questionnaire being suitable for field testing was ready for the next stage of final survey.

## 4.10 DATA COLLECTION

A survey questionnaire was designed using the simplified five-point Likert Systems (Blumberg et al., 2014:418) with closed questions. The survey ensured confidentiality and non-bias. Respondents were expected to take about 15 minutes to complete the

questionnaire. The respondents were given two weeks to respond to the questionnaire. A gentle weekly reminder was sent to respondents to solicit voluntarily participation in the survey. A further week was allowed for completion of the survey to maximise the participation. A deadline for completion of the survey was sent to participants indicating the final day of collection.

As an efficient method to reach potential participants in geographically dispersed offices, the researcher used an online questionnaire to solicit responses. The HSSREC-approved questionnaire was transferred to the Survey Monkey platform. Survey Monkey provided an internet-based web link that allowed potential participants to gain access online for this survey. The researcher distributed the web link via email to all potential participants.

Once the participant opened the web link, they gained access to the Survey Monkey web site containing the questionnaire. The questionnaire in Survey Monkey was configured such that the participants were unable to proceed to the next question without completing the current question. The email notice to solicit participation and Survey Monkey questionnaire was configured to ensure confidentiality and anonymity of all participants in the survey.

## 4.11 DATA ANALYSIS STAGES

According to Sekaran and Bougie (2013:395) the analysis of data is described as a process of preparing, examining, verifying and modelling data with the intent of ascertaining meaningful information that leads the researcher to determine conclusions and suggestions for making decisions. A caution was raised by Hair et al. (2011:295) that quantitative data analysis is a complex knowledge process. In this study, the researcher sought the assistance of an experienced statistician to support and peer-review the results of the study. Data analysis can be divided into two stages, namely, data preparation and data analysis.

### 4.11.1 Data preparation

During the data preparation stage, the data is edited, coded and captured (Blumberg et al., 2014: 514). This process of data preparation involves breaking down the data in such a manner that they can be entered into a statistical package. The data were entered into the SPSS which allows for convenient electronic processing and analysis. Survey Monkey provides an Excel spread sheet with the responses to all the statements in the questionnaire that was administered. The responses were imported from Survey Monkey and prepared for export to STATA version 14 of the SPSS for statistical analysis and calculations. The SPSS

software was made available by the University of KwaZulu-Natal and it was highly recommended by the institution for analysing quantitative data.

### 4.11.2 Data Analysis

#### 4.11.2.1 Univariate data analysis

The study used univariate analysis that summarises data by examining the frequency distribution, and descriptive statistics in the form of measures of central tendency and the measure of dispersion. Univariate analysis involves a single variable; it does not deal with causes and relationships. A pattern of responses to the variable is described. It also looks at the range of values, as well as central tendency of the values. The main purpose of univariate analysis as articulated by Gravetter and Wallnau (2013:201) is to describe through the use of central tendency (mean, mode and median), dispersion (range variance, minimum, maximum, quantiles and standard deviation), frequency distribution and graphical presentation.

According to Churchill, Brown and Suter (2010:430) "the mean is the arithmetic value of the response of the variable. The median is the value found at the exact middle of the set of values after the data has been arranged in an orderly manner. If there is no one value in the middle, the average of the two values in the middle is taken". According to Bryman and Bell (2007:61), "the median informs the study that 50 per cent of the value lies below a particular range. The mode is the value that occurs most frequently in the sample". Churchill, Brown and Suter (2010:432) note that, "not every sample has a distinct mode; sometimes the sample has two modes which is referred to as bimodal".

Standard deviation measures the variation of the values around the mean. The standard deviation of the sample is always given in the same units as the observations. Standard deviation is a square root of variance, which is always positive. As stated by Gravetter and Wallnau (2013:205) "the disadvantage of a standard deviation is that extreme values or outliers for that matter can have a substantial effect on the value of the standard deviation". According to Gravetter and Wallnau (2013:207), "an increase in the size of the sample is associated with a decrease in the value of the standard deviation. A negative relationship exists between the sample size and the size of the standard deviation".

4.11.2.2 Bivariate data analysis

The data were analysed using frequency distributions, percentages and cross tabulation. This enabled the research hypotheses to be tested. Bivariate data analysis determines whether there is a correlation between the variables in question. The first step is to look for a relationship among the variables. However, hypothesis testing tests the existence of variations between two samples' distributions; they define variations that can be explained either through random chance or not.

In determining whether two distributions vary in a meaningful way, care must be taken to ensure that differences do not simply occur through random chance as this raises the possibility of type 1 or type 2 errors. According to Cunningham and Aldrich (2012:216), "a 'false positive' refers to "a type one error, such as the error of rejecting a null hypothesis when it is actually true". It also means that there is a difference when in actual truth there is none. A type 2 error is also referred to as a "false negative". They further state that "It is the error of failing to reject a null hypothesis when in actual truth it is false". This error implies that the results in the study fail to observe a difference when in fact there is a difference.

### 4.11.3 Factor analysis

Factor analysis was applied to the data to categorise items in each dimension of the independent variables. Factor analysis helps in identifying the factors among the observed variables. Variables with similar characteristics can be grouped. According to Reinmann, Filzmoser, Garrett and Dutter (2014:628), "research can also produce a small number of factors from a large number of variables which are capable of explaining the observed variance in a large number of variables".

In order to determine whether or not the sample was adequate to conduct factor analysis, the analysis used the Kaiser-Meyer-Olkin (KMO) test. The Bartlett test, which is "an indication of the strength of the relationship among the variables", was also used to test the null hypotheses. The rotation method based on maximum Varian (Varimax) was used to identify valid items for each dimension of the independent variables.

### 4.11.4 Parametric Test

To ascertain whether the parametric or non-parametric test should be used, a Normality Test was first conducted. Where the Kolmogorov-Smirnov test showed that the data did not follow a normal distribution, then non-parametric statistics were employed.

### 4.11.5 Non-parametric tests

Inferential statistics calculations were undertaken to determine correlation, regression and principle component analysis. Statistical analysis techniques were used for the Likert survey questionnaire. The frequency distribution was computed for each statement on the questionnaire. Statistical data including the mean, median, mode, variance and standard deviation will be applied to the results. Six inferential statistical tools were used: correlation coefficients, Spearman/Pearson correlation, regression, t-test, significance test and factor analysis to analyse aspects of the field data. Three tests were performed on the data:

- Pearson Correlation Test
- Mann-Whitney Test
- Kruskal-Wallis ANOVA

4.11.5.1 Spearman's Rank Order (Pearson Correlation Test)

Spearman's rank order correlation is a non-parametric "measure of statistical dependence between two variables. It assesses how well the relationship between two variables can be described using a monotonic function. When there is no repeated data value, a perfect Spearman correlation of +1 or -1 occurs when each of the variables is a perfect monotone function of the other. The Spearman correlation coefficient is defined as the Pearson correlation coefficient between the ranked variables".

Cunningham and Aldrich (2012:216) state that when there is an increase in one variable, this leads to a decrease in the other variable; therefore, a negative correlation exists". They further articulate that "there is a positive correlation where a high value of an independent variable in association with a high value of a dependency, a negative correlation where a high value of an independent variability is associated with a low value of a dependent variability and no correlation, where a value of an independent variability is not by any chance a predictive value of a dependent variable". However, according to Reimann, Filzmoser, Garret and Dutter (2008:22), as much as the Pearson correlation provides the

direction and strength of the relationship, it does not provide the casual relationship. Reimann et al. (2008:22) point out that there are several assumptions for using the Pearson correlation coefficient, namely, that a linear relationship exists and the traits measured are normally distributed among the population. Although data in the sample may not be normally distributed, there is some level of certainty. If the data were collected from the entire population, the results would be distributed normally. An interval scale consists of data with equal intervals between two points on the scale, but with no zero point, while ratio scale data have both equal intervals between points on their scale and a true zero point and the scores on dependent variables are distributed across each value of the independent variable (homoscedasticity).

#### 4.11.5.2 Kruskal-Wallis Test

Blumberg et al. (2014:571) state that "this test is a generalised vision of the Mann-Whitney Test". All the scores in the observations are ranked from smallest to largest and then calculated. Cooper and Schindler (2008:672) further articulate that "The Kruskal-Wallis test is also a non-parametric test which is used in place of one-way ANOVA". In this test, no assumptions are made about the type of distribution and no population parameters are estimated. This test is quite robust as there are no confidence intervals; however, it is assumed that all groups have a distribution with the same shape.

#### 4.11.5.3 Mann-Whitney Test

Blumberg et al. (2014:696) state that "this test is used with two independent samples if the data are at least ordinal". The Mann-Whitney U test was used in this study because the measurement was at least ordinal and the assumption under the parametric t-test was rejected.

According to Mann and Whitney (1947:56):

"a very general formulation is to assume that; all the observations from both groups are independent of each other; the responses are ordinal (i.e. one can at least say, of any two observations which one is greater); the distributions of both groups are equal under the null hypothesis, so that the probability of an observation from one population (x) exceeding an observation from the second population(y) equals the probability of an observation from t exceeding an observation from x. That is, there is symmetry between populations with respect to the probability of random drawing of a larger observation and under the alternative hypothesis, that probability of an observation from one

population (x) exceeding an observation from the second population (y) (after excluding ties is not equal to 0.5)"

## 4.12 RELIABILITY

To increase the probability of finding correct answer to the research problem Blumberg et al. (2014:405) provide guidance that attention must be paid to two critical focus areas of research design namely reliability and validity.

According to Sekaran and Bougie (2013: 228) reliability refers to the extent that a scale produces consistent results if measurements are repeated for characteristic being tested. Reliability is a crucial requirement for measuring quality measurement but alone reliability only indicates the extent of measurement consistency however it must be valid before accepting any measure.

To determine the reliability of the data, Cronbach's alpha coefficient, which confirmed that data measurements were within the accepted range of 0,7 and 1.0 as recommended by scholars (Gliem & Gliem, 2003:87). Reliability was further improved by making the test instructions to be by simply understood, writing items clearly and making scoring as easy as possible (Sekaran & Bougie, 2013:228).

## 4.13 VALIDITY

Drost (2012: 111) describe validity as "the extent to which the constructs of an instrument adequately measures what it is supposed to measure". Validity provides a platform for the researcher to provide answers to questions pertaining to the study however the researcher needs to develop a strong and valid position to ensure that measurements can be determined with an acceptable level of certainty (Vogt et al., 2012:322). In addition, Sekaran and Bougie (2013:228) highlight that there are many types of validity tests that can be used to test the measures, which can be classified under four broad headings namely:

- Face validity which indicates that the items included in the questionnaire are comprehensible and understandable to the respondents.
- Content validity that ensures that the measures included are adequate and representative set of items that draw on the concept.
- Criterion-related validity which is determined when the measure differentiates individuals in terms of a criterion that the measure is expected to predict.

- Construct validity is the achievement of how well the results achieved from the use of the measure fit the theories around which the test is designed.

### 4.13.1 Validity of the Instrument

The validity and quality of the research instrument was determined, calibrated and closed by applying the following three considerations:

- Content validity was addressed by applying a simple, unambiguous questionnaire that maintained consistency and clarity throughout. Terminology used in the survey instrument used project management meta-language that participants could easily identify with. The key gaps and weaknesses of mega-project challenges that surfaced from the literature study were applied to the questionnaire.
- Face validity was sought from project management specialists, practitioners and academics as a means of reinforcing 'expert agreement' to the content of the questionnaire instrument as explained by Sekaran (2013:228). Critique and inputs were solicited and considered for improvements before being subjected to pilot-testing. Face validity proved to be successful with many experts supporting the content of the questionnaire and the undertaking of the study overall. They also indicated their excitement at looking forward to the results of this study.
- For this study, a convenience sample of 10 respondents was solicited to participate in the pilot test. The instrument was tested for internal consistency by analysing the Cronbach's alpha coefficient. Pre-test participants felt engaged in the completion of the questionnaire. The pilot-test respondents were subsequently excluded from participating in the final survey process. The questionnaire proved to be adequate for the next stage of final survey.

## 4.14 BIAS

As this study is quantitative in nature, it did not intend to look at any individual project and its delivery. Instead it looked at the basket of projects being undertaken by TCP and the challenges faced in delivering these projects i.e. all projects both successful and unsuccessful. The study considered projects with a project value greater that R300 million. Data were analysed using descriptive and inferential statistical techniques.

## 4.15 ETHICAL CONSIDERATIONS

Special care was taken to ensure that University of KwaZulu-Natal (UKZN) ethical guidelines were adhered to. A submission was made to UKZN Ethics Committee to obtain the necessary approvals to proceed with the study. The researcher approached Transnet to obtain approval to conduct the study. Transnet was provided with the guidelines containing the conditions under which the survey would be undertaken. The final report will be provided to Transnet. All respondents participated with informed consent. All measures were taken to ensure that respondents remained anonymous and that their privacy was respected. Information collected will remain confidential. The researcher did not transgress any UKZN rules and guidelines pertaining to plagiarism, copyright or intellectual property.

## 4.16 CHAPTER SUMMARY

This chapter discussed the methodology used for this empirical study. It outlined the research objectives, research paradigm and the research instrument that was constructed in order to achieve the research objectives. The sample design (sample size, response rate and sampling criteria), questionnaire design, the validity of the questionnaire, data collection technique, and data analysis (including reliability analysis) were also discussed.

The chapter concluded by highlighting the ethical considerations taken into account in conducting the study. The following chapter presents and interprets the statistical findings derived from the data collection.

# CHAPTER 5:
# PRESENTATION OF RESULTS

## 5.1 INTRODUCTION

The purpose of this chapter is to present the analysis and results of the study. The study was undertaken to critically understand the challenges facing the delivery of mega-projects in TCP. The results have been arranged to present data in a simplified and meaningful format using charts, tables and graphs.

Using a quantitative design approach with a cross-sectional quantitative data set for this study, statistical analysis was undertaken using SPSS. The first section of this chapter presents the results of the socio-demographic analysis of the participants. In the descriptive analysis section of this chapter, the results of the study using the methods of univariate (descriptive), bivariate (correlation of two or more factors) and multivariate analysis (principle component analysis using regressions) are presented under each of the research objectives. The latter section of this chapter presents the inferential statistics results of 21 hypotheses that were constructed and tested in this study.

The chapter concludes with a summary of the findings of the descriptive statistical analysis, the inferential statistical analysis and responses to the open-ended questions.

## 5.2 DESCRIPTIVE STATISTICS

The descriptive statistics section of this chapter draws on the data gathered from respondents, sorts out the data and presents summarised data in charts and tables. Socio-demographic analysis and the analysis of statement under each of the 10 project dimensions are presented in this section.

### 5.2.1 Socio-demographic analysis

5.2.1.1 Gender

Thirty one percent of the respondents were female and males made up 69% of the participants. The gender data indicates that project teams are largely dominated by males.

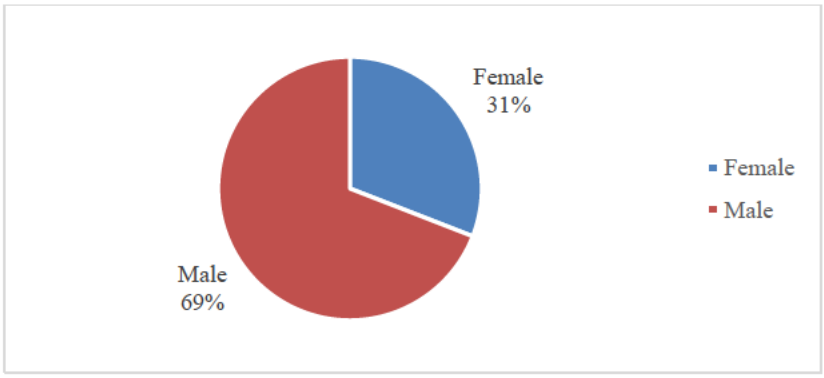


Figure 5.1: Participants' gender distribution

5.2.1.2 Age

The findings reveal that 24,7% of participants are less than thirty years of age while the bulk of participants (33,5%) are in the 30-40 year age group; 29,4% are in the 41-50 year age group and the over 50-year age group makes up 12,4%.

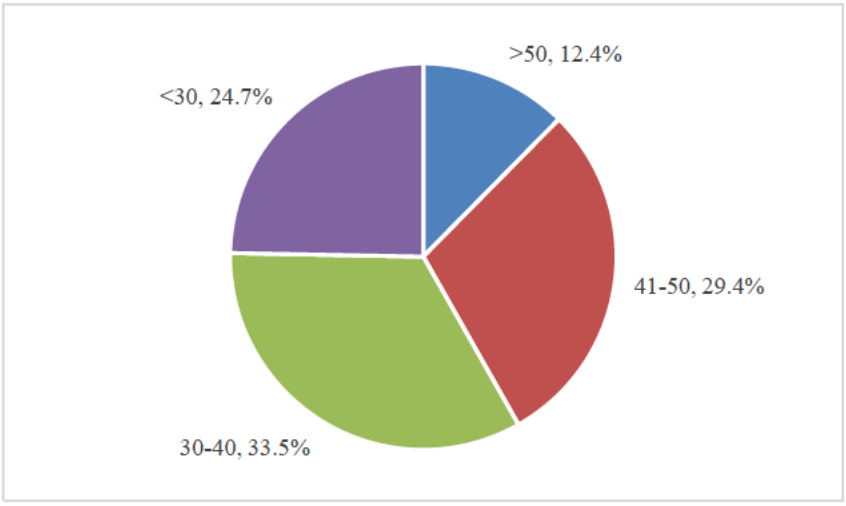


Figure 5.2: Participants' age distribution

5.2.1.3 Race

The majority (51%) of the participants were Blacks, while Whites made up 23,2% of the participants; 18% of the participants were Indian, 5,3% Coloured and 2,1% were represented by other race groups.

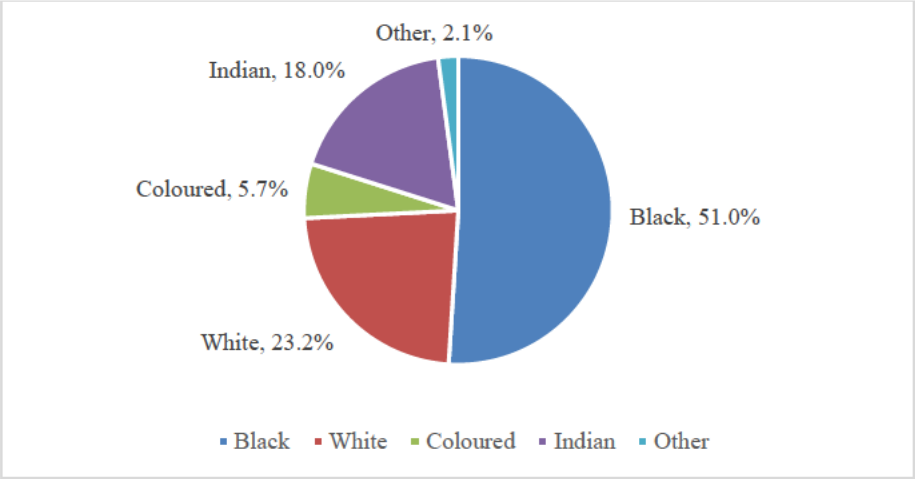


Figure 5.3: Distribution of race

5.2.1.4 Marital Status

Most (62%) of participants are married while 32% are single; 4% of participants are divorced while 2% chose 'other' as a status. The sample is indicative that all participants irrespective of marital status had a chance to participate in this survey.

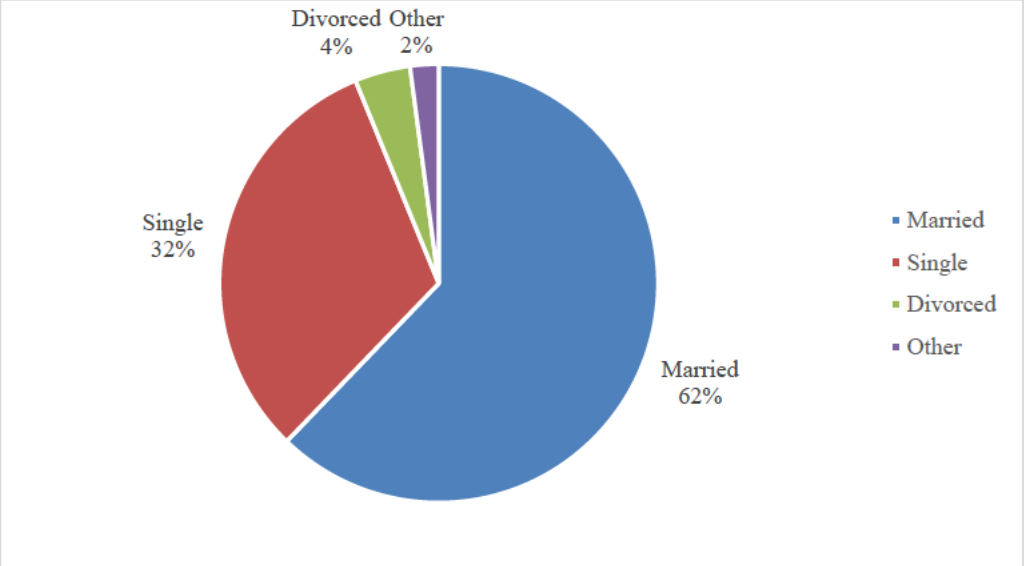


Figure 5.4: Marital status of the participants

5.2.1.5 Level of Education

Almost 40,9% of participants possess an undergraduate qualification although the majority (59,7%) of participants have a postgraduate qualification.

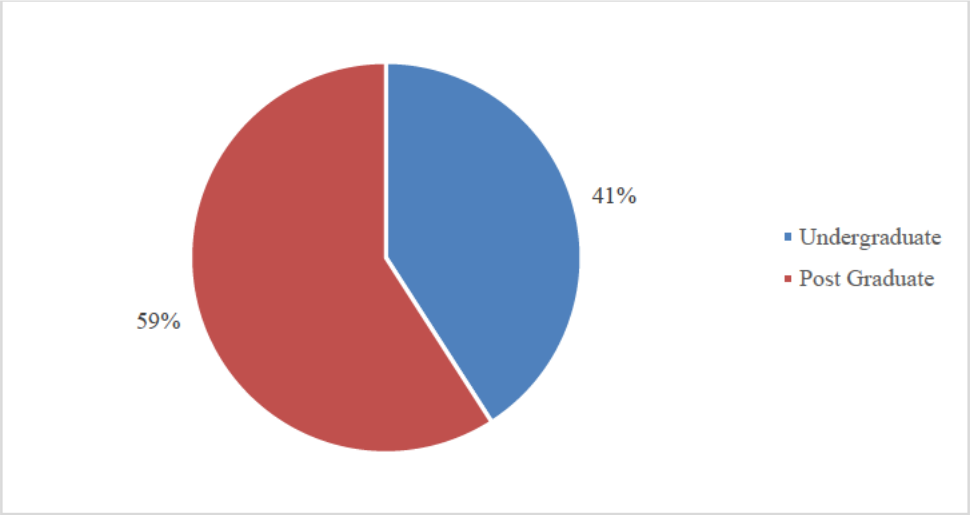


Figure 5.5: Distribution of qualifications

5.2.1.6 Nationality

Ninety nine percent of all participants were South African while other nationalities represent 1% of the participants in this survey.

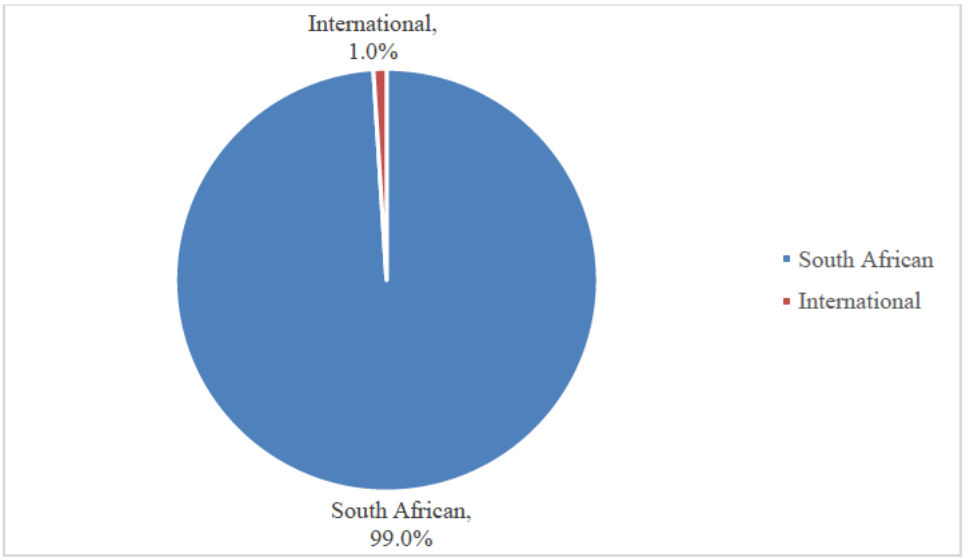


Figure 5.6: Nationality of the participants

5.2.1.7 Years of employment in TCP

According to figure 5.7, more than half (54,6%) of the participants were in the company for less than 5 years and 6% were more than 20 years in the company. The second largest group of participants (28,9%) have been in TCP for between 5 and 10 years. Almost 83,5% of participants have been in TCP for less than 10 years.

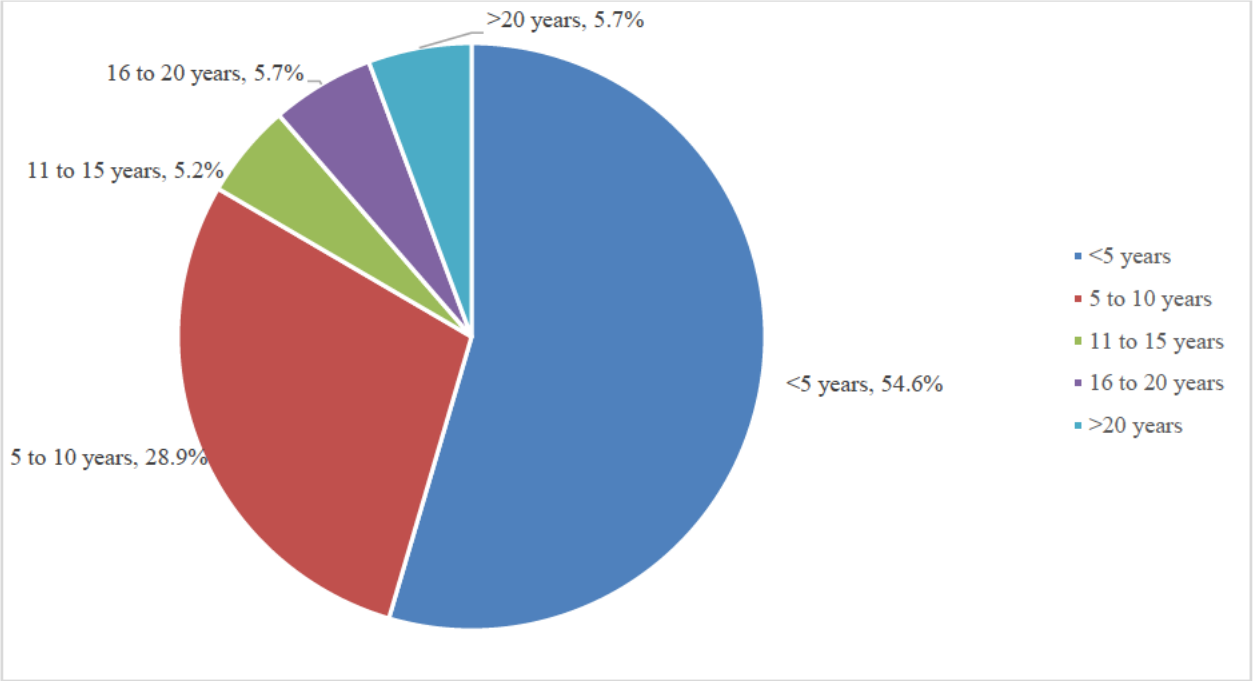


Figure 5.7: Years in the company

## 5.3 OBJECTIVE 1: TO UNDERSTAND THE INTEGRATION PROCESSES OF MEGA-PROJECTS

The initiation and integration process in mega-processes are primarily associated with the commencement of the project following necessary approvals, engaging the relevant stakeholders for project scope development and developing the project plan.

Thirteen statements were posed to participants to understand the integration processes of mega-projects in TCP. All the statements were 5-point Likert-type statements. Out of the 13 statements, eight statements had a mean value of greater than 3 which indicated that more participants responded positively to these statements. For example, most of the participants stated that it is necessary for stakeholders to be involved in the initiation phase to obtain ownership and acceptance (mean=4.40). Similarly, most participants agreed or strongly agreed that there are too many stakeholders to manage on mega-projects, internal and external stakeholders are identified, and the business need is clearly defined. On the other hand, most participants negatively reported that a realistic schedule is developed, and EPCM's are clear about Transnet's internal project management processes.

Table 5.1: Summary of statements regarding integration processes in mega-projects of the company

| Statements | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree | Rating Average |
|---|---|---|---|---|---|---|
| 8.1 The project scope is clearly defined | 18 | 57 | 37 | 72 | 9 | 2.98 |
| 8.2 There are too many Stakeholders to manage on mega-projects | 2 | 24 | 32 | 82 | 53 | 3.83 |
| 8.3 Internal and external Stakeholders are identified | 5 | 31 | 34 | 107 | 16 | 3.51 |
| 8.4 The business need is clearly defined | 9 | 32 | 42 | 89 | 21 | 3.42 |
| 8.5 Customers and stakeholders are involved in the project initiation phase | 18 | 54 | 40 | 72 | 9 | 3.00 |
| 8.6 It is necessary for stakeholders to be involved in the initiation phase to obtain ownership and acceptance | 5 | 1 | 14 | 65 | 108 | 4.40 |
| 8.7 A realistic schedule is developed | 38 | 65 | 41 | 44 | 5 | 2.55 |
| 8.8 Stakeholder expectations are determined | 11 | 50 | 48 | 75 | 9 | 3.11 |
| 8.9 A detailed monitoring plan is developed | 22 | 61 | 50 | 50 | 10 | 2.82 |
| 8.10 The business environment and business plan is well known | 10 | 55 | 59 | 59 | 10 | 3.02 |
| 8.11 The legal environment, standards and are well known and documented | 11 | 37 | 48 | 79 | 18 | 3.29 |
| 8.12 Expert and Peer Reviews are undertaken | 17 | 44 | 56 | 68 | 8 | 3.03 |
| 8.13 EPCM's are clear about Transnet's internal project management processes | 25 | 53 | 45 | 58 | 12 | 2.89 |

KMO and Bartlett's Test showed that the data were adequate for factor analysis with regards to integration processes in mega-projects of the company (Table 5.2). Figure 5.8 shows the eigenvalue distribution of all the statements for the dimension. The variables having eigenvalues one or higher were included for further analysis. There were three variables that had eigenvalues > 1.

Table 5.2: KMO and Bartlett's Test for integration processes in mega-projects of the company

| KMO and Bartlett's test | | |
|---|---|---|
| KMO Measure of Sampling Adequacy. | | .891 |
| Bartlett's Test of Sphericity | Approx. Chi-Square | 938.107 |
| | df | 78 |
| | Sig. | .000 |

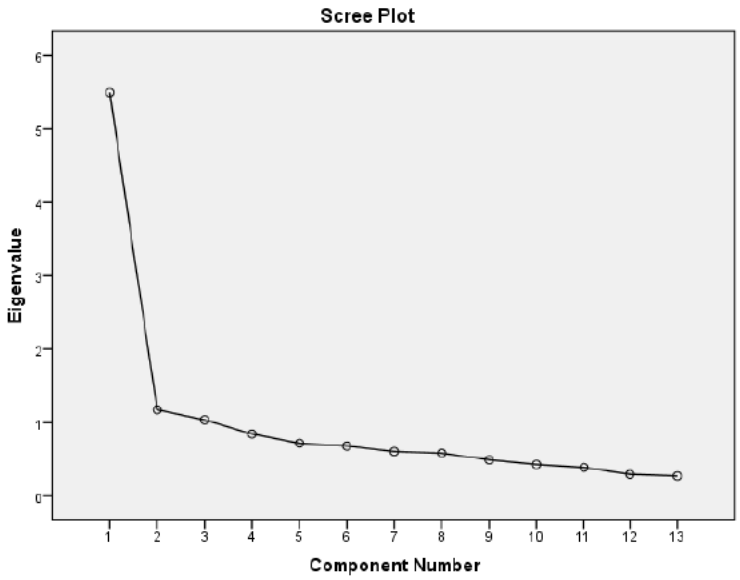


Figure 5.8: Distribution of Eigenvalue for integration processes in mega-projects of the company

Table 5.3: Total variance explained for integration processes in mega-projects of the company

| Component | Extraction Sums of Squared Loadings[a] | | |
|---|---|---|---|
| | Total | % of Variance | Cumulative % |
| 1 | 5.495 | 42.268 | 42.268 |
| 2 | 1.173 | 9.025 | 51.294 |
| 3 | 1.036 | 7.967 | 59.260 |

[a]Extraction Method: Principal component analysis

Table 5.4: Rotated component matrix for integration processes in mega-projects of the company

| **Rotated Component Matrix[a]** | | | |
|---|---|---|---|
| | **Component** | | |
| | 1 | 2 | 3 |
| 8.1 The project scope is clearly defined | .684 | .281 | -.201 |
| 8.2 There are too many Stakeholders to manage on mega-projects | -.116 | .847 | .006 |
| 8.3 Internal and external Stakeholders are identified | .553 | .328 | .220 |
| 8.4 The business need is clearly defined | .603 | .392 | .098 |
| 8.5 Customers and stakeholders are involved in the project initiation phase | .649 | .307 | -.046 |
| 8.6 It is necessary for stakeholders to be involved in the initiation phase to obtain ownership and acceptance | -.004 | .026 | .958 |
| 8.7 A realistic schedule is developed | .748 | -.090 | -.153 |
| 8.8 Stakeholder expectations | .724 | .226 | -.017 |
| 8.9 A detailed monitoring plan is developed | .758 | -.069 | -.058 |
| 8.10 The business environment and business plan is well known | .779 | -.018 | .097 |
| 8.11 The legal environment, standards and are well known and documented | .728 | -.084 | .066 |
| 8.12 Expert and Peer Reviews are undertaken | .741 | -.039 | .003 |
| 8.13 EPCM's are clear about Transnet's internal project management processes | .693 | -.013 | .145 |
| *Extraction Method: Principal component analysis.*<br>*Rotation Method: Varimax with Kaiser Normalization.* | | | |
| *a. Rotation converged in four iterations.* | | | |

Using Varimax with Kaiser Normalization, the study found that the following three variables could explain 59% of the variability of the dimension of integration:

- It is necessary for stakeholders to be involved in the initiation phase to obtain ownership and acceptance
- There are too many stakeholders to manage on mega-projects
- The business environment and business plan is well known.

## 5.4 OBJECTIVE 2: TO DETERMINE IF THE SCOPE OF MEGA-PROJECTS IS CLEAR, UPDATED AND MANAGED

There were seven statements presented to determine if the scope of mega-projects are clear, updated and managed. Arising from the 5-point Likert-type statements, most of the statements had a mean score greater than 3. This implies that more participants responded positively to those statements. For example, most of the participants positively reported that there were too many changes on mega-projects leading to cost and schedule overruns, and major scope changes are common on TCP's mega-projects. It was also found that more participants negatively indicated that the ORS has sufficient detail to develop a detailed scope of work, or that change-control processes are effective (Table 5.5).

Table 5.5: Summary of statements for Scope of mega-projects

| Statements | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree | Rating Average |
|---|---|---|---|---|---|---|
| 9.1 The project scope is clearly defined | 13 | 59 | 41 | 71 | 8 | 3.01 |
| 9.2 Change-control processes are effective | 17 | 67 | 50 | 52 | 6 | 2.81 |
| 9.3 There are too many changes on mega-projects leading to cost and schedule overruns | 1 | 9 | 19 | 75 | 88 | 4.25 |
| 9.4 The scope on mega-projects are complex to define | 4 | 47 | 48 | 71 | 22 | 3.31 |
| 9.5 The ORS has sufficient detail to develop a detailed scope of work | 20 | 77 | 53 | 37 | 5 | 2.64 |
| 9.6 Major scope changes are common on TCP's mega-projects | 3 | 13 | 26 | 87 | 63 | 4.01 |
| 9.7 Due to the long duration of mega-projects, new technology is bound to negatively impact scope and costs | 4 | 29 | 47 | 79 | 33 | 3.56 |

KMO and Bartlett's Test showed that the data were adequate for factor analysis with regards to the scope of mega-project (Table 5.7). Figure 5.9 shows the eigenvalue distribution of all

the statements for the scope of mega-project. The variables having eigenvalues one or higher can be included for further analysis. There were three variables that had eigenvalues greater than one.

Table 5.6: KMO and Bartlett's Test for scope of mega-project

| **KMO and Bartlett's test** | | |
|---|---|---|
| KMO Measure of Sampling Adequacy. | | .637 |
| Bartlett's Test of Sphericity | Approx. Chi-Square | 178.016 |
| | df | 21 |
| | Sig. | .000 |

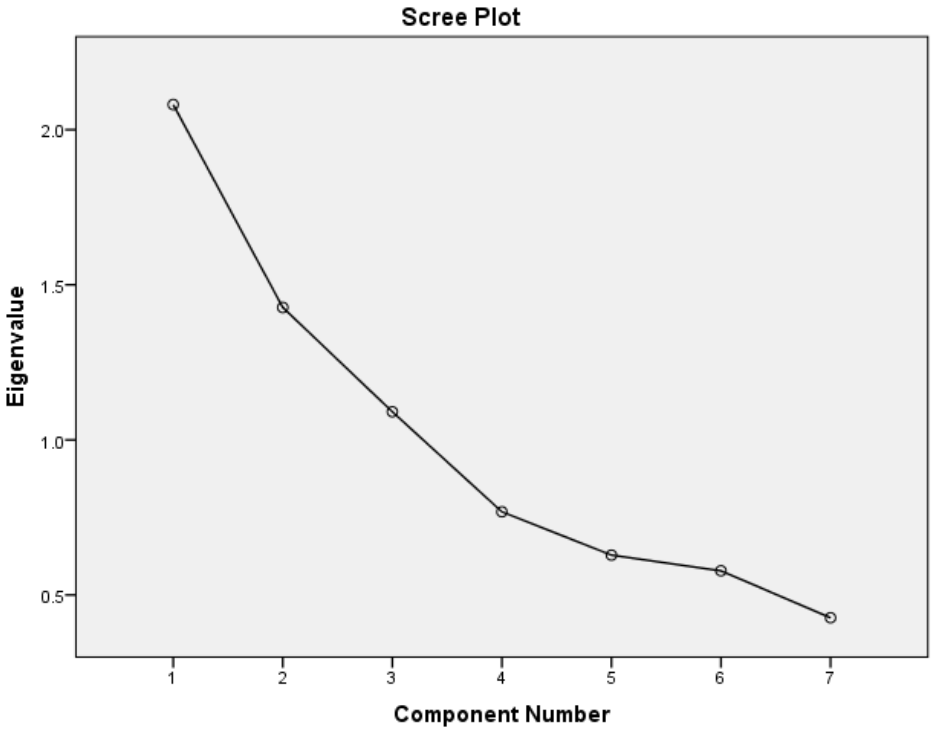


Figure 5.9: Eigenvalue distribution for scope of mega-project

Table 5.7: Total Variance Explained for the scope of mega-projects

| | Extraction Sums of Squared Loadings# | | |
|---|---|---|---|
| Component | Total | % of Variance | Cumulative % |
| 1 | 2.081 | 29.727 | 29.727 |
| 2 | 1.427 | 20.385 | 50.112 |
| 3 | 1.091 | 15.581 | 65.694 |

#Extraction Method: Principal component analysis.

Table 5.8: Rotated Component Matrix[a]

| | Component | | |
|---|---|---|---|
| | 1 | 2 | 3 |
| 9.1 The project scope is clearly defined | .831 | -.172 | .045 |
| 9.2 Change-control processes are effective | .725 | -.034 | .234 |
| 9.3 There are too many changes on mega-projects leading to cost and schedule overruns | -.013 | .832 | .048 |
| 9.4 The scope on mega-projects are complex to define | .162 | .091 | .721 |
| 9.5 The ORS has sufficient detail to develop a detailed scope of work | .817 | .033 | -.042 |
| 9.6 Major scope changes are common on TCP's mega-projects | -.108 | .829 | .005 |
| 9.7 Due to the long duration of mega-projects, new technology is bound to negatively impact scope and costs | -.012 | -.037 | .821 |
| *Extraction Method: Principal component analysis.*<br>*Rotation Method: Varimax with Kaiser Normalization.* | | | |
| *a. Rotation converged in four iterations.* | | | |

It was found that three variables could explain 66% of the variability of the dimensions (Table 5.7). Using Varimax with Kaiser Normalization, the study found that the three variables that could construct the dimensions were the following statements: The project scope is clearly defined, there are too many changes on mega-projects leading to cost and schedule overruns, and due to the long duration of mega-projects, new technology is bound to negatively impact scope and costs (Table 5.8).

## 5.5 OBJECTIVE 3: TO DETERMINE IF MEGA-PROJECTS ARE COMPLETED ON TIME

To understand schedules in mega-projects in TCP and to determine if mega-projects are completed on time, 16 statements were posed to the participants. The results indicate that most of the statements had a mean score greater than three indicating more participants responded positively to all those statements. For example, most of the participants agreed or strongly agreed that upfront careful planning and realistic schedules will keep mega-projects on schedule, and too many decision-makers negatively impact a mega-project. It was also found that the majority of the participants negatively mentioned that mega-projects are completed on time. Summary of all other statements are shown in Table 5.9.

A significant number of respondents (62%) believe that contractors underestimate the time required to complete the projects and 51% agree that labour unrest is a contributor to construction delays on mega-projects.

Table 5.9: Statements regarding mega-projects' schedule

| Statements | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree | Rating Average |
|---|---|---|---|---|---|---|
| 10.1 Mega-projects are completed on time | 70 | 87 | 26 | 5 | 3 | 1.87 |
| 10.2 Long approval processes are the main reasons for schedule overruns | 5 | 20 | 28 | 88 | 50 | 3.83 |
| 10.3 Frequent re-redesigns are chief causes of schedule overruns | 5 | 14 | 42 | 97 | 33 | 3.73 |
| 10.4 Contractors underestimate the time required to complete the projects | 4 | 27 | 34 | 89 | 37 | 3.67 |
| 10.5 Major scope changes by the Asset Owner are the root causes of schedule overruns | 2 | 20 | 52 | 80 | 37 | 3.68 |
| 10.6 Rework in design is the chief reason for mega-project delays | 4 | 22 | 52 | 79 | 34 | 3.61 |
| 10.7 Upfront careful planning and realistic schedules will keep mega-projects on schedule | 3 | 5 | 11 | 81 | 91 | 4.32 |
| 10.8 Labour unrests are a certainty to construction delays on mega- projects | 7 | 41 | 45 | 77 | 21 | 3.34 |
| 10.9 The Asset Owner demands an unrealistic deadline to complete the project | 3 | 21 | 57 | 72 | 38 | 3.63 |
| 10.10 The project team is over-optimistic on completion dates | 5 | 25 | 43 | 84 | 34 | 3.61 |
| 10.11 Project schedules are compressed to match the business-case requirements | 1 | 8 | 49 | 80 | 53 | 3.92 |
| 10.12 Not enough time is given to the project's team to plan the project before executing | 2 | 28 | 36 | 80 | 45 | 3.72 |
| 10.13 There are too many decision-makers negatively impacting on a mega-project | 1 | 10 | 31 | 92 | 57 | 4.02 |
| 10.14 Delegation of Authority hampers approvals and adds to extra schedule time | 3 | 22 | 47 | 76 | 43 | 3.70 |
| 10.15 Mega-projects are completed on time | 66 | 76 | 34 | 10 | 5 | 2.02 |
| 10.16 There are inexperienced Schedulers planning mega-projects | 8 | 33 | 51 | 52 | 47 | 3.51 |

The KMO and Bartlett's Test shows that the data were adequate for factor analysis with regard to the schedule of mega-project (Table 5.10). Figure 5.10 shows the eigenvalue distribution of all the statements for the schedule of mega-project. The variables having eigenvalues one or higher were included for further analysis. There were five variables that had eigenvalues greater than one (01) (Figure 5.10).

Table 5.10: KMO and Bartlett's Test for scheduling mega-projects

| **KMO and Bartlett's Test** | | |
|---|---|---|
| KMO Measure of Sampling Adequacy. | | .716 |
| Bartlett's Test of Sphericity | Approx. Chi-Square | 625.055 |
| | df | 120 |
| | Sig. | .000 |

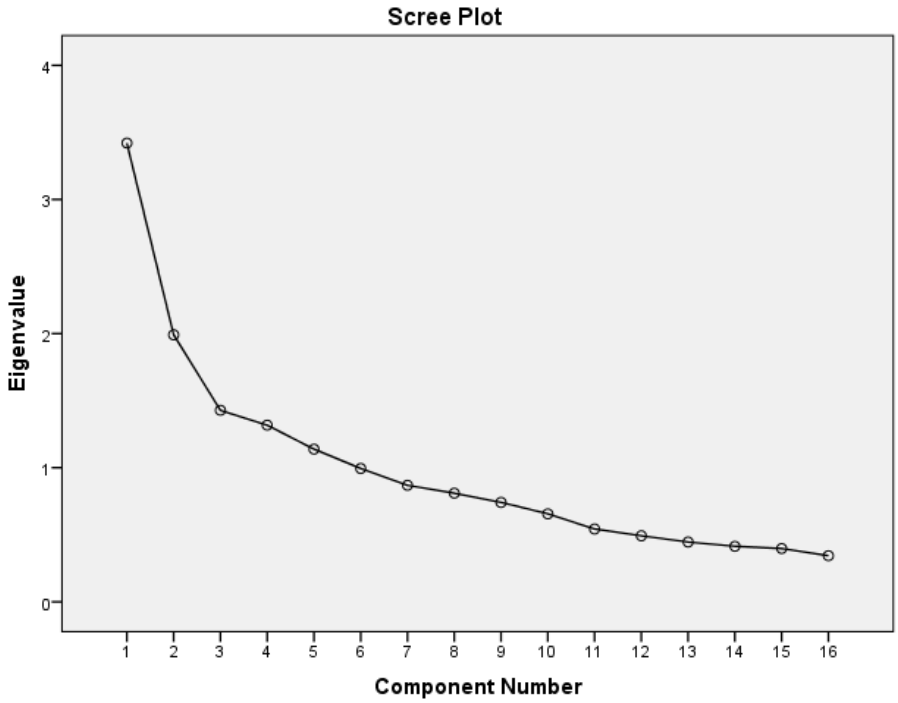


Figure 5.10: Eigenvalue distribution for scheduling mega-projects

The present study found that the five variables could explain 58% of the variability of the dimensions (Table 5.11). Using Varimax with Kaiser Normalization, it was found that the five variable that could construct the dimensions were: Rework in design is the chief reason for mega-project delays, Project schedules are compressed to match the business-case requirements, mega-projects are completed on time. Upfront careful planning and realistic schedules will keep mega-projects on schedule, and labour unrests are a certainty to construction delays on mega-projects (Table 5.12).

Table 5.11: Total variance explained for scheduling mega-projects

| | Extraction Sums of Squared Loadings | | |
|---|---|---|---|
| Component | Total | % of Variance | Cumulative % |
| 1 | 3.420 | 21.377 | 21.377 |
| 2 | 1.991 | 12.442 | 33.819 |
| 3 | 1.428 | 8.925 | 42.744 |
| 4 | 1.317 | 8.232 | 50.976 |
| 5 | 1.138 | 7.115 | 58.091 |

Table 5.12: Rotated Component Matrix[a] for scheduling mega-projects

| | Component | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| 10.1 Mega-projects are completed on time | .033 | -.018 | .871 | .031 | .037 |
| 10.2 Long approval processes are the main reasons for schedule overruns | .580 | .056 | .129 | .247 | .011 |
| 10.3 Frequent re-redesigns are chief causes of schedule overruns | .772 | .157 | .067 | .042 | -.124 |
| 10.4 Contractors underestimate the time required to complete the projects | .423 | .019 | .015 | -.007 | .597 |
| 10.5 Major scope changes by the Asset Owner are the root causes of schedule overruns | .762 | .150 | -.088 | -.001 | .194 |
| 10.6 Rework in design is the chief reason for mega-project delays | .782 | -.024 | .002 | .162 | .026 |
| 10.7 Upfront careful planning and realistic schedules will keep mega-projects on schedule | -.029 | -.050 | .226 | .647 | .027 |
| 10.8 Labour unrests are a certainty to construction delays on mega | -.160 | .060 | .064 | .111 | .847 |
| 10.9 The Asset Owner demands an unrealistic deadline to complete the project | .272 | .669 | -.065 | -.101 | .377 |
| 10.10 The project team is over-optimistic on completion dates | .085 | .637 | -.138 | .216 | -.039 |
| 10.11 Project schedules are compressed to match the business-case requirements | .064 | .803 | .002 | .050 | .102 |
| 10.12 Not enough time is given to the project's team to plan the project before executing | .006 | .730 | -.047 | .171 | -.101 |
| 10.13 There are too many decision-makers negatively impacting on a mega-project | .174 | .188 | -.072 | .648 | .027 |
| 10.14 Delegation of Authority hampers approvals and adds to extra schedule time | .214 | .126 | -.353 | .579 | .128 |
| 10.15 Mega-projects are completed on time | .091 | -.145 | .806 | -.077 | .039 |
| 10.16 There are inexperienced Schedulers planning mega-projects | .083 | .117 | -.055 | .525 | -.015 |
| *Extraction Method: Principal component analysis.*<br>*Rotation Method: Varimax with Kaiser Normalization.* | | | | | |
| *a. Rotation converged in six iterations.* | | | | | |

This study found that the five variables could explain 58% of the variability of the dimensions (Table 5.11). Using Varimax with Kaiser Normalization, it was found that the five variables that could construct the dimensions were: rework in design is the chief reason for mega-project delays; project schedules are compressed to match the business-case requirements; mega-projects are completed on time; upfront careful planning and realistic schedules will keep mega-projects on schedule; and labour unrests contribute to construction delays on mega-projects (Table 5.12).

## 5.6 OBJECTIVE 4: TO ASCERTAIN THE REASONS FOR COST OVERRUNS

To establish how the costs of mega-projects are managed, 11 statements were asked. It was found that all the statements had a mean score greater than 3 from 5-point Likert-type statements. For example, more participants agreed or strongly agreed that detailed cost plans are developed, there are too many changes on mega-projects leading to higher prices, and project costs are underestimated at the business-case development stage (Table 5.13)

Table 5.13: Managing costs on mega-projects

| Statements | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree | Rating Average |
|---|---|---|---|---|---|---|
| 11.1 Detailed cost plans are developed | 10 | 28 | 61 | 85 | 7 | 3.27 |
| 11.2 All cost packages are known at the commencement of a mega-project | 18 | 67 | 43 | 54 | 9 | 2.84 |
| 11.3 Contractors underpriced bids | 4 | 33 | 65 | 71 | 18 | 3.35 |
| 11.4 Bid documents have sufficient detail for compiling a robust bid price | 9 | 45 | 63 | 67 | 7 | 3.09 |
| 11.5 There adequate processes and tools for cost management | 3 | 37 | 60 | 82 | 9 | 3.30 |
| 11.6 Owner increases scope and costs | 0 | 9 | 51 | 101 | 30 | 3.80 |
| 11.7 There is inadequate experienced personnel to control costs | 9 | 43 | 51 | 62 | 26 | 3.28 |
| 11.8 Onerous Transnet bid processes translates to higher costs | 2 | 26 | 66 | 70 | 27 | 3.49 |
| 11.9 There are too many changes on mega-projects leading to higher prices | 0 | 8 | 27 | 102 | 54 | 4.06 |
| 11.10 Project costs are underestimated at the business-case development stage | 5 | 12 | 42 | 77 | 55 | 3.86 |
| 11.11 There is insufficient engineering done for a robust business-case | 2 | 28 | 47 | 74 | 40 | 3.64 |

KMO and Bartlett's Test showed that the data was adequate for factor analysis with regards to Managing Costs on mega-projects (Table 5.14). Figure 5.11 shows the eigenvalue distribution of all the statements for managing costs on mega-projects. The variables having eigenvalues 1 or higher were included for further analysis. There were three variables that had eigenvalues greater than 1.

Table 5.14: KMO and Bartlett's Test for Managing Costs on mega-projects

| KMO and Bartlett's Test | | |
|---|---|---|
| KMO Measure of Sampling Adequacy. | | .706 |
| Bartlett's Test of Sphericity | Approx. Chi-Square | 355.531 |
| | df | 55 |
| | Sig. | .000 |

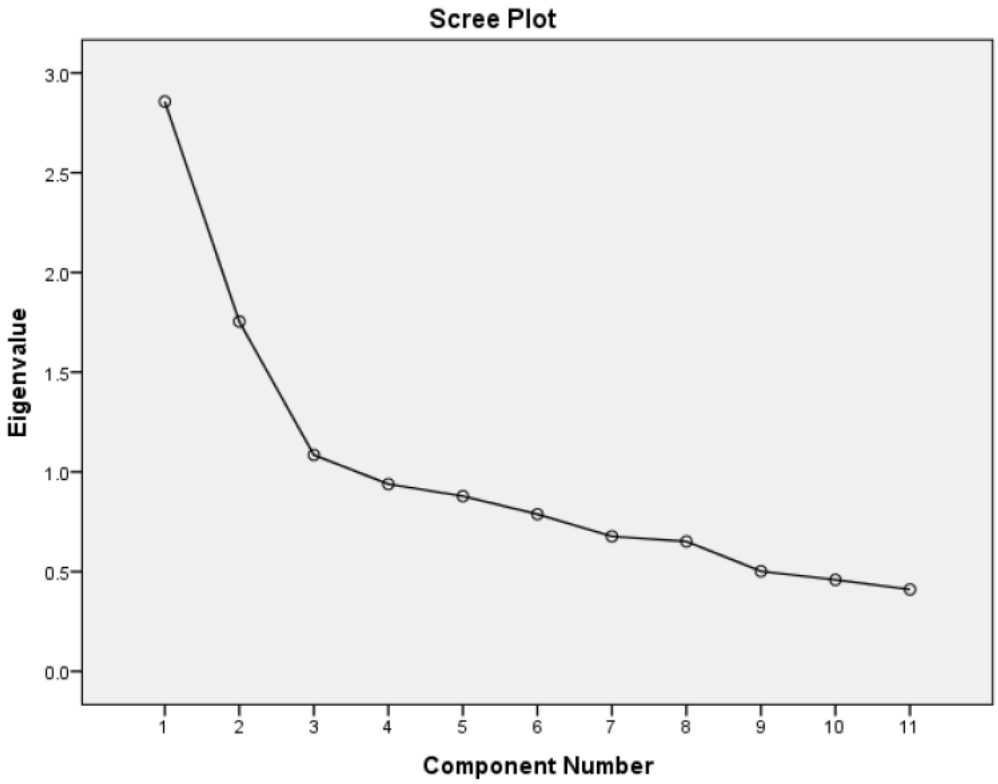


Figure 5.11: Distribution of eigenvalues for managing costs on mega-projects

The present study found that three variables could explain 52% of the variability of the dimensions (Table 5.15). Using Varimax with Kaiser Normalization, it was found that the three (03) variable that could construct the dimensions were: Detailed cost plans are developed, there are too many changes on mega-projects leading to higher prices, and there is inadequate experienced personnel to control costs (Table 5.16).

Table 5.15: Total variance explained for managing costs on mega-projects

| | Extraction Sums of Squared Loadings | | |
|---|---|---|---|
| Component | Total | % of Variance | Cumulative % |
| 1 | 2.857 | 25.972 | 25.972 |
| 2 | 1.754 | 15.946 | 41.918 |
| 3 | 1.085 | 9.863 | 51.781 |

Table 5.16: Rotated Component Matrix[a] for managing costs on mega-projects

| | Component | | |
|---|---|---|---|
| | 1 | 2 | 3 |
| 11.1 Detailed cost plans are developed | .723 | .106 | -.182 |
| 11.2 All cost packages are known at the commencement of a mega-project | .685 | -.284 | .166 |
| 11.3 Contractors under-price bids | .196 | .458 | .327 |
| 11.4 Bid documents have sufficient detail for compiling a robust bid price | .671 | -.087 | -.020 |
| 11.5 There are adequate processes and tools for cost management | .629 | .076 | -.110 |
| 11.6 Owner increases scope and costs | .186 | .608 | .181 |
| 11.7 There is inadequate experienced personnel to control costs | -.153 | .053 | .797 |

| | Component | | |
|---|---|---|---|
| | 1 | 2 | 3 |
| 11.8 Onerous Transnet bid processes translates to higher costs | -.059 | .233 | .705 |
| 11.9 There are too many changes on mega-projects leading to higher prices | -.093 | .790 | -.049 |
| 11.10 Project costs are underestimated at the business-case development stage | -.323 | .618 | .123 |
| 11.11 There is insufficient engineering done for a robust business-case | -.433 | .530 | .259 |
| *Extraction Method: Principal component analysis.*<br>*Rotation Method: Varimax with Kaiser Normalization.* | | | |
| *a. Rotation converged in 5 iterations.* | | | |

The present study found that three variables could explain 52% of the variability of the dimensions (Table 5.15). Using Varimax with Kaiser Normalization, it was found that the three variables that could construct the dimensions were: detailed cost plans are developed; there are too many changes on mega-projects leading to higher prices; and there is inadequate experienced personnel to control costs (Table 5.16).

## 5.7 OBJECTIVE 5: TO UNDERSTAND THE DEGREE TO WHICH PROJECTS ACHIEVE THEIR QUALITY REQUIREMENTS

To determine the quality management of mega-projects, 10 statements were probed. The results found that most participants responded positively to most of the statements. For example, more participants positively indicated that there are inadequate experienced personnel to control quality, project quality requirements are underestimated at the business-case development stage, and insufficient Transnet quality requirements translates into poor quality management. A summary of all the statements are shown in Table 5.17 below.

Table 5.17: Quality management in mega-projects

| Statements | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree | Rating Average |
|---|---|---|---|---|---|---|
| 12.1 Detailed quality plans are developed | 21 | 44 | 51 | 69 | 6 | 2.97 |
| 12.2 All quality packages are known at the commencement of a mega-project | 20 | 56 | 54 | 54 | 7 | 2.85 |
| 12.3 EPCM and Contractors are aware of quality requirements | 9 | 42 | 38 | 89 | 13 | 3.29 |
| 12.4 Bid documents have sufficient details for quality management | 9 | 44 | 58 | 74 | 6 | 3.13 |
| 12.5 There are adequate processes and tools for quality management | 14 | 48 | 55 | 66 | 8 | 3.03 |
| 12.6 Quality management requires too much detail for mega-projects | 4 | 57 | 58 | 48 | 24 | 3.16 |
| 12.7 There is inadequate experienced personnel to control quality | 6 | 33 | 39 | 62 | 51 | 3.62 |
| 12.8 Insufficient Transnet quality requirements translates to poor quality management | 9 | 35 | 42 | 76 | 29 | 3.42 |
| 12.9 EPCM's working on Transnet's mega-projects | 8 | 54 | 60 | 52 | 17 | 3.08 |

| Statements | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree | Rating Average |
|---|---|---|---|---|---|---|
| are not quality conscious | | | | | | |
| 12.10 Project quality requirements are underestimated at the business-case development stage | 0 | 30 | 54 | 78 | 29 | 3.55 |

KMO and Bartlett's Test showed that the data were adequate for factor analysis with regards to quality management in mega-projects (Table 5.18). Figure 5.12 shows the eigenvalue distribution of all the statements for quality management in mega-projects. The variables having eigenvalues 1 or higher were to be included for further analysis. There were three variables that had eigenvalues greater than 1.

Table 5.18: KMO and Bartlett's Test for quality management in mega-projects

| KMO and Bartlett's Test | | |
|---|---|---|
| KMO Measure of Sampling Adequacy. | | .811 |
| Bartlett's Test of Sphericity | Approx. Chi-Square | 540.599 |
| | df | 45 |
| | Sig. | .000 |

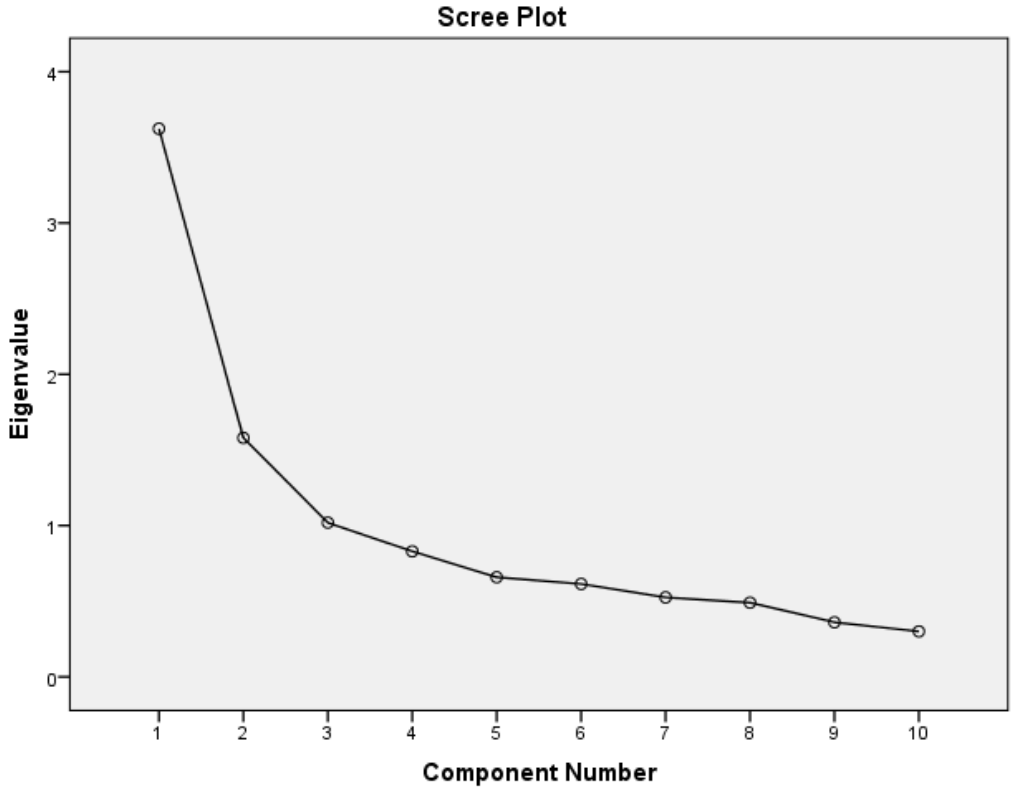


Figure 5.12: Eigenvalue distribution for quality management in mega-projects

The present study found that the three variables could explain 62% of the variability of the dimensions (Table 5.19).

Table 5.19: Total variance explained for quality management in mega-projects

| Component | Extraction Sums of Squared Loadings | | |
|---|---|---|---|
| | Total | % of Variance | Cumulative % |
| 1 | 3.623 | 35.232 | 35.232 |
| 2 | 1.580 | 15.798 | 52.029 |
| 3 | 1.019 | 10.190 | 62.219 |

Table 5.20: Rotated Component Matrix[a] for quality management in mega-projects

| **Rotated Component Matrix[a]** | | | |
|---|---|---|---|
| | Component | | |
| | 1 | 2 | 3 |
| 12.1 Detailed quality plans are developed | .816 | -.070 | -.051 |
| 12.2 All quality packages are known at the commencement of a mega-project | .843 | -.137 | -.032 |
| 12.3 EPCM and Contractors are aware of quality requirements | .736 | -.062 | -.060 |
| 12.4 Bid documents have sufficient details for quality management | .768 | -.212 | .044 |
| 12.5 There are adequate processes and tools for quality management | .550 | -.417 | .241 |
| 12.6 Quality management requires too much detail for mega-projects | .101 | -.043 | .810 |
| 12.7 There is inadequate experienced personnel to control quality | .006 | .814 | .052 |
| 12.8 Insufficient Transnet quality requirements translates to poor quality management | -.203 | .777 | .017 |
| 12.9 EPCM's working on Transnet's mega-projects are not quality conscious | -.143 | .344 | .620 |
| 12.10 Project quality requirements are underestimated at the business-case development stage | -.270 | .671 | .271 |
| *Extraction Method: Principal component analysis.*<br>*Rotation Method: Varimax with Kaiser Normalization.* | | | |
| *a. Rotation converged in four iterations.* | | | |

Using Varimax with Kaiser Normalization, it was found that the three variables that could construct the dimensions were: all quality packages are known at the commencement of a mega-project; there is inadequate experienced personnel to control quality; and quality management requires too much detail for mega-projects (Table 5.20).

## 5.8 OBJECTIVE 6: TO ASCERTAIN IF PROJECTS HAVE ADEQUATE HUMAN RESOURCES AND SKILLS

Regarding HR and skills on mega-projects, arising from the responses to 17 statements, it was found that most of the statements had a mean score of 3 or more. This indicates that most participants responded positively to these statements. For example, most of the respondents agreed or strongly agreed that Transnet has lots of resources but experience and exposure is limiting; there are too many people changes in the life of mega-project affecting smooth project delivery; and there is a massive gap in the experience levels required for mega-projects. It was also found that more respondents negatively reported that asset owners

have good experience in managing mega-project. Table 5.21 shows the summary of all the statements regarding HR and skills on mega-projects.

Table 5.21: Distribution of statements regarding HR and skills on mega-projects

| Statements | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree | Rating Average |
|---|---|---|---|---|---|---|
| 13.1 Mega-projects have the correct skill sets | 37 | 53 | 53 | 45 | 3 | 2.60 |
| 13.2 Owners have good experience in managing mega-project | 40 | 68 | 45 | 29 | 9 | 2.47 |
| 13.3 EPCM teams work well with Transnet | 20 | 51 | 60 | 52 | 8 | 2.88 |
| 13.4 EPCM's have the correct skill sets for delivering mega-projects | 13 | 34 | 68 | 63 | 13 | 3.15 |
| 13.5 There is a massive gap in the experience levels required for mega-projects | 4 | 24 | 41 | 77 | 45 | 3.71 |
| 13.6 There are too many people changes in the life of mega-project affecting smooth project delivery | 2 | 13 | 35 | 79 | 62 | 3.97 |
| 13.7 Construction Contractors have the right skill sets for delivery of mega-projects | 7 | 34 | 59 | 85 | 6 | 3.26 |
| 13.8 Transnet, EPCM and Construction teams are all chasing the same limited pool of skills | 6 | 25 | 51 | 75 | 34 | 3.55 |
| 13.9 International experience in similar mega-projects are required | 5 | 26 | 42 | 72 | 46 | 3.67 |
| 13.10 Transnet has lots of resources but experience and exposure is limiting | 5 | 16 | 23 | 74 | 73 | 4.02 |
| 13.11 t is too long since TCP executed mega-projects hence the lack of skills | 13 | 38 | 59 | 59 | 22 | 3.20 |
| 13.12 Suitable skills for resource hungry mega-projects are seldom available at the time of project execution | 7 | 24 | 46 | 92 | 22 | 3.51 |
| 13.13 Owner and EPCM roles are clear | 13 | 59 | 49 | 61 | 9 | 2.97 |
| 13.14 Local and Expatriates skills sets are required for mega-project execution | 6 | 17 | 40 | 97 | 31 | 3.68 |
| 13.15 Transnet has trained its staff to deal with mega-projects | 35 | 70 | 45 | 31 | 10 | 2.53 |
| 13.16 Mega-projects in TCP fail as a result of TCP not having the correct skill sets | 10 | 33 | 30 | 75 | 43 | 3.57 |
| 13.17 Asset Owners have good experience in managing mega-project | 36 | 70 | 59 | 20 | 6 | 2.42 |

KMO and Bartlett's Test showed that the data were adequate for factor analysis with regards to the HR and skills on mega-project (Table 5.22). Figure 5.13 shows the eigenvalue distribution of all the statements for HR and skills on Mega-Projects. The variables having eigenvalues 1 or higher were to be included for further analysis. There were five variables that had eigenvalues greater than 1.

Table 5.22: KMO and Bartlett's Test for HR and skills on Mega-Projects

| **KMO and Bartlett's Test** | | |
|---|---|---|
| KMO Measure of Sampling Adequacy. | | .743 |
| Bartlett's Test of Sphericity | Approx. Chi-Square | 825.056 |
| | df | 136 |
| | Sig. | .000 |

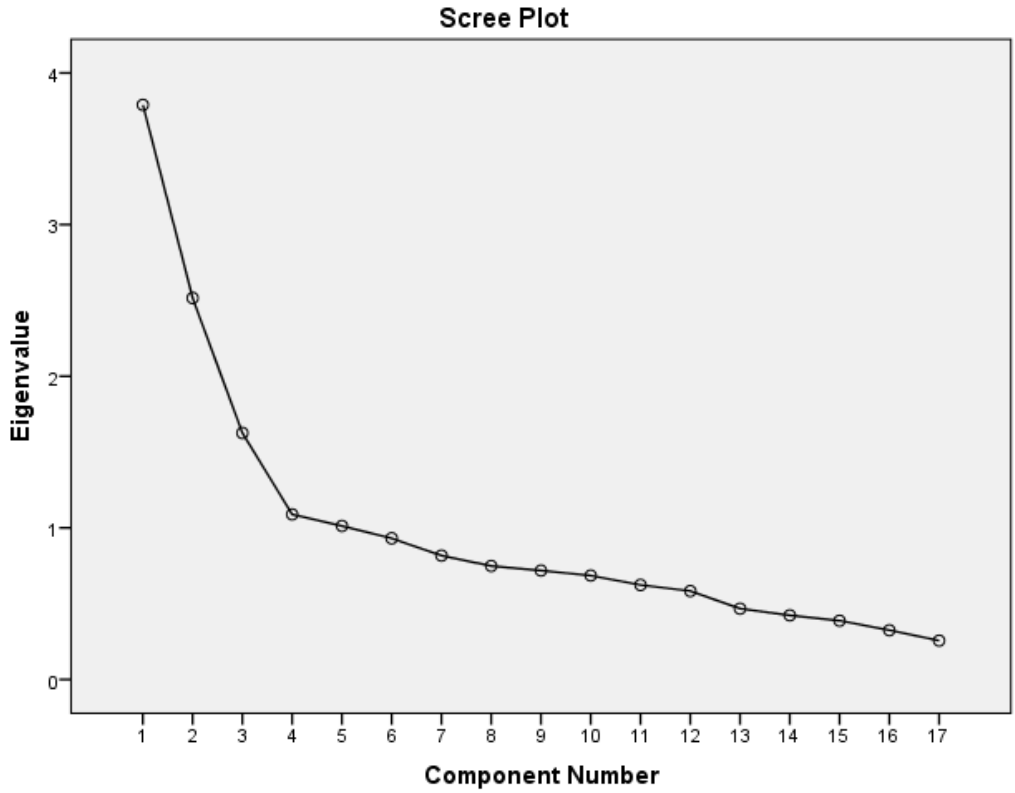


Figure 5.13: Distribution of eigenvalues for HR and skills on Mega-Projects

The study found that the five variables could explain 59% of the variability of the dimensions (Table 5.23).

Table 5.23: Total variance explained for HR and skills on mega-projects

| | Extraction Sums of Squared Loadings | | |
|---|---|---|---|
| Component | Total | % of Variance | Cumulative % |
| 1 | 3.790 | 22.293 | 22.293 |
| 2 | 2.516 | 14.798 | 37.092 |
| 3 | 1.626 | 9.563 | 45.655 |
| 4 | 1.089 | 5.404 | 53.058 |
| 5 | 1.013 | 5.956 | 59.015 |

Table 5.24: Rotated Component Matrix[a] for HR and skills on mega-projects

| **Rotated Component Matrix[a]** | Component | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| 13.1 Mega-projects have the correct skill sets | .825 | -.136 | .075 | .047 | -.067 |
| 13.2 Owners have good experience in managing mega-project | .823 | -.072 | .037 | .061 | -.107 |
| 13.3 EPCM teams work well with Transnet | .485 | .202 | .471 | .095 | -.021 |
| 13.4 EPCM's have the correct skill sets for delivering mega-projects | .251 | -.009 | .758 | .056 | .059 |
| 13.5 There is a massive gap in the experience levels required for mega-projects | -.194 | .132 | .013 | .084 | .788 |
| 13.6 There are too many people changes in the life of mega-project affecting smooth project delivery | -.080 | .143 | -.035 | .088 | .816 |
| 13.7 Construction Contractors have the right skill sets for delivery of mega-projects | .018 | -.100 | .713 | -.013 | -.242 |
| 13.8 Transnet, EPCM and Construction teams are all chasing the same limited pool of skills | -.102 | .256 | .557 | -.093 | .186 |
| 13.9 International experience in similar mega-projects are required | .064 | .237 | -.112 | .771 | .200 |
| 13.10 Transnet has lots of resources but experience and exposure is limiting | -.196 | .718 | -.043 | -.094 | .075 |
| 13.11 t is too long since TCP executed mega-projects hence the lack of skills | .142 | .711 | .107 | .164 | .077 |
| 13.12 Suitable skills for resource hungry mega-projects are seldom available at the time of project execution | -.072 | .566 | .083 | .359 | .124 |
| 13.13 Owner and EPCM roles are clear | .458 | -.191 | .261 | .317 | -.080 |
| 13.14 Local and Expatriates skills sets are required for mega-project execution | .064 | .013 | .050 | .824 | .011 |
| 13.15 Transnet has trained its staff to deal with mega-projects | .569 | -.165 | .299 | -.288 | .068 |
| 13.16 Mega-projects in TCP fail as a result of TCP not having the correct skill sets | -.380 | .600 | -.004 | .017 | .147 |
| 13.17 Asset Owners have good experience in managing mega-project | .737 | -.039 | -.077 | .072 | -.194 |
| *Extraction Method: Principal component analysis.*<br>*Rotation Method: Varimax with Kaiser Normalization.* | | | | | |
| *a. Rotation converged in six iterations.* | | | | | |

Using Varimax with Kaiser Normalization, it was found that the five variables that could construct the dimensions were: Mega-projects have the correct skill sets; Transnet has lots of resources but experience and exposure is limiting' EPCMs have the correct skill sets for delivering mega-projects; local and expatriate skills sets are required for mega-project execution; and there are too many people changes in the life of mega-project affecting smooth project delivery (Table 5.24).

## 5.9 OBJECTIVE 7: COMMUNICATION

Nine Likert-type statements were posed to determine communication status in mega-projects. Results show that there were mixed responses in this regard. For example, most of the participants positively highlighted that project managers are responsible for communications, and that there are too many people giving different instructions in mega-projects. On the other hand, most of the participants negatively reported that there are no

issues with communications, and the time span of mega-project is too long to have effective communications (Table 5.25).

Table 5.25: Summary of statements regarding communications in Mega-Projects

| Statements | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree | Rating Average |
|---|---|---|---|---|---|---|
| 14.1 Project Managers are responsible for Communications | 3 | 10 | 12 | 96 | 70 | 4.15 |
| 14.2 There is adequate resources to deal with external stakeholders | 11 | 52 | 51 | 67 | 10 | 3.07 |
| 14.3 There are no issues with communications | 63 | 74 | 28 | 23 | 3 | 2.10 |
| 14.4 There is inadequate communications between the Owners team and EPCM to manage mega-projects | 10 | 47 | 47 | 62 | 25 | 3.24 |
| 14.5 There are too many people giving different instructions in mega-projects | 3 | 24 | 36 | 84 | 44 | 3.74 |
| 14.6 The time span of mega-project is too long to have effective communications | 27 | 82 | 42 | 33 | 7 | 2.53 |
| 14.7 Project progress meetings are effective | 8 | 37 | 29 | 85 | 32 | 3.50 |
| 14.8 There are detailed communications plans developed for mega-projects | 18 | 56 | 57 | 51 | 9 | 2.88 |
| 14.9 Communication plans are effective | 17 | 58 | 60 | 44 | 12 | 2.87 |

KMO and Bartlett's Test showed that the data were adequate for factor analysis with regard to communications in mega-projects (Table 5.26).

Table 5.26: KMO and Bartlett's Test for communications in mega-projects

| KMO and Bartlett's Test | | |
|---|---|---|
| KMO Measure of Sampling Adequacy. | | .684 |
| Bartlett's Test of Sphericity | Approx. Chi-Square | 262.796 |
| | df | 36 |
| | Sig. | .000 |

Figure 5.14 shows the eigenvalue distribution of all the statements for communications in mega-projects. The variables having eigenvalues 1 or higher were included for further analysis. There were five variables that had eigenvalues greater than 1 (Figure 5.14).

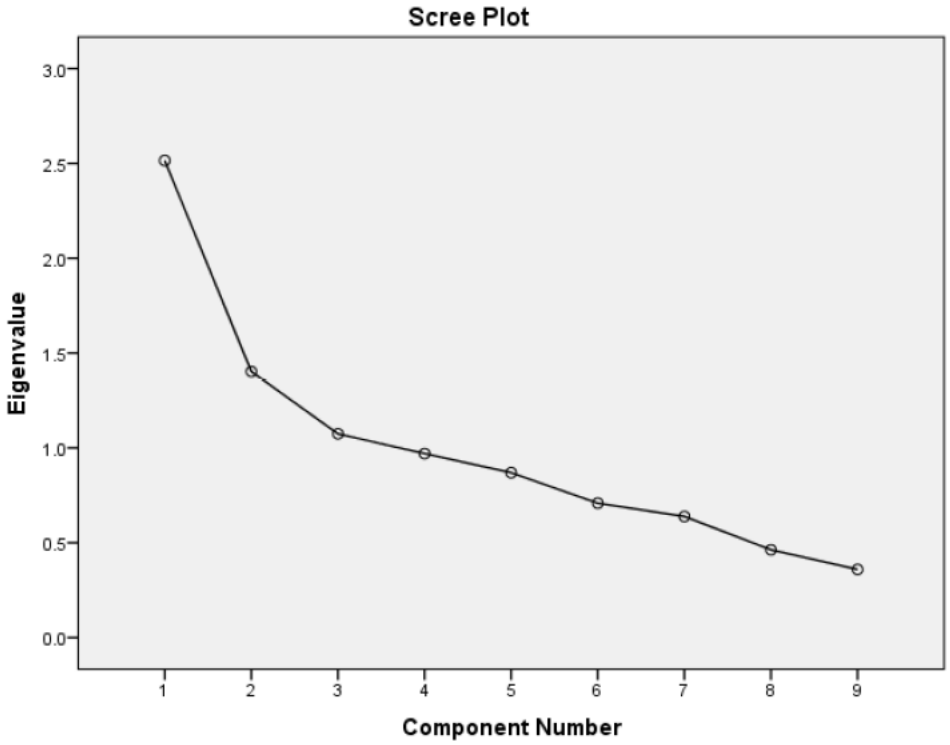


Figure 5.14: Eigenvalue distribution for communications in mega-projects

The present study found three variables could explain 55% of the variability of the dimensions (Table 5.27).

Table 5.27: Total variance explained for communications in mega-projects

| Component | Extraction Sums of Squared Loadings | | |
|---|---|---|---|
| | Total | % of Variance | Cumulative % |
| 1 | 2.515 | 27.947 | 27.947 |
| 2 | 1.403 | 15.586 | 43.533 |
| 3 | 1.074 | 11.935 | 55.468 |

Table 5.28: Rotated Component Matrix[a] for communications in mega-projects

| **Rotated Component Matrix[a]** | Component | | |
|---|---|---|---|
| | 1 | 2 | 3 |
| 14.1 Project Managers are responsible for Communications | .098 | .571 | -.081 |
| 14.2 There is adequate resources to deal with external stakeholders | .639 | .341 | -.283 |
| 14.3 There are no issues with communications | .601 | -.149 | .224 |
| 14.4 There is inadequate communications between the Owners team and EPCM to manage mega-projects | -.041 | .713 | .243 |
| 14.5 There are too many people giving different instructions in mega-projects | -.045 | .670 | -.070 |
| 14.6 The time span of mega-project is too long to have effective communications | .093 | .033 | .937 |
| 14.7 Project progress meetings are effective | .642 | .003 | .018 |
| 14.8 There are detailed communications plans developed for mega-projects | .801 | .077 | .050 |
| 14.9 Communication plans are effective | .798 | -.021 | .005 |
| *Extraction Method: Principal component analysis.*<br>*Rotation Method: Varimax with Kaiser Normalization.* | | | |
| *a. Rotation converged in four iterations.* | | | |

Using Varimax with Kaiser Normalization, it was found that the three variables that could construct the dimension were: there are detailed communications plans developed for mega-projects; there is inadequate communications between the owner's team and EPCM to manage mega-projects; and the time span of mega-projects is too long to have effective communications (Table 5.28).

## 5.10 OBJECTIVE 8: TO DETERMINE IF RISKS ARE CONTINUALLY IDENTIFIED, REVIEWED AND MANAGED

To investigate the risk management for the mega-project, seven Likert-type statements were presented. It was found that all the statements had a mean score of 3.00 or higher. This meant that more participants responded positively to all the statements. For example, more participants agreed or strongly agreed that there are too many risks to manage in mega-projects, and mega-projects are complex therefore there will always be unknown risks that cannot be managed (Table 5.29).

Table 5.29: Summary of statements regarding Managing risks in mega-projects

| Statements | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree | Rating Average |
|---|---|---|---|---|---|---|
| 15.1 There are too many risks to manage in mega-projects | 4 | 49 | 18 | 74 | 46 | 3.57 |
| 15.2 It is difficult to manage all risks in mega-projects | 10 | 62 | 26 | 77 | 16 | 3.14 |
| 15.3 Mega-projects are complex therefore there will always be unknown risks that cannot be managed | 6 | 40 | 29 | 87 | 29 | 3.49 |
| 15.4 The appropriate level of risk management skill sets is not available on mega-projects | 7 | 49 | 39 | 69 | 27 | 3.31 |
| 15.5 The Transnet risk model is adequate to manage risks on mega-projects | 17 | 45 | 59 | 56 | 14 | 3.03 |
| 15.6 There are too many risks to manage in mega-projects | 5 | 48 | 31 | 77 | 30 | 3.41 |
| 15.7 It is difficult to manage all risks in mega-projects | 12 | 61 | 27 | 74 | 17 | 3.12 |

KMO and Bartlett's Test showed that the data were adequate for factor analysis with regards to managing risks in mega-projects (Table 5.30).

Table 5.30: KMO and Bartlett's Test for managing risks in mega-projects

| **KMO and Bartlett's Test** | | |
|---|---|---|
| KMO Measure of Sampling Adequacy. | | .640 |
| Bartlett's Test of Sphericity | Approx. Chi-Square | 411.298 |
| | df | 21 |
| | Sig. | .000 |

Figure 5.15 shows the eigenvalue distribution of all the statements for managing risks in mega-projects. The variables having eigenvalues 1 or higher to be included for further analysis. There were five variables that had eigenvalues greater than 1 (Figure 5.15).

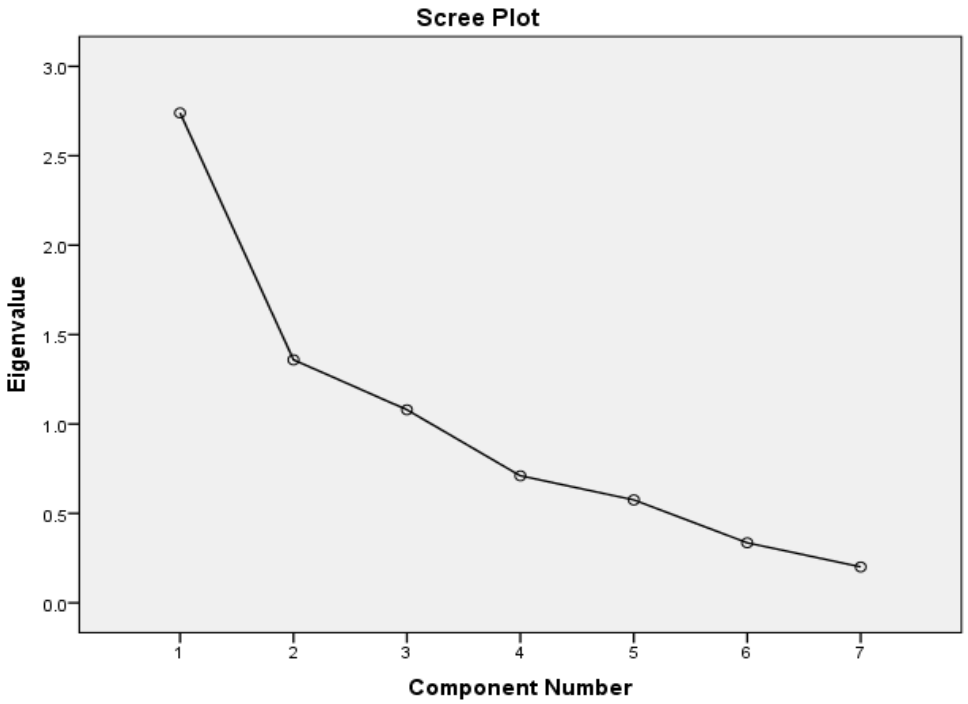


Figure 5.15: Eigenvalues for managing risks in mega-projects

The study found three variables could explain 74% of the variability of the dimensions (Table 5.31).

Table 5.31: Total variance explained for managing risks in mega-projects

| | Extraction Sums of Squared Loadings | | |
|---|---|---|---|
| Component | Total | % of Variance | Cumulative % |
| 1 | 2.740 | 39.136 | 39.136 |
| 2 | 1.359 | 19.411 | 58.547 |
| 3 | 1.080 | 15.423 | 73.970 |

Table 5.32: Rotated component matrix[a] for managing risks in mega-projects

| **Rotated Component Matrix[a]** | | | |
|---|---|---|---|
| | Component | | |
| | 1 | 2 | 3 |
| 15.1 There are too many risks to manage in mega-projects | .131 | .933 | -.005 |
| 15.2 It is difficult to manage all risks in mega-projects | .831 | .190 | .081 |
| 15.3 Mega-projects are complex therefore there will always be unknown risks that cannot be managed | .743 | .081 | .129 |
| 15.4 The appropriate level of risk management skill sets is not available on mega-projects | .400 | -.012 | .641 |
| 15.5 The Transnet risk model is adequate to manage risks on mega-projects | .079 | -.062 | -.883 |
| 15.6 There are too many risks to manage in mega-projects | .191 | .912 | .071 |
| 15.7 It is difficult to manage all risks in mega-projects | .851 | .153 | .003 |
| *Extraction Method: Principal component analysis.*<br>*Rotation Method: Varimax with Kaiser Normalization.* | | | |
| *a. Rotation converged in five iterations.* | | | |

Using Varimax with Kaiser Normalization, it was found that the three variables that could construct the dimension were: it is difficult to manage all risks in mega-projects; there are too many risks to manage in mega-projects; and the appropriate level of risk management skill sets are not available on mega-projects (Table 5.32).

## 5.11 OBJECTIVE 9: TO ASCERTAIN IF PROCUREMENT PROCESSES ARE AFFECTING THE DELIVERY OF PROJECTS

In complex mega-projects, the entire supply chain and its networks are required to be efficiently coordinated and managed to deliver the business-case's investment value (Pilbeam et al., 2012). The management of contractor's teams plays a key role in achieving the projects schedule performance. Thus, a sound relationship between the client and contractor teams is a winning formula for project success (Apooja et al., 2013).

There were 20 statements posed to investigate the procurement of the mega-projects. Results showed that most of the statements had a mean score higher than three (3) indicating more participants agreed or strongly agreed with most of the statements. For example, the majority of the participants agreed or strongly agreed that procurement processes are too long and there are too many work packages on mega-projects. The study also found that more participants responded negatively to: good contractor performance is rewarded; contractors are effectively managed by TCP's EPCMs; and client teams respond efficiently to contractor queries.

Table 5.33: Summary of statements with regards to procurement in mega-projects

| Statements | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree | Rating Average |
|---|---|---|---|---|---|---|
| 16.1 Procurement processes are too long | 2 | 19 | 25 | 67 | 78 | 4.05 |
| 15.2 There are too many work packages on mega-projects | 3 | 31 | 39 | 84 | 34 | 3.60 |
| 15.3 Contract strategies are aligned to transformation requirements | 9 | 21 | 67 | 67 | 27 | 3.43 |
| 15.4 Transformation requirements are easily met by Contractors | 25 | 62 | 55 | 43 | 6 | 2.70 |
| 15.5 The appropriate suite of contracts is applied to mega-projects | 13 | 23 | 80 | 60 | 15 | 3.21 |
| 15.6 Contract administration is a nightmare on mega-projects | 5 | 40 | 51 | 59 | 36 | 3.42 |
| 15.7 Disputes are easily resolved | 35 | 71 | 64 | 20 | 1 | 2.38 |
| 15.8 BEE contractors have good support from Transnet | 13 | 29 | 56 | 78 | 15 | 3.28 |
| 15.9 Transnet tender requirements are well supported by BEE contractors | 10 | 31 | 72 | 66 | 12 | 3.20 |
| 15.10 Transnet project managers have the appropriate level of delegation of authority (DOA) to efficiently managers | 17 | 46 | 67 | 52 | 9 | 2.95 |
| 15.11 Contractors are effectively managed by TCP | 21 | 56 | 48 | 59 | 7 | 2.87 |
| 15.12 Good contractor performance is rewarded | 22 | 52 | 75 | 36 | 6 | 2.75 |
| 15.13 Contractors have the right teams to manage construction work | 9 | 48 | 69 | 59 | 6 | 3.03 |
| 15.14 There is sufficient contingencies in mega-project budgets | 16 | 52 | 62 | 56 | 5 | 2.91 |
| 15.15 The design team plays a meaningful role in the selection of construction contractors | 11 | 58 | 55 | 57 | 10 | 2.98 |
| 15.16 TCP has the right skill levels to manage contractors | 19 | 57 | 40 | 63 | 12 | 2.96 |
| 15.17 Clients' teams respond efficiently to contractor queries | 14 | 55 | 69 | 49 | 4 | 2.86 |
| 15.18 Contractor / Client conflict is hampering mega-project delivery | 1 | 32 | 66 | 75 | 17 | 3.39 |
| 16.19 Procurement processes are too long | 5 | 21 | 31 | 71 | 63 | 3.87 |
| 15.20 Contractors are effectively managed by TCP's EPCM's | 18 | 57 | 56 | 53 | 7 | 2.86 |

KMO and Bartlett's Test showed that the data were adequate for factor analysis with regards to procurement in mega-projects (Table 5.34).

Table 5.34: KMO and Bartlett's Test for procurement in mega-projects

| **KMO and Bartlett's Test** | | |
|---|---|---|
| KMO Measure of Sampling Adequacy. | | .730 |
| Bartlett's Test of Sphericity | Approx. Chi-Square | 1043.168 |
| | df | 190 |
| | Sig. | .000 |

Figure 5.16 shows the eigenvalue distribution of all the statements for procurement in mega-projects. The variables having eigenvalues 1 or higher were included for further analysis. There were six variables that had eigenvalues greater than 1 (Figure 5.16).

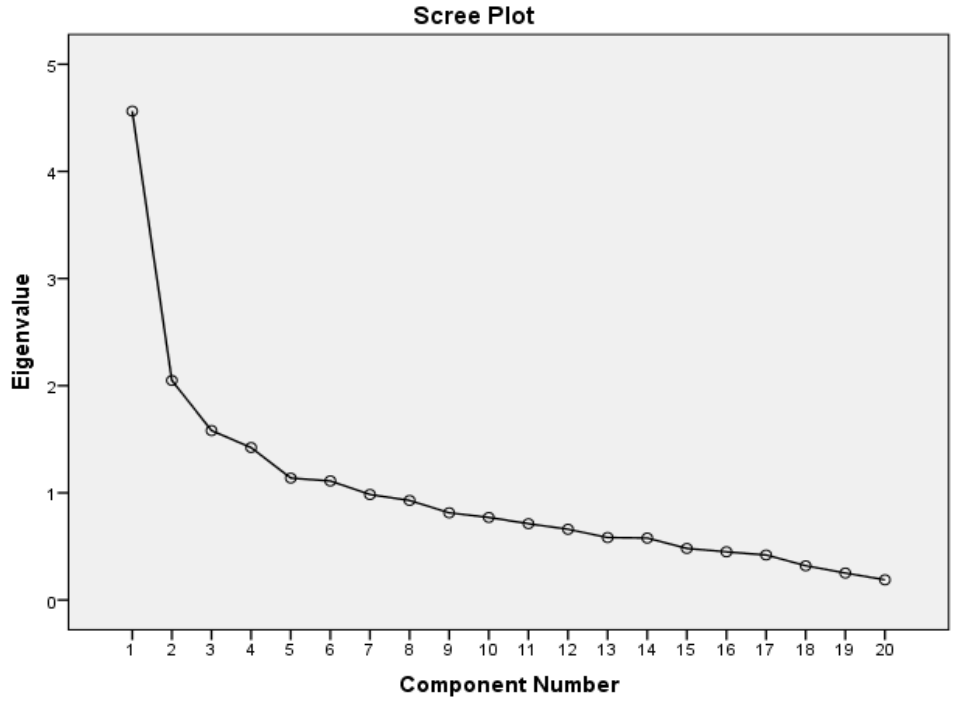


Figure 5.16: Distribution of eigenvalues for procurement in mega-projects

The present study found that the six variables could explain 59% of the variability of the dimensions (Table 5.36).

Table 5.35: Total variance explained for procurement in mega-projects

| | Extraction Sums of Squared Loadings | | |
|---|---|---|---|
| Component | Total | % of Variance | Cumulative % |
| 1 | 4.562 | 22.811 | 22.811 |
| 2 | 2.049 | 10.243 | 33.054 |
| 3 | 1.581 | 7.904 | 40.958 |
| 4 | 1.422 | 7.112 | 48.070 |
| 5 | 1.138 | 5.688 | 53.758 |
| 6 | 1.111 | 5.553 | 59.312 |

Using Varimax with Kaiser Normalization, it was found that the six variables that could construct the dimension were: contractors are effectively managed by TCP's EPCMs; the appropriate suite of contracts is applied to mega-projects; BEE contractors have good support from Transnet; procurement processes are too long; disputes are easily resolved; and contractor / client conflict hampers mega-project delivery (Table 5.36).

Table 5.36: Rotated component matrix[a] for procurement in mega-projects

| **Rotated Component Matrix[a]** | | | | | | |
|---|---|---|---|---|---|---|
| | Component | | | | | |
| | 1 | 2 | 3 | 4 | 5 | 6 |
| 16.1 Procurement processes are too long | -.137 | -.005 | -.042 | .892 | -.157 | .053 |
| 15.2 There are too many work packages on mega-projects | .195 | .119 | -.192 | .242 | -.309 | .478 |
| 15.3 Contract strategies are aligned to transformation requirements | -.010 | .680 | .270 | .028 | -.192 | -.113 |
| 15.4 Transformation requirements are easily met by Contractors | -.065 | .408 | .358 | -.051 | .425 | .282 |
| 15.5 The appropriate suite of contracts is applied to mega-projects | .168 | .741 | .085 | -.067 | .078 | .049 |
| 15.6 Contract administration is a nightmare on mega-projects | -.247 | .177 | -.028 | .132 | -.686 | .195 |
| 15.7 Disputes are easily resolved | .190 | .179 | .153 | -.108 | .697 | .009 |
| 15.8 BEE contractors have good support from Transnet | .090 | .165 | .830 | .012 | -.038 | -.043 |
| 15.9 Transnet tender requirements are well supported by BEE contractors | .187 | .124 | .703 | .062 | .214 | -.019 |
| 15.10 Transnet project managers have the appropriate level of DOA to efficiently managers | .499 | .162 | .337 | -.304 | .039 | -.063 |
| 15.11 Contractors are effectively managed by TCP | .710 | .379 | .000 | .045 | .068 | -.083 |
| 15.12 Good Contractor performance is rewarded | .578 | -.135 | .433 | -.088 | .079 | .043 |
| 15.13 Contractors have the right teams to manage construction work | .151 | .549 | -.148 | .000 | .425 | .049 |
| 15.14 There is sufficient contingencies in mega-project budgets | .471 | -.107 | .377 | -.120 | .067 | .115 |
| 15.15 The design team plays a meaningful role in the selection of construction contractors | .316 | .209 | .041 | -.064 | -.003 | .509 |
| 15.16 TCP has the right skill levels to manage Contractors | .711 | -.006 | .069 | -.084 | .135 | .098 |
| 15.17 Clients' teams respond efficiently to contractor queries | .627 | -.004 | -.014 | -.242 | .140 | .136 |
| 15.18 Contractor / Client conflict is hampering mega-project delivery | -.139 | -.216 | .025 | .064 | .005 | .771 |
| 16.19 Procurement processes are too long | -.122 | -.034 | .061 | .908 | -.059 | .049 |
| 15.20 Contractors are effectively managed by TCP's EPCM's | .718 | .348 | .097 | .112 | .110 | -.073 |
| *Extraction Method: Principal component analysis.*<br>*Rotation Method: Varimax with Kaiser Normalization.* | | | | | | |
| *a. Rotation converged in 10 iterations.* | | | | | | |

## 5.12 OBJECTIVE 10: TO UNDERSTAND THE IMPACTS OF STAKEHOLDER MANAGEMENT IN MEGA-PROJECTS

According to PMI (2013:23), stakeholders can be defined as "a person or organisations such as customers, sponsors, the performing organisation or the public, who are actively involved in the project, or whose interest may be positively or negatively affected by the performance or completion of the project". PMI explains further that stakeholders have different levels of responsibility and authority when participating in a project and these responsibilities and authority can change during the course of the project life cycle.

With regard to managing stakeholders in mega-projects, it was found that more participants positively responded to most of the statements as the mean score was three (3) or higher. For example, most of the participants agreed or strongly agreed that mega-projects create a large number of jobs during the construction phase; more time should be spent on mega-projects to understand community issues and requirements; and stakeholder stoppages lead to added costs to projects.

Table 5.37: Summary of statements with regards to managing stakeholders in mega-projects

| Statements | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree | Rating Average |
|---|---|---|---|---|---|---|
| 17.1 There are dedicated resources to manage stakeholders | 11 | 61 | 46 | 73 | 0 | 2.95 |
| 17.2 Budget for stakeholder management is available on mega-projects | 14 | 55 | 70 | 49 | 3 | 2.85 |
| 17.3 Work-stoppages are common on mega-projects | 0 | 16 | 60 | 105 | 10 | 3.57 |
| 17.4 ER is effective in the Contractor's teams | 6 | 36 | 92 | 54 | 3 | 3.06 |
| 17.5 Work is allocated to local communities | 4 | 32 | 64 | 82 | 9 | 3.31 |
| 17.6 Stakeholders are regularly consulted and provided with updates | 5 | 41 | 65 | 74 | 6 | 3.18 |
| 17.7 Customers in the end are satisfied with the project | 6 | 24 | 91 | 65 | 5 | 3.20 |
| 17.8 More time should be spent on mega-projects to understand community issues and requirements | 2 | 9 | 32 | 108 | 40 | 3.92 |
| 17.9 Mega-projects create large number of jobs during the construction phase | 0 | 5 | 29 | 100 | 57 | 4.09 |
| 17.10 Stakeholder stoppages lead to added costs to projects | 2 | 4 | 34 | 111 | 40 | 3.96 |
| 17.11 The cost of investing in community needs outweighs the risks of community resistance | 5 | 14 | 53 | 90 | 29 | 3.65 |
| 17.12 Environmental Authorisation processes delay projects | 8 | 27 | 37 | 78 | 41 | 3.61 |

KMO and Bartlett's Test showed that the data were adequate for factor analysis with regards to managing stakeholders in mega-projects (Table 5.38).

Table 5.38: KMO and Bartlett's Test for managing stakeholders in mega-projects

| **KMO and Bartlett's Test** | | |
|---|---|---|
| KMO Measure of Sampling Adequacy. | | .697 |
| Bartlett's Test of Sphericity | Approx. Chi-Square | 410.001 |
| | df | 66 |
| | Sig. | .000 |

Figure 5.17 shows the eigenvalue distribution of all the statements for managing stakeholders in mega-projects. The variables having eigenvalues 1 or higher were included for further analysis. There were five variables that had eigenvalues greater than 1.

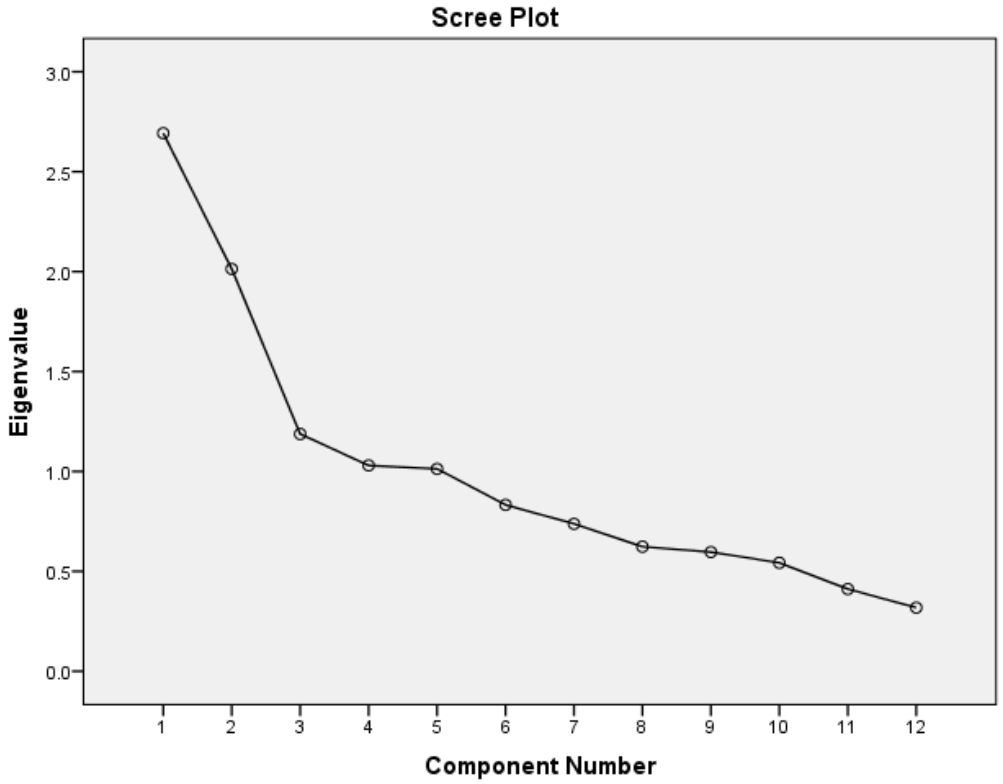


Figure 5.17: Distribution of eigenvalues for managing stakeholders in mega-projects

The study found that the five variables could explain 66% of the variability of the dimensions (Table 5.39).

Table 5.39: Total variance explained for managing stakeholders in mega-projects

| Component | Extraction Sums of Squared Loadings | | |
|---|---|---|---|
| | Total | % of Variance | Cumulative % |
| 1 | 2.693 | 22.438 | 22.438 |
| 2 | 2.014 | 15.779 | 39.217 |
| 3 | 1.187 | 9.894 | 49.111 |
| 4 | 1.030 | 8.583 | 57.694 |
| 5 | 1.013 | 8.442 | 65.136 |

Table 5.40: Rotated component matrix[a] for managing stakeholders in mega-projects

| **Rotated Component Matrix[a]** | | | | | |
|---|---|---|---|---|---|
| | Component | | | | |
| | 1 | 2 | 3 | 4 | 5 |
| 17.1 There are dedicated resources to manage stakeholders | .870 | -.064 | .076 | .069 | .004 |
| 17.2 Budget for stakeholder management is available on mega-projects | .871 | .018 | .174 | .072 | -.024 |
| 17.3 Work-stoppages are common on mega-projects | -.150 | .355 | -.228 | .667 | -.025 |
| 17.4 ER is effective in the contractor's teams | .262 | -.088 | .204 | .754 | .038 |
| 17.5 Work is allocated to local communities | .076 | .099 | .449 | .473 | -.031 |
| 17.6 Stakeholders are regularly consulted and provided with updates | .474 | .119 | .664 | .109 | .145 |
| 17.7 Customers in the end are satisfied with the project | .081 | .020 | .824 | .023 | -.062 |
| 17.8 More time should be spent on mega-projects to understand community issues and requirements | -.115 | .721 | .241 | -.181 | -.266 |
| 17.9 Mega-projects create large number of jobs during the construction phase | .113 | .598 | .155 | .306 | .127 |
| 17.10 Stakeholder stoppages lead to added costs to projects | -.190 | .689 | .056 | .079 | .185 |
| 17.11 The cost of investing in community needs outweighs the risks of community resistance | .232 | .600 | -.296 | .093 | .021 |
| 17.12 Environmental authorisation processes delay projects | -.006 | .083 | -.005 | -.008 | .960 |
| *Extraction Method: Principal component analysis.*<br>*Rotation Method: Varimax with Kaiser Normalization.* | | | | | |
| *a. Rotation converged in seven iterations.* | | | | | |

Using Varimax with Kaiser Normalization, it was found that the five variables that could construct the dimensions were: budget for stakeholder management is available on mega-projects; stakeholder stoppages lead to added costs to projects; customers in the end are satisfied with the project; employee relations (ER) are effective in the contractor's teams; and the environmental authorisation processes delay projects (Table 5.40).

## 5.13 NORMALITY TEST

Once all the important items were selected based on the factor analysis, and all the items scores were added to get the final score for the specific dimensions, a normality test was conducted. A normality test was conducted to ascertain whether the data follows a normal distribution. A normality test was conducted for all the dimensions before doing any further analysis. Kolmogorov-Smirnov test showed that the overall scores for all the dimensions

were not normally distributed (Table 5.41). Therefore, inferential test was done using non-parametric tests.

Table 5.41: Tests of normality output

| | Kolmogorov-Smirnov[a] | | | Shapiro-Wilk | | |
|---|---|---|---|---|---|---|
| | **Statistic** | **df** | **Sig.** | **Statistic** | **df** | **Sig.** |
| mega-projects' schedule | .088 | 191 | .001 | .982 | 191 | .013 |
| Managing costs on mega-projects | .127 | 191 | <.001 | .966 | 191 | .000 |
| Quality Management in Mega-Projects | .111 | 191 | <.001 | .972 | 191 | .001 |
| HR and skills on Mega-Projects | .125 | 191 | <.001 | .979 | 191 | .006 |
| Communications in Mega-Projects | .168 | 191 | <.001 | .902 | 191 | .000 |
| Managing risks in mega-projects | .098 | 191 | <.001 | .976 | 191 | .002 |
| Procurement in Mega-Projects | .111 | 191 | <.001 | .975 | 191 | .002 |
| Managing Stakeholders in Mega-Projects | .091 | 191 | .001 | .978 | 191 | .004 |
| **a. Lilliefors Significance Correction** | | | | | | |

## 5.14 INFERENTIAL STATISTICS

Under this section, the descriptive statistics data was used to estimate parameters of the population. The results of calculations performed on the data are presented in this section.

### 5.14.1 Nonparametric Test

Nonparametric testing was performed on the data namely Mann-Whitney Test where medians were compared between two groups. The Kruskal-Wallis Test was conducted to compare the means for three or more groups.

### 5.14.2 Hypotheses

Hypotheses were formulated to test the influence of variables among the different dimensions.

5.14.3.1 Hypothesis 1: There is no statistically significant difference in the mean ranks of the dimensions among the age groups.

Table 5.43 shows that the median scores for the entire dimensions were similar among the age group. None of the dimensions were significantly different when compared among the different age groups of the participants. The p-value for each dimension is greater than 0.05, therefore the null hypothesis fails is accepted.

Table 5.42: Comparison of median scores for all the dimensions among different age groups: Kruskal-Wallis Test- Dimension by Age

| Ranks | | | | Chi-Square | df | p-value |
|---|---|---|---|---|---|---|
| | Age group | N | Mean Rank | | | |
| Integration processes in mega-projects | <=30 years | 46 | 93.92 | 5.936 | 3 | 0.074 |
| | 31 -40 years | 64 | 100.41 | | | |
| | 41-50 years | 57 | 103.54 | | | |
| | | | | | | |
| | >50 years | 24 | 70.31 | | | |
| Scope of mega-projects | <=30 years | 46 | 105.53 | 2.708 | 3 | 0.439 |
| | 31 -40 years | 64 | 93.44 | | | |
| | 41-50 years | 57 | 94.54 | | | |
| | >50 years | 24 | 85.10 | | | |
| Mega-projects' schedule | <=30 years | 46 | 83.78 | 3.150 | 3 | 0.369 |
| | 31 -40 years | 64 | 99.03 | | | |
| | 41-50 years | 57 | 101.89 | | | |
| | >50 years | 24 | 97.33 | | | |
| Managing costs on mega-projects | <=30 years | 46 | 85.20 | 5.227 | 3 | 0.101 |
| | 31 -40 years | 64 | 92.05 | | | |
| | 41-50 years | 57 | 100.15 | | | |
| | >50 years | 24 | 117.40 | | | |
| Quality management in mega-projects | <=30 years | 46 | 104.02 | 1.532 | 3 | 0.675 |
| | 31 -40 years | 64 | 95.80 | | | |
| | 41-50 years | 57 | 91.30 | | | |
| | >50 years | 24 | 92.31 | | | |
| HR and skills on mega-projects | <=30 years | 46 | 97.09 | 2.968 | 3 | 0.397 |
| | 31 -40 years | 64 | 101.11 | | | |
| | 41-50 years | 57 | 86.05 | | | |
| | >50 years | 24 | 103.92 | | | |
| Communications in mega-projects | <=30 years | 46 | 103.75 | 3.596 | 3 | 0.309 |
| | 31 -40 years | 64 | 97.82 | | | |
| | 41-50 years | 57 | 85.18 | | | |
| | >50 years | 24 | 101.98 | | | |
| Managing risks in mega-projects | <=30 years | 46 | 100.78 | .544 | 3 | 0.909 |
| | 31 -40 years | 64 | 93.16 | | | |
| | 41-50 years | 57 | 96.02 | | | |
| | >50 years | 24 | 94.38 | | | |
| Procurement in mega-projects | <=30 years | 46 | 97.26 | .212 | 3 | 0.976 |
| | 31 -40 years | 64 | 94.66 | | | |
| | 41-50 years | 57 | 97.85 | | | |
| | >50 years | 24 | 92.75 | | | |
| Managing stakeholders in mega-projects | <=30 years | 46 | 95.78 | .533 | 3 | 0.912 |
| | 31 -40 years | 64 | 98.45 | | | |
| | 41-50 years | 57 | 95.41 | | | |
| | >50 years | 24 | 88.92 | | | |

- **Integration process in mega-projects**

The results concluded that for integration processes for mega-projects the chi-square is 5.936, the df= 3 and p= 0.075. Since p> 0.05, it can be concluded that there is no significant difference in the dimension for integration process for mega-projects and the age group of the respondents.

- **Scope of mega-projects**

The test show that for scope of mega-projects the chi-square is 2.708, the df= 3 and p= 0.439. Since p> 0.05, the test further shows that there is no significant difference in the dimension scope of mega-projects and the age group of the respondents.

- **Schedule of mega-projects**

The test show that for schedule of mega-projects the chi-square is 3.150, the df= 3 and p= 0.369. Since p> 0.05, the test further shows that there is no significant difference in the dimension for schedule of mega-projects and the age group of the respondents.

- **Managing costs on mega-projects**

The test show that for managing cost on mega-projects the chi-square is 5.227, the df= 3 and p= 0.101. Since p> 0.05, the test further shows that there is no significant difference in the dimension managing cost on mega-projects and the age group of the respondents.

- **Quality management in mega-projects**

The test show that for quality management in mega-projects the chi-square is 1.532, the df= 3 and p= 0.675. Since p> 0.05, the test further shows that there is no significant difference in the dimension for quality management in mega-projects and the age group of the respondents.

- **HR and skills on mega-projects**

The test show that for HR and skills on mega-projects the chi-square is 2.968, the df= 3 and p= 0.397. Since p> 0.05, the test further shows that there is no significant difference in the dimension for HR and skills on mega-projects and the age group of the respondents.

- **Communication in mega-projects**

The test show that for communication in mega-projects the chi-square is 3.596, the df= 3 and p= 0.309. Since p> 0.05, the test further shows that there is no significant difference in the dimension for communication in mega-projects and the age group of the respondents.

- **Managing risk in mega-projects**

The test show that for managing risk in mega-projects the chi-square is 0.544, the df= 3 and p= 0.909. Since p> 0.05, the test further shows that there is no significant difference in the dimension for managing risk in mega-projects and the age group of the respondents.

- **Procurement in mega-projects**

The test show that for procurement in mega-projects the chi-square is 0.212, the df= 3 and p= 0.976. Since p> 0.05, the test further shows that there is no significant difference in the dimension for integration process for mega-projects and the age group of the respondents.

- **Managing stakeholders in mega-projects**

The test show that for managing stakeholders in mega-projects the chi-square is 0.533, the df= 3 and p= 0.912. Since p> 0.05, the test further shows that there is no significant difference in the dimension for integration process for mega-projects and the age group of the respondents.

Table 5.43 shows that the median scores for the entire dimensions were similar among the age group. None of the dimensions were significantly different when compared among the different age groups of the participants. The p-value for each dimension is greater than 0.05, therefore the null hypothesis fails to be rejected.

5.14.3.2 Hypothesis 2: There is no statistically significant difference in the mean ranks of the dimensions among gender groups.

Table 5.44 shows that the median scores for the entire dimensions were similar among the gender groups. None of the dimensions were significantly different when compared among the different gender groups of the participants. The p-value for each dimension is greater than 0.05, therefore the null hypothesis fails to be rejected.

Table 5.43: Comparison of median scores for all the dimensions with regards to gender: Mann-Whitney Test: Dimension by Gender

| Ranks | | | | | Mann-Whitney U | Z value | p-value |
|---|---|---|---|---|---|---|---|
| | Gender | N | Mean Rank | Sum of Ranks | | | |
| Integration processes in mega-projects | Female | 59 | 89.48 | 5279.50 | 3509.500 | -1.107 | 0.268 |
| | Male | 132 | 98.91 | 13055.50 | | | |
| Scope of mega-projects | Female | 59 | 99.66 | 5880.00 | 3678.000 | -0.623 | 0.534 |
| | Male | 132 | 94.36 | 12456.00 | | | |
| Mega-projects' schedule | Female | 59 | 94.76 | 5591.00 | 3821.000 | -0.208 | 0.835 |
| | Male | 132 | 95.55 | 12745.00 | | | |
| Managing costs on mega-projects | Female | 59 | 94.94 | 5601.50 | 3831.500 | -0.180 | 0.857 |
| | Male | 132 | 95.47 | 12734.50 | | | |
| Quality management in mega-projects | Female | 59 | 87.51 | 5163.00 | 3393.000 | -1.440 | 0.150 |
| | Male | 132 | 99.80 | 13173.00 | | | |
| HR and skills on mega-projects | Female | 59 | 89.25 | 5265.50 | 3495.500 | -1.142 | 0.254 |
| | Male | 132 | 99.02 | 13070.50 | | | |
| Communications in mega-projects | Female | 59 | 96.03 | 5665.50 | 3892.500 | -0.004 | 0.997 |
| | Male | 132 | 95.99 | 12670.50 | | | |
| Managing risks in mega-projects | Female | 59 | 99.69 | 5881.50 | 3675.500 | -0.622 | 0.534 |
| | Male | 132 | 94.35 | 12454.50 | | | |
| Procurement in mega-projects | Female | 59 | 90.97 | 5367.00 | 3597.000 | -0.848 | 0.396 |
| | Male | 132 | 98.25 | 12969.00 | | | |
| Managing stakeholders in mega-projects | Female | 59 | 90.84 | 5359.50 | 3589.500 | -0.871 | 0.384 |
| | Male | 132 | 98.31 | 12975.50 | | | |

- **Integration process in mega-projects**

The test show that for integration processes for mega-projects U= 3509.500, Z= -1.107 and p= 0.268 Since p> 0.05, the test further shows that there is no significant difference in the dimension for integration process for mega-projects and the gender of the respondents.

- **Scope of mega-projects**

The test show that for scope of mega-projects U= 3678.000, Z= -0.623 and p= 0.534. Since p> 0.05, the test further shows that there is no significant difference in the dimension scope of mega-projects and the gender of the respondents.

- **Schedule Mega-projects**

The test show that for schedule of mega-projects U=3821.000, Z=-0.208 and p= 0.835. Since p> 0.05, the test further shows that there is no significant difference in the dimension for schedule of mega-projects and the gender of the respondents.

- **Managing costs on mega-projects**

The test show that for managing cost on mega-projects U= 3831.500, Z= -0.180 and p= 0.857. Since p> 0.05, the test further shows that there is no significant difference in the dimension managing cost on mega-projects and the gender of the respondents.

- **Quality management in mega-projects**

The test show that for quality management in mega-projects U= 3393.000, Z = -1.440 and p= 0.150. Since p> 0.05, the test further shows that there is no significant difference in the dimension for quality management in mega-projects and the gender of the respondents.

- **HR and skills on mega-projects**

The test show that for HR and skills on mega-projects U= 3495.500, Z = -1.142 and p= 0.254. Since p> 0.05, the test further shows that there is no significant difference in the dimension for HR and skills on mega-projects and the gender of the respondents.

- **Communication in mega-projects**

The test show that for communication in mega-projects U = 3892.500, Z = -0.004 and p= 0.997. Since p> 0.05, the test further shows that there is no significant difference in the dimension for communication in mega-projects and the gender of the respondents.

- **Managing risk in mega-projects**

The test show that for managing risk in mega-projects U= 3675.500, Z = -0.622 and p= 0.534. Since p> 0.05, the test further shows that there is no significant difference in the dimension for managing risk in mega-projects and the gender of the respondents.

- **Procurement in mega-projects**

The test show that for procurement in mega-projects U = 3597.000, Z = -0.848 and p= 0.396. Since p> 0.05, the test further shows that there is no significant difference in the dimension for integration process for mega-projects and the gender of the respondents.

- **Managing stakeholders in mega-projects**

The test show that for managing stakeholders in mega-projects U = 3589.500, Z = -0.871 and p= 0.912. Since p> 0.05, the test further shows that there is no significant difference in the dimension for integration process for mega-projects and the gender of the respondents.

5.14.3.3 Hypothesis 3: There is no statistically significant difference in the mean ranks of the dimensions among race groups.

The study found that the median scores for mega-projects dimensions Schedule, Costs, Communications, Risk and Procurement were similar among the different race groups (p>0.05). However, the dimensions of Integration, Scope, Quality, HR and Skills, Stakeholder management had p-values < 0.05. Since p< 0.05, the test shows that there is a significant difference in these dimensions and the race of the respondents, hence the null hypothesis is rejected.

Table 5.44: Comparison of median scores for all the dimensions among different race groups: Kruskal-Wallis Test: Dimension by Race

| Ranks | | | | Chi-Square | df | p-value |
|---|---|---|---|---|---|---|
| | Race | N | Mean Rank | | | |
| Integration processes in mega-projects | Black | 98 | 105.60 | 9.643 | 4 | 0.047 |
| | Coloured | 11 | 81.41 | | | |
| | Indian | 35 | 85.40 | | | |
| | White | 44 | 83.55 | | | |
| | Other | 3 | 142.17 | | | |
| Scope of mega-projects | Black | 98 | 109.07 | 15.955 | 4 | 0.002 |
| | Coloured | 11 | 99.50 | | | |
| | Indian | 35 | 74.31 | | | |
| | White | 44 | 80.26 | | | |
| | Other | 3 | 140.00 | | | |
| Mega-projects' schedule | Black | 98 | 95.97 | 3.094 | 4 | 0.542 |
| | Coloured | 11 | 85.95 | | | |
| | Indian | 35 | 105.66 | | | |
| | White | 44 | 91.09 | | | |
| | Other | 3 | 60.50 | | | |
| Managing costs on mega-projects | Black | 98 | 88.27 | 7.635 | 4 | 0.106 |
| | Coloured | 11 | 108.50 | | | |
| | Indian | 35 | 94.76 | | | |
| | White | 44 | 107.30 | | | |
| | Other | 3 | 151.50 | | | |
| Quality management in mega-projects | Black | 98 | 105.57 | 10.480 | 4 | 0.033 |
| | Coloured | 11 | 85.41 | | | |
| | Indian | 35 | 86.07 | | | |
| | White | 44 | 80.09 | | | |
| | Other | 3 | 135.00 | | | |
| HR and skills on mega-projects | Black | 98 | 105.60 | 11.379 | 4 | 0.023 |
| | Coloured | 11 | 75.82 | | | |
| | Indian | 35 | 74.27 | | | |

| Ranks | | | | Chi-Square | df | p-value |
|---|---|---|---|---|---|---|
| | Race | N | Mean Rank | | | |
| | White | 44 | 99.28 | | | |
| | Other | 3 | 61.83 | | | |
| Communications in mega-projects | Black | 98 | 100.36 | 7.581 | 4 | 0.108 |
| | Coloured | 11 | 94.59 | | | |
| | Indian | 35 | 103.99 | | | |
| | White | 44 | 77.92 | | | |
| | Other | 3 | 130.83 | | | |
| Managing risks in mega-projects | Black | 98 | 103.21 | 5.917 | 4 | 0.205 |
| | Coloured | 11 | 94.77 | | | |
| | Indian | 35 | 97.40 | | | |
| | White | 44 | 79.10 | | | |
| | Other | 3 | 95.33 | | | |
| Procurement in mega-projects | Black | 98 | 99.28 | .847 | 4 | 0.932 |
| | Coloured | 11 | 87.86 | | | |
| | Indian | 35 | 94.46 | | | |
| | White | 44 | 92.13 | | | |
| | Other | 3 | 93.50 | | | |
| Managing stakeholders in mega-projects | Black | 98 | 105.99 | 10.904 | 4 | 0.028 |
| | Coloured | 11 | 102.23 | | | |
| | Indian | 35 | 77.90 | | | |
| | White | 44 | 83.91 | | | |
| | Other | 3 | 135.17 | | | |

- **Integration process in mega-projects**

The test show that for integration processes for mega-projects the chi-square is 9.643, the df= 4 and p= 0.047. Since p< 0.05, the test further shows that there is a significant difference in the dimension for integration process for mega-projects and the race of the respondents.

- **Scope of mega-projects**

The test show that for scope of mega-projects the chi-square is 15.955, the df= 4 and p= 0.002. Since p< 0.05, the test further shows that there is a significant difference in the dimension scope of mega-projects and the race of the respondents.

- **Schedule of mega-projects**

The test show that for schedule of mega-projects the chi-square is 3.094, the df= 4 and p= 0.542. Since p> 0.05, the test further shows that there is no significant difference in the dimension for schedule of mega-projects and the race of the respondents.

- **Managing costs on mega-projects**

The test show that for managing cost on mega-projects the chi-square is 7.635, the df= 4 and p= 0.106. Since p> 0.05, the test further shows that there is no significant difference in the dimension managing cost on mega-projects and the race of the respondents.

- **Quality management in mega-projects**

The test show that for quality management in mega-projects the chi-square is 10.480, the df= 4 and p= 0.033. Since p< 0.05, the test further shows that there is a significant difference in the dimension for quality management in mega-projects and the race of the respondents.

- **HR and skills on mega-projects**

The test show that for HR and skills on mega-projects the chi-square is 11.379, the df= 4 and p= 11.379. Since p< 0.05, the test further shows that there is a significant difference in the dimension for HR and skills on mega-projects and the race of the respondents.

- **Communication in mega-projects**

The test show that for communication in mega-projects the chi-square is 7.581, the df= 4 and p= 0.108. Since p> 0.05, the test further shows that there is no significant difference in the dimension for communication in mega-projects and the race of the respondents.

- **Managing risk in mega-projects**

The test show that for managing risk in mega-projects the chi-square is 5.917, the df= 4 and p= 0.205. Since p> 0.05, the test further shows that there is no significant difference in the dimension for managing risk in mega-projects and the race of the respondents.

- **Procurement in mega-projects**

The test show that for procurement in mega-projects the chi-square is 0.847, the df= 4 and p= 0.932. Since p> 0.05, the test further shows that there is no significant difference in the dimension for integration process for mega-projects and the race of the respondents.

- **Managing stakeholders in mega-projects**

The test show that for managing stakeholders in mega-projects the chi-square is 10.904, the df= 4 and p= 0.028. Since p< 0.05, the test further shows that there is a significant difference in the dimension for integration process for mega-projects and the race of the respondents.

5.14.3.4 Hypothesis 4: There is no statistically significant difference in the mean ranks of the dimensions among marital status

The results presented in Table 5.45 indicates that the median scores for all the dimensions were similar with regards to participants' marital status ($p>0.05$). None of the dimensions were significantly different when compared among the different age groups of the participants. The p-value for each dimension is greater than 0.05, therefore the null hypothesis is accepted.

Table 5.45: Comparison of median scores for all the dimensions among different marital status groups: Kruskal-Wallis Test: Dimension by Marital Status

| Ranks | | | | Chi-Square | df | p-value |
|---|---|---|---|---|---|---|
| | Marital status | N | Mean Rank | | | |
| Integration processes in mega-projects | Single | 60 | 85.33 | 3.077 | 3 | 0.380 |
| | Married | 120 | 99.38 | | | |
| | Divorced | 7 | 96.07 | | | |
| | Other | 3 | 122.33 | | | |
| Scope of mega-projects | Single | 60 | 101.35 | 2.543 | 3 | 0.468 |
| | Married | 120 | 91.17 | | | |
| | Divorced | 7 | 115.79 | | | |
| | Other | 3 | 104.50 | | | |
| Mega-projects' schedule | Single | 60 | 81.89 | 5.510 | 3 | 0.089 |
| | Married | 120 | 102.21 | | | |
| | Divorced | 7 | 107.71 | | | |
| | Other | 3 | 70.83 | | | |
| Managing costs on mega-projects | Single | 60 | 83.23 | 10.470 | 3 | 0.015 |
| | Married | 120 | 98.09 | | | |
| | Divorced | 7 | 127.71 | | | |
| | Other | 3 | 162.33 | | | |
| Quality management in mega-projects | Single | 60 | 105.38 | 3.621 | 3 | 0.305 |
| | Married | 120 | 91.43 | | | |
| | Divorced | 7 | 93.57 | | | |
| | Other | 3 | 65.17 | | | |
| HR and skills on mega-projects | Single | 60 | 91.73 | 1.148 | 3 | 0.766 |
| | Married | 120 | 95.63 | | | |
| | Divorced | 7 | 95.50 | | | |
| | Other | 3 | 123.67 | | | |
| Communications in mega-projects | Single | 60 | 99.50 | 0.696 | 3 | 0.874 |
| | Married | 120 | 93.15 | | | |
| | Divorced | 7 | 102.71 | | | |
| | Other | 3 | 92.50 | | | |
| Managing risks in mega-projects | Single | 60 | 95.43 | 4.532 | 3 | 0.209 |
| | Married | 120 | 94.70 | | | |
| | Divorced | 7 | 75.86 | | | |
| | Other | 3 | 155.00 | | | |
| Procurement in mega-projects | Single | 60 | 94.22 | 1.149 | 3 | 0.765 |
| | Married | 120 | 95.60 | | | |
| | Divorced | 7 | 113.14 | | | |
| | Other | 3 | 76.00 | | | |
| Managing stakeholders in mega-projects | Single | 60 | 101.98 | 1.734 | 3 | 0.629 |
| | Married | 120 | 91.99 | | | |

| Ranks | | | | Chi-Square | df | p-value |
|---|---|---|---|---|---|---|
| | Marital status | N | Mean Rank | | | |
| | Divorced | 7 | 92.07 | | | |
| | Other | 3 | 114.33 | | | |

- **Integration process in mega-projects**

The test show that for integration processes of mega-projects the chi-square is 3.077, the df= 3 and p= 0.380. Since p> 0.05, the test further shows that there is a significant difference in the dimension for integration process for mega-projects and the marital status of the respondents.

- **Scope of mega-projects**

The test show that for scope of mega-projects the chi-square is 2.543, the df= 3 and p= 0.468. Since p> 0.05, the test further shows that there is no significant difference in the dimension scope of mega-projects and the marital status of the respondents.

- **Schedule of mega-projects**

The test show that for schedule of mega-projects the chi-square is 5.510, the df= 3 and p= 0.089. Since p> 0.05, the test further shows that there is no significant difference in the dimension for schedule of mega-projects and the marital status of the respondents.

- **Managing costs on mega-projects**

The test show that for managing cost on mega-projects the chi-square is 10.470, the df= 3 and p= 0.015. Since p< 0.05, the test further shows that there is a significant difference in the dimension managing cost on mega-projects and the marital status of the respondents.

- **Quality management in mega-projects**

The test show that for quality management in mega-projects the chi-square is 3.621, the df= 3 and p= 0.305. Since p> 0.05, the test further shows that there is no significant difference in the dimension for quality management in mega-projects and the marital status of the respondents.

- **HR and skills on mega-projects**

The test show that for HR and skills on mega-projects the chi-square is 1.148, the df= 3 and p= 0.766. Since p> 0.05, the test further shows that there is no significant difference in the dimension for HR and skills on mega-projects and the marital status of the respondents.

- **Communication in mega-projects**

The test show that for communication in mega-projects the chi-square is 0.696, the df= 3 and p= 0.874. Since p> 0.05, the test further shows that there is no significant difference in the dimension for communication in mega-projects and the marital status of the respondents.

- **Managing risk in mega-projects**

The test show that for managing risk in mega-projects the chi-square is 4.532, the df= 3 and p= 0.209. Since p> 0.05, the test further shows that there is no significant difference in the dimension for managing risk in mega-projects and the marital status of the respondents.

- **Procurement in mega-projects**

The test show that for procurement in mega-projects the chi-square is 1.149, the df= 3 and p= 0.765. Since p> 0.05, the test further shows that there is no significant difference in the dimension for integration process for mega-projects and the marital status of the respondents.

- **Managing stakeholders in mega-projects**

The test show that for managing stakeholders in mega-projects the chi-square is 1.734, the df= 3 and p= 0.629. Since p> 0.05, the test further shows that there is no significant difference in the dimension for integration process for mega-projects and the marital status of the respondents. Therefore this hypothesis is accepted.

5.14.3.5 Hypothesis 5: There is no statistically significant difference in the mean ranks of the dimensions among participants level of education.

It was found that the median scores for all the dimensions were similar (Table 5.46) with regards to level of education (p>0.05). This meant that education did not have any impact on the dimensions, hence the null hypothesis is accepted.

Table 5.46: Comparison of median scores for all the dimensions among participants' level of education: Mann-Whitney test: Dimension by level of education

| Ranks | | | | | Mann-Whitney U | Z value | p-value |
|---|---|---|---|---|---|---|---|
| | Education | N | Mean Rank | Sum of Ranks | | | |
| Integration processes in mega-projects | Undergraduate | 78 | 94.13 | 7342.50 | 4261.500 | -0.290 | 0.772 |
| | Postgraduate | 112 | 95.45 | 10802.50 | | | |
| Scope of mega-projects | Undergraduate | 78 | 98.13 | 7654.00 | 4163.000 | -0.559 | 0.576 |
| | Postgraduate | 112 | 93.67 | 10491.00 | | | |
| Mega-projects' schedule | Undergraduate | 78 | 88.08 | 6870.00 | 3789.000 | -1.565 | 0.118 |
| | Postgraduate | 112 | 100.67 | 11275.00 | | | |
| Managing costs on mega-projects | Undergraduate | 78 | 90.58 | 7065.00 | 3984.000 | -1.049 | 0.294 |
| | Postgraduate | 112 | 98.93 | 11080.00 | | | |
| Quality management in mega-projects | Undergraduate | 78 | 93.20 | 7269.50 | 4188.500 | -0.488 | 0.625 |
| | Postgraduate | 112 | 97.10 | 10875.50 | | | |
| HR and skills on mega-projects | Undergraduate | 78 | 95.96 | 7562.50 | 4254.500 | -0.308 | 0.758 |
| | Postgraduate | 112 | 94.49 | 10582.50 | | | |
| Communications in mega-projects | Undergraduate | 78 | 95.87 | 7478.00 | 4339.000 | -0.080 | 0.937 |
| | Postgraduate | 112 | 95.24 | 10667.00 | | | |
| Managing risks in mega-projects | Undergraduate | 78 | 97.81 | 7629.00 | 4188.000 | -0.487 | 0.626 |
| | Postgraduate | 112 | 93.89 | 10516.00 | | | |
| Procurement in mega-projects | Undergraduate | 78 | 98.44 | 7678.50 | 4138.500 | -0.620 | 0.535 |
| | Postgraduate | 112 | 93.45 | 10465.50 | | | |
| Managing stakeholders in mega-projects | Undergraduate | 78 | 101.44 | 7912.50 | 3904.500 | -1.254 | 0.210 |
| | Postgraduate | 112 | 91.36 | 10232.50 | | | |

- **Integration process in mega-projects**

The test show that for integration processes of mega-projects U= 4261.500, Z= -0.290 and p= 0.772 Since p> 0.05, the test further shows that there is no significant difference in the dimension for integration process for mega-projects and the level of education of the respondents.

- **Scope of mega-projects**

The test show that for scope of mega-projects U= 4163.000, Z= -0.559 and p= 0.576. Since p> 0.05, the test further shows that there is no significant difference in the dimension scope of mega-projects and the level of education of the respondents.

- **Schedule of mega-projects**

The test show that for schedule of mega-projects U=3789.000, Z= -1.565 and p= 0.118. Since p> 0.05, the test further shows that there is no significant difference in the dimension for schedule of mega-projects and the level of education of the respondents.

- **Managing costs on mega-projects**

The test show that for managing cost on mega-projects U= 3984.000, Z= -1.049 and p= 0.294 Since p> 0.05, the test further shows that there is no significant difference in the dimension managing cost on mega-projects and the level of education of the respondents.

- **Quality management in mega-projects**

The test show that for quality management in mega-projects U= 4188.500, Z = -0.488 and p= 0.625 Since p> 0.05, the test further shows that there is no significant difference in the dimension for quality management in mega-projects and the level of education of the respondents.

- **HR and skills on mega-projects**

The test show that for HR and skills on mega-projects U= 4254.500, Z = -0.308 and p= 0.758. Since p> 0.05, the test further shows that there is no significant difference in the dimension for HR and skills on mega-projects and the level of education of the respondents.

- **Communication in mega-projects**

The test show that for communication in mega-projects U = 4339.000, Z = -0.080 and p= 0.937. Since p> 0.05, the test further shows that there is no significant difference in the dimension for communication in mega-projects and the level of education of the respondents.

- **Managing risk in mega-projects**

The test show that for managing risk in mega-projects U= 4188.000, Z = -0.487 and p= 0.626. Since p> 0.05, the test further shows that there is no significant difference in the dimension for managing risk in mega-projects and the level of education of the respondents.

- **Procurement in mega-projects**

The test show that for procurement in mega-projects U = 4138.500, Z = -0.620 and p= 0.535. Since p> 0.05, the test further shows that there is no significant difference in the dimension for integration process for mega-projects and the level of education of the respondents.

- **Managing stakeholders in mega-projects**

The test show that for managing stakeholders in mega-projects U = 3904.500, Z = -1.254 and p= 0.210. Since p> 0.05, the test further shows that there is no significant difference in the dimension for integration process for mega-projects and the level of education of the respondents.

The results presented in Table 5.46 indicate that participants' level of education did not have any impact on all the dimensions being investigated (p>0.05). Therefore, this hypothesis fails to be rejected.

5.14.3.6 Hypothesis 6: There is no statistically significant difference in the mean ranks of the dimensions among participants nationality

The results presented in Table 5.47 indicates that the median scores for all the dimensions were similar with regards to participants' nationality (p>0.05). None of the dimensions were significantly different when compared among the different age groups of the participants. The null hypothesis is accepted.

Table 5.47: Comparison of median scores for all the dimensions with regards to nationality of the participants: Mann-Whitney Test: Dimension by Nationality

| Ranks | | | | | Mann-Whitney U | Z value | p-value |
|---|---|---|---|---|---|---|---|
| | Nationality | N | Mean Rank | Sum of Ranks | | | |
| Integration processes in mega-projects | South African | 189 | 95.34 | 18208.50 | 124.500 | -0.843 | 0.399 |
| | International | 2 | 63.75 | 127.50 | | | |
| Scope of mega-projects | South African | 189 | 95.31 | 18202.50 | 130.500 | -0.765 | 0.444 |
| | International | 2 | 65.75 | 133.50 | | | |
| Mega-projects' schedule | South African | 189 | 95.32 | 18204.50 | 128.500 | -0.784 | 0.433 |
| | International | 2 | 65.75 | 131.50 | | | |
| Managing costs on mega-projects | South African | 189 | 96.06 | 18154.50 | 178.500 | -0.138 | 0.891 |
| | International | 2 | 90.75 | 181.50 | | | |
| Quality management in mega-projects | South African | 189 | 95.86 | 18118.00 | 163.000 | -0.339 | 0.734 |
| | International | 2 | 109.00 | 218.00 | | | |
| HR and skills on mega-projects | South African | 189 | 95.15 | 18171.50 | 161.500 | -0.358 | 0.721 |
| | International | 2 | 82.25 | 164.50 | | | |
| Communications in mega-projects | South African | 189 | 95.40 | 18219.50 | 113.500 | -0.993 | 0.321 |
| | International | 2 | 58.25 | 115.50 | | | |
| Managing risks in mega-projects | South African | 189 | 95.98 | 18141.00 | 186.000 | -0.039 | 0.969 |
| | International | 2 | 97.50 | 195.00 | | | |
| Procurement in mega-projects | South African | 189 | 95.54 | 18247.00 | 86.000 | -1.335 | 0.182 |
| | International | 2 | 44.50 | 89.00 | | | |
| Managing stakeholders in mega-projects | South African | 189 | 95.16 | 18174.50 | 158.500 | -0.396 | 0.692 |
| | International | 2 | 80.75 | 161.50 | | | |

- **Integration process in mega-projects**

The test show that for integration processes of mega-projects U= 124.500, Z= -0.843 and p= 0.399 Since p> 0.05, the test further shows that there is no significant difference in the dimension for integration process for mega-projects and the nationality of the respondents.

- **Scope of mega-projects**

The test show that for scope of mega-projects U= 130.500, Z= -0.765 and p= 0.444. Since p> 0.05, the test further shows that there is no significant difference in the dimension scope of mega-projects and the nationality of the respondents.

- **Schedule of mega-projects**

The test show that for schedule of mega-projects U=128.500, Z= -0.784 and p= 0.433. Since p> 0.05, the test further shows that there is no significant difference in the dimension for schedule of mega-projects and the nationality of the respondents.

- **Managing costs on mega-projects**

The test show that for managing cost on mega-projects U= 178.500, Z= -0.138 and p= 0.891 Since p> 0.05, the test further shows that there is no significant difference in the dimension managing cost on mega-projects and the nationality of the respondents.

- **Quality management in mega-projects**

The test show that for quality management in mega-projects U= 163.000, Z = -0.339 and p= 0.734 Since p> 0.05, the test further shows that there is no significant difference in the dimension for quality management in mega-projects and the nationality of the respondents.

- **HR and skills on mega-projects**

The test show that for HR and skills on mega-projects U= 161.500, Z = -0.358 and p= 0.721. Since p> 0.05, the test further shows that there is no significant difference in the dimension for HR and skills on mega-projects and the nationality of the respondents.

- **Communication in mega-projects**

The test show that for communication in mega-projects U = 113.500, Z = -0.993 and p= 0.321. Since p> 0.05, the test further shows that there is no significant difference in the dimension for communication in mega-projects and the nationality of the respondents.

- **Managing risk in mega-projects**

The test show that for managing risk in mega-projects U= 186.000, Z = -0.039 and p= 0.969. Since p> 0.05, the test further shows that there is no significant difference in the dimension for managing risk in mega-projects and the nationality of the respondents.

- **Procurement in mega-projects**

The test show that for procurement in mega-projects U = 86.000, Z = -1.335 and p= 0.182. Since p> 0.05, the test further shows that there is no significant difference in the dimension for integration process for mega-projects and the nationality of the respondents.

- **Managing stakeholders in mega-projects**

The test show that for managing stakeholders in mega-projects U = 158.500, Z = -0.396 and p= 0.692. Since p> 0.05, the test further shows that there is no significant difference in the dimension for integration process for mega-projects and the nationality of the respondents.

Therefore, this hypothesis fails to be rejected.

5.14.3.7 Hypothesis 7: There is no statistically significant difference in the mean ranks of the dimensions among years of employment

According to Table 5.48, it was found that years of employment had an impact only on scheduling of mega-projects (p=0.015) and did not have any impact on all other dimensions (p>0.05). Thus, the null hypothesis is rejected.

Table 5.48: Comparison of median scores for all the dimensions among with regards to years of experience in the company: Kruskal-Wallis: Dimension by years of experience

| Ranks | | | | Chi-Square | df | p-value |
|---|---|---|---|---|---|---|
| | Experience | N | Mean Rank | | | |
| Integration processes in mega-projects | 5 years or less | 103 | 99.59 | 1.454 | 4 | 0.835 |
| | 6-10 years | 56 | 92.69 | | | |
| | 11-15 years | 10 | 99.70 | | | |
| | 16-20 years | 11 | 85.45 | | | |
| | >20 years | 11 | 85.45 | | | |
| Scope of mega-projects | 5 years or less | 103 | 101.80 | 5.368 | 4 | 0.173 |

| Ranks | | | | Chi-Square | df | p-value |
|---|---|---|---|---|---|---|
| | Experience | N | Mean Rank | | | |
| | 6-10 years | 56 | 85.84 | | | |
| | 11-15 years | 10 | 113.05 | | | |
| | 16-20 years | 11 | 69.68 | | | |
| | >20 years | 11 | 99.18 | | | |
| Mega-projects' schedule | 5 years or less | 103 | 90.67 | 10.908 | 4 | 0.028 |
| | 6-10 years | 56 | 114.81 | | | |
| | 11-15 years | 10 | 72.50 | | | |
| | 16-20 years | 11 | 91.23 | | | |
| | >20 years | 11 | 75.23 | | | |
| Managing costs on mega-projects | 5 years or less | 103 | 88.64 | 8.483 | 4 | 0.075 |
| | 6-10 years | 56 | 110.59 | | | |
| | 11-15 years | 10 | 105.15 | | | |
| | 16-20 years | 11 | 73.18 | | | |
| | >20 years | 11 | 105.14 | | | |
| Quality management in mega-projects | 5 years or less | 103 | 102.14 | 7.069 | 4 | 0.132 |
| | 6-10 years | 56 | 90.88 | | | |
| | 11-15 years | 10 | 113.80 | | | |
| | 16-20 years | 11 | 71.73 | | | |
| | >20 years | 11 | 72.68 | | | |
| HR and skills on mega-projects | 5 years or less | 103 | 105.88 | 11.160 | 4 | 0.025 |
| | 6-10 years | 56 | 90.96 | | | |
| | 11-15 years | 10 | 74.30 | | | |
| | 16-20 years | 11 | 57.45 | | | |
| | >20 years | 11 | 87.36 | | | |
| Communications in mega-projects | 5 years or less | 103 | 101.29 | 3.024 | 4 | 0.554 |
| | 6-10 years | 56 | 85.55 | | | |
| | 11-15 years | 10 | 100.90 | | | |
| | 16-20 years | 11 | 97.95 | | | |
| | >20 years | 11 | 88.18 | | | |
| Managing risks in mega-projects | 5 years or less | 103 | 97.02 | 7.019 | 4 | 0.135 |
| | 6-10 years | 56 | 99.64 | | | |
| | 11-15 years | 10 | 53.004 | | | |
| | 16-20 years | 11 | 108.41 | | | |
| | >20 years | 11 | 94.59 | | | |
| Procurement in mega-projects | 5 years or less | 103 | 95.38 | .740 | 4 | 0.946 |
| | 6-10 years | 56 | 96.19 | | | |
| | 11-15 years | 10 | 108.95 | | | |
| | 16-20 years | 11 | 95.86 | | | |
| | >20 years | 11 | 89.23 | | | |
| Managing stakeholders in mega-projects | 5 years or less | 103 | 97.22 | 1.246 | 4 | 0.870 |
| | 6-10 years | 56 | 98.06 | | | |
| | 11-15 years | 10 | 79.95 | | | |
| | 16-20 years | 11 | 87.68 | | | |
| | >20 years | 11 | 95.95 | | | |

- **Integration process in mega-projects**

The test show that for integration processes in mega-projects chi-square = 1.454, df = 4 and p = 0.835 Since p > 0.05, the test further shows that there is no significant difference in the dimension for integration process in mega-projects and the years of experience of the respondents.

- **Scope of mega-projects**

The test show that for scope of mega-projects chi-square = 5.368, df = 4 and p= 0.173. Since p> 0.05, the test further shows that there is no significant difference in the dimension scope of mega-projects and the years of experience of the respondents.

- **Schedule of mega-projects**

The test show that for schedule of mega-projects chi-square = 10.908, df = 4 and p= 0.028. Since p< 0.05, the test further shows that there is a significant difference in the dimension for schedule of mega-projects and the years of experience of the respondents.

- **Managing costs on mega-projects**

The test show that for managing cost on mega-projects chi-square = 8.483, df = 4 and p= 0.075 Since p > 0.05, the test further shows that there is no significant difference in the dimension managing cost on mega-projects and the years of experience of the respondents.

- **Quality management in mega-projects**

The test show that for quality management in mega-projects chi-square = 7.069, df = 4 and p= 0.132 Since p > 0.05, the test further shows that there is no significant difference in the dimension for quality management in mega-projects and the years of experience of the respondents.

- **HR and skills on mega-projects**

The test show that for HR and skills on mega-projects chi-square = 11.160, df = 4 and p= 0.025. Since p < 0.05, the test further shows that there is a significant difference in the dimension for HR and skills on mega-projects and the years of experience of the respondents.

- **Communication in mega-projects**

The test show that for communication in mega-projects chi-square = 3.024, df = 4 and p = 0.554. Since p > 0.05, the test further shows that there is no significant difference in the dimension for communication in mega-projects and the years of experience of the respondents.

- **Managing risk in mega-projects**

The test show that for managing risk in mega-projects chi-square = 7.019, df = 4 and p= 0.135. Since p > 0.05, the test further shows that there is no significant difference in the dimension for managing risk in mega-projects and the years of experience of the respondents.

- **Procurement in mega-projects**

The test show that for procurement in mega-projects chi-square = 0.740, df = 4 and p = 0.946. Since p > 0.05, the test further shows that there is no significant difference in the dimension for integration process for mega-projects and the years of experience of the respondents.

- **Managing stakeholders in mega-projects**

The test show that for managing stakeholders in mega-projects chi-square = 1.246, df = 4 and p= 0.870. Since p> 0.05, the test further shows that there is no significant difference in the dimension for integration process for mega-projects and the years of experience of the respondents.

### 5.14.3 Spearman's Rank Correlation Test

Spearman's rank correlation test was conducted to find significant relationship between dimensions. It was found that most of the dimensions were significantly moderately correlated to each other (p<0.05).

Table 5.49: Spearman's correlation analysis output

| Section | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Spearman's rho | Integration processes in mega-projects | 1.000 | .344** | .170* | .178* | .167* | .330** | .239** | .184* | .143* | .326** |
| | | . | .000 | .019 | .014 | .021 | .000 | .001 | .011 | .049 | .000 |
| | Scope of mega-projects | .344** | 1.000 | .226** | .230** | .164* | .390** | .139 | .188** | .279** | .377** |
| | | .000 | . | .002 | .001 | .023 | .000 | .056 | .009 | .000 | .000 |
| | Mega-projects' schedule | .170* | .226** | 1.000 | .239** | .090 | .288** | .105 | .146* | .104 | .038 |
| | | .019 | .002 | . | .001 | .216 | .000 | .149 | .044 | .153 | .602 |
| | Managing costs on mega-projects | .178* | .230** | .239** | 1.000 | .045 | .192** | .108 | .266** | .044 | .213** |
| | | .014 | .001 | .001 | . | .539 | .008 | .136 | .000 | .547 | .003 |
| | Quality management in mega-projects | .167* | .164* | .090 | .045 | 1.000 | .169* | .110 | .144* | .223** | .206** |
| | | .021 | .023 | .216 | .539 | . | .020 | .130 | .047 | .002 | .004 |
| | HR and skills on mega-projects | .330** | .390** | .288** | .192** | .169* | 1.000 | .233** | .226** | .260** | .260** |
| | | .000 | .000 | .000 | .008 | .020 | . | .001 | .002 | .000 | .000 |
| | | .239** | .139 | .105 | .108 | .110 | .233** | 1.000 | .168* | .225** | .131 |

| Section | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Communications in mega-projects | .001 | .056 | .149 | .136 | .130 | .001 | . | .020 | .002 | .072 |
| | Managing risks in mega-projects | .184* | .188** | .146* | .266** | .144* | .226** | .168* | 1.000 | -.079 | .115 |
| | | .011 | .009 | .044 | .000 | .047 | .002 | .020 | . | .275 | .112 |
| | Procurement in mega-projects | .143* | .279** | .104 | .044 | .223** | .260** | .225** | -.079 | 1.000 | .394** |
| | | .049 | .000 | .153 | .547 | .002 | .000 | .002 | .275 | . | .000 |
| | Managing stakeholders in mega-projects | .326** | .377** | .038 | .213** | .206** | .260** | .131 | .115 | .394** | 1.000 |
| | | .000 | .000 | .602 | .003 | .004 | .000 | .072 | .112 | .000 | . |

5.14.3.1 Hypothesis 8: There is no relationship between the development of realistic schedules and mega-project completion on time

Since the data were not normally distributed, Spearman's rho test was conducted to determine the relationship between variables. It was found that there was moderate but significant relationship exists between a realistic schedule is developed and mega-projects are completed on time ($r=0.401$, $p<0.01$). Therefore, the null hypothesis is rejected.

Table 5.50: Correlation between the development of realistic schedules and mega-projects completion on time

| Correlations | | | | |
|---|---|---|---|---|
| | | | Mega-projects are completed on time | A realistic schedule is developed |
| Spearman's rho | Mega-projects are completed on time | Correlation Coefficient | 1.000 | .401** |
| | | Sig. (2-tailed) | . | .000 |
| | | N | 191 | 191 |
| | A realistic schedule is developed | Correlation Coefficient | .401** | 1.000 |
| | | Sig. (2-tailed) | .000 | . |
| | | N | 191 | 191 |
| **. Correlation is significant at the 0.01 level (2-tailed). | | | | |

5.14.3.2 Hypothesis 9: There is no relationship between clearly defined mega-project scope and the necessity to involve stakeholders in the initiation phase

The study showed low negative relationship between the project scope is clearly defined and it is necessary for stakeholders to be involved in the initiation phase ($r=-0.148$). But this relationship was significant ($p=0.041$) therefore the null hypothesis is rejected.

Table 5.51: Correlation between clearly defined mega-project scope and the necessity to involve stakeholders in the initiation phase

| Correlations | | | | |
|---|---|---|---|---|
| | | | The project scope is clearly defined | It is necessary for stakeholders to be involved in the initiation phase |
| Spearman's rho | The project scope is clearly defined | Correlation Coefficient | 1.000 | -.148* |
| | | Sig. (2-tailed) | . | .041 |
| | | N | 191 | 191 |
| | It is necessary for stakeholders to be involved in the initiation phase | Correlation Coefficient | -.148* | 1.000 |
| | | Sig. (2-tailed) | .041 | . |
| | | N | 191 | 191 |
| *. Correlation is significant at the 0.05 level (2-tailed). | | | | |

5.14.3.3 Hypothesis 10: There is no relationship between effective change-control processes and mega-project completion on time

The relationship between effective change-control processes and megA project completion on time were found to have low positive but significant relationship (r=0.236, r=0.001). The null hypothesis therefore is rejected.

Table 5.52: The correlation between effective change-control processes and mega-projects completion on time

| Correlations | | | | |
|---|---|---|---|---|
| | | | Mega-projects are completed on time | Change-control processes are effective |
| Spearman's rho | Mega-projects are completed on time | Correlation Coefficient | 1.000 | .236** |
| | | Sig. (2-tailed) | . | .001 |
| | | N | 191 | 191 |
| | Change-control processes are effective | Correlation Coefficient | .236** | 1.000 |
| | | Sig. (2-tailed) | .001 | . |
| | | N | 191 | 191 |
| **. Correlation is significant at the 0.01 level (2-tailed). | | | | |

5.14.3.4 Hypothesis 11: There is no relationship between major scope changes by the asset owner and redesigns leading to schedule overruns

It was found that there was significant positive relationship exist between major scope changes by the owner and schedule overruns (r=0.446, p<0.01). The null hypothesis therefore is rejected

Table 5.53: The correlations between major scope changes by the asset owner and redesigns leading to schedule slippages

| Correlations | | | |
|---|---|---|---|
| | | Frequent re-redesigns leads to schedule overruns | Major scope changes by the asset owner |
| Frequent re-redesigns leads to schedule overruns | Pearson Correlation | 1 | .446** |
| | Sig. (2-tailed) | | .000 |
| | N | 191 | 191 |
| Major scope changes by the asset owner | Pearson Correlation | .446** | 1 |
| | Sig. (2-tailed) | .000 | |
| | N | 191 | 191 |
| **. Correlation is significant at the 0.01 level (2-tailed). | | | |

5.14.3.5 Hypothesis 12: There is no relationship between insufficient engineering done for the business-case and underestimated project costs

It was found that there was significant positive relationship existing between there is insufficient engineering done for a robust business-case and project costs are underestimated at the business-case development stage (r=0.437, p=0.01) hence the null hypothesis is rejected.

Table 5.54: Correlation between insufficient engineering done for the business-case and underestimated project costs

| Correlations | | | |
|---|---|---|---|
| | | Project costs are underestimated at the business-case development stage | There is insufficient engineering done for the business-case |
| Project costs are underestimated at the business-case development stage | Pearson Correlation | 1 | .437** |
| | Sig. (2-tailed) | | .000 |
| | N | 191 | 191 |
| There is insufficient engineering done for a robust business-case | Pearson Correlation | .437** | 1 |
| | Sig. (2-tailed) | .000 | |
| | N | 191 | 191 |
| **. Correlation is significant at the 0.01 level (2-tailed). | | | |

5.14.3.6 Hypothesis 13: There is no relationship between inadequate experienced personnel and the development of detailed quality plans

The study did not find significant relationship between detailed quality plans are developed and there are inadequate experienced personnel to control quality (r=-0.132, p=0.069. The null hypothesis is accepted.

Table 5.55: Correlation between inadequate experienced personnel and the development of detailed quality plans

| Correlations | | | | |
|---|---|---|---|---|
| | | | Detailed quality plans are developed | There is inadequate experienced personnel to control quality |
| Spearman's rho | Detailed quality plans are developed | Correlation Coefficient | 1.000 | -.132 |
| | | Sig. (2-tailed) | . | .069 |
| | | N | 191 | 191 |
| | There are inadequate experienced personnel to control quality | Correlation Coefficient | -.132 | 1.000 |
| | | Sig. (2-tailed) | .069 | . |
| | | N | 191 | 191 |

5.14.3.7 Hypothesis 14: There is no relationship between correct skills sets in TCP and the availability of skills at the time of mega-project execution

The study found significant negative relationship between statements 13.1 and 13.12 (r=-0.157, p=0.030). Therefore, the null hypothesis is rejected.

Table 5.56: Correlation between correct skills sets in TCP and the availability of skills at the time of mega-project execution

| Correlations | | | | | |
|---|---|---|---|---|---|
| | | | Correct skill sets in mega-projects | Availability of resources at time of project execution | Mega-projects are completed on time |
| Spearman's rho | Correct skill sets in mega-projects | Correlation Coefficient | 1.000 | -.157* | .411** |
| | | Sig. (2-tailed) | . | .030 | .000 |
| | | N | 191 | 191 | 191 |
| | Availability of resources at time of project execution | Correlation Coefficient | -.157* | 1.000 | -.055 |
| | | Sig. (2-tailed) | .030 | . | .450 |
| | | N | 191 | 191 | 191 |
| | Mega-projects are completed on time | Correlation Coefficient | .411** | -.055 | 1.000 |
| | | Sig. (2-tailed) | .000 | .450 | . |
| | | N | 191 | 191 | 191 |

5.14.3.8 Hypothesis 15: There is no relationship between correct skill sets in mega-projects and mega-project completion on time

The study found positive relationship between statements "correct skill sets in mega-projects" and "mega-projects are completed on time" (r=0.411, p<0.01). Therefore, the null hypothesis is rejected in this aspect.

Table 5.57: Correlation the correct skill sets in mega-projects and mega-project completion on time

| Correlations | | | | | |
|---|---|---|---|---|---|
| | | | Correct skill sets in mega-projects | Availability of resources at time of project execution | Mega-projects are completed on time |
| Spearman's rho | Correct skill sets in mega-projects | Correlation Coefficient | 1.000 | -.157* | .411** |
| | | Sig. (2-tailed) | . | .030 | .000 |
| | | N | 191 | 191 | 191 |
| | Availability of resources at time of project execution | Correlation Coefficient | -.157* | 1.000 | -.055 |
| | | Sig. (2-tailed) | .030 | . | .450 |
| | | N | 191 | 191 | 191 |
| | Mega-projects are completed on time | Correlation Coefficient | .411** | -.055 | 1.000 |
| | | Sig. (2-tailed) | .000 | .450 | . |
| | | N | 191 | 191 | 191 |

5.14.3.9 Hypothesis 16: There is no relationship between inadequate communications between contracting teams and easy resolution of disputes

No significant relationships were found between there is inadequate communications between the contracting teams and disputes are easily resolved (r=-0.139, p=0.056). Therefore, the null hypothesis is accepted.

Table 5.58: Correlation between inadequate communications between contracting teams and easy resolution of disputes

| Correlations | | | | |
|---|---|---|---|---|
| | | | 14.4 There is inadequate communications between the Owners team and EPCM to manage mega-projects | 16.7 Disputes are easily resolved |
| Spearman's rho | 14.4 There is inadequate communications between the Owners team and EPCM to manage mega-projects | Correlation Coefficient | 1.000 | -.139 |
| | | Sig. (2-tailed) | . | .056 |
| | | N | 191 | 191 |
| | 16.7 Disputes are easily resolved | Correlation Coefficient | -.139 | 1.000 |
| | | Sig. (2-tailed) | .056 | . |
| | | N | 191 | 191 |

5.14.3.10 Hypothesis 17: There is no relationship between the availability of risk skill sets and the capability to manage risks

The study found a significant relationship between the difficulty to manage all risks in mega-projects and the appropriate level of risk management skill sets are not available on mega-projects (r=-0.231, p=0.001). Therefore, the null hypothesis is rejected.

Table 5.59: Correlation between the availability of risk skill sets and the capability to manage risks

| Correlations | | | | |
|---|---|---|---|---|
| | | | Difficulty to manage all risks in mega-projects | Availability risk management skill sets |
| Spearman's rho | Difficult to manage all risks in mega-projects | Correlation Coefficient | 1.000 | .231** |
| | | Sig. (2-tailed) | . | .001 |
| | | N | 191 | 191 |
| | 15.4 The appropriate level of risk management skill sets are not available on mega-projects | Correlation Coefficient | .231** | 1.000 |
| | | Sig. (2-tailed) | .001 | . |
| | | N | 191 | 191 |
| **. Correlation is significant at the 0.01 level (2-tailed). | | | | |

5.14.3.11 Hypothesis 18: There is no relationship between the complexity of mega-projects and the difficulty to manage all risks in mega-projects

The study found significant relationship between the complexity of mega-projects and the difficulty to manage all risks in mega-projects (r=-0.492, p=0.000). Therefore, the null hypothesis is rejected.

Table 5.60: Correlation between the complexity of mega-projects and the difficulty to manage all risks in mega-projects

| Correlations | | | | |
|---|---|---|---|---|
| | | | Difficulty to manage all risks in mega-projects | Complexity of mega-projects |
| Spearman's rho | Difficult to manage all risks in mega-projects | Correlation Coefficient | 1.000 | .492** |
| | | Sig. (2-tailed) | . | .000 |
| | | N | 191 | 191 |
| | Complexity of mega-projects | Correlation Coefficient | .492** | 1.000 |
| | | Sig. (2-tailed) | .000 | . |
| | | N | 191 | 191 |
| **. Correlation is significant at the 0.01 level (2-tailed). | | | | |

5.14.3.12 Hypothesis 19: There is no relationship between rewarding good contractor performance and mega-project completion on time

No significant relationships were found between rewarding good contractor performance and mega-projects completion on time (r=0.111, p=0.125). Therefore, the null hypothesis fails is accepted.

Table 5.61: Correlation between rewarding contractor performance and mega-project completion on time

| Correlations | | | | |
|---|---|---|---|---|
| | | | 16.11 Good Contractor performance is rewarded | 10.1 Mega-projects are completed on time |
| Spearman's rho | 16.11 Good Contractor performance is rewarded | Correlation Coefficient | 1.000 | .111 |
| | | Sig. (2-tailed) | . | .125 |
| | | N | 191 | 191 |
| | 10.1 Mega-projects are completed on time | Correlation Coefficient | .111 | 1.000 |
| | | Sig. (2-tailed) | .125 | . |
| | | N | 191 | 191 |

5.14.3.13 Hypothesis 20: There is no relationship between contractors having the right teams to manage construction work and mega-projects completion on time

It was found that there a significant relationship exists between mega-projects are completed on time and contractors have the right teams to manage construction work (r=0.154, p=0.033). Therefore, the null hypothesis is rejected.

Table 5.62: Correlation between contractors having the right teams to manage construction work and mega-projects completion on time

| Correlations | | | | |
|---|---|---|---|---|
| | | | 10.1 Mega-projects are completed on time | 16.12 Contractors have the right teams to manage construction work |
| Spearman's rho | 10.1 Mega-projects are completed on time | Correlation Coefficient | 1.000 | .154* |
| | | Sig. (2-tailed) | . | .033 |
| | | N | 191 | 191 |
| | 16.12 Contractors have the right teams to manage construction work | Correlation Coefficient | .154* | 1.000 |
| | | Sig. (2-tailed) | .033 | . |
| | | N | 191 | 191 |
| *. Correlation is significant at the 0.05 level (2-tailed). | | | | |

5.14.3.14 Hypothesis 21: There is no relationship between inadequate experienced personnel and the underestimation of project costs at the business-case stage

It was found that there was significant positive relationship exist between there is inadequate experienced personnel to control costs and project costs are underestimated at the business-case development stage (r=0.226, p=0.002) therefore the null hypothesis is rejected.

Table 5.63: Correlation between inadequate experienced personnel and the underestimation of project costs at the business-case stage

| Correlations | | | | |
|---|---|---|---|---|
| | | | 11.7 There is inadequate experienced personnel to control costs | 11.10 Project costs are underestimated at the business-case development stage |
| Spearman's rho | 11.7 There is inadequate experienced personnel to control costs | Correlation Coefficient | 1.000 | .226** |
| | | Sig. (2-tailed) | . | .002 |
| | | N | 191 | 191 |
| | 11.10 Project costs are underestimated at the business-case development stage | Correlation Coefficient | .226** | 1.000 |
| | | Sig. (2-tailed) | .002 | . |
| | | N | 191 | 191 |
| **. Correlation is significant at the 0.01 level (2-tailed). | | | | |

## 5.15 OPEN-ENDED QUESTIONS

### 5.15.1 Summary of comments from question 18: Do you think that South Africans have the skills to deliver mega-projects?

On this question, some of the comments from TCP participants were:

- Yes, but it's very limited to only the type of projects that we have done in the past 20 years but 50% of the resources that were involved are retired and are replaced by newly graduated professionals with no experience.
- Yes, but people should be appointed because of their skill and not their gender or race. Many skilled people are overlooked as they perhaps are not "black female."
- No. This is due to the fact that solid experience foundations are no longer being laid in the careers of individuals.
- I do think that we as South Africans have the skills to deliver mega-projects. There a lot of experienced professional with the right attitude and mind and skill set to deliver on mega-projects. Fear paralyses ability.

- Yes, South Africans have the skills, all that is needed is to do placement of skills based on competition, scrap the women placement first away.
- Yes, I have worked with expatriates and I did not see a different skill set from them.
- Yes. But TCP have not.
- South Africa has the skill to deliver "Mega" project, nothing is new to the SA community the skill set is available only leadership is missing.
- Skills are limited across SA and get stretched very quickly.
- Yes, the challenges that we are facing we are not attracting right skills and also not applying marketing related salaries.
- There is a limited pool of competent resources.

### 5.15.2 Summary of comments from question 19: Is there too much 'red tape' that makes project delivery difficult?

On this question, some of the comments from TCP participants were:

- Yes, there are too much red tapes within TCP and/or Transnet, hence we experience project delays.
- Yes! in my experience within Transnet 60% if not more of the critical decision-makers are not even directly involved in the project and therefore in making those decisions they can take as much time as they want because they do not share the same urgency of delivering the project as the project manager and most importantly they are not measured on project timelines. especially financial decision-makers and procurement personnel. They must be measured on project schedule.
- Yes. There are too many advisory and approval bodies, some of which could be merged to reduce red tape.
- Strict Project procedures on mega-projects are very important in order to maintain adequate control over cost and time, but due to the great amount of incompetent people in Transnet, top management does not trust their subordinate managers to make decisions, hence requiring most (sometimes insignificant) approvals to be done at only the top management level. The top management then effectively micro manages their management resources because they do not trust the very people which they have appointed as their subordinates to use the necessary discretion to take smaller business decisions.

- I order to be effective and efficient to deliver on mega-projects we need agile, responsive and organic, in other pliable. Red tape stifle effectiveness and Efficiency and do lead to increase costs.
- Red Tape is necessary to ensure corruption is averted.
- Yes. PLP is a great framework but is bureaucratically applied.

### 5.15.3 Summary of comments from question 20: What are your reasons for mega-projects not meeting planned budgets?

On this question, some of the comments from TCP participants were:

- Insufficient information at time of preparing the budget. Inexperienced team.
- Poor planning. Insufficient scope of works.
- Unrealistic timelines, change in scope.
- Poorly defined expectations up front that change during the execution stage. Insufficient time spent on budgeting which leads to unrealistic expectations. Contractors may price simply to get the work and then exploit loopholes in the contract for additional time and money.
- Contractor's under-price projects to win tenders. Project teams understate escalations and contingencies due to pressure from asset owners. Due to affordability issues, approval bodies approve ETCs that are less than what the project team is asking for. This leads to forced compromises in terms of quality of the end product. Where quality standards are adhered to, the project cost ends up exceeding the originally approved amounts.
- Scope changes, unknown site risks, poor contractor skills, disputes.
- Unclear scope of work and tight deadlines.
- Leaders in Transnet distance themselves from the necessary hard work to develop robust business plans and execution strategies - these tasks are delegated away and are reviewed in silos. A truly integrated project initiation phase is required, where the adequately skilled people are engaged, and leadership participates sufficiently in order to commence on the right foot.
- Not employing appropriately qualified and experienced people with the required skill set.
- Economic inflation and lengthy procurement processes.

- Poor engineering design and contract management.
- Change of scope, under budget, poorly managed CEs, project members working is silos, project manager ignoring advices from support services.
- Primarily costly delays due to long internal approval processes, external authorisations, unforeseen site conditions or late scope changes.
- Fear from top management and corruption.
- Long procurement cycles, Lack of chain of command or too many bosses, Lack of proper planning, Transnet FEL model is not effective.
- Complexity and unknown risks identified as the projects progress.
- Client delay the approval and the execution of the project thus escalation cost will be more.

### 5.15.4 Summary of comments from question 21: Are EPCM's capable of successfully delivering mega-projects for Transnet?

On this question, some of the comments from TCP participants were:

- Yes, as long as they are correctly managed and the correct form of contract is used.
- Yes, because they work more effectively compare to Transnet and they have limited red tapes.
- Not at all. They are clueless. Cannot deliver anything without the full involvement of the Transnet personnel - might as well have asked the internal people to do the job.
- EPCM companies are capable of doing so but it needs to be taken into consideration that South Africa is a developing country which has a great backlog of inequality in the past which needs to be addressed simultaneously while trying to achieve required deadlines. The correct resources in the correct positions can however find this balance and make it happen.
- Yes, only if they work together to successfully finish the project.
- Yes, and they are not constrained by cumbersome Transnet procurement processes for Specialist Consultant's etc.
- Certain EPCM's are better suited, however the EPCM's are not always familiar with Transnet's business and therefore they need to work with Transnet.
- Yes, they are as they have skilled employees.

### 5.15.5 Summary of comments from question 22: Is Transnet's owners team adequate to manage EPCMs?

On this question, some of the comments from TCP participants were:

- No! Transnet resources are bitter and feel their jobs are threatened by the hiring of EPCMs. They develop attitude. Leadership of the organisation needs to give attention to properly drive the change and sell the idea of EPCMs to the employees and build their confidence in managing them.
- Not with current staff complement.
- No, not all unless they have the right skills and knowledge.
- Yes, but need exposure and more skills.
- There are pockets of adequate expertise, but these individuals are often overloaded due to the shortage of suitable resources.
- Not really since the concept is not understandable yet.
- Not anymore – demobilising people with skills and historical knowledge.
- No, always a power struggle.
- Not adequate. Shortage of people at the right skills level.
- Transnet owner's teams are understaffed and not necessarily well trained and or conversed in managing EPCMs.
- No, inadequate hands on project management experience to effectively manage EPCMs. Tend to manage EPCMs on high level and focusing on contractual arrangements.
- Yes, but they too soft to the EPCMs. They need to exercise a certain level of authority.

### 5.15.6 Summary of comments from question 24: What are your reasons for cost overruns on mega-projects?

On this question, some of the comments from TCP participants were:

- Scope changes, projects being rushed into FEL 4 (execution).
- Incomplete designs, poor planning and construction management.
- Undefined scope and client changes.
- Unrealistic timelines, change in scope.
- Poor Contract Management.
- Frequent changes to the team and communication problems.

- Poor planning and cost estimates that actually understate the project cost, together with duplication of functions between the owners, project managers and EPCM team, contribute to the huge cost overruns. Poor management of EPCM teams as in some cases they forget that they are a service delivery entity also contribute.
- Addition of scope, undefined scope and poor planning.
- Unplanned risks.
- Cost overruns happens due to selection of the wrong contracting strategy, poor project management, poor quality control by Transnet and due to lack of skills and experience. All mega-projects in our country involve a great amount of corruption and there is too much political interference. South African construction companies hugely inflates prices when doing business with government parastatals. Construction companies also collude and in such a way eliminate competition in the construction sector which leads to higher prices.
- Inexperienced project control teams.
- Price hikes/Strikes/Contract renewals.

### 5.15.7 Summary of comments from question 24: Any other comments you think should be made for this study?

On this question, some of the comments from TCP participants were:

- I think we need more of these study for TCP in order to effectively manage our projects. The level of experience of our project managers is questionable, mostly are graduates with only a minimum of 2 years working experience, and they were never exposed in other projects.
- Many of the most suitable candidates are being overlooked, simply due to them not having the ideal BEE status, even within Transnet. So, the HR department achieves their BEE targets in terms of their scorecards, yet the project/s suffers as a result of a simplistic BEE selection.
- It would add value to also focus on the selection of Conditions of Contracts that we use for the mega-projects as I find NEC to be outside of the local contractors and hence we see less participation from SMEs but only have CIDB grade 5 and plus.
- Transnet has the best tools, processes and methodologies in place but there is no consistent approach to using them and half of the resources are not familiar with them. There is a need to ensure that Transnet practices the best project management practices.

- Identification of skills and growing and motivating them is still lacking at TCP. Young skills are not mentored enough to be PMs, Prof Engineers, etc.
- With the right people, any project can be delivered; politics should influence desired project outcomes, not project management processes; people with authority must be decisive and if they make mistakes, they shouldn't be crucified (a bad decision on a mega-project is often better than no decision at all... or spending too much time on trying to make the perfect one).
- Transnet must employ their own skilled and experienced employees to work on mega-projects. Do away with contract workers.
- Experienced project management personnel who will not be afraid to call EPCM service providers to order are required. Too many times project viability models are totally ignored. These are important from the start all the way post implementation by way of regular reviews of any changes to the viability of the project due to prevailing economic and other conditions. Project teams tend to want to ensure that they business cases and financial viability fly at all costs. These at times leads to the overstatement of benefits and understatement of operating costs, capital maintenance related costs and costs required to sustain the project into the future. It is also important to ensure alignment in volume projections and the useful lives of the sources of such volumes, e.g. if a mine producing iron ore has a remaining life of 10 years, there is need to be as practical as possible and review the project for this limited period not a longer period of say 30 years.
- Mega-projects are treated in isolation and lessons learnt on previous projects are not shared on new projects and create same challenges experienced on previous projects. Cost comparison is not easy to do and since mega-projects are unique, there are no basis for negotiations and savings. there are also few contractors to handle the works and price collisions might occur.
- Mega-projects should be reverse-engineered. What do we want? "programme vision" broken into multiple "product descriptions", how are these products to be achieved? skilled engineers, support staff, outsourced work. How will this be managed? Transnet quality management systems, standard operating procedures etc. .....we however do not have the necessary quality management systems, document control systems, HR systems etc. Our support staff are not passionate about service delivery and a culture of apathy is evident. People are appointed although they lack the ability and capacity to do the work they are supposed to do – this places extra work stress on successful managers who are

often on these owners' teams - and they in turn have insufficient time to adequately engage with the project and EPCM. this allows errors to flood in - and a host or redesign and rework is necessary.

- People on the ground should be listened to, management should stop the power battle and changing resources from one project to another in the middle of teh project.
- For management of mega-projects, adequately experienced PM's should be appointed, all decisions should be realistic and not just to please the asset owner. Communication plans should be deemed more important.
- Reduce administration and red tape.
- Establish long-term regarding Engineering and Project Management Career paths, thereby maintaining a relevant pool of experts, to prevent fatal flaws and rework.
- Senior project managers with a good track record should handle mega-projects... *or Chief project managers if there is such.
- Please do look at corruption, look at previous mega-projects e.g Medupe.....corruption in procurement and tendering has a huge effect on project failure. Also, inexperienced project managers.
- At time, organisation leadership have limited skills on mega-projects and this led to challenges on decision and approval process. Another challenge is that projects are seen as part of the operations and projects are different from operations. We always appoint resources that have not managed an infrastructure project before and thus expect them to perform while. We need to move away from overlooking skilled project.
- SA and Transnet has really skilled and experienced people however they are often blocked or hampered. Politics affect project delivery negatively. Yes, procurement lead times are far too long - but that is not due to process but people not managing the process. The processes are necessary and will work if done as they should and not there for personal gain. Good luck in your thesis - we need this.

## 5.16 CHAPTER SUMMARY

In this chapter, the field data from TCP were analysed and the results were presented in simple table and line graph formats. Annexure D contains further data in percentage format on the responses received for each of the constructs under the 10 dimensions. A brief discussion was undertaken to explain the statistical analysis employed at the various stages of both the descriptive and inferential statistics sections. Significant findings were further

highlighted in this chapter as well as a compilation of the comments emanating from the open-ended questions. The data analysis was undertaken under the guidance and supervision of an independent statistician and there were no flaws detected in this undertaking. In Chapter 6, the results are discussed, key findings on mega-project challenges are summarised and recommendations for mitigating these challenges are presented.

# CHAPTER 6:
# DISCUSSION OF RESULTS

## 6.1 INTRODUCTION

This chapter presents an interpretation and discussion of the findings of the study concluded in chapter 5. The study was undertaken to critically identify the challenges facing the delivery of mega-projects in TCP.

Together with the scholastic support of the literature review in Chapter 2 and Chapter 3, the findings are carefully interrogated, cross-examined and compared to theory to identify the challenges facing the delivery of mega-projects in TCP.

The findings are discussed in two sections namely descriptive analysis interpretations and discussions, and inferential analysis interpretations and discussions.

The chapter concludes with a summary of mega-project challenges in TCP.

## 6.2 SOCIO-DEMOGRAPHICS DISCUSSION

### 6.2.1 Gender

Thirty one percent of the respondents were female and males made up 69% of the participants. The gender data indicates females are participating in the execution of mega-projects however project teams are dominated by males. The results of this study have close alignment with Transnet's reporting of 70,1% of males in the company (Transnet, 2017:56)

### 6.2.2 Age

The findings reveal that 24,7% of participants are less than thirty years of age while the bulk of participants (33,5%) are in the 30-40-year age group. Almost 29,4% are in the 41-50-year age group and the over 50-year age group make up 12,4%. The results are indicative that a quarter of all participants are fairly younger group of individuals with possibly limited experience and exposure to mega-projects. The inferential statistics analysis in this study indicates that there is a strong relationship between the availability of the correct skill sets in TCP and mega-projects completion on time. Many participants (47%) disagreed that mega-projects have the correct skill sets thus raising concerns that skills are a major challenge in mega-projects in TCP and may be the result of a fairly young team. However,

there are opportunities for the younger group to grow in their careers and add value to Transnet with effective coaching and mentoring programs.

### 6.2.3 Race

The majority (51%) of the participants were Blacks while Whites made up 23.2% of the participants. 18% of the participants were Indian, 5.3% Coloured and 2.1% were represented by Other race groups. The results indicate that racial transformation in TCP is evident with larger majority of the participants being Blacks are participating in mega-projects. The study presents evidence that racial profiles have significant relationships with regards to project dimensions related to integration processes, scope, quality management, HR and skills, and managing stakeholders.

### 6.2.4 Marital Status

Most (62%) of participants are married and 32% are single. 4% of participants are divorced while 2% chose other as a status. The sample is indicative that all participants irrespective of marital status had a chance to participate in this survey. The results further indicate that TCP may be in a favourable position to deploy project staff to remote project locations as a result of one-third of respondents being single.

### 6.2.5 Level of Education

Almost 40,9% of participants possess an undergraduate qualification and the majority (59,7%) of participants have a postgraduate qualification. The results are indicative that the larger proportion of TCP project staff have additional qualifications to undergraduate qualifications. The findings are also supportive of TCP's strategy of acquiring and maintaining qualified personnel in its projects teams.

### 6.2.6 Nationality

Ninety nine percent of all participants are of South African nationality while other nationalities represent 1% of the participant in this survey. There is evidence from the findings that TCP has provided opportunities for foreign nationals to be part of its project execution teams. The JIPSA (2016:5) report and Transnet's (2015:28) in its Sustainability Report indicates a shortage of skills pertaining to the project environment. There may be additional opportunities for TCP to attract foreign nationals with the correct skills to supplement its project teams as an interim measure.

## 6.3 OBJECTIVE 1: TO UNDERSTAND THE INTEGRATION PROCESSES OF PROJECTS

It was found that three variables could explain 59% of the variability of the dimension (Table 5.4). Using Varimax with Kaiser Normalization (Table 5.5), the study found that the following three variables could explain 59% of the variability of the dimension of integration:

- It is necessary for stakeholders to be involved in the initiation phase to obtain ownership and acceptance
- There are too many stakeholders to manage on mega-projects
- The business environment and business plan is well known.

### 6.3.1 Stakeholder Involvement

The majority (90%) of TCP respondents deem it is necessary for stakeholders to be involved in the initiation phase to obtain ownership and acceptance. The TCP views are congruent with literature indicating the importance and necessity of stakeholders to be integrated into the initiation of the project for ownership and acceptance. Respondents are also aligned to Transnet's stakeholder policy whereby Transnet aims to work closely with stakeholders for sustainable business solutions and operations. The TCP results are aligned to Culmsee and Awati's (2012:258) study of Australian projects which found that stakeholders play a key role in the early stages of a project where a great deal of viewpoints and ambiguity is prevalent.

### 6.3.2 Number of Stakeholders

TCP respondents appear to have a challenge with the quantum of stakeholders in mega-projects with a large majority (69%) of respondents indicating that there are too many stakeholders to manage in mega-projects. This situation poses a risk that TCP mega-projects may not be identifying and engaging all stakeholders. Hence all project requirements and deliverables are not fully developed and complete. Incomplete development of deliverables may contribute to a reduction in mega-project efficiency, rework, delays and additional costs as indicated by Alnuaimi et al. (2013:267). The findings on this construct reveal that number of stakeholders on mega-projects is a challenge. There are both internal and external stakeholders that the project team needs to identify, engage and manage through the lifecycle

of the project. Internal stakeholders play a critical role in the definition of mega-projects, whereas external stakeholders play a critical role in socio-economic support, sustainability and environmental approvals (Windapo & Goulding, 2013:25). Transnet in its stakeholder management policy aims to take a proactive view in engaging and managing its stakeholders but mega-project teams appear to be overwhelmed with the number of stakeholders that need to be managed.

### 6.3.3 The Business Environment and Business Plan

Nearly one-third (33%) of all respondents disagree that the business environment and business plan is well known by the project team while 31% of respondents remained neutral on this construct. The results appear to suggest that TCP's mega-project teams do not fully understand the business environment of the mega-project. As a consequence, the project team may not be adequately prepared to manoeuvre the project in a manner that aims to achieve the best investment results. Following on from the argument of McKinsey (2013:5) that mega-projects have a long duration for the delivery of the end product and, as a result of this lengthy duration, the project may encounter one or several positive and negative economic cycles, TCP's mega-projects may traverse through strong or weak economic cycles. Should this be the case TCP's project teams may not be in an adequate position to steer the project through weak economic conditions, which may unintentionally lead to abandonment of the project, wasteful expenditure or major cost overruns.

### 6.3.4 The Project Scope

39% of all respondents disagree that the project scope is clearly defined while 19% of respondents did not take a view on this construct. The results indicate that most of TCP's mega-projects may not be clearly defined as required by the project team; therefore, the challenges of poor planning, rework, cost overruns and schedule slippages will manifest themselves as indicated by Merrow (2011:40) in his international study of mega industrial projects. The results of hypothesis testing in this study (section 5.2.2.9) indicates that there is a significant relationship between clearly defined mega-project scope and the necessity to involve stakeholders in the initiation phase.

## 6.4 OBJECTIVE 2: TO DETERMINE IF THE SCOPE OF PROJECTS ARE CLEAR, UPDATED AND MANAGED

It was found that three variables could explain 66% of the variability of the dimensions (Table 5.8). Using Varimax with Kaiser Normalization, the study found that the three variables that could construct the dimensions were the following statements: The project scope is clearly defined, there are too many changes on mega-projects leading to cost and schedule overruns, and due to the long duration of mega-projects, new technology is bound to negatively impact scope and costs (Table 5.9).

### 6.4.1 Changes in Mega-Projects

Eighty five percent of respondents in TCP indicate that there are too many changes in mega-projects leading to cost and schedule overruns, while 78% indicate that major scope changes are common in mega-projects. It is a concern that TCP faces a challenge with scope changes which negatively impact on costs and schedules. Contingencies for costs and time are allowed in projects to cater for changes as well as unforeseen events. TCP appears to be facing a quantum of changes that appear to be outside the norms of its contingency plans and these changes have a direct negative impact on planned project cost and schedule. The challenge of mega-project changes in TCP appear to support a similar situation in Oman whereby Alnuaimi et al. (2013:267) found that in four major public construction projects, changes were the most important reasons for design modifications and additional project costs.

### 6.4.2 Definition of Project Scope

While 41% of respondents agree that the project scope is clearly defined, it is a concern that 38% of respondents disagree on this construct. Twenty-one percent of respondents did not present a view on scope definition and remained neutral. The results are indicative that TCP has a challenge with clearly defining the scope on over 1/3 of all its mega-projects. The results are further aligned to the results of integrations processes (section 6.3.4) whereby 39% of respondents indicated that scope development was lagging in mega-projects. As cautioned by Ibrahim and Wilkinson (2015:321) in a study of Malaysian projects, TCP runs the risk of changes to its execution plans, cost overruns and schedule slippages when project scopes are not clearly defined.

### 6.4.3 Impact of New Technology

More than half of all respondents (58%) agreed that due to the long duration of mega-projects, new technology is bound to negatively impact scope and costs. The high rate of the evolution of technology especially related to IT and control systems mega-project is likely to remain as a challenge as long as technology continues to evolve at a rapid rate. However, systems can be designed to be upgraded at later stages without holding back the entire mega-project. The findings of this study build on the notion of Arthur and Kennedy (2014:23) whom emphasise that appropriate technology that must be adopted for mega-projects given the long operational lifespans of mega-infrastructure. TCP appears to suggest that the timing of implementing new technology will be a challenge on mega-projects and negatively impact on project costs.

## 6.5 OBJECTIVE 3: TO DETERMINE IF MEGA-PROJECTS ARE COMPLETED ON TIME

This study found that the five variables could explain 58% of the variability of the dimensions (Table 5.12). Using Varimax with Kaiser Normalization, it was found that the five variables that could construct the dimensions were: rework in design is the chief reason for mega-project delays; project schedules are compressed to match the business-case requirements; mega-projects are completed on time; upfront careful planning and realistic schedules will keep mega-projects on schedule; and labour unrests contribute to construction delays on mega-projects (Table 5.13).

### 6.5.1 Completion of Mega-projects

The majority of respondents (83%) disagreed that mega-projects are completed on time. The findings in TCP resonate with studies in literature (Merrow, 2011:34, Anderson, 2013:105; Amoatey et al., 2015:200) whom indicate a high failure rate of international mega-projects as a result of mega-projects not meeting their schedule targets. When mega-projects are delayed, a direct consequence is that additional funding is needed to support the extended timelines. Delayed schedules are bound to impact negatively on Transnet's MDS and goes against Transnet's strategy to deliver capacity ahead of demand and to reduce the cost of doing business in South Africa.

### 6.5.2 Compression of Project Schedules

A significant proportion of respondents (70%) agreed that project schedules are compressed to match the business-case requirements. Almost 58% of respondents concurred that the asset owner demands an unrealistic deadline to complete the project. The results of TCP compressing schedules and unrealistic deadlines demanded from the project team requires that the project team adopts a higher schedule-risk approach as reported by Haznini et al. (2014:333). This approach largely relies on completing activities in parallel with reduced time contingencies and float rather than the naturally sequential approach in which activities should be undertaken (PMI, 2013:190). In summary, the results of this construct are indicative of TCP taking high-risk approaches in compressing schedules and as cautioned by Haznini et al. (2014:333), compression generally means more costs are added to an activity and overlapping tasks through compression can cause additional schedule risks such rework, cost overruns and further schedule slippages if compression strategies are ineffective.

### 6.5.3 Rework in Design

Fifty nine percent of TCP respondents support the view that rework in designs is the chief cause of schedule overruns in mega-projects undertaken by Transnet. TCP undertakes mega-projects related port, rail and pipelines. The results of TCP are congruent with evidence in international industrial mega-projects where Merrow, (2011:40) indicates that a high level of rework in designs result from incomplete scope definition and is cause of project failure. Mark and Ellis (2013:82) further report that large agricultural projects are facing similar a situation as TCP when it comes to reworking of designs and schedule delays. The results of hypothesis testing in this study (section 5.2.2.11) confirms that there is a significant relationship between scope changes and redesigns leading to schedule slippages

### 6.5.4 Careful Planning and Realistic Schedules

Most TCP respondents (90%) agree that upfront careful planning will keep mega-projects on schedule and are supportive of Mark and Ellis's (2013:83) comments that it is essential that the schedule of major projects are not optimistic and that they are have a suitable budget to match an appropriate project timeline. This view of unrealistic project schedules is supports to Fyvberg (2009:350) view that 90% of mega-projects fail due to unrealistic schedules. Haznini et al. (2014:335) further note that schedule compression is poses a risk

of further rework, schedule slippage and cost overruns sending the project into a 'loss situation' if such unrealistic, subjective compression strategies are implemented. TCP's results are aligned with literature that upfront careful planning and the production of realistic schedules are requirements for successful mega-project delivery.

### 6.5.5 Labour Unrest

The findings in TCP indicate that labour unrest can lead to construction delays. Mark and Ellis (2013:84) in the case of major agricultural infrastructure in Guyana relate that Labour issues were identified as one of the top eight reasons for delays. The finding of TCP is indicative that Labour is a key input for successful mega-project delivery as per schedule and that successful Labour management will result in successful project delivery. There appears to be further alignment that Labour issues in developing nations require further investigation.

## 6.6 OBJECTIVE 4: TO ASCERTAIN THE REASONS FOR COST OVERRUNS

The present study found that three variables could explain 52% of the variability of the dimensions (Table 5.16). Using Varimax with Kaiser Normalization, it was found that the three variables that could construct the dimensions were: detailed cost plans are developed; there are too many changes on mega-projects leading to higher prices; and there is inadequate experienced personnel to control costs (Table 5.17).

### 6.6.1 Detailed Cost Plans

Almost half of all respondents (49%) agree that detail cost plans are developed for mega-projects. The availability of detailed cost plans is a best practice and congruent with PMI's (2013:191) requirement that the teams have the relevant tools for the production of detailed cost plans. Detailed cost plans allow the team to plan, track and manage the work packages of the project. As the project progresses to finalising its detailed engineering, the cost estimates and planning are updated to provide the latest estimate of total project costs as suggested by Zhang and Fan (2013:195). It is a concern that 32% of respondents (almost one-third) remained neutral on this construct and further concerns are raised with 20% of all respondents not supporting the notion that detailed cost plans are developed. It appears that selected project teams or respondents may be challenged with the production of detailed cost planning. The unavailability of detailed cost plans places TCP cost engineers in an awkward position where monitoring and control of costs are less than satisfactory. In construct 11.7,

48% of respondents appear not have the relevant experience to control costs. The combined effect of non-availability of detailed cost plans and inexperienced personnel to control costs is a serious risk to TCP's execution of mega-projects and potentially to Transnet's investment plans.

### 6.6.2 Changes on Mega-Projects

The majority (81%)of TCP respondents support the view that there are too many changes on mega-projects leading to higher prices. A supporting finding was presented under the dimension of scope management where a large majority of TCP respondents supported the view that there were too many changes to the scope. It is a concern that TCP mega-projects encounter the challenge of too many changes in the execution of its projects. From the onset of the early concept design phases of a project until the appointment of a construction contractor, mega-projects pass though Transnet's gate review and approval process, yet it appears that the project team continues to be faced with changes that de-stabilise the project with negative impacts on costs and schedules. 'Changes' in reality are unavoidable in projects so guidelines have been developed by leading project management institutions such as PMI (2013:213) on how to govern changes through change-control procedures. Contingencies for costs and time are allowed in projects to cater for changes as well as unforeseen events. TCP appears to be facing a quantum of changes that appear to be outside the norms of its contingency plans and these changes are hampering planned project costs and schedule. The results of hypothesis testing in this study (section 5.2.2.11) confirms that there is a significant relationship between scope changes and redesigns leading to schedule slippages

### 6.6.3 Insufficient Experienced Personnel to control Costs

A total of 48% of respondents concur that there are inadequate experienced personnel to control costs. Projects must use proper estimation and the appropriate level of resources and skills coupled with the required governance to effectively keep the project under control or else the project runs out of control with disastrous results (Muller et al, 2012:757). JIPSA (2016:5) further reflects that there is a shortage in critical skills including skills in project management, engineering, architecture and geology. It is a concern that almost half of all respondents (48%) report that there are inadequate experienced personnel to control costs. The results indicate that while TCP may have personnel appointed to undertake the duties of cost control, there is a challenge that the levels of experience in its personnel on its mega-

projects are inadequate to fulfil these requirements. Transnet (2015:28) further reports that there is a shortage of selected critical skills in its workforce but this report is unclear in its indication of a shortage in project control resources in its list of critical skills. The results of this construct is supportive of literature but in addition this study converges the skills shortages to cost-control personnel. The results of hypothesis testing in this study (section 5.2.2.21) relays that there is a significant relationship between inadequate experienced personnel and the underestimation of project costs. This study findings cautions that Transnet's 7-year MDS runs the risk of cost overruns on mega-projects if TCP does not take a serious position to address the number of sufficiently experienced people mobilised on its mega-projects.

## 6.7 OBJECTIVE 5: TO UNDERSTAND THE DEGREE TO WHICH PROJECTS ACHIEVE THEIR QUALITY REQUIREMENTS

The present study found that the three variables could explain 62% of the variability of the dimensions (Table 5.20). Using Varimax with Kaiser Normalization, it was found that the three variables that could construct the dimensions were: all quality packages are known at the commencement of a mega-project; there are inadequate experienced personnel to control quality; and quality management requires too much detail for mega-projects (Table 5.21).

### 6.7.1 All Quality Packages are known at the Commencement of a Mega-Project

The response by 39% of respondents indicates that quality packages are not available at commencement of a mega-project which places TCP in a position where the project team may not be able to measure, verify and fulfil the requirements of achieving the required quality standards for project work packages. Only one-third of all respondents (32%) agreed that all quality packages are known at the commencement of a mega-project. The availability of quality package plans is misaligned to best practices requirements such as PMI (2013:242) requirements. PMI reports that quality packages allow the team to plan, track and manage the quality of work packages in the project. As the project progresses through the four stages of TCP's PLP, namely concept stage, prefeasibility stage, design and construction, the relevant quality package at the commencement of each stage allows the project team to monitor and control quality requirements. In the high-cost phases of design and construction, the absence of quality requirements may result that designers and construction teams do not have an agreed framework or basis to measure deliverables and may lead to costly rework. In this prevailing environment, TCP personnel are bound to find themselves in disagreement

with designers or construction teams and conflict may arise leading to rework, delays and additional costs as alluded by Leite et al. (2016:570).

In construct 12.7, 59% of TCP respondents report that there are inadequate experienced personnel to control quality requirements of its mega-projects. The combined effect of non-availability of quality packages at the commencement of mega-projects and inexperienced personnel is a serious risk to TCP's delivery of mega-projects. The project owner's team, operations personnel and stakeholders may not accept a project with sub-standard quality and that the cost to rectify defects may be substantial. The results are also indicative that TCP quality management systems may not have reached the maturity levels as indicated by Zuo, Zillante and Xia (2014:801). Transnet may find itself in a challenging position that is uncompetitive when dealing with international project bids in the African continent.

### 6.7.2 Inadequate Supply of Experienced Personnel

Over half of all respondents (59%) report that there is an inadequate supply of experienced personnel to deliver quality. The results indicate that while TCP may have personnel appointed to undertake the duties of quality control, there may be a deficiency in the levels of experience in its mega-project teams to adequately fulfil the requirements of quality control. Transnet (2015:28) reports that there is a shortage of selected critical skills in its portfolio of required personnel but this report is does not specifically report a shortage of experienced personnel in quality control as found in this study. The TCP results are supportive of the JIPSA (2016:5) on skills shortages. TCP findings strengthen Xiaofen's (2013:417) view that major efforts are required by enterprises to redefine quality management, achieve excellence and be in a position to respond with agility and success in tough markets.

Another situation in TCP could point to fragmented teams and unclear responsibilities for training and development of the necessary skills. According to Lavikka and Jaatinen (2015:207) and Leite et al. (2016: 570), when project teams are fragmented, it is not clear who is responsible for the control of project quality.

The findings of the study under this objective indicate that quality packages are not available at the commencement of mega-projects. The project team is placed in a situation where it will not be able to fulfil the requirements of achieving the required quality standards for project work packages. The absence of quality requirements leaves a gap for designers and

construction teams to measure quality standards. Disagreement and conflict over quality deliverables between TCP quality personnel and design and construction may lead to rework, delays and additional costs. TCP reports that quality management requires too much detail while the level of personnel appointed to undertake quality management responsibilities do not possesses adequate experience to fulfil the role.

### 6.7.3 Quality Detail for Mega-Projects

Mega-projects by their nature are complex with a large variety of disciplines, interactions and integration that is required to achieve the required quality goals (Chagas, 2014: 624). Of the respondents, 38% agree that quality management requires too much detail in mega-project whereas under a third (32%) of respondents do not agree with this view. The larger majority of project personnel in TCP appear to suggest that a lot more detail than is required is imposed by Transnet's quality policy and procedures for its mega-projects execution. The effort required may be regarded as too much of detail to if the level of detail is not clearly understood by a large majority of the quality personnel. In section 6.7.1, there appears to be related evidence that indicates that not all quality packages are known at the commencement of its mega-projects. This section further illustrates that the absence of quality packages reduces the span and depth required to ensure that the relevant specifications meet their quality requirements. Results indicate that TCP quality management teams require assistance in understanding and coping

## 6.8 OBJECTIVE 6: TO ASCERTAIN IF PROJECTS HAVE ADEQUATE HUMAN RESOURCES AND SKILLS

The present study found that the five variables could explain 59% of the variability of the dimensions (Table 5.24). Using Varimax with Kaiser Normalization, it was found that the five variables that could construct the dimensions were: Mega-projects have the correct skill sets; Transnet has lots of resources but experience and exposure is limiting' EPCMs have the correct skill sets for delivering mega-projects; local and expatriate skills sets are required for mega-project execution; and there are too many people changes in the life of mega-project affecting smooth project delivery (Table 5.25).

### 6.8.1 Mega-Projects have the Correct Skill Sets

Many participants (47%) disagreed that mega-projects have the correct skill sets. IPMA ICB 3.0 (2006:9) describes competence as 'a collection of knowledge, personal attitudes, skills and the relevant experience required to successfully carry out a function'. These competencies operate at three levels namely technical, behavioural and contextual levels. It is a concern that 47% percent of respondents reported that project personnel that have been mobilised on mega-projects do not have the necessary competence to undertake the role of planning, leading, organising and control of mega-projects as required by certifying project management fraternities such as IPMA ICB 3.0 (2006:9). Langer et al. (2008: 24) in a study conducted in the IT sector assessing the impact of project managers' skills found that in high complexity projects having large teams, project execution can be improved when project managers demonstrate high-level skills sets in both 'hard' skills (technical, general) and 'soft' skills (tacit, non-technical). In the TCP scenario, there is evidence that there are major challenges in the availability of the correct skill sets to drive successful project delivery. In sections 5.5, 5.7 and section 5.8 the findings further suggest that there are deficiencies in the skill sets related to scheduling, cost control and quality. Cost, quality and time are commonly referred to as the 'iron triangle' of project management that are hard constraints for management and control of projects (Burke, 2013:24). The results on the skills challenge support the JIPSA (2016:5) skills audit and Transnet's recognition of deficiencies in skill sets (Transnet, 2015:28). The results of hypothesis testing in this study (section 5.2.2.21) demonstrates that there is a significant relationship between having the correct skill sets in mega-projects and mega-projects completion on time. Transnet runs a high risk of not completing project on time while the status of not having the correct skill sets prevails.

### 6.8.2 Transnet has Sufficient Resources but Experience and Exposure is Limiting

An overall majority (77%) of respondents agree that Transnet has sufficient resources but experience and exposure is limited. Twelve percent of respondents remained neutral while 11% disagreed. Competence is compromised when a combination of knowledge, attitudes or experience poses a limitation. The findings at TCP are a concern as they signify a situation that is contrary to Roe's (2014:2) view that in an organisation's commitment to delivering successful complex large projects, experienced and competent personnel must be mobilised to ensure desired investment outcomes. Mckinsey (2010:20) in their finding of industry best practice indicates that incompetency in workforce is in the order of 15%. The indications

from the majority of the respondents that TCP deploys limited experienced project personnel with limited exposure to execute high value mega-projects is a challenge that requires attention. The age analysis of TCP's resources executing projects reveals that 24% of the team is less than thirty years of age and 58% of the team is less than forty years old hence age may be a contributing factor. As argued by Roe (2014:2), TCP may not be sufficiently resourced to handle the complexity of mega-projects with the result that the desired investment outcomes may be compromised. Hypotheses 17 and 21 further show significant relationships between skills requirements and successful project delivery requirements

### 6.8.3 EPCMs have the Correct Skill Sets for Delivering Mega-Projects

External service providers (EPCM) are contracted-in by TCP for selected mega-projects to execute the roles of detailed engineering designs, procurement, construction and management of mega-projects. EPCMs have access to both local and international resources in assembling a project team that is best suited in executing mega-projects (Hatch, Mott McDonald & Fluor, n.p.). In the bidding for EPCM services, Transnet requires that CVs and experience levels of personnel that must be included in bid documents be submitted to TCP for evaluation purposes. Forty percent of the respondents (majority) agree with the statement that EPCMs have the correct skill sets for delivering mega-projects while 36% of the respondents were unsure of the EPCMs' skill sets for mega-projects. Twenty three percent of respondents disagreed that the EPCMs have the correct skill sets for mega-projects. The results appear to suggest that the EPCMs have stronger competencies in their teams than TCP to successfully execute mega-projects.

### 6.8.4 Local Residents and Expatriates are required for Mega-Project Execution

Sixty-seven percent of respondents agree that TCP should consider international people with similar project experience for its mega-project execution which may be directly related to the shortages reported by JIPSA (2016:15) several critical skills in South Africa including project managers, engineers, architects and geotechnical-engineers are in short supply. The views of TCP respondents are aligned to Nersheim and Smith (2015:260) view that project execution is a temporary task with a 'high degree of uniqueness' hence local parties should consider a hybrid of local skills intertwined with external short-term contracts. Nersheim and Smith further caution that high levels of maturity in working with local and expatriate resources, acceptance and respect of cultures differences. In the socio-demographic analysis there are indications that TCP has employed the services of expatriates whom make up 1%

of the project workforce. Therefore, respondents are indicating that there may be further opportunities for TCP to consider recruiting expatriates to benefit both effective project management, transfer of skills, and improved success of its MDS infrastructure plan.

### 6.8.5 Too many People Changes in the Life of Mega-Projects

TCP respondents indicate that there are too many people changes in the life of mega-projects which is affecting smooth delivery. While literature (Berg & Karlsen, 2014:455; Graham & Englund, 2008:110) points to people changes being a reality of project execution, the case of TCP indicates that this change occurs more often than not with subsequent negative impacts on the mega-project's execution profile. It is not clear where these changes occur in the mega-project organogram and the reasons for higher number of changes are also not certain. It is also unclear as to whether TCP is aware of the frequency of changes and if TCP has a resource contingency plan to effectively deal with this situation of resource changes that are affecting the project delivery effort. Further investigation is required into the numbers and levels of personnel leaving. In the case of the core team being destroyed, there may be serious challenges in loss of institutional knowledge, change management effects on the team, and productivity performance as indicated by Graham and Englund (2004: 113). Noting that 24% of personnel are less than 30 years of age and that 58% of personnel are less than 40 years, may relate to higher levels of job hopping due to demand for skills and transformation (LGSETA, 2016:7). Other be contributing factors. Other contributing factors for team personnel changes could be related to including poor morale and high levels of stress (Sharma & Lutchman, 2006:161). This matter needs to be investigated further.

## 6.9 OBJECTIVE 7: COMMUNICATION

The present study found three variables could explain 55% of the variability of the dimensions (Table 5.28). Using Varimax with Kaiser Normalization, it was found that the three variables that could construct the dimensions were: there are detailed communications plans developed for mega-projects; there is inadequate communications between the owner's team and EPCM to manage mega-projects; and the time span of mega-projects is too long to have effective communications (Table 5.29).

### 6.9.1 Communication Plans

In TCP, 32% of respondents agree that there are detailed communications plans developed for mega-projects whereas 30% of respondents did not take a view on this construct. The majority of respondents (38%) disagreed that detailed communications are developed. The absence of detailed communication plans in TCP limits project personnel to effectively respond to the frequent demands of complex and highly time-sensitive mega-projects as indicated by Chiocchio et al. (2012: 23). It is also important that the project manager and project personnel build up networks with the key stakeholders during the early implementation phase of the project and continually update data in a well-defined detailed communications plan. As discussed by Brill et al. (2006: 115), it is questionable whether TCP project managers together with their teams have the relevant competencies to develop the detailed communications plans that are an essential requirement for the extensive stakeholder management required in mega-projects. In section 6.8.2 there were strong indications from TCP respondents that competencies and skills in mega-projects were a challenge. The absence of detailed communication plans as indicated by most respondents is a further challenge to effective internal and external communications posing further risks to TCP's efficiency in delivering mega-projects

### 6.9.2 Inadequate Communications

The TCP results are a concern and may be an early warning indicator of a reduced rate of project success and conflict with inadequate communication in the current situation. Thirty percent of respondents disagree that there are adequate communications between the owner's team and the EPCMs to manage mega-projects while 30% of respondents chose to remain neutral. The largest number (45%) of respondents support the view that there is inadequate communications between owners teams and the EPCM to manage mega-projects which poses a risk to project efficiency when compared to Chiocchio et al. (2012:26) finding that there is a high rate of messages exchanged between the owner and the managing contractor (similar relation to owners' team and EPCM) in high performing teams which ultimately leads to project success. According to Soderlund (2011:154), inadequate communications between stakeholders is detrimental and leads to project failure. The perception of majority of respondents that there are inadequate communications between the owner and the service provider is a concern and raises an early warning of challenges of conflict between contracting parties, rework and related project delays as found by Parker et al. (2017:149).

### 6.9.3 The Time-Span of Mega-Projects affects Communications

Twenty one percent of the respondents agreed that the timespan of mega-projects is too long to have effective communications while 22% percent of respondents did not take a view. Most respondents (57%) disagreed that the time of mega-projects is too long to have effective communications and are supportive of the view of Zick and Anderson (2014: 788) as well as Chiocchio et al. (2012:26) in so far as establishing that with the skill of communications, consistent engagements and well-developed relationships, effective communications can be maintained during complex, long-duration mega-projects. The response from most of TCP's participants is positive and supportive of effective communications for the achievement of interim milestones and common goals in long-duration mega-projects.

## 6.10 OBJECTIVE 8: TO DETERMINE IF RISKS ARE CONTINUALLY IDENTIFIED, REVIEWED AND MANAGED

The present study found three variables could explain 74% of the variability of the dimensions (Table 5.32). Using Varimax with Kaiser Normalization, it was found that the three variables that could construct the dimensions were: it is difficult to manage all risks in mega-projects; there are too many risks to manage in mega-projects; and the appropriate level of risk management skill sets are not available on mega-projects (Table 5.33).

### 6.10.1 Managing all Risks

Over one-third (37%) of participants disagreed that it is difficult to manage all risks and 14% are undecided on this construct. Almost half of all participants (48%) making up the majority of all participants were in agreement that it is difficult to manage all risks in mega-projects. It is noteworthy to reflect on Piperca and Floricel's (2012:253) findings that complex mega-projects by their nature are embedded by many unknown risks. The findings in TCP resonate with Piperca and Floricel's (2012:254) argument that risk management can be an overwhelming task in managing known and unknown risk in complex mega-projects. However, TCP may be challenged in planning, identifying, updating and managing risks as recommended by Richardson (2010:139) since evidence from a majority of TCP respondents indicates that the appropriate risk management skill sets are not available on mega-projects.

Project managers generally tend to underestimate risks. While some risks are predictable, others are 'simply unpredictable'. According to PMI (2013:311), risk management planning is undertaken in the early phases of the project. This risk management plan incorporates the development of project risk plans, identification of risks, undertaking risk analysis on qualitative and quantitative risks and development risk response plan. Huang and Hans (2008:177) follow a similar approach when they highlight that risks need to be quantified, and that their impact on performance of the project must be evaluated together with the development of strategies of control.

### 6.10.2 Too Many Risks on Mega-Projects

Over a quarter (28%) of all respondents firmly negated the view that there are too many risks to manage in mega-projects and 9% of respondents remained uncertain. The largest proportion of respondents (63%) are in agreement that there are too many risks to manage on mega-projects. The results are supportive of Baccarini et al. (2004:290) view that risks related to the implementation of mega-projects can become significantly challenging for project managers. The risk identification process consists of identifying and documenting potential project risk events throughout the lifecycle and is iterative since new risks might become known as the project progresses (Richardson, 2010:1). It appears that TCP mega-project teams are facing a quantum of risks beyond risk planning and identification stages as indicated by Hansen et al. (2013:160) and the appropriate levels of resourcing and effort as suggested by Susser (2012:46) may be ineffective in continually updating and managing the risks through the various project stages. The outcomes highlight that TCP may be ineffective in proactively monitoring the likelihood and impacts of risk events, managing risk outcomes, and maximising opportunities as mega-projects in TCP face too many risks. There are opportunities for scholars to unpack this overwhelming quantum of risks in future studies.

### 6.10.3 Level of Risk Management Skill Sets

Half (50%) of all TCP participants are in agreement that the appropriate level of risk management skill sets is not available on mega-projects, while 30% of participants disagreed with this view and 20% of participants were unsure about this construct. The findings at TCP are a concern as they signify a situation that is contrary to Kerzner' (2013:21) view that resources with knowledge and skills must be mobilised as this is one of the most critical requirements for risk management in mega-projects. TCP runs the risk of project failure as

indicated by Roe (2014:2) argument that in an organisation's commitment to delivering successful complex large projects, experienced and competent personnel must be mobilised to ensure desired investment outcomes. The findings that a high percentage of TCP respondents indicated that experience is limiting resources deployed in mega-projects is inconsistent with the competency requirements of leading project management authority IMPA ICB 3.0, (2006:9). This is a serious concern relating to TCP's selection of resources to manage risks in high complexity, high-value mega-projects. TCP may not be adequately resourced in its current mega-project teams with deficiency in risk skills becoming in itself a risk to planned business investment goals.

## 6.11 OBJECTIVE 9: TO ASCERTAIN IF PROCUREMENT PROCESSES ARE AFFECTING THE DELIVERY OF PROJECTS

The present study found that the six variables could explain 59% of the variability of the dimensions (Table 5.36). Using Varimax with Kaiser Normalization, it was found that the six variables that could construct the dimensions were: contractors are effectively managed by TCP's EPCMs; the appropriate suite of contracts is applied to mega-projects; BEE contractors have good support from Transnet; procurement processes are too long; disputes are easily resolved and contractor / client conflict hampers mega-project delivery (Table 5.37).

### 6.11.1 Contractors are effectively managed by TCP's EPCMs

Almost one-third (32%) of all participants agree that contractors are effectively managed by TCP's EPCMs, while 29% remained neutral on this construct. The largest majority (39%) of participants disagree that contractors are being effectively managed by TCP's EPCMs. It is worth noting that in the study undertaken by Apooja et al. (2013:709) on contracting and managing strategy, the authors illustrate that the effective management of the contractor's team plays a key role in the mega-project meeting its budget and schedule goals hence TCP's EPCM's may be facing challenges that need to be explored further. EPCMs indicate to have access to international and local resources, practices and processes (Hatch, Mott MacDonald & Fluor, 2016:n.p); however, the majority of TCP participants indicate that its EPCMs are not effective in managing contractors is a concern. The ineffective management of contractors by TCP's EPCMs points to several challenges that may be encountered by TCP which include disputes, delayed schedules, costs overruns with the outcome that mega-

projects may not meet their desired investment goals. The results of this construct is contrary to the strategic intent and reporting by EPCMs (Hatch, Mott MacDonald & Fluor, 2016:n.p.)

### 6.11.2 The Appropriate Suite of Contracts is applied to Mega-Projects

Nineteen percent of participants disagree that the appropriate suite of contracts is applied to mega-projects while 42% of participants preferred to remain neutral. A substantial number (39%) agreed that the appropriate suite of contracts is applied to mega-projects. Transnet (2016:1) indicates that it uses the New Engineering Contract 3 (NEC3) suite of contracts for contracting with suppliers and contractors. The NEC3 is a set of contracts that can be used throughout the projects lifecycle that is planning, designing, procurement and construction (Neccontract.com, n.p). NEC3 asserts to facilitate sound project management practices, principles, collaboration and definition of legal relationships. It claims to be endorsed worldwide by industry and governments as it further indicates that leading project management fraternity APM uses its professional service contract as the standard for the appointment of project managers. The neutral stance taken by almost half of all respondents on the NEC3 being the appropriate suite of contracts could possibly be related to disputes not being easily resolved (refer Table 5.34, construct 15.7), conflict that is hampering the mega-project delivery section (refer Table 5.34, construct 15.18) or the availability of the right skills to manage the administrative demands of the NEC3 contracts. A fair proportion of respondents (39%) support the NEC3 and may be enjoying the benefits of its suite of contracts in executing mega-projects in TCP.

### 6.11.3 BEE Contractors have good Support from Transnet

Almost half (49%) of all respondents agreed that BEE contractors have good support from Transnet, while 29% of respondents chose to remain neutral. Twenty-two percent of respondents disagreed that BEE contractors have good support from Transnet. Results of this construct alludes to Transnet's BEE policy and strategy enjoying success as most respondents agreed that BEE contractors have good support and commitment from Transnet. DTI (2016:10) reinforces the purpose of BEE is to provide equal opportunities for all South Africans and to encourage the support of previously disadvantaged race groups. The results demonstrate that BBE development in Transnet is on a solid grounding and that BEE targets are being met. The results in TCP further demonstrate that BEE can be successful in mega-projects supporting Kleynhans and Kruger's (2014:7) findings that BEE is working

successfully in South Africa and Transnet's positive results reported on BEE (Transnet, 2015:32)

### 6.11.4 Procurement Processes are too Long

Public entities such as Transnet are in the 'eyes of the public' and governance requirements provides detailed guidance on 'fair and transparent process' and various levels of DOA in selection and approval of service providers (Transnet, 2016:1). Thus, the higher the value of the mega-project and the value of its contracting packages, the longer the chain of DOA that is required for approvals. The sentiment by TCP respondents that procurement processes are too long is a concern and may impact on cost escalations if processes are long and more so inefficient as reported in studies undertaken by Pilbeam et al. (2012: 358) and Bogus et al. (2013:382) on complex mega-projects. There are further opportunities for scholars to investigate the duration of procurement processes and compare these to the total project duration in an attempt to calculate costs and schedule impacts.

### 6.11.5 Disputes are easily Resolved

Eleven percent of respondents agreed that disputes are easily resolved, 34% remained neutral while 55% responded negatively to the notion that disputes are easily resolved. This study leans to support the notion by Apooja et al. (2013:710), that procurement and contracting approach based on a client / contractor two-party system with a contract awarded at the lowest price can be a stumbling block to a cooperative and collaborative approach to efficient delivery of mega-projects. One of the fundamental principles of NEC3 contract, as adopted by Transnet, is a win-win, collaborative, fair approach to contracting between parties. Clause 10.1 of the NEC3 alludes to the contracting parties engaging on a basis of "mutual trust and respect". The negative response to disputes being easily resolved is an indicator that dispute resolution in TCP is contrary to the aims of the NEC3's mutual trust, respect and collaboration. The results on this construct further misalign to the findings of Ibrahim et al. (2015: 322) on the requirements of efficient dispute resolution for effective project delivery. Finally, apart from the contract being a legal document, Kamminga (2014: 215) adds that the interpretation and efficient execution of the contract is critical to large project delivery. TCP faces the challenge of a demanding contracting management environment and runs the risks of claims, cost overruns and delayed schedules in an environment that does not promote the easy resolution of disputes.

### 6.11.6 Contractor/Client Conflict

Eighteen percent of participants disagree that contractor/client conflict is hampering mega-project delivery and just over one-third (35%) of participants did not take a view on this matter. Almost half of all respondents agree that contractor/client conflict is hampering the delivery of mega-projects. The perception by almost half of all TCP participants that client/contractor conflict is hampering mega-project delivery shows that conflict in the contracting relationship as a stumbling block and a challenge in TCP. The contract environment in TCP appears to be aligned to Amoatey et al. (2015:207) findings that client and contractor conflict coupled with frequent price changes are common factors in project delivery in developing countries. The reasons for conflict need to be unpacked further; however, there may be some related behaviour that may be related this conflict between the client and the contractor. There are indications (refer Table 5.10, construct 10.5) that the client makes major changes, and as suggested by Lahdenpera (2012:57) client issues contribute to conflict. The indication of inadequate levels of experience and maturity as alluded by Ebrahim et al. (2015: 311) could be other contributor to conflict not being managed and hampering delivery in TCP. In summary, the client/contractor conflict that is negatively impacting on the TCP's delivery of mega-projects does not support Transnet's mandate of delivering infrastructure ahead of demand and lowering the cost of doing business in South Africa.

## 6.12 OBJECTIVE 10: TO UNDERSTAND THE IMPACTS OF STAKEHOLDER MANAGEMENT IN MEGA-PROJECTS

The present study found that five variables could explain 66% of the variability of the dimensions (Table 40). Using Varimax with Kaiser Normalization, it was found that the five variables that could construct the dimensions were: budget for stakeholder management is available on mega-projects; stakeholder stoppages lead to added costs to projects; customers in the end are satisfied with the project; ER are effective in the contractor's teams; and the environmental authorisation processes delay projects (Table 41).

### 6.12.1 Budget for Stakeholder Management

Twenty eight percent of respondents agreed that budget for stakeholder management is available on mega-projects, 37% remained neutral and 35% disagreed that budget for stakeholder management is available on mega-projects. The TCP results are indicative that

some mega-projects may have created budgets to manage the critical activity of stakeholder management as suggested by Doloi (2012:532). It is a concern that 37% of respondents remained neutral on this construct which may indicate that respondents are not sure about whether budgets for stakeholder management are indeed available in mega-projects. There is a possibility that budgets may be available in other departments of Transnet that are not included the formal project team and that these departments are managing stakeholders on behalf of the mega-project team. This needs to be probed further. Transnet (2014:27), in its stakeholder engagement policy, indicates that stakeholder engagement is an integral domain of value creation. While 36% of respondents disagreed that budget availability for stakeholder management is included in the project budget, in section 5.3 80% of respondents agreed that it is necessary for stakeholders to be involved in the initiation phase of the project to obtain expectations and buy-in. The results positively indicate that mega-project teams are aligned with the literature on the value of stakeholders and that mega-project teams are supportive of Transnet's stakeholder policy.

### 6.12.2 Stakeholder Stoppages

A smaller portion (10%) of respondents disagree that stakeholder stoppages lead to higher cost, 18% chose not to present a view while 79% agreed that stakeholder stoppages lead to added costs to projects, supporting the view of Doloi (2012:533) that stakeholders play a major role in defining and sustaining major project value. TCP's feedback is further aligned to Xie et al. (2014:230) whom indicate that stakeholders have a significant influence in measuring project benefits including job creation, economic growth, as well as a balance in the environment and should there be any suspicions on the compromise of expected value, this may lead to resistance. The responses appear to be aligned to Doloi's (2012:534) and Xie et al.'s (2014:235) view on the influence of stakeholders and agree that the stakeholder stoppages of the project can lead to added costs.

### 6.12.3 Customers Satisfaction

A large percentage (37%) of participants agreed while 16% disagreed that customers are satisfied with the project outcomes and 48% of participants preferred not to present a view on this construct. The majority of respondents remaining neutral on this construct could be attributed to the absence of customer feedback or the absence of any post-delivery evaluations. However, a smaller portion (16%) of participants were certain that customers

are not satisfied at the end thus raising questions about whether this dissatisfaction could be attributed to adversarial relationships, failure to meet cost and schedule targets or poor quality of work. There are indications however that TCP, after managing a large number changes, rework, contract disputes, delays and with limited skilled experienced personnel, is indeed satisfying customers with the infrastructure that was intended to be developed. The results of TCP is supportive of Windapo and Goulding (2013:424) proposal that value can be created in projects by ongoing engagements which eventually leads to successful execution and acceptance of the end product. The outcomes in TCP is also a contribution to Ibrahim et al. (2015:327) view that adopting an integrated approach an lead to successful outcome in mega-projects. The findings in TCP is a positive outcome and supports Transnet's strategic objectives and goals of providing modern, efficient infrastructure that satisfies end users.

### 6.12.4 ER is effective in Contractors' Teams

For this construct, there was agreement among 30% of respondents that ER is effective in contractor's teams, while 22% disagreed. Almost half (48%) of all respondents chose to remain neutral on the subject of effective ER in contractors' teams. TCP's contractors' teams may be indicative of limited trust, collaboration and good team performance since Bond et al. (2013:1010) assert that ER is strengthened through collaboration and trust. TCP's mega-project performance team may further be at risk as Roehrich et al. (2014:695) point out that the construction industry is in the best position placed to manage culture at the mega-project level. Pinto and Pinto (1990:205) indicates that high performing teams cooperate much more than low performing teams hence there is room for improvement in TCP's contractors' teams.

### 6.12.5 Environmental Authorisation

In terms of the National Environmental Management Act 1998, an environmental impact assessment (EIA) must be undertaken and an environmental authorisation (EA) must be obtained prior to the construction works being undertaken (DEA, 2016:n.p). Eighteen percent of participants disagreed that EA processes delays projects and 18% remained neutral. A majority (62%) of TCP respondents appear to support the view that EAs have a negative impact on mega-projects leading to project delays. The results of TCP that EA processes delay projects appear to have some bearing on the long timelines indicated by Retief and Chabalala (2009:15). There is however insufficient evidence to benchmark EIAs

causing delays to projects as a result of the long EIA timelines. There is evidence according to Retief and Chabalala (2009:15), in a survey of 148 EIAs in South Africa, that the costs for undertaking an EIA in South Africa is much higher than international projects and that could be an indicator of long time-times for approvals. The results in TCP supports the view of Flyvberg (2009:345) whereby he indicates that the laws and regulations empowers community groups and decision-makers to contest project information and methodologies with possible significant negative impacts to delivery of mega-projects.

## 6.13 HYPOTHESIS DISCUSSION

This section discusses the findings of the hypothesis testing conducted in this study. In Table 6.1, a summary of the results of the hypothesis testing is presented. For each hypothesis, a discussion a presented in the sections that follow.

Table 6.1: Summary of the results of hypotheses testing

| Null Hypotheses | Statistical measures used | Result | Interpretation |
|---|---|---|---|
| $H_{01}$ | Kruskal-Wallis Test | Accept | There is no significant difference of the median values of all the dimensions in mega-projects among the different Age groups. |
| $H_{02}$ | Mann-Whitney Test | Accept | There is no significant difference of the median values of all the dimensions in mega-projects and the categories of Gender |
| $H_{03}$ | Kruskal-Wallis Test | Reject | The medians of all dimensions in mega-projects are not the same across categories of Race. There is a significant relationship between Race and the dimensions of integration processes, scope, quality management, HR and skills, stakeholder management |
| $H_{04}$ | Kruskal-Wallis Test | Reject | The medians of all dimensions in mega-projects are the same across categories of Marital status except managing costs on mega-projects. There is a significant relationship between the dimension of cost and marital status. |
| $H_{05}$ | Kruskal-Wallis Test | Accept | There is no significant difference of the median values of all the dimensions in mega-projects and the categories of Education |
| $H_{06}$ | Kruskal-Wallis Test | Accept | There is no significant difference of the median values of all the dimensions in mega-projects and the categories of Nationality |
| $H_{07}$ | Kruskal-Wallis Test | Reject | There is a significant relationship between years of employment in the company and dimensions of schedule, costs, HR and Skills. |
| $H_{08}$ | Spearman's rho correlation test | Reject | There is a significant relation between the development of realistic schedules and mega-projects completion time |

| Null Hypotheses | Statistical measures used | Result | Interpretation |
|---|---|---|---|
| $H_{09}$ | Spearman's rho correlation test | Reject | There is a significant relationship between the clearly defined mega-project scope and the necessity for stakeholders to be involved in the initiation phase |
| $H_{010}$ | Spearman's rho correlation test | Reject | There is a relationship between effective change-control processes and mega-projects completion on time |
| $H_{011}$ | Spearman's rho correlation test | Reject | There is a significant relationship between major scope changes by the asset owner and redesigns leading to schedule slippages. |
| $H_{012}$ | Spearman's rho correlation test | Reject | There is a significant relationship between insufficient engineering done for the business-case and underestimated project costs. |
| $H_{013}$ | Spearman's rho correlation test | Accept | There is no relationship between inadequate experienced personnel and the development of detailed quality plans. |
| $H_{014}$ | Spearman's rho correlation test | Reject | There is a significant relationship between correct skill sets and the availability of skills in the market at the time of project execution. |
| $H_{015}$ | Spearman's rho correlation test | Reject | There is a significant relationship between the correct skill sets and mega-projects completion on time |
| $H_{016}$ | Spearman's rho correlation test | Accept | There is no relationship between contracting parties and easy resolution of disputes. |
| $H_{017}$ | Spearman's rho correlation test | Reject | There is a significant relationship between the availability of risk skill sets and the capability to manage risks. |
| $H_{018}$ | Spearman's rho correlation test | Reject | There is a significant relationship between the complexity of mega-projects and the difficulty to manage all risks in mega-projects |
| $H_{019}$ | Spearman's rho correlation test | Accept | There is no relationship between rewarding good contractor performance and mega-project completion on time |
| $H_{020}$ | Spearman's rho correlation test | Reject | There is a significant relationship between contractors having the right teams to manage construction work and mega-projects completion on time |
| $H_{021}$ | Spearman's rho correlation test | Reject | There is a significant relationship between inadequate experienced personnel and the underestimation of project costs at the business-case stage |

### 6.13.1 The relationship between the mean ranks of the dimensions and the age groups of participants

The study failed to establish any relationship between any of the 10 dimensions and the age groups of the participants. It therefore appears that there is no influence in which the various age groups view the challenges facing the delivery of mega-projects in TCP.

### 6.13.2 The relationship between the mean ranks of the dimensions and the gender groups of participants

The hypotheses testing failed to record any relationship between any of the project management dimensions and male or female respondents. It can therefore be stated that in the study of mega-project challenges in TCP that the gender of respondents does not influence the view of the constructs of the 10 dimensions.

### 6.13.3 The relationship between the mean ranks of the dimensions of integration, scope, quality, HR and Skills, stakeholders and race groups of participants

The study found that there was a significant relationship between the following knowledge area dimensions and race:

- Integration processes in mega-projects
- Scope of mega-projects
- Quality management in mega-projects
- HR and skills in mega-projects
- Managing stakeholders in mega-projects

The hypotheses tests failed to establish any relationship between the knowledge area dimensions and race on for the following dimensions:

- Mega-projects schedule
- Managing cost on mega-projects
- Communications in mega-projects
- Managing risk in mega-projects
- Procurement in mega-projects

The iron triangle of project management regards scope, schedule, cost and quality as the core functions of project management (PMI, 2013:). In the study of mega-projects challenges in TCP the race groups of respondents have differing views on two core functions that is ‘scope of mega-projects’ ‘and quality management in mega-projects’. The different race groups

further differ on ‘facilitating’ project functions that is integration processes, managing stakeholders and HR and skills in mega-projects.

### 6.13.4 The relationship between the mean ranks of the dimensions and the marital status of groups of participants

The study did not provide any positive relationship between the marital status of the respondents and the following dimensions of integration processes, scope, schedule, quality, HR and skills, communications, risks, procurement and managing stakeholders in mega-projects.

However, the study does indicate that there is a significant relationship between managing costs on mega-projects and marital status. There can therefore be acknowledged that the marital status of TCP respondents does indeed influence the views of managing costs in mega-projects in TCP.

### 6.13.5 The relationship between the mean ranks of the dimensions and participants groups of education levels

The study failed to establish any relationship between any of the 10 dimensions and the level of education of the participants. It therefore appears that there is no difference in which the various education levels of participants view the challenges facing the delivery of mega-projects in TCP.

### 6.13.6 The relationship between the mean ranks of the dimensions and participants nationality groups

The hypotheses testing failed to record any relationship between any of the project management dimensions and the nationality of respondents. It can therefore be stated that in the study of mega-project challenges in TCP that the nationality of respondents does not influence the view of the constructs of the 10 dimensions.

### 6.13.7 The relationship between the mean ranks of the dimensions and participant’s years of experience groups

The study did not provide any positive relationship between the years of experience of participants and the dimensions of integration processes, scope, schedule, quality, HR and skills, communications, risks, procurement and managing stakeholders in mega-projects.

However, the study does indicate that there is a significant relationship between:

- Mega-projects schedule and years of experience of participants
- HR and skills in mega-projects, and years of experience of participants

There can therefore be acknowledged that the participant's years of experience does indeed influences the views on mega-projects schedules as well as HR and skills in TCP.

### 6.13.8 The relationship between the development of realistic schedules and mega-project completion on time

The study found that that there is a strong relationship between the development of realistic schedules and completion of mega-projects on time. The findings in TCP support the views of Berg and Karlsen (2014:455) as well as Narbaev and De Marco (2013:6) whom all claim that the projects teams that develop accurate schedules with detailed levels of activities and durations that are reflective of the project will have improved schedule management and successful completion. The results of infrastructure mega-projects in TCP further support Merrow's (2012:38) view that successful completion of mega industrial projects is associated with detailed planning.

### 6.13.9 The relationship between clearly defined mega-project scope and the necessity to involve stakeholders in the initiation phase

The analysis of the TCP data indicates that there is a significant relationship between clearly defined mega-project scope and the necessity to involve stakeholders in the initiation phase. The findings of this study support PMI's (2013:23) explanation that stakeholders should be involved in the early stages of the project to develop the project's scope. Windapo and Goulding (2013:424) further support this notion and agree that stakeholders play a key role in the definition of project scope which eventually leads to successful execution and acceptance of the end product.

### 6.13.10 The relationship between effective change-control processes and mega-project completion on time

The study found a positive correlation between effective change-control processes and mega-project completion on time. The results of TCP have bearings with the views of Mark and Ellis (2013:79) that excessive change order and ineffective change-control processes

were one of the major contributing factors for schedule slippages in major agricultural projects in Guyana. Norouzi et al. (2015:1) expound further on this relationship stating that ineffective change-control processes for large complex networks such as in mega-projects can be complicated, with impacts on schedule processing and performance.

### 6.13.11 The relationship between major scope changes by the asset owner and redesigns lead to schedule slippages

Merrow' s (2011: 27) emphasis that the scope changes in mega industrial project are a key factor contributing to ongoing redesigns and ultimately project failure. Merrow therefore provides valuable guidance in advising that the entire FEL2 phase of the projects lifecycle should be devoted to development a robust scope for mega-projects. Alnuaimi et al. (2013: 267) found that major scope changes initiated by the Owner had a direct impact on redesigns of major infrastructure projects in Oman with disastrous results. The hypotheses testing in TCP's mega-projects is congruent with literature and provides statistical evidence that there is indeed a significant relationship between major scope changes and frequent redesigns.

### 6.13.12 The relationship between insufficient engineering done for the business-case and underestimated project costs

There is a significant relationship between insufficient engineering done prior to the business-case and underestimated project costs. The findings of this hypotheses is aligned to the discussions of Rosenfelt (2014:61) and Anderson et al. (2016:180) whereby they indicate that at the early stages of a project there is a massive underestimation of costs resulting from limited low levels of engineering.

### 6.13.13 The relationship between inadequate experienced personnel and the development of detailed quality plans

The found no relationship between the presence of inadequate experienced quality management personnel and the development of detailed quality management plans. This finding supports the notion of PMI (2013:5) and APM (2010:2) that experience alone is insufficient for the detailed quality management plans but other factors such as polices, processes and tools are also essential requirements

### 6.13.14 The relationship between correct skills sets and the availability of skills in the market at the time of mega-project execution

There is a significant relationship between industry competition for skills and the availability of the correct skill sets in TCP. JIPSA (2015:5) critical skills report identifies a national demand for critical skills such as project managers, engineers, architects and geologists. Transnet (2015: 28) Sustainability Report acknowledges the need to address the issue critical skills with the organisation and elaborates on actions plans to address this issue. The findings in TCP reinforces that there is a significant relationship between the market scarcity of skills and the availability of correct skill sets within TCP.

### 6.13.15 The relationship between correct skill sets in mega-projects and mega-project completion on time

Data processing of TCP feedback demonstrates a significant relationship between correct skills sets in TCP and mega-projects completion on time. This relationship is meaningful and relevant as demonstrated by Muller and Jugdev (2012:760) reinforcing the view that that mega-projects need to maintain the appropriate level of resources and skills to effectively keep projects under control, else projects can go out of control with disastrous results. Roe (2014:2) further supports the notion that an organisation's commitment to delivering successful large complex projects, experienced and competent personnel must be mobilised to ensure successful business outcomes.

### 6.13.16 The relationship between inadequate communications between contracting parties and easy resolution of disputes

The study found that there was no relationship between inadequate communications between contracting parties and the easy resolution of disputes. The results are contrary to the views of Chiocchio et al. (2012:26), Piperca and Floricel (2012: 256) and Smulowits and Ziek (2012: 90 whom found that there was as high rate of exchange of messages between the owner's teams and contractors in high performing teams thus providing evidence of maturity in relationships and ultimately leading to project success. A possible explanation for this situation in TCP could be that the easy resolution of disputes requires more than adequate communications between parties such as co-location, teamwork and a spirit of collaboration as indicated by Apooja et al. (2013:699).

### 6.13.17 The relationship between the availability of risk management skill and the capability to manage mega-project risks

The TCP study results indicates that there is a significant relationship between the availability of risk management skill sets in TCP and the capability to manage mega-project risks. This relationship appears to be aligned to the views of Javani and Rwelamita (2016:392), Ramos and Mota (2014:351) and Susser (2012: 46) that the capability to manage risk requires the strength of a capable and competent risk management team. Ramos and Mota (2014:35) add further that organisations have heavily invested in technologies and processes but have dismally failed to invest in developing personnel capability to manage large and complex mega-projects which are usually fraught with risks that could destroy the project. The findings of this hypotheses in TCP completes the link between availability of skill sets and risk management capability.

### 6.13.18 The relationship between the complexity of mega-projects and the difficulty to manage all risks in mega-projects

Hypothesis testing shows a significant relationship between the complexity of mega-projects and the difficulty to manage all risks. The findings of this study reinforce the comments of Didraga (2013:89) whom states that even with the availability project management risk tools, processes and management approaches, the complexity of large projects present numerous challenging risks both manageable and unmanageable through the life of the project. The findings in TCP reinforces with empirical evidence the views of Ramos and Mota (2014: 354) that project managers fail to manage all risks even with the most sophisticated risk tools and systems.

### 6.13.19 The relationship between rewarding good contractor performance and mega-project completion on time

Data processing of TCP feedback demonstrates that there no relationship between the rewarding of contractor performance and mega-project completion on time. The findings are contrary to Bogus et al. (2013:175), Apooja et al. (2013:699) whom concluded that incentive schemes for contractors have a positive impact on early completion of projects. It therefore appears that contractors working on TCP's projects are not motivated by incentives but to other factors. These factors may include a harmonious working relationship, fair compensation for changes and regular payments to maintain cash flow. Another explanation

could be that public entities in South Africa do not usually offer incentives for early contractor completion, hence contractors do not plan their schedule based on an incentive regime in public projects.

### 6.13.20 The relationship between contractors having the right teams to manage construction work and mega-projects completion on time

The study found that there is a significant relationship between mega-projects having the right team for construction and mega-project completion on time. The finding of this hypothesis supports the views of Apooja et al. (2013:701) whom elaborate that the experience, skill sets and team sizes are critical factors for achieving the schedule performance and completion as planned.

### 6.13.21 The relationship between inadequate experienced personnel and the underestimation of project costs at the business-case stage

Ebrahim et al. (2015: 311) and Muller and Jugdev (2012:760) indicate that that mega-projects need to maintain the appropriate level of resources and skills to effectively keep projects under control, else projects can go out of control with disastrous results. Roe (2014:2) further argues that an organisation's commitment to delivering successful large complex projects, experienced and competent personnel must be mobilised to ensure successful business outcomes. The hypothesis test results in TCP provides empirical evidence that there is a relationship between inadequate experienced personnel and the underestimation of project costs at the business-case stage

## 6.14 DISCUSSION ON OPEN-ENDED QUESTIONS

While this study took the path of a quantitative research method, the researcher adopted to further probe participants viewpoints in order to gauge the feelings pertinent to critical areas of this study. At the end of the questionnaire, TCP participants were provided an opportunity to provide their feedback to five questions. The questions focused on six key areas namely:

Question 18: Skills to deliver mega-projects
Question 19: Governance on mega-projects
Question 20: Reasons for budget overruns
Question 21: EPCM capability to successfully deliver EPCM
Question 22: TCP's ability to manage EPCM's

Question 23: Reasons for cost overruns
Question 24: Any comments for this study

### 6.14.1 Discussion on the Comments from Question 18

***"Do you think that South Africans have the skills to deliver mega-projects?"***

There were strong responses that South Africans have the skills to deliver mega-projects; however. many of these responses were backed up with qualifications such as selected skilled personnel are overlooked in appointments, more training and development are required to adapt to the mega-project environment, and that there are pockets of competence. A fair proportion of respondents indicated that skills are not available and that the mitigation for this situation is to train personnel, use expatriates, fair recruitment of skilled people based on ability, head-hunt required skilled people for mega-projects with the intention of executing mega-projects as well as developing less experienced personnel. The feedback on this question is fairly well aligned to the qualitative analysis whereby 47% of respondents indicated that mega-projects do not have the correct skill sets as well as the views of JIPSA (2016: 07) report on skills shortages

### 6.14.2 Discussion on the Comments from Question 19

***"Is there too much 'red tape' that makes project delivery difficult?"***

This question was posed to gauge the feeling on bureaucracy in TCP and its impacts on mega-project challenges. A large portion of respondents agreed that there was too much 'red tape' in TCP and that the impacts resulted in long procurement processes, delayed projects, lack of resources and high costs. The comments are indicative of approval processes having negative impacts on mega-projects and is further aligned the qualitative results whereby 70% of respondents indicated that procurement processes are too long and 33% of respondents indicated that project managers do not have the appropriate delegation of authority on mega-projects.

### 6.14.3 Discussion on the Comments from Question 20

***"What are your reasons for mega-projects not meeting planned budgets?"***

Most respondents provided reason for mega-projects not meeting budgets. Some of the main reasons are undefined scope, poor planning, scope changes, unknown risks, long approvals, inadequate engineering design, poor contact management and ineffective controls and inadequate experienced personnel. The comments are strongly aligned to constructs 11.9 whereby 81% of respondents agreed that there were too many changes on mega-projects leading to higher prices. In construct 11.7, 69% of respondents agreed that there is inadequate experienced personnel to control costs.

### 6.14.4 Discussion on the Comments from Question 21

***"Are EPCMs capable of successfully delivering mega-projects for Transnet?"***

Most respondents agreed that EPCMs are capable of successfully delivering mega-projects for Transnet however there were several qualifications linked to this response. These qualifications include effective management, working in collaboration and EPCMs mobilising skilled experienced personnel. The qualification on effective management has a fair bearing to the qualitative analysis whereby 40% of respondents (construct 16.10) disagreed that contractors are effectively managed by TCP. It is a matter of concern that 40% of respondents to construct 8.13 disagreed that EPCMs are clear about Transnet's internal project management processes, hence reinforcing the notion that TCP management and unclear processes are a risk to the EPCM's capability of successfully delivering mega-projects for Transnet.

### 6.14.5 Discussion on the Comments from Question 22

***"Is Transnet's owner's team adequate to manage EPCMs?"***

Most responses point to Transnet's owners' teams not being adequate to manage EPCMs and the chief reason that stand out for this response is that Transnet does not possess the correct experience and skills level to manage EPCMs. In construct 16.16 of the qualitative analysis, there is a supporting finding where 40% of TCP respondents disagreed that TCP has the right skill sets to manage contractors.

### 6.14.6 Discussion on the Comments from Question 23

***"What are your reasons for cost overruns on mega-projects?"***

The reasons that frequently appeared as a response to this question were: poor planning, scope changes, design changes, poor contract management and inexperienced project control teams. The comments are consistent to the responses in section 6.14.3 related to projects not meeting planned budgets.

### 6.14.7 Discussion on the Comments from Question 24

***"Any other comments you think should be made for this study?"***

Some of the reinforcing themes to the responses are: unavailability of skilled and experience personnel; Transnet must invest in training project personnel; experienced personnel must be deployed on project teams; and governance processes/approval processes must be more efficient. The responses to this question provides valuable information for TCP to consider in its business and operational strategies.

## 6.15 CHAPTER SUMMARY

The study validates through empirical methods that there are several challenges facing the delivery of mega projects in TCP. The hypotheses testing using statistical methods has demonstrated that there are several factors with significant relationships to project cost overruns, schedule slippages, procurement, contractor performance and mega project complexity. A significant number of the challenges and relationships are new findings that adds value to the body of knowledge for academics, TCP and project practitioners both nationally and internationally. A fair portion of this chapter was dedicated to the presentation of recommendations to address the challenges facing mega projects in TCP. The chapter concluded with a discussion of the COMMP model as a recommendation for a new approach to effective mega-project management and successful outcomes.

# CHAPTER 7:
# REVIEW, CONCLUSIONS AND RECOMMENDATIONS

## 7.1 INTRODUCTION

The goal of this study was to critically investigate and understand the challenges facing the delivery of mega-projects at TCP. This study reinforces the notion that mega-infrastructure projects are complex interventions that are challenging to owners, project teams and stakeholders. Nations, economies and societies are highly dependent on mega projects to transform their infrastructure thus contributing to their future economic viability, sustainability and growth. As a major role player in South Africa, Transnet's success or challenges in infrastructure delivery impacts directly on the national logistics platforms and socio-economic well-being of the nation.

This chapter summarises the major findings for each of the project dimensions in this study. In-depth recommendations are put forward to guide Transnet to mitigate mega project challenges surfacing from this study. A proposed theoretical model for addressing the challenges in mega-projects is also highlighted in this chapter.

## 7.2 LIMITATIONS OF THE STUDY

Recently Transnet has undergone organisational restructuring with a change to TCP's role. Two new portfolios have been added to TCP role that i.e. long-term framework planning (LTFP) and programme management. As a result of these changes, TCP is now called Transnet Group Capital (TGC). The bulk of this study including the survey and analysis was completed prior to the advent of TGC. The project personnel of TGC remain the same as the previous TCP.

Local, South African research on mega-projects and project management in general is limited. Therefore, the larger portion of relevant research material was obtained from international sources.

Only TCP project personnel directly involved in the execution of projects were solicited to participate in this study. Transnet operational divisions such as Transnet National Ports Authority (TNPA), Transnet Port Terminals (TPT) and Transnet Pipelines (TP ) who are the asset owners of the projects, Transnet Corporate office and service providers such as EPCMs did not participate in this study. This study therefore has a bias towards a TCP viewpoint.

This study focused on mega-projects with an individual value in excess of R300 million. In the literature survey, there are notional boundaries confining mega-projects in the industrial sector with a value greater that US $1 billion dollars. Since this study is about TCP, the researcher adhered to TCP's definition of mega-projects as projects in excess of R300 million. However, it appears that TCP's mega-projects are similar in nature, size and complexity as highlighted in literature.

TCP's mega-projects are infrastructure projects primarily related to port, rail and pipeline disciplines.

## 7.3 SUMMARY OF THE MAJOR FINDINGS AND RECOMMENDATIONS

In this section, a summary of the major findings, conclusions and recommendations is provided for each of the ten project management dimensions examined in this study. Furthermore, all significant new contributions arising from this study are indicated under each dimension.

### 7.3.1 Summary of the findings and recommendations for Objective 1: To understand the integration processes of projects

In understanding the integration processes of projects, the results of this dimension positively indicate that TCP mega-project teams agree that it is necessary for stakeholders to be involved in the project initiation phase to determine requirements and solicit 'buy-in'. However, TCP respondents appear to have a challenge with the number of stakeholders in mega-projects with most respondents indicating that there are too many stakeholders to manage in mega-projects. Internal and external stakeholders need to be identified, engaged and managed through the lifecycle of the project.

TCP's mega-project teams do not fully understand the business environment in which the mega-project operates and this may have an impact on investment decisions. Furthermore, they may not have full understanding of the business plan or the scope of the project, particularly because of the long duration of most mega-projects. Thus raising a risk that the project team may not have adequate knowledge and information to robustly steer the mega-project through uncertain and volatile economic conditions.

#### 7.3.1.1 Conclusions on Objective 1

It can be concluded that TCP acknowledges the necessity of stakeholder engagement in the integration processes of mega-projects. Challenges include: high number of stakeholders that need to be managed; the project team does not fully understand the business-case; and budgets are not available on the project for stakeholder management.

#### 7.3.1.2 Interventions and recommendations pertaining to the challenges in Objective 1

To manage the challenges of integration processes in TCP, the following interventions are recommended:

- TCP must develop a robust generic register of all stakeholders both external and internal as TCP operates in a fairly stable environment of stakeholders. This register can be acquired by mega-project teams and modified/adapted to match the specific requirements of the mega-project in a particular geographic location
- Stakeholders need to be ranked and their requirements and impacts determined by the project team. For the various phases of the project (initiation, planning, design and construction), stakeholder requirements must be determined and approved at the commencement of each phase. For example, in the early planning stages, the business, local authority and environmental fraternity may carry a heavy weighting for buy-in and approvals, whereas in the construction phase, BEE and the local labour market may carry greater weight.
- A strong and dedicated TCP stakeholder management team needs to be developed to support the project team in determining, engaging and managing the large number of stakeholders. Alternatively, the project team needs to appoint dedicated personnel or service providers to support the teams.
- A firm budget must be set aside by the project team that caters for stakeholder management. TCP could capitalise these costs, if not doing so already, hence reducing the burden on operational costs.
- TCP mega-project teams can acquaint themselves with the business-case deliverables via workshops, quarterly economic bulletins and bi-annual reviews.

- TCP needs to develop a mechanism to incentivise both internal project teams as well as designers, EPCMs and contractors to achieve targets aligned to the business-case investment. The incentive could be a monetary bonus-type scheme and or recognition of performance.

7.3.1.3 Contributions to the body of knowledge for Objective One

This study reveals a unique finding in the execution of mega-projects in the South African environment namely:

- Literature reveals that mega-projects draw a large number of stakeholders that need to be managed in order to strengthen alignment, ownership and acceptance of mega-project deliverables. However, this study reveals a unique situation whereby the project team is unable to cope with the quantum of stakeholders with the result of negative impacts on delivery

- As related by scholars, infrastructure development in recent times is facing a volatile and uncertain economic climate. This study presents a unique view that that mega-project teams need to fully understand the business environment and business-case to steer long-duration mega-projects through uncertain and volatile economic cycles for ultimate project success

### 7.3.2 Summary of findings and recommendations for Objective 2: To understand if mega-project scope is clearly defined, managed and updated

The assessment of this dimension reveals that that TCP has a challenge with clearly defining the scope of its mega-projects. In the execution of its mega-projects, TCP runs the risk of scope changes, changes to its execution plan, cost overruns and schedule slippages as a consequence of incomplete scope definition.

TCP appears to be facing a large number of changes during mega-project execution that fall outside the norms of its planning with the consequence that scope updating and managing of scope is a serious challenge. The quantum of changes is having a direct negative impact on execution planning, project costs and schedules.

As a result of the long duration of mega-projects, new technology is bound to negatively impact on scope and costs. The high rate of the evolution of technology especially related to

IT and control systems may be a challenge that TCP is facing but will continue to exist as long as technology evolves.

#### 7.3.2.1 Conclusion on Objective 2

In conclusion, it has been established that TCP's mega-projects face the following challenges: scope of works are not clearly defined; there are too many changes during project execution; and the long duration of mega-projects and technology changes are bound to negatively impact project costs.

#### 7.3.2.2 Interventions and recommendations pertaining to Objective 2

In order to manage the variability of scope is it recommended that:

- TCP should develop a team of specialist project scope professionals (PSP) with strong skills related to the type of infrastructure, e.g. port, rail or pipeline.
- PSP specialists must work closely with the projects teams and the owners' teams to deliver firm scope of works.
- Change controls teams need be strengthened with additional experienced resources. These resources can be sourced via internal resourcing, Fixed Term Contractors (FTCs) or via EPCMs. Change-control updates should be undertaken at least fortnightly with the project teams. Monthly change-control management reviews need to be undertaken.
- As the project progresses through the various phases, the scope should be reaffirmed and approved.
- Transnet procurement strategy should build flexibility and partnerships contracts for long-lead technology systems required for infrastructure projects with multi-year schedules. This strategy must allow for changes for enhancing systems and minimising interface dependency risks to major construction works.

#### 7.3.2.3 Objective 2 contributions to the body of knowledge

This study revealed a unique finding in the execution of mega-projects in the South African environment, viz:

- The changes in technology are happening at a rapid pace whilst the duration of mega projects can last several years and even decades. This study reveals that technological

changes negatively impact costs and schedules on long duration mega-projects and needs to be carefully managed for successful outcomes

### 7.3.3 Summary of findings and recommendations for Objective 3: To ascertain if projects are completed on time

The findings in TCP is that mega-projects are not completed on time. The findings resonate with studies in literature that indicate a high failure rate of mega-projects in international projects that do not achieve their schedule targets.

Project schedules are unrealistic and schedules are compressed to match the business-case requirements. Respondents concur that asset owners demand unrealistic deadlines to complete projects. The act of compressing schedules and unrealistic deadlines demanded from the project team requires that the project team adopts a higher schedule-risk approach. Skilled, experienced schedulers are required for mega-projects.

Empirical analysis shows that rework in designs is the chief cause of schedule overruns in mega-projects undertaken by Transnet. The owner changing scope as well as incomplete scope definition in TCP are associated with reworking engineering designs that require additional time and funding. TCP reports that upfront careful planning will keep mega-projects on schedule.

#### 7.3.3.1 Conclusion to Objective 3

TCP supports the notion that upfront careful planning will keep mega-projects on schedule. However, arising from the analysis of this objective, the challenges that surface are: mega-project completion on time is a challenge; mega-project schedules are unrealistic; schedules are compressed to match investment requirements; incomplete scope definition and asset changing scope are major contributors to mega-project delays; and skilled and experienced schedulers are required in mega-projects.

#### 7.3.3.2 Interventions and recommendations pertaining to Objective 3

In order to address the challenges faced by the mega-project team in TCP, the following recommendations are made:

- TCP needs to spend additional time upfront in the early stages of the project for the development of a realistic schedule on all aspects of the project. TCP needs to robustly

engage via regular, integrated planning with client bodies to develop norms for realistic schedule development.

- The project team should again spend a considerable time upfront to document, agree and obtain approval on scope requirements. Changes to scope must be tracked and their impact on the schedule determined immediately for the client's decision and approvals
- The challenges on adequate experience and skilled personnel can be addressed by training and the contracting of specialised experts to support the team and for skills transfer.

7.3.3.3 Objective 3 contribution to the body of knowledge

- South African literature reveals that skills shortages are a concern however there is an absence of evidence of the challenges on mega projects. Global project review is further silent on the impact of skills sets on project schedules and focuses more attention on the tools and processes for improved schedule management. The study of TCP presents a unique case in revealing that inexperienced and skilled schedulers can indeed negatively impact the management of schedules of mega-projects.

### 7.3.4 Summary of findings and recommendations for Objective 4: To ascertain the reasons for cost overruns

In the analysis of this objective, it is evident that TCP has developed detailed cost plans for mega-projects. The availability of detailed cost plans is aligned to best practices and teams should have the relevant tools that allow them to plan, track and manage the cost packages of the project. However, there is a challenge that TCP does not have adequate numbers of experienced personnel to control costs in mega-projects. It is also evident that TCP is challenged with a high number of changes on mega-projects leading to higher prices. The combined effect of inadequate experienced personnel to control costs and the large number of changes is a serious risk to TCP's planned costs and potentially to Transnet's investment strategy.

7.3.4.1 Conclusion to Objective 4

Conclusions drawn are that there are cost overruns although there are robust systems and processes in place. The number of experienced project control personnel is a challenge and there are too many changes leading to cost overruns

7.3.4.2 Interventions and recommendations pertaining to Objective 4

The following recommendations are offered to address the challenges of cost management in TCP:

- Change controls teams must be strengthened with additional experienced resources. These resources can be sourced via internal, FTCs or via EPCMs.
- Change-control updates should be undertaken at least fortnightly with the project control teams. Monthly change-control management reviews need to be undertaken.
- Risk assessments must be carried out on cost packages to determine the cost-risk profile related to changes and cost escalations. Mitigation and tracking strategies must be developed to manage higher risk cost items.
- TCP should further develop databases for tracking historical trends on cost items as well as impacts of change. These databases can be used to track the cost-risk in the execution phase mega-projects
- A 'Dynamic Cost Management (DCM)' approach should be adopted by TCP for project cost-control processes and management review. DCM will support the dynamically-changing mega-project cost profile.
- A half-yearly independent cost review audit should be adopted to impartially review changes, costs and risk management for cost containment.
- Cost-control management should be incentivised to achieve interim and final cost targets.

7.3.4.3 Objective 4 Contribution to the body of knowledge

- Literature on global project cost management is limited with much attention being paid to quantitative retrospective aspects such construction-contractor productivity and work-completion to date. However, literature appears to present gaps on proactive control of costs and investment preservation in mega projects. This study presents an new dimension to managing mega project costs and preservation of the business case investment by suggesting that cost-control processes in mega-projects must also be aligned to a dynamically-changing project environment for enhanced successful outcomes. The study further reveals a unique finding by demonstrating that there is a

significant relationship between inexperienced skilled project control personnel and cost overruns.

### 7.3.5 Summary of findings and recommendations for Objective 5: To understand the degree to which projects achieve their quality requirements

The findings of the study under this objective indicate that not all quality packages are available at commencement of the mega-project thus limiting the project team to fulfil the requirements of achieving the required quality standards for project work packages. The absence of quality requirements posed a measurement risk to designer and construction teams. Skilled, experienced schedules are required in mega-projects. TCP reports that quality management requires too much detail while the personnel appointed to undertake quality management responsibilities do not possesses adequate experience to fulfil the role.

#### 7.3.5.1 Conclusion to Objective 5

Incomplete quality requirements for mega-projects and inadequate experienced personnel to fulfil the requirements of quality control in mega-projects are a challenge. TCP runs the risk of the asset owner not accepting the quality of work and additional costs are incurred to correct substandard work.

#### 7.3.5.2 Interventions and recommendations pertaining to Objective 5

In order to address the quality management challenges facing mega-project teams in TCP, the following actions are recommended.

- TCP must develop a robust, quality-specifications database (QSD) of all the infrastructure components for port, rail and pipelines as TCP repeatedly executes similar developments. The TCP QSD should be accessible to mega-project teams and modified/adapted to match the specific requirements of each mega-project.
- A stronger and dedicated TCP quality management team needs to be developed to support the project team in determining, engaging with and managing the large number of quality requirements. Alternatively, the project team needs to appoint dedicated FTCs or service providers to support the execution teams.

7.3.5.3 Objective 5 contributions to the body of knowledge

This study revealed a unique finding in the execution of mega-projects in the South African environment, viz:

- Scholars agree that quality management systems are necessary and that organisations need to invest more efforts in developing this system. This study reveals a distinctive new finding that the level of detail for quality management is extremely high and several gaps exist. Quality management suffers further with the low skill levels of quality management's personnel appointed to mega projects whom are unable to cope with quality management requirements.

### 7.3.6 Summary of findings and recommendations for Objective 6: To ascertain if projects have adequate human resources and skills

The results under this dimension highlight problems with the adequacy of human resources and skills mobilised on mega-projects in TCP. The data analysis and discussion point out that there may be major challenges in the availability of the correct skill sets to drive successful project delivery. Evidence suggests that there are deficiencies in the skill sets related to scheduling, cost control and quality (cost, quality and time are commonly referred to as the 'iron triangle' of project management).

Results indicate that almost a quarter of TCP personnel are under the age of 30 years. Although TCP has sufficient resources, experience and exposure requirements appear to be a limitation for the execution of complex, high-value mega-projects. There are strong indications that TCP skill-sets are inadequate to handle the complexity of mega-projects with the result that the desired investment outcomes may be compromised. Furthermore, there are too many people changes in the life of mega-projects which is affecting smooth delivery.

TCP's service providers (EPCMs), having the exposure to international mega-projects and access to international personnel, appear to possess the relevant skill sets and competencies for delivering mega-projects. The use of local and expatriate resources is essential to bridge the experience-gap required for TCP's mega-project execution.

7.3.6.1 Conclusion to Objective 6

It can be concluded that TCP faces the following challenges: inadequate human resources and skill sets for the execution of its mega-projects, exposure and experience on mega-

projects are limiting factors. However, Transnet's service providers (EPCMs) have strong teams of skilled personnel mobilised on mega-projects. The use of local and expatriate resources is essential to supplement project teams.

7.3.6.2 Interventions and recommendations pertaining to Objective 6

The following recommendations address the challenges facing human resources and skills requirements in TCP:

- Experienced FTCs should be considered for mega-project teams as a short- to medium-term intervention. Experienced FTCs can be sourced from local and international pools if local markets are in shortages.
- Transnet should expand its School of Excellence to cater for project management skills development. This 'school of project excellence' needs to focus on the following activities:
  - Industry experts should be regularly contracted to share lessons on leading practices and to tailor-make programmes for various levels of experience – developing, intermediate and advanced programmes on mega-project management.
  - Memoranda of understanding with leading project management institutions for training and development, registration and certification should be considered.
  - Exchange programmes for 'on-job training and exposure' both locally and internationally should be included in EPCMs' contracts.
- Retired personnel with the relevant discipline experience should be contracted-in (as for FTCs) for coaching and mentorship programmes.

7.3.6.3 Objective 6 contribution to the body of knowledge

- South African literature reveals that skills shortages are a concern however there is an absence of evidence relating skills shortages and its impacts on mega project success. Global project review briefly touches on the matter of personnel competence on projects leaving several gaps on the challenges of skills on critical project dimesions of cost and schedule management. This study closes the gap in literature and reveals that there is a significant relationship between the experience and skills levels of mega-project personnel and mega-project completion on time and budget.

### 7.3.7 Summary of findings and recommendations for Objective 7: To determine if communications are disseminated timeously and feedback is managed at the various levels of the project

The analysis of this objective revealed that detailed communication plans are not developed for mega-projects. The absence of detailed communication plans limits project personnel from timeously responding to the frequent demands of complex and highly time-sensitive mega-projects. Furthermore, the absence of detailed communication plans is a further challenge to effective management of internal and external communications posing further risks to TCP's efficiency in delivering mega-projects. The perception of most respondents that there are inadequate communications between the owner and the EPCM service provider is a challenge and is a source of conflict between contracting parties, leading to rework and related project delays.

#### 7.3.7.1 Conclusion on Objective 7

Arising from the study, it can therefore be concluded that management of communications is not timeous and responsive to time-sensitive demands of complex mega-projects. There is a challenge of inadequate communications between the owner's teams and the EPCM service providers.

#### 7.3.7.2 Interventions and recommendations pertaining to Objective 7

In closing the gaps in the challenges of communications, the following interventions are recommended:

- TCP must develop a robust communications plan for mega-projects. This plan must cater for internal and external communications. Generic TCP communications can be adapted for specific mega-projects requirements.
- Weekly team 'high-level' short duration (90 min) team meetings ("Team Connect" meetings) should be implemented. The same should be done with service providers and contractors.
- Fortnightly, 'high-level' progress meetings must be implemented.
- Monthly, detailed progress meetings must be implemented.
- Daily electronic dashboards or 'Project Bulletin' updates on early warning, changes, decisions, progress updates should be implemented.

- TCP teams and EPCM teams should be co-located in same single office facilities both in the design and construction phases. This intervention will allow effective daily communications on progress updates, issues, early warnings, problem-solving and decision-making.
- A code of conduct inclusive of all parties must be adopted.
- Regular team-building activities including sports, recreation and community service should be considered.

7.3.7.3 Objective 7 contributions to the body of knowledge

This study revealed a unique finding in the execution of mega-projects in the South African environment, viz:

- Whilst literature provides adequate information on the importance of communications and much guidance on engagements, this study goes further to understand some of the challenges facing mega project team at a practical level. The study of TCP reveals that there is an absence of communication planning on mega projects. In addition, respondents reveal new quantitative evidence that inadequate communications in TCP's mega projects is a source for conflict between the owner's teams and consultants.

### 7.3.8 Summary of findings and recommendations for Objective 8: To determine if risks are continually identified, reviewed and managed

In this study, results drawn from the analysis of responses and discussions show that TCP is challenged with gaps in planning, identifying, updating and managing risks as recommended by leading project management authorities. Respondents further indicated that it is difficult to manage all known and unknown risks embedded in complex mega-projects. Furthermore 50% of participants indicated that the appropriate level of risk management skill sets is not available on mega-projects. The outcomes of the study indicate that TCP may be ineffective in proactively monitoring the likelihood and impacts of risk events, managing risk outcomes, and maximising opportunities.

7.3.8.1 Conclusion on Objective 8

It can be concluded that risk management is not effective and the following challenges are identified: there are gaps in planning, updating and managing risks in mega-projects; there are too many risks to manage on mega-projects; TCP teams find it difficult to manage all

known and unknown risks embedded in complex mega-projects; and the appropriate level of risk management skill sets is not available on mega-projects.

#### 7.3.8.2 Interventions and recommendations pertaining to Objective 8

In order to address the risk management challenges facing mega-project teams in TCP, the following actions are recommended.

- A strong, dedicated, competent TCP quality management team needs to be developed to support the project team in determining, engaging and managing the large number of quality requirements. Alternatively, the project team could appoint dedicated FTCs or service providers to support the execution teams as an interim measure.
- TCP must develop a robust, risk-profile database of all the infrastructure activities for port, rail and pipelines as TCP repeatedly executes similar developments. The TCP QSD can be acquired by mega-project teams for benchmarking and validation purposes. QSD will assist in decision related with resource requirements and the quantum of resources.
- There should be a weekly, high-level profiling of risks.
- TCP respondents indicated that there are too many risks. There following needs to be determined:
    - Are all 'risks' in the risk register really risks or are they internal /external issues that need to be resolved? Risks and issues should be separated.
    - TCP needs to profile its risk in high, medium and low categories. The impacts on costs, schedules and safety also needs profiled and mitigation action plans developed
- Risk experts should be mobilised every six months to review/interrogate risks, identify 'blind-spot risks', provide an independent assessment and jointly update mitigation plans

#### 7.3.8.3 Objective 8 contributions to the body of knowledge

This study revealed a unique finding in the execution of mega-projects in the South African environment, viz:

- Scholars and literature focuses heavily on risk management processes and tools whilst there are several gaps on the resourcing and quantum of risks in mega projects. In this study TCP declares that the quantum of risks in TCP's mega projects is overwhelming and that there are inadequate resources to manage risks on mega projects.

### 7.3.9 Summary of findings and recommendations for Objective 9: To ascertain if procurement processes are affecting the delivery of projects

Based on the findings of this study, there is evidence that the procurement processes are a challenge. The impact of long procurement processes is evident with subsequent impacts on cost escalations. Respondents indicated that the appropriate suite of contracts is used in TCP. Transnet's BEE policy and strategy have been successful as most respondents agree that BEE contractors have good support and commitment from Transnet. The results in TCP further demonstrate that BEE can be successful in mega-projects.

The ineffective management of contractors by TCP's EPCMs points to several challenges that may be encountered by TCP including disputes, delayed schedules and costs overruns with the outcome that mega-projects may not meet their desired investment goals. Disputes are not easily resolved and contractor /client conflict is hampering the delivery of mega-projects which is contrary to the aims of the NEC3 contractors' mutual trust, respect and collaboration.

#### 7.3.9.1 Conclusions to Objective 9

Arising from the study of this dimension, it can be concluded that the NEC3 is a suitable form of contract and socio-economic transformation is successful in TCP's mega-projects. There are challenges such as long procurement process impacting negatively on project costs as well as client/contractor conflict hampering mega-project delivery, and disputes are not easily resolved.

#### 7.3.9.2 Interventions and recommendations pertaining to Objective 9

In order to address the challenges in TCP's procurement processes, the following interventions are recommended:

- TCP must develop stand-alone, standardised procurement strategies and processes for procurement in mega-projects. Procurement processes must allow for special arrangements to drastically reduce documentation and approvals while still maintaining all governance requirements.
- TCP teams and contractors' teams should be co-located with offices on the same site. This intervention will allow effective daily communications on progress updates, issues, early warnings, problem-solving, decision-making and dispute resolution.

- A code of conduct equally applicable to all parties must be adopted.
- Regular team-building activities including sports, community service, strategies will help to build trust and collaboration.
- If disputes are not resolved within a month, an independent party should be brought in to intervene before disputes are referred to higher formal authorities.

7.3.9.3 Objective 9 contributions to the body of knowledge

This study revealed a unique finding in the execution of mega-projects in the South African environment, viz:

- The NEC contract was developed to promote harmonious contracting relationships supporting effective project delivery. Client/contractor conflict in TCP is working contrary to the NEC contract requirements with negative impacts on mega project delivery.

### 7.3.10 Summary of findings and recommendations for Objective 10: To understand the impacts of stakeholder management in mega-projects

In the assessment of the impacts of stakeholder management in mega-projects, 80% of respondents agreed that it is necessary for stakeholders to be involved in the initiation phase of the project to determine expectations and obtain buy-in. However, respondents indicate a large number of stakeholders that need to be managed. Most respondents agreed that stakeholder stoppages led to added costs to projects thereby reinforcing the notion that stakeholders play a major role in defining and sustaining mega-project value. TCP respondents concurred that long EA processes have a negative impact on mega-projects leading to project delays. There are indications, however, that customers are satisfied with TCP's mega-project delivery. This is a positive result and it supports Transnet strategic objectives and goals of providing modern, efficient infrastructure that satisfies end users.

7.3.10.1 Conclusions to Objective 10

Based on the findings on this dimension, it can be concluded that customers are generally satisfied with TCP's delivery of mega-projects. However, there are challenges with the large number of stakeholders and the long environmental authorisation processes that delay mega-

projects. There is also cautionary note that stakeholder stoppages of a mega-projects lead to added costs.

7.3.10.2 Interventions and recommendations pertaining to Objective 10

In closing the gaps in the challenges of stakeholder management, the following interventions are recommended:

- TCP must develop a robust generic register of all stakeholders, both external and internal, as TCP operates in a fairly stable environment of stakeholders. This register can be accessed by mega-project team and modified/adapted to match the specific requirements of the mega-project in a particular geographic location.
- Stakeholders need to be ranked and their requirements and impacts determined by the project team as a first pass, thereafter confirming the status through consultation. For the various phases of the project (initiation, planning, design and construction), stakeholder requirements must be determined and approved at the commencement of each phase. For example, at the early planning stages, the business, local authority, and environmental fraternity may carry a heavy weighting for buy-in and approvals, whereas in the construction phase, BEE and the local labour market may carry more weight.
- A strong and dedicated TCP stakeholder management team needs to be developed to support the project team in determining, engaging and managing the large number of stakeholders. Alternatively, the project team needs to appoint dedicated personnel or service providers to support the teams.
- A firm budget must be set aside by the project team that caters for stakeholder management.
- TCP must develop a robust communications plan for stakeholder management for mega-projects. This plan must cater for internal and external communications. A generic TCP communication plan can be adapted for specific mega-projects requirements.
- A monthly electronic ‘Stakeholder Bulletin’ with updates on progress and issues could be useful for regular informal engagements.

7.3.10.3 Objective 10 contributions to the body of knowledge

This study revealed a unique finding in the execution of mega-projects in the South African environment, viz:

- Whilst literature provides adequate information on the importance of stakeholders and much guidance on engagements, this study goes further to unpack some of the challenges facing mega project team at a practical level. The study of TCP reveals that the large number of stakeholders on mega projects is a challenge to manage. In addition, respondents reveal new evidence that stakeholder stoppages lead to additional mega project costs.

## 7.4 PROPOSING A NEW CONCEPTUAL MODEL FOR ADRESSING CHALLENGES IN MEGAPROJECTS

This study has produced a deeper understanding on the challenges in mega projects from which a proposed new conceptual model has been developed by the researcher. This conceptual model refocuses project management effort to address these challenges and is discussed further in this section

In recognising the high failure rate of projects in Transnet, the study set out to critically assess the challenges facing the delivery of mega-projects within the organisation. This study examined mega-project challenges using a theoretical model based on the PMI's 10 knowledge areas. In recognizing the key challenges in complex mega-projects related to project scope, cost overruns, schedule slippages, procurement and contracting, contractor performance, human resourcing and skills. The researcher found it necessary to further reflect on literature, traditional approaches and gaps related to mega project management and findings of this study. Following hereunder the 'Core Model for Mega-Projects - COMMP Model' triggered by this study is put forward and discussed.

### 7.4.1 A Brief Overview on the 'Core Model for Mega-Projects'' - COMMP Model

In the preceding chapters, there have been various pertinent scholastic contributions that relate to factors impacting on mega-projects. It has been further established that the project management is undergoing major rethinking in attempts to increase the rate of success of project delivery. In period between 1960 and 1980, there is evidence that supports project practitioners' focus on the cost, scope and quality. In the decade 1980 to 2000, soft skills such personnel behaviour and communications grew in prominence as additional factors supporting success. In recent times, soft skills such as ethics, personnel competency and attitudes continue to be an area of interest as well as external factors such as stakeholder management.

Traditional studies on project management success factors continue to evolve and the list of factors project factors is steadily growing.

Figure 7.1 provides an illustration of the 'Core Model for Mega-Projects' (COMMP). The COMMP model illustrates that there are essential elements that are central to the success of a project. When the core elements are successfully managed, there will be ultimate success in mega-project delivery. The model illustrates an inner core, outer core and the external environment. The elements of the inner core consist of mega project scope requirements, competent resources and collaborative contracting whereas the outer core comprises mega project communication, risk, schedule, internal stakeholders, quality and cost. The external factors impacting on the mega project consists the natural environment, legal compliance, socio-economic factors and the external stakeholders.

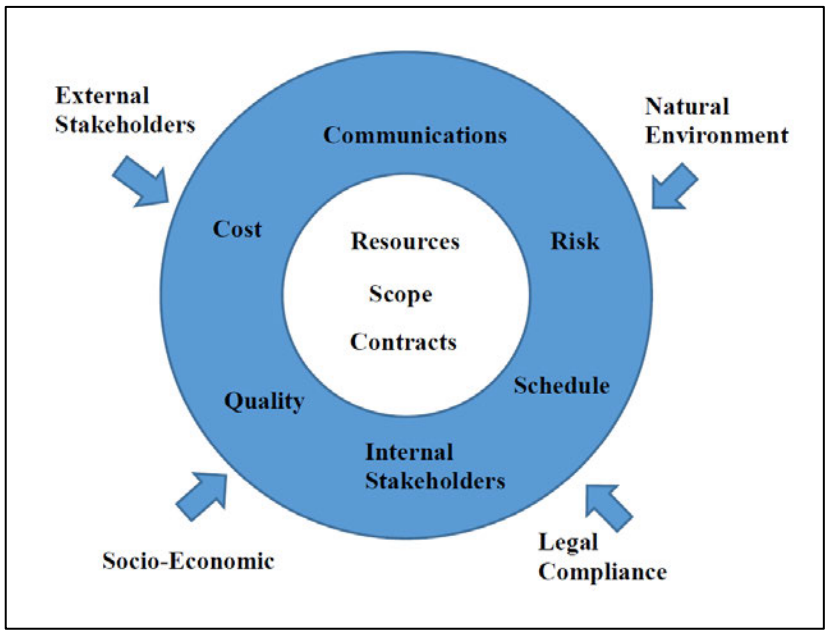


Figure 7.1: Core Model for Mega-Projects (COMMP)

It is recommended that a Mega-Project Steering Committee (MP-Steerco) is created as a 'special vehicle' to deliver the mega-projects and that the MP-Steerco is accountable for managing the inner core elements apart from steering the mega-project, funding management, governance, scope approval, scope-change approval and contract approvals. The MP-Steerco should consist of representatives from the project owner and the project execution teams. In the case of Transnet, the MP-Steerco must include the asset owner/s, and TCP executive management.

### 7.4.2 Unpacking the Inner Core

***Resources:*** The value of mega-projects exceeds the value of many medium to large enterprises. The mega-project team needs to be suitably resourced with an organogram that promotes efficiency. Competent resources are required to execute according to project procedures and design parameters. The competency of resources is applicable to members from the client body, project management team, design team and construction team. A thorough review of CVs must be undertaken before team members are mobilised. The MP-Steerco being mandated to execute the project is also the accountable body approving the appointment of senior members of the mega-project execution team.

***Scope:*** Project teams must devote more time in the early stages of a project to thoroughly understanding the owner's requirements. A solid grounding of the owner requirements will allow the design team to prepare accurate design details and avoid costly, time-consuming rework. Further benefits of firm designs will also be beneficial to efficient construction – a phase where any design rework results in exorbitant increases in cost overruns and schedule delays.

***Contracts:*** Contracting between parties is a source of strained relations, disputes and claims which eventually destroys project execution-value and results is an upward spiralling of costs to either party. A contracting strategy must be developed consisting of the following key elements: approach to contracting (design/build, design/procure/build), contract type, procedures for engaging, proactive dispute resolution, and regular team-building exercises between the various parties: owner/designer/construction-contractor. The MP-Steerco must be the approving body for the contracting strategy. It is recommended that the chairperson of the Steerco is the delegated person approving all major contracts required for the mega-project.

### 7.4.3 Unpacking the Outer Core

The outer core are factors that must be managed by the project team on a day-to-day basis. These factors include schedule management, cost management, communications, risk management, quality management and internal stakeholder management. The management of these factors is adequately covered in extant literature. The MP Steerco plays a vital role in monitoring the outer core factors and providing the necessary support when required by the project team.

### 7.4.4 Unpacking the External Factors

External factors include socio-economic factors, legal and compliance requirements, natural environment sustainability and management of external stakeholders. External factors are demanding greater attention thus project teams must possess the competencies and skills to address these matters. The MP Steerco must play a vital directive role in providing the necessary guidance and support to the mega-project team.

## 7.5 RECOMMENDATIONS FOR FUTURE RESEARCH

Research focusing on mega-projects is extremely limited in the African Continent and virtually non-existent in the south of Africa. International studies on mega-projects related to ports and railway projects are extremely limited. Further recommended research will be extremely beneficial as follows:

- This study should be extended to included participation from the owner's teams, EPCM's and construction contractors in order to broaden and obtain a 360-degree view of mega-projects in TCP.
- Further comparative studies of mega-projects in South Africa and the African continent are encouraged in an attempt to support successful infrastructure rollout locally and in Africa. As indicated by leading consultants, high levels of mega-infrastructure requirements are forecast on the African continent for the next few decades.
- There is an opportunity to study international enterprises similar in nature to TCP to compare results and solutions to mega-project challenges
- Socio-economic and transformation factors in mega-projects should be explored further in an attempt continuously improve social transformation, job creation and socio-economic gaps.
- Another pertinent research area is the impact of technology and its benefits in streamlining efficiencies within mega projects more especially in the project controls domain.

## 7.6 SUMMARY

From the empirical investigation, the study reveals that there are several challenges facing the delivery of mega-projects in TCP. The quantitative analysis testing, findings and discussions reveal that there are several challenges in TCP's complex mega-projects related

to project scope, cost overruns, schedule slippages, procurement and contracting, contractor performance, human resourcing and skills.

Hypotheses testing using statistical methods has demonstrated significant relationships between project cost overruns, schedule slippages, procurement, contractor performance, skills and mega-project complexity. Many of the challenges and relationships are new findings that add value to the body of knowledge for academics, TCP and project practitioners both nationally and internationally. The study developed and introduced a new theoretical model, called the 'COMMP' model, as a recommendation for a new approach to effective mega-project management and successful outcomes. The results of the study are firmly rooted in the sphere of mega-project execution. The learnings from TCP are useful to similar organisations embarking on rail, port and pipelines infrastructure development.

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# APPENDICES

## APPENDIX A: ETHICAL CLEARANCE


09 February 2016

**Mr Rajan Chetty (881282268)**
**School of Management, IT & Governance**
**Westville Campus**

Dear Mr Chetty,

**Protocol reference number: HSS/1792/015D**
**Project title:** Challenges facing the delivery of Mega Projects in TCP

**Full Approval – Expedited Approval**

In response to your application dated 04 December 2015, the Humanities & Social Sciences Research Ethics Committee has considered the abovementioned application and the protocol have been granted **FULL APPROVAL.**

**Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment/modification prior to its implementation. In case you have further queries, please quote the above reference number.**

**Please note: Research data should be securely stored in the discipline/department for a period of 5 years.**

**The ethical clearance certificate is only valid for a period of 3 years from the date of issue. Thereafter Recertification must be applied for on an annual basis.**

I take this opportunity of wishing you everything of the best with your study.

Yours faithfully

[redacted]

Dr Shenuka Singh (Chair)

/ms

cc Supervisor: Dr Vannie Naidoo
cc Academic Leader Research: Professor Brian McArthur
cc School Administrator: Ms Angela Pearce

**Humanities & Social Sciences Research Ethics Committee**
**Dr Shenuka Singh (Chair)**
**Westville Campus, Govan Mbeki Building**
**Postal Address:** Private Bag X54001, Durban 4000
**Telephone:** +27 (0) 31 260 3587/8350/8557 **Facsimile:** +27 (0) 31 260 4609 **Email:** singhsh@ukzn.ac.za / snymanm@ukzn.ac.za / mohunp@ukzn.ac.za
**Website:** www.ukzn.ac.za

1910 - 2010
100 YEARS OF ACADEMIC EXCELLENCE

Founding Campuses: Edgewood, Howard College, Medical School, Pietermaritzburg, Westville

## APPENDIX B: TURNITIN SUMMARY REPORT

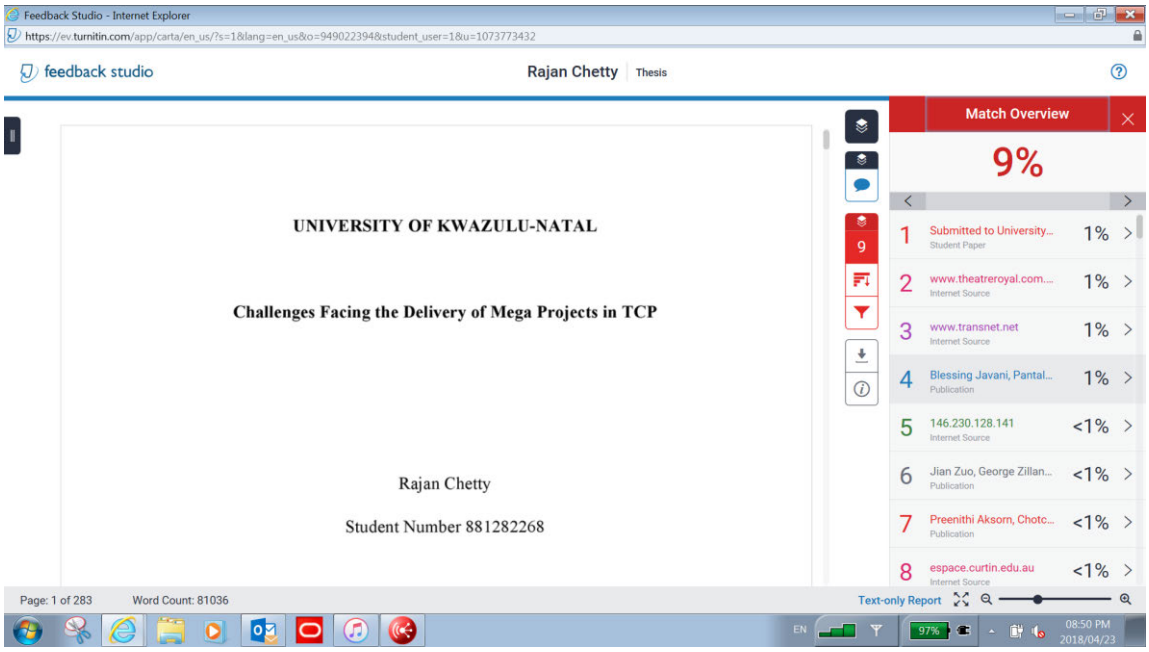
Thesis

ORIGINALITY REPORT

| 9% | 7% | 3% | 4% |
|---|---|---|---|
| SIMILARITY INDEX | INTERNET SOURCES | PUBLICATIONS | STUDENT PAPERS |

PRIMARY SOURCES

| | | |
|---|---|---|
| 1 | Submitted to University of Leeds<br>Student Paper | 1% |
| 2 | www.theatreroyal.com.au<br>Internet Source | 1% |
| 3 | www.transnet.net<br>Internet Source | 1% |



## APPENDIX C: QUESTIONNAIRE

**UNIVERSITY OF KWAZULU-NATAL**

**SCHOOL OF MANAGEMENT**

**PhD Research Project**

**Researcher:** Rajan Chetty, Telephone, No: 083 287 2295

**Supervisor:** Dr. Vannie Naidoo, Office Telephone, No: 031-2608080

**HSSREC**: Mariette Snyman, Telephone, No: 031 2608350

**Dear Respondent,**

I, Rajan Chetty PhD candidate, in the School of Management, of the University of Kwa-Zulu Natal, hereby invite you to participate in a research study entitled:

**"Challenges facing the delivery of mega-projects in TCP**"

Your participation in this questionnaire is voluntary. You may refuse to participate or withdraw from this study at any time with, No negative consequences. Confidentiality and anonymity of records identifying you as a participant will be maintained by the School of Management, UKZN.

If you have any questions or concerns about completing the questionnaire or about participating in this study, you may contact me or my supervisor at the numbers listed above.

The survey should take you about 15 minutes to complete. I hope you will take the time to complete this survey.

Sincerely

Investigator's Signature: Date:

**CONSENT**

I _____ (*Name: Optional*) the undersigned have read and understood the above information. I hereby consent to participate in the study outlined in this document. I understand that participation is voluntary and that I may withdraw at any stage of the process.

Participant 's Signature_____ Date_____

FOR OFFICIAL USE ONLY: Respondent Code: _____

**Supervisor**: Dr Vannie Naidoo Telephone 031 2608080

**Researcher**: Rajan Chetty Telephone: 083 287 2295, 031-361-1971

## Title of Study: Challenges Facing the Delivery of mega-projects in TCP

**Research questions:**

- How are the projects processes integrated?
- To what extent is the scope of projects clearly defined, managed and updated?
- To what extent are projects completed on time?
- Why are there cost overruns on projects?
- How are projects achieving their quality requirements?
- How are human resources allocated to projects?
- How are communications disseminated at the various levels of the project?
- To what degree are project risks continually identified and managed?
- How are procurement processes affecting the project delivery?

**Research Objectives**

1. To understand the integration processes of projects
2. To determine if the scope of projects are clear, updated and managed
3. To ascertain if projects are completed on time
4. To ascertain the reasons for cost overruns
5. To understand the degree to which projects achieve their quality requirements
6. To ascertain if projects have adequate human resources and skills
7. To determine if communications are disseminated timeously and feedback managed at the various levels of the project managed
8. To determine if risks are continually identified, reviewed and managed
9. To ascertain if procurement processes are affecting the delivery of mega-projects
10. To understand the impacts of stakeholder management in mega-projects

This questionnaire comprises of eleven sections:

| | |
|---|---|
| **Section A:** | **Demographic** |
| **Section B:** | **Integration processes in mega-projects** |
| **Section C:** | **Scope of mega-projects** |
| **Section D:** | **mega-projects' schedule** |
| **Section E:** | **Managing costs on mega-projects** |
| **Section F** | **Quality Management in Mega-Projects** |
| **Section G:** | **HR and skills on Mega-Projects** |
| **Section H:** | **Communications in Mega-Projects** |
| **Section I:** | **Managing risks in mega-projects** |

**Section J:** **Procurement in Mega-Projects**

**Section K:** **Managing Stakeholders in Mega-Projects**

How to complete the questionnaire:

- You can mark each response by making a tick (√) or a cross (X) or encircling each Appropriate response with a PEN (not a pencil), or by filling in the required words or numbers.
- Please remember to choose an answer on the scale from 1 to 5 for Section B, C, D, E.
- **1** being an answer to a statement that you **"Strongly Disagree"** with.
- **5** being an answer to a statement that you **"Strongly Agree"** with.

Remember to answer **ALL** the questions even if they are, Not directly relevant to your experience.

**SECTION A: DEMOGRAPHICS**

Please provide only ONE option per question below in the space provided.

1. Your age group is

| < 30 | 31-40 | 41-50 | >50 |
|---|---|---|---|
| | | | |

2. Are you?

| Male | Female |
|---|---|
| | |

3. What is your race?

| Black | White | Coloured | Indian | Other (specify) |
|---|---|---|---|---|
| | | | | |

4. What is your marital status?

| Married | Single | Divorced | Widow | Other (specify) |
|---|---|---|---|---|
| | | | | |

5. What is your highest formal education?

| Undergraduate | Postgraduate |
|---|---|
| | |

6. Are you?

| South African | International |
|---|---|
| | |

7. How long have you been employed in Transnet Capital Projects?

| <5 years | 5 to 10 year | 11 to 15 year | 16 to 20 years | >20 years |
|---|---|---|---|---|
| | | | | |

**SECTION B: Integration processes in mega-projects**

| | **Integration processes in mega-projects** | Strongly Disagree | Disagree | Undecided | Agree | Strongly Agree |
|---|---|---|---|---|---|---|
| 1 | The project scope is clearly defined | | | | | |
| 2 | There are too many Stakeholders to manage on mega-projects | | | | | |
| 3 | Internal and external Stakeholders are identified | | | | | |
| 4 | The business need is clearly defined | | | | | |
| 5 | Customers and stakeholders are involved in the project initiation phase | | | | | |
| 6 | It is necessary for stakeholders to be involved in the initiation phase to obtain ownership and acceptance | | | | | |
| 7 | A realistic schedule is developed | | | | | |
| 8 | Stakeholder expectations are determined | | | | | |
| 9 | A detailed monitoring plan is developed | | | | | |
| 10 | The business environment and business plan is well known | | | | | |
| 11 | The legal environment, standards and are well known and documented | | | | | |
| 12 | Expert and Peer Reviews are undertaken | | | | | |
| 13 | EPCM's are clear about Transnet's internal project management processes | | | | | |

**SECTION C: Scope of mega-projects**

| | **Scope of mega-projects** | Strongly Disagree | Disagree | Undecided | Agree | Strongly Agree |
|---|---|---|---|---|---|---|
| 1 | The project scope is clearly defined | | | | | |
| 2 | Change-control processes are effective | | | | | |
| 3 | There are too many changes on mega-projects leading to cost and schedule overruns | | | | | |
| 4 | The scope on mega-projects are complex to define | | | | | |
| 5 | The ORS has sufficient detail to develop a detailed scope of work | | | | | |
| 6 | Major scope changes are common on TCP's mega-projects | | | | | |
| 7 | Due to the long duration of mega-projects, new technology is bound to negatively impact scope and costs | | | | | |

## SECTION D: Mega-Project Schedules

| | **Mega-Project Schedules** | Strongly Disagree | Disagree | Undecided | Agree | Strongly Agree |
|---|---|---|---|---|---|---|
| 1 | Mega-projects are completed on time | | | | | |
| 2 | Long Approval processes are the main reasons for schedule overruns | | | | | |
| 3 | Frequent re-redesigns are chief causes of schedule overruns | | | | | |
| 4 | Contractors underestimate the time required to complete the projects | | | | | |
| 5 | Major scope changes by the Asset Owner are the root causes of schedule overruns | | | | | |
| 6 | Rework in design is the chief reason for mega-project delays | | | | | |
| 7 | Upfront careful planning and realistic schedules will keep mega-projects on schedule | | | | | |
| 8 | Labour unrests are a certainty to construction delays on mega projects | | | | | |
| 9 | The Asset Owner demands an unrealistic deadline to complete the project | | | | | |
| 11 | The project team is over-optimistic on completion dates | | | | | |
| 12 | Project schedules are compressed to match the business-case requirements | | | | | |
| 13 | Not enough time is given to the project's team to plan the project before executing | | | | | |
| 14 | There are too many decision-makers negatively impacting on a mega-project | | | | | |
| 15 | Delegation of Authority hampers Approvals and adds to extra schedule time | | | | | |
| 16. | Mega-projects are completed on time | | | | | |
| 17 | There are inexperienced Schedulers planning mega-projects | | | | | |

## Section E: Managing Costs on mega-projects

| | **Managing costs on mega-projects** | Strongly Disagree | Disagree | Undecided | Agree | Strongly Agree |
|---|---|---|---|---|---|---|
| 1 | Detailed cost plans are developed | | | | | |
| 2 | All cost packages are known at the commencement of a mega-project | | | | | |
| 3 | Contractors under-price bids | | | | | |
| 4 | Bid documents have sufficient detail for compiling a robust bid price | | | | | |
| 5 | There adequate processes and tools for cost management | | | | | |
| 6 | Owner increases scope and costs | | | | | |
| 7 | There is inadequate experienced personnel to control costs | | | | | |
| 8 | Onerous Transnet bid processes translates to higher costs | | | | | |
| 9 | There are too many changes on mega-projects leading to higher prices | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 10 | Project costs are underestimated at the business-case development stage | | | | | |
| 11 | There is insufficient engineering done for a robust business-case | | | | | |

## Section F: Quality Management in Mega-Projects

| | **Quality Management in Mega-Projects** | Strongly Disagree | Disagree | Undecided | Agree | Strongly Agree |
|---|---|---|---|---|---|---|
| 1 | Detailed quality plans are developed | | | | | |
| 2 | All quality packages are known at the commencement of a mega-project | | | | | |
| 3 | EPCM and Contractors are aware of quality requirements | | | | | |
| 4 | Bid documents have sufficient details for quality management | | | | | |
| 5 | There adequate processes and tools for quality management | | | | | |
| 6 | Quality management requires too much detail for mega-projects | | | | | |
| 7 | There is inadequate experienced personnel to control quality | | | | | |
| 8 | Insufficient Transnet quality requirements translates to poor quality management | | | | | |
| 9 | EPCM's working on Transnet's mega-projects are, Not quality conscious | | | | | |
| 10 | Project quality requirements are underestimated at the business-case development stage | | | | | |

## Section G: HR and skills on Mega-Projects

| | HR and skills on Mega-Projects | Strongly Disagree | Disagree | Undecided | Agree | Strongly Agree |
|---|---|---|---|---|---|---|
| 1 | Mega-projects have the correct skill sets | | | | | |
| 2 | Owners have good experience in managing mega-project | | | | | |
| 3 | EPCM teams work well with Transnet | | | | | |
| 4 | EPCM's have the correct skill sets for delivering mega-projects | | | | | |
| 5 | There is a massive gap in the experience levels required for mega-projects | | | | | |
| 6 | There are too many people changes in the life of mega-project affecting smooth project delivery | | | | | |
| 7 | Construction Contractors have the right skill sets for delivery of mega-projects | | | | | |
| 8 | Transnet, EPCM and Construction teams are all chasing the same limited pool of skills | | | | | |
| 9 | International experience in similar mega-projects are required | | | | | |
| 10 | Transnet has lots of resources must experience and exposure is limiting | | | | | |
| 11 | It is too long since TCP executed mega-projects hence the lack of skills | | | | | |
| 12 | Suitable skills for resource hungry mega-projects are seldom available at the time of project execution | | | | | |
| 13 | Owner and EPCM roles are clear | | | | | |
| 14 | Local and Expatriates skills sets are required for mega-project execution | | | | | |
| 15 | Transnet has trained its staff to deal with mega-projects | | | | | |
| 16 | Mega-projects in TCP fail as a result of, Not having the correct skill sets | | | | | |
| 17 | Asset Owners have good experience in managing mega-project | | | | | |

## Section H: Communications in Mega-Projects

| | Communications in Mega-Projects | Strongly Disagree | Disagree | Undecided | Agree | Strongly Agree |
|---|---|---|---|---|---|---|
| 1 | Project Managers are responsible for Communications | | | | | |
| 2 | There is adequate resources to deal with external stakeholders | | | | | |
| 3 | There are, No issues with communications | | | | | |
| 4 | There is inadequate communications between the Owners team and EPCM to manage mega-projects | | | | | |
| 5 | There are too many people giving different instructions in mega-projects | | | | | |
| 6 | The time span of mega-project is too long to have effective communications | | | | | |
| 7 | Project progress meetings are effective | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 8 | There are detailed communications plans developed for mega-projects | | | | | |
| 9 | Communication plans are effective | | | | | |

## Section I: Managing Risks on mega-projects

| | **Managing Risks on mega-projects** | Strongly Disagree | Disagree | Undecided | Agree | Strongly Agree |
|---|---|---|---|---|---|---|
| 1 | There are too many risks to manage in mega-projects | | | | | |
| 2 | It is difficult to manage all risks in mega-projects | | | | | |
| 3 | Mega-projects are complex therefore there will always be unknown risks that cannot be managed | | | | | |
| 4 | The Appropriate level of risk management skill sets are, Not available on megaprojects | | | | | |
| 5 | The Transnet risk model is adequate to manage risks on mega-projects | | | | | |
| 6 | There are too many risks to manage in mega-projects | | | | | |
| 7 | It is difficult to manage all risks in mega-projects | | | | | |

## Section J: Procurement in Mega-Projects

| | **Procurement in Mega-Projects** | Strongly Disagree | Disagree | Undecided | Agree | Strongly Agree |
|---|---|---|---|---|---|---|
| 1 | Procurement processes are too long | | | | | |
| 2 | There are too many work packages on mega-projects | | | | | |
| 3 | Contract strategies are aligned to transformation requirements | | | | | |
| 4 | Transformation requirements are easily met by contractors | | | | | |
| 5 | The Appropriate suite of contracts is Applied to mega-projects | | | | | |
| 6 | Contract administration is a nightmare on mega-projects | | | | | |
| 7 | Disputes are easily resolved | | | | | |
| 8 | BEE contractors have good support from Transnet | | | | | |
| 9 | Transnet tender requirements are well supported by BEE contractors | | | | | |
| 10 | Transnet project managers have the Appropriate level of DOA to efficiently managers | | | | | |
| 11 | Contractors are effectively managed by TCP | | | | | |
| 12 | Good contractor performance is rewarded | | | | | |
| 13 | Contractors have the right teams to manage construction work | | | | | |
| 14 | There is sufficient contingencies in mega-project budgets | | | | | |
| 15 | The design team plays a meaningful role in the selection of construction contractors | | | | | |
| 16 | TCP has the right skill levels to manage Contractors | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 16 | Clients team responds efficiently to contractor queries | | | | | |
| 17 | Contractor / Client conflict is hampering mega-project delivery | | | | | |
| 18 | Procurement processes are too long | | | | | |
| 19 | Contractors are effectively managed by TCP's EPCM's | | | | | |

## Section K: Managing Stakeholders in Mega-Projects

| | **Managing Stakeholders in Mega-Projects** | Strongly Disagree | Disagree | Undecided | Agree | Strongly Agree |
|---|---|---|---|---|---|---|
| 1 | There are dedicated resources to manage stakeholders | | | | | |
| 2 | Budget for stakeholder management is available on mega-projects | | | | | |
| 3 | Work-stopp.ages are common on mega-projects | | | | | |
| 4 | ER is effective in the Contractor's teams | | | | | |
| 5 | Work is allocated to local communities | | | | | |
| 6 | Stakeholders are regularly consulted and provided with updates | | | | | |
| 7 | Customers in the end are satisfied with the project | | | | | |
| 8 | More time should be spent on mega-projects to understand community issues and requirements | | | | | |
| 9 | Mega-projects create large number of jobs during the construction phase | | | | | |
| 11 | Stakeholder stopp.ages lead to added costs to projects | | | | | |
| 12 | The cost of investing in community needs outweighs the risks of community resistance | | | | | |
| 13 | Environmental Authorisation processes delay projects | | | | | |

## Section L: Open-ended questions

| | |
|---|---|
| 1 | Do you think that South Africans have the skills to deliver mega-projects? |
| | |
| | |
| | |

| | |
|---|---|
| 2 | Is there too much of 'red tape' that makes project delivery difficult? |
| | |
| | |
| | |

| | |
|---|---|
| 3 | What are your reasons for mega-projects, Not meeting planned budgets? |
| | |
| | |
| | |

| | |
|---|---|
| 5 | Are EPCM's capable of successfully delivering mega-projects for Transnet |
| | |
| | |
| | |

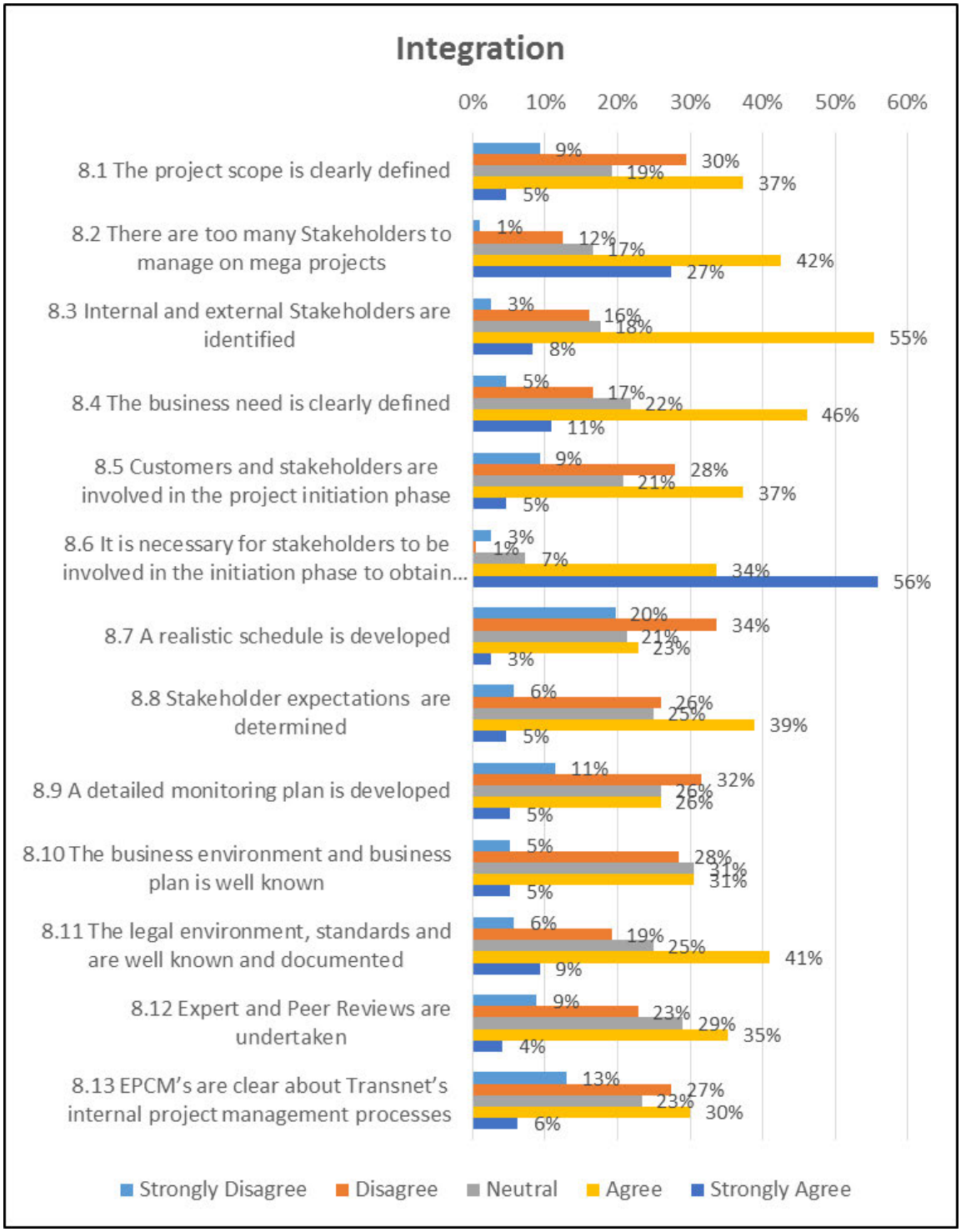
| | |
|---|---|
| 6 | Is Transnet's owners team adequate to manage EPCM's |
| | |
| | |
| | |

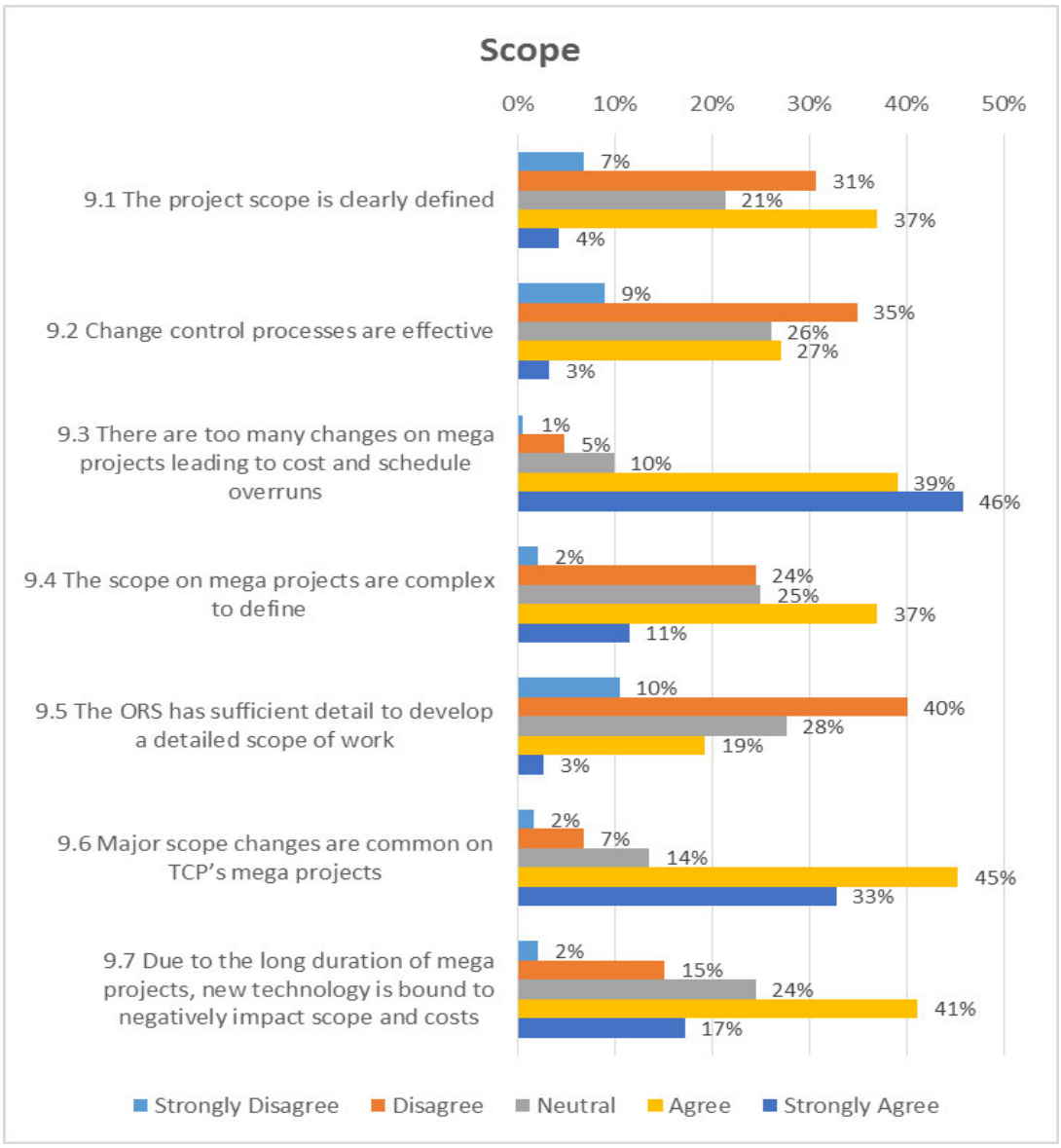
| | |
|---|---|
| 7 | What are your reasons for the cost overruns on mega-projects? |
| | |
| | |
| | |

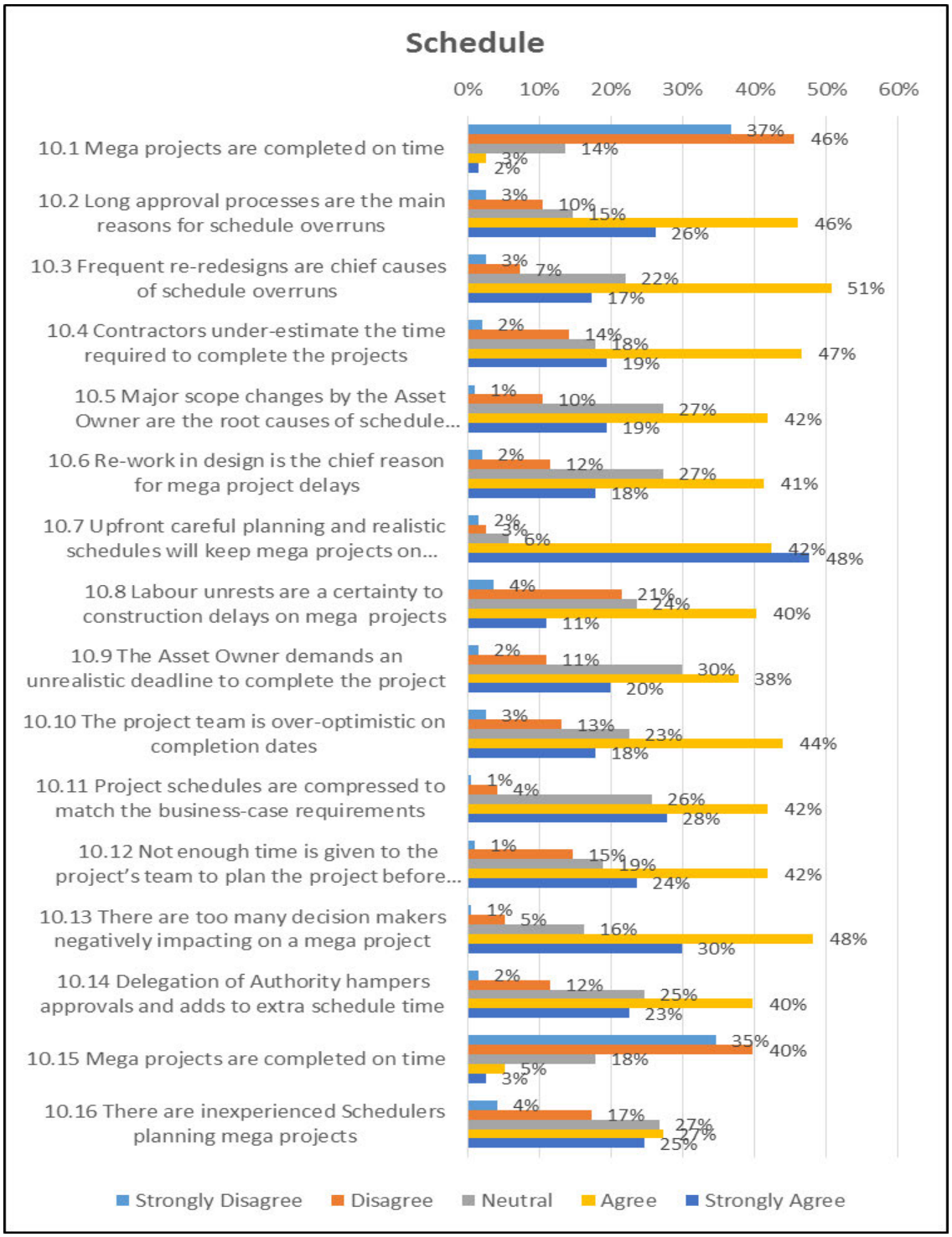
| | |
|---|---|
| 8 | Any other comments you think should be made for this study? |
| | |
| | |
| | |

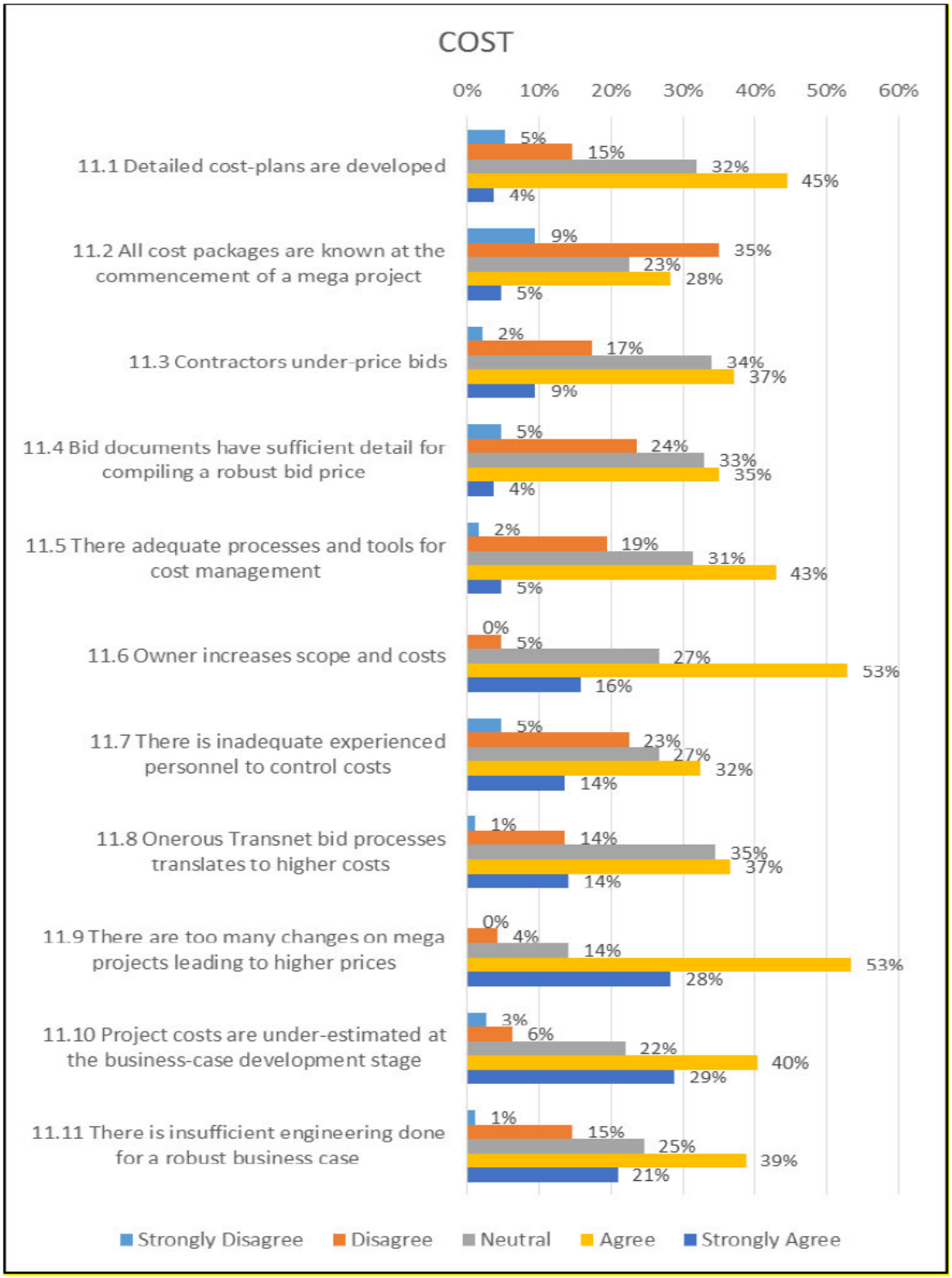
Thank you for your time.

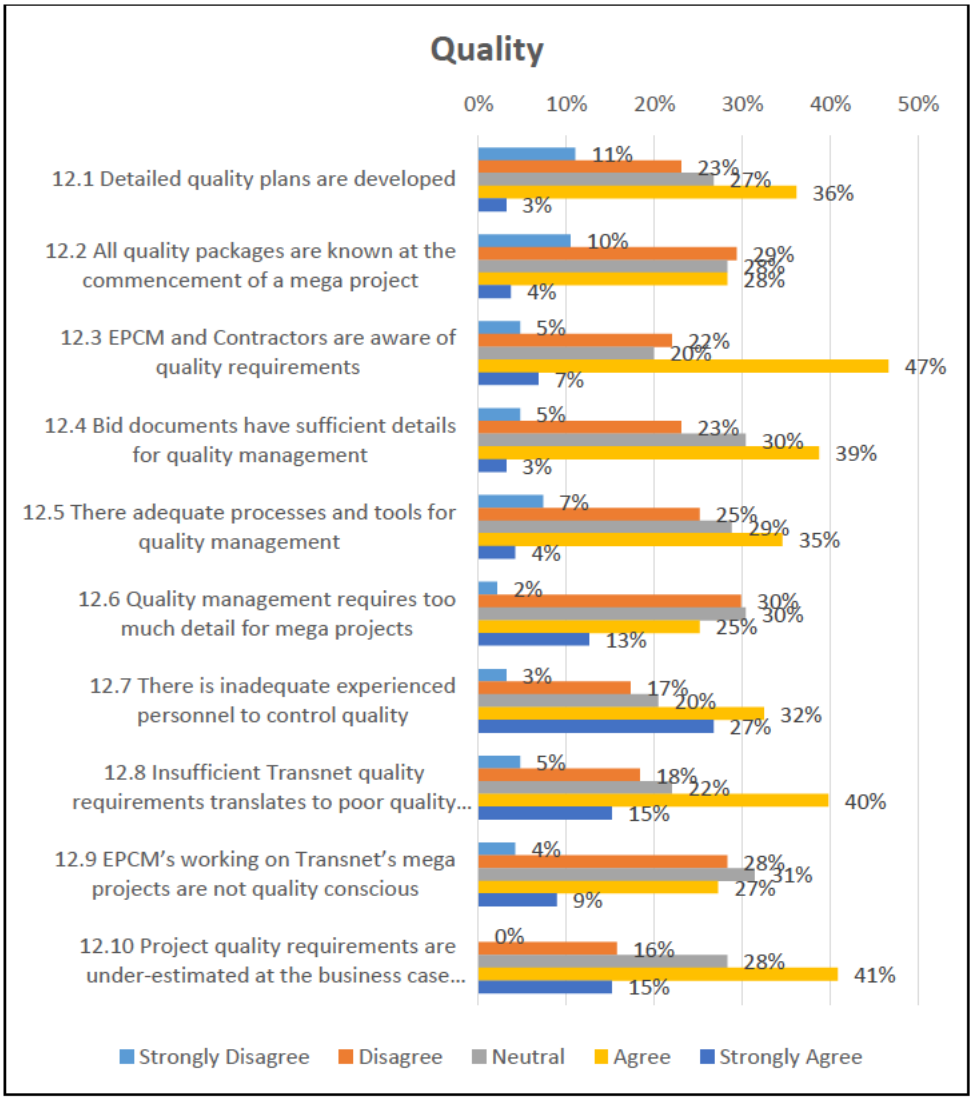
**APPENDIX D: GRAPHS**

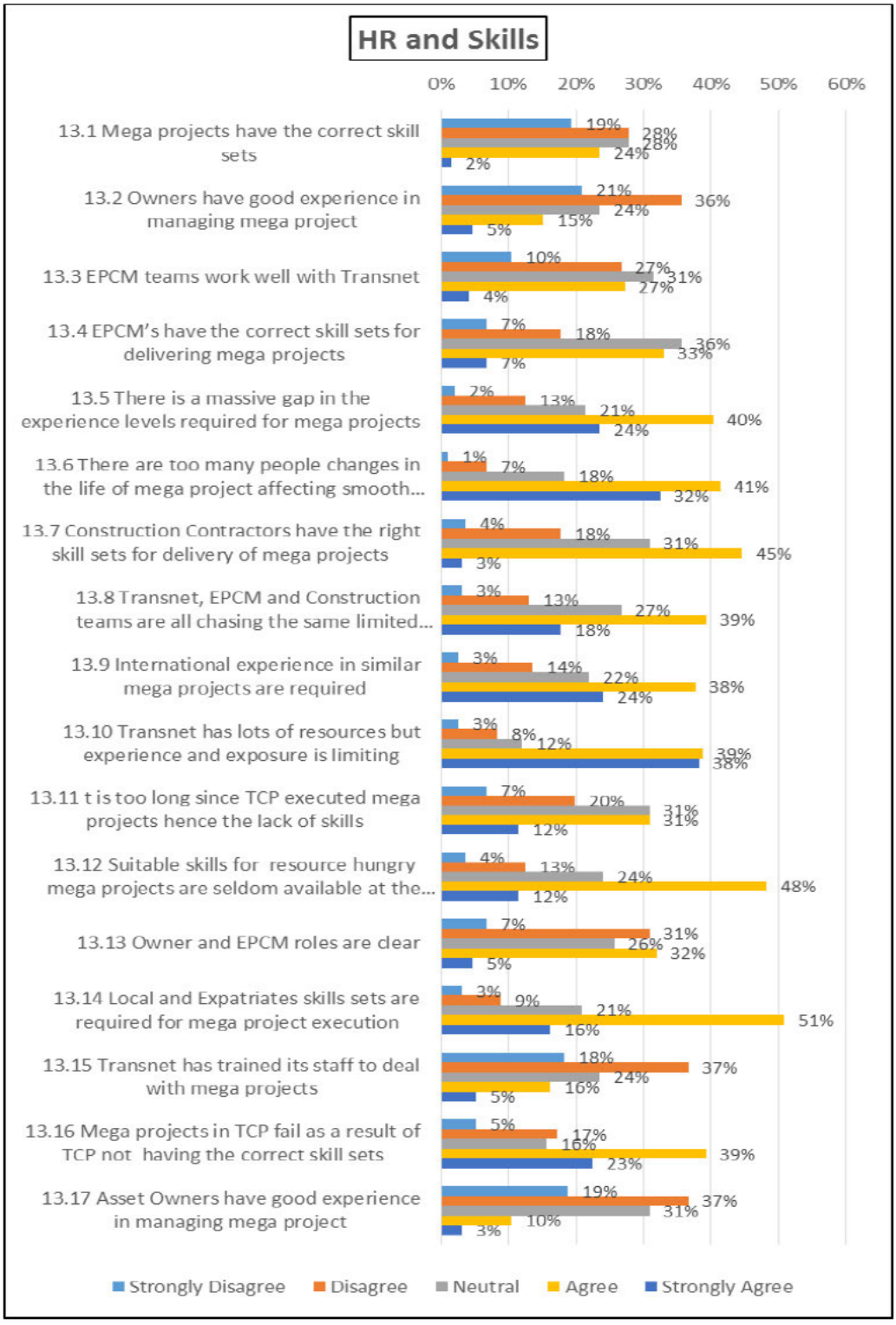



Scope
0%
10%
20%
30%
40%
50%
9.1 The project scope is clearly defined
7%
31%
21%
37%
4%
9.2 Change control processes are effective
9%
35%
26%
27%
3%
9.3 There are too many changes on mega projects leading to cost and schedule overruns
1%
5%
10%
39%
46%
9.4 The scope on mega projects are complex to define
2%
24%
25%
37%
11%
9.5 The ORS has sufficient detail to develop a detailed scope of work
10%
40%
28%
19%
3%
9.6 Major scope changes are common on TCP's mega projects
2%
7%
14%
45%
33%
9.7 Due to the long duration of mega projects, new technology is bound to negatively impact scope and costs
2%
15%
24%
41%
17%
Strongly Disagree
Disagree
Neutral
Agree
Strongly Agree


Schedule
0%
10%
20%
30%
40%
50%
60%
10.1 Mega projects are completed on time
37%
46%
14%
3%
2%
10.2 Long approval processes are the main reasons for schedule overruns
3%
10%
15%
46%
26%
10.3 Frequent re-redesigns are chief causes of schedule overruns
3%
7%
22%
51%
17%
10.4 Contractors under-estimate the time required to complete the projects
2%
14%
18%
47%
19%
10.5 Major scope changes by the Asset Owner are the root causes of schedule...
1%
10%
27%
42%
19%
10.6 Re-work in design is the chief reason for mega project delays
2%
12%
27%
41%
18%
10.7 Upfront careful planning and realistic schedules will keep mega projects on...
2%
3%
6%
42%
48%
10.8 Labour unrests are a certainty to construction delays on mega projects
4%
21%
24%
40%
11%
10.9 The Asset Owner demands an unrealistic deadline to complete the project
2%
11%
30%
38%
20%
10.10 The project team is over-optimistic on completion dates
3%
13%
23%
44%
18%
10.11 Project schedules are compressed to match the business-case requirements
1%
4%
26%
42%
28%
10.12 Not enough time is given to the project's team to plan the project before...
1%
15%
19%
42%
24%
10.13 There are too many decision makers negatively impacting on a mega project
1%
5%
16%
48%
30%
10.14 Delegation of Authority hampers approvals and adds to extra schedule time
2%
12%
25%
40%
23%
10.15 Mega projects are completed on time
35%
40%
18%
5%
3%
10.16 There are inexperienced Schedulers planning mega projects
4%
17%
27%
27%
25%
Strongly Disagree
Disagree
Neutral
Agree
Strongly Agree


COST
0%
10%
20%
30%
40%
50%
60%
11.1 Detailed cost-plans are developed
5%
15%
32%
45%
4%
11.2 All cost packages are known at the commencement of a mega project
9%
35%
23%
28%
5%
11.3 Contractors under-price bids
2%
17%
34%
37%
9%
11.4 Bid documents have sufficient detail for compiling a robust bid price
5%
24%
33%
35%
4%
11.5 There adequate processes and tools for cost management
2%
19%
31%
43%
5%
11.6 Owner increases scope and costs
0%
5%
27%
53%
16%
11.7 There is inadequate experienced personnel to control costs
5%
23%
27%
32%
14%
11.8 Onerous Transnet bid processes translates to higher costs
1%
14%
35%
37%
14%
11.9 There are too many changes on mega projects leading to higher prices
0%
4%
14%
53%
28%
11.10 Project costs are under-estimated at the business-case development stage
3%
6%
22%
40%
29%
11.11 There is insufficient engineering done for a robust business case
1%
15%
25%
39%
21%
Strongly Disagree
Disagree
Neutral
Agree
Strongly Agree


Quality
0%
10%
20%
30%
40%
50%
12.1 Detailed quality plans are developed
11%
23%
27%
36%
3%
12.2 All quality packages are known at the commencement of a mega project
10%
29%
28%
28%
4%
12.3 EPCM and Contractors are aware of quality requirements
5%
22%
20%
47%
7%
12.4 Bid documents have sufficient details for quality management
5%
23%
30%
39%
3%
12.5 There adequate processes and tools for quality management
7%
25%
29%
35%
4%
12.6 Quality management requires too much detail for mega projects
2%
30%
30%
25%
13%
12.7 There is inadequate experienced personnel to control quality
3%
17%
20%
32%
27%
12.8 Insufficient Transnet quality requirements translates to poor quality...
5%
18%
22%
40%
15%
12.9 EPCM's working on Transnet's mega projects are not quality conscious
4%
28%
31%
27%
9%
12.10 Project quality requirements are under-estimated at the business case...
0%
16%
28%
41%
15%
Strongly Disagree
Disagree
Neutral
Agree
Strongly Agree


HR and Skills
0%
10%
20%
30%
40%
50%
60%
13.1 Mega projects have the correct skill sets
19%
28%
28%
24%
2%
13.2 Owners have good experience in managing mega project
21%
36%
24%
15%
5%
13.3 EPCM teams work well with Transnet
10%
27%
31%
27%
4%
13.4 EPCM's have the correct skill sets for delivering mega projects
7%
18%
36%
33%
7%
13.5 There is a massive gap in the experience levels required for mega projects
2%
13%
21%
40%
24%
13.6 There are too many people changes in the life of mega project affecting smooth...
1%
7%
18%
41%
32%
13.7 Construction Contractors have the right skill sets for delivery of mega projects
4%
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3%
13.8 Transnet, EPCM and Construction teams are all chasing the same limited...
3%
13%
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13.9 International experience in similar mega projects are required
3%
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38%
24%
13.10 Transnet has lots of resources but experience and exposure is limiting
3%
8%
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13.11 t is too long since TCP executed mega projects hence the lack of skills
7%
20%
31%
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12%
13.12 Suitable skills for resource hungry mega projects are seldom available at the...
4%
13%
24%
48%
12%
13.13 Owner and EPCM roles are clear
7%
31%
26%
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13.14 Local and Expatriates skills sets are required for mega project execution
3%
9%
21%
51%
16%
13.15 Transnet has trained its staff to deal with mega projects
18%
37%
24%
16%
5%
13.16 Mega projects in TCP fail as a result of TCP not having the correct skill sets
5%
17%
16%
39%
23%
13.17 Asset Owners have good experience in managing mega project
19%
37%
31%
10%
3%
Strongly Disagree
Disagree
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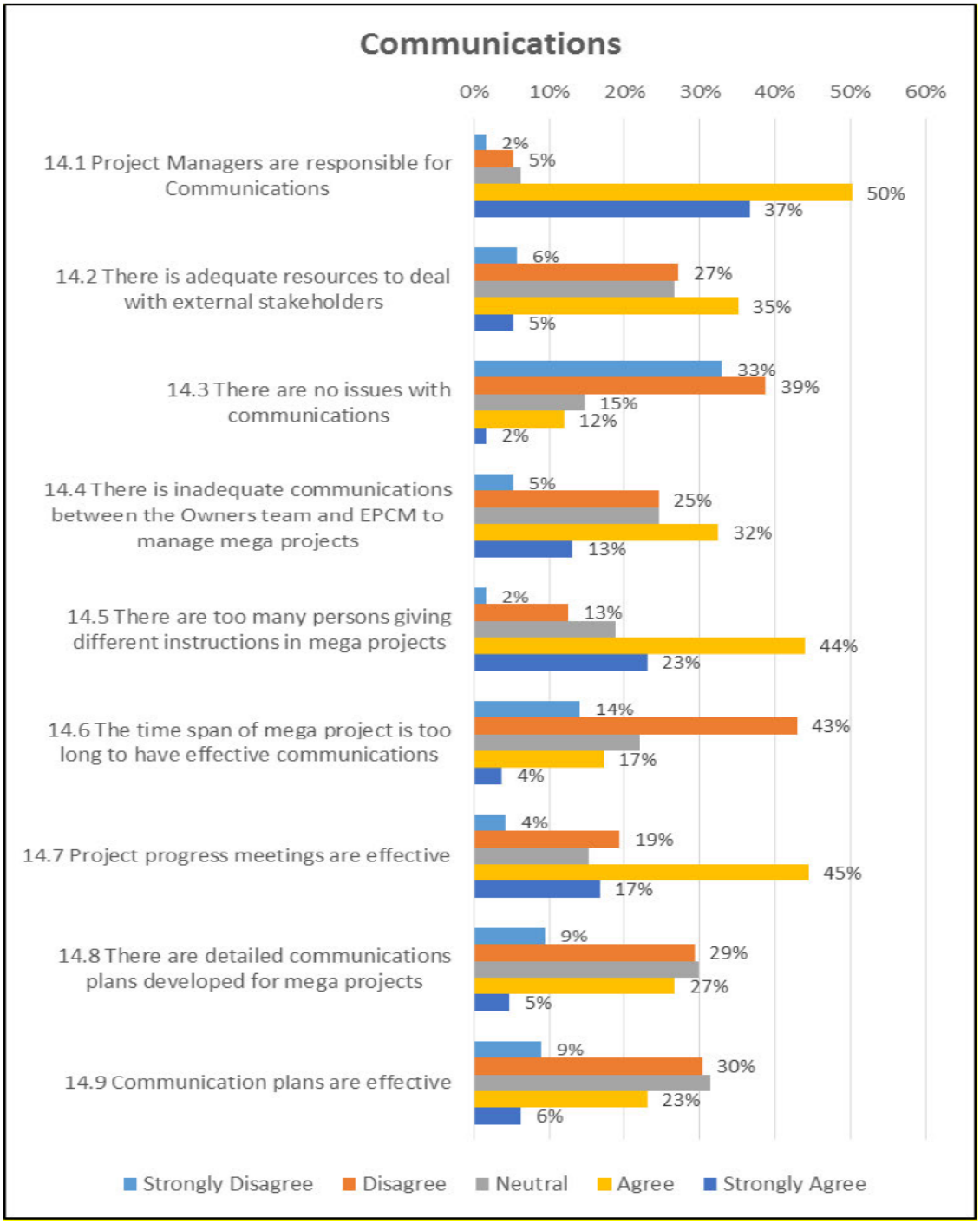
Agree
Strongly Agree


Communications
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14.1 Project Managers are responsible for Communications
2%
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50%
37%
14.2 There is adequate resources to deal with external stakeholders
6%
27%
35%
5%
14.3 There are no issues with communications
33%
39%
15%
12%
2%
14.4 There is inadequate communications between the Owners team and EPCM to manage mega projects
5%
25%
32%
13%
14.5 There are too many persons giving different instructions in mega projects
2%
13%
44%
23%
14.6 The time span of mega project is too long to have effective communications
14%
43%
17%
4%
14.7 Project progress meetings are effective
4%
19%
45%
17%
14.8 There are detailed communications plans developed for mega projects
9%
29%
27%
5%
14.9 Communication plans are effective
9%
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Strongly Disagree
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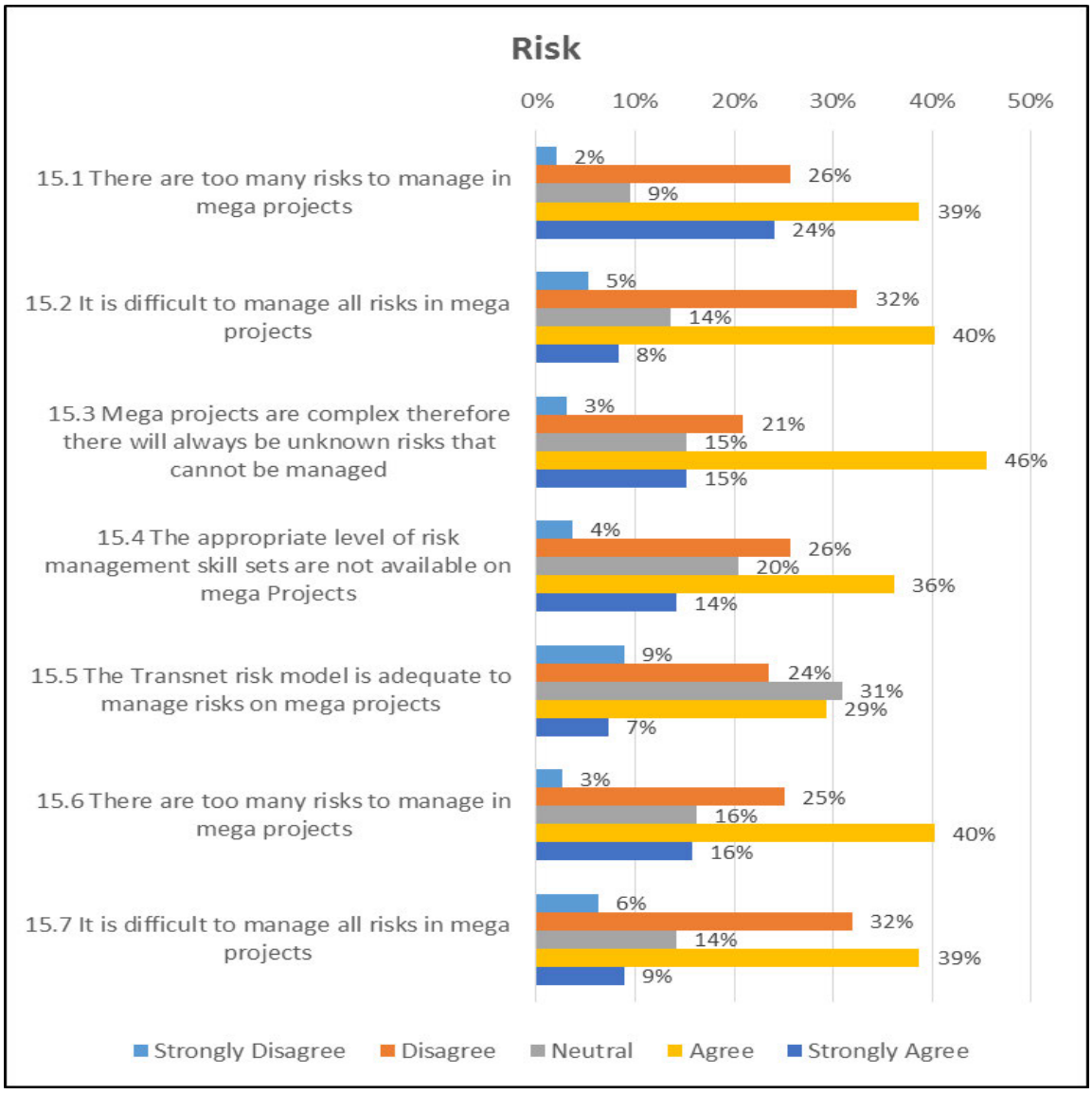
Agree
Strongly Agree


Risk
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15.1 There are too many risks to manage in mega projects
2%
26%
9%
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24%
15.2 It is difficult to manage all risks in mega projects
5%
32%
14%
40%
8%
15.3 Mega projects are complex therefore there will always be unknown risks that cannot be managed
3%
21%
15%
46%
15%
15.4 The appropriate level of risk management skill sets are not available on mega Projects
4%
26%
20%
36%
14%
15.5 The Transnet risk model is adequate to manage risks on mega projects
9%
24%
31%
29%
7%
15.6 There are too many risks to manage in mega projects
3%
25%
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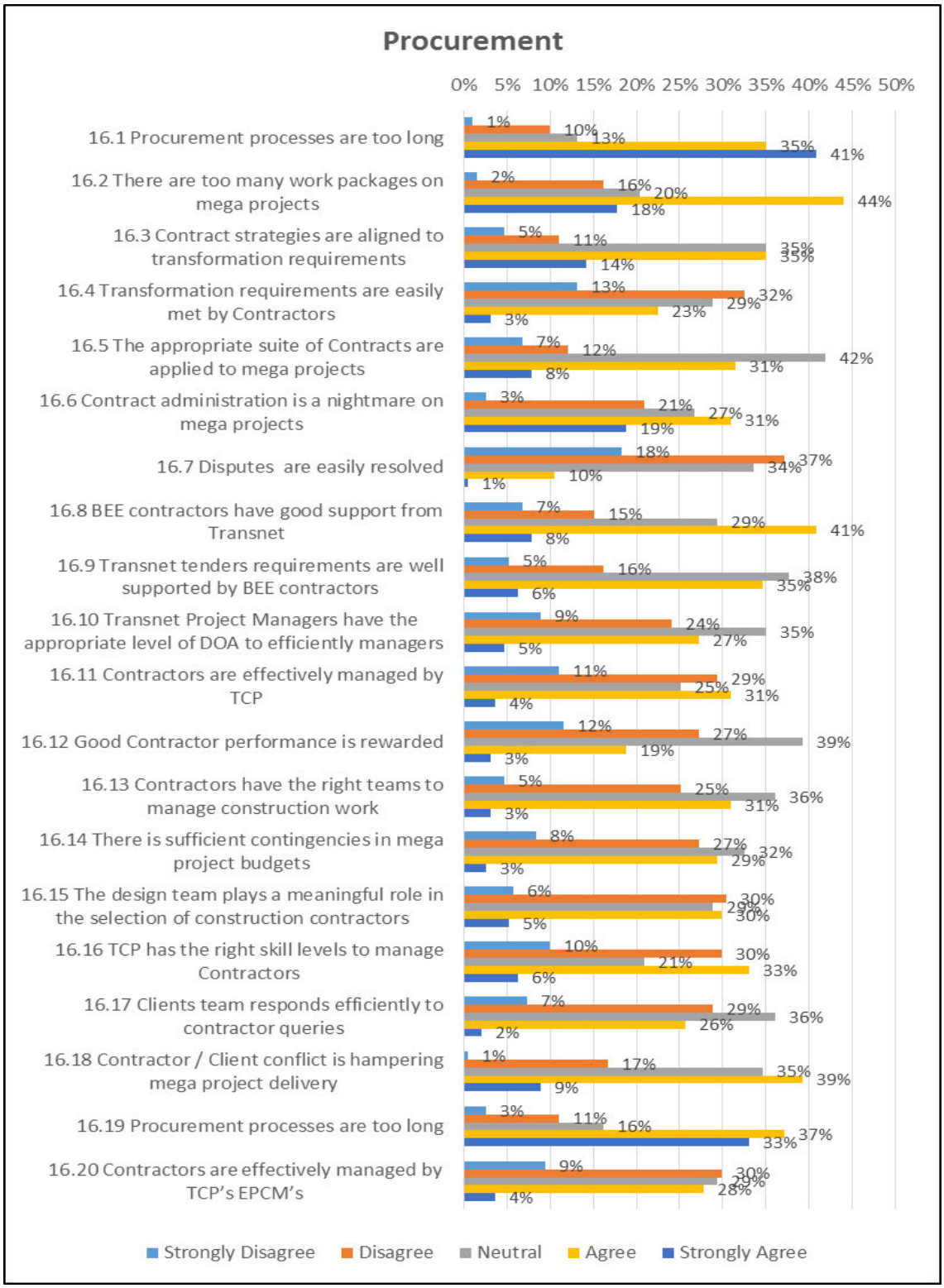
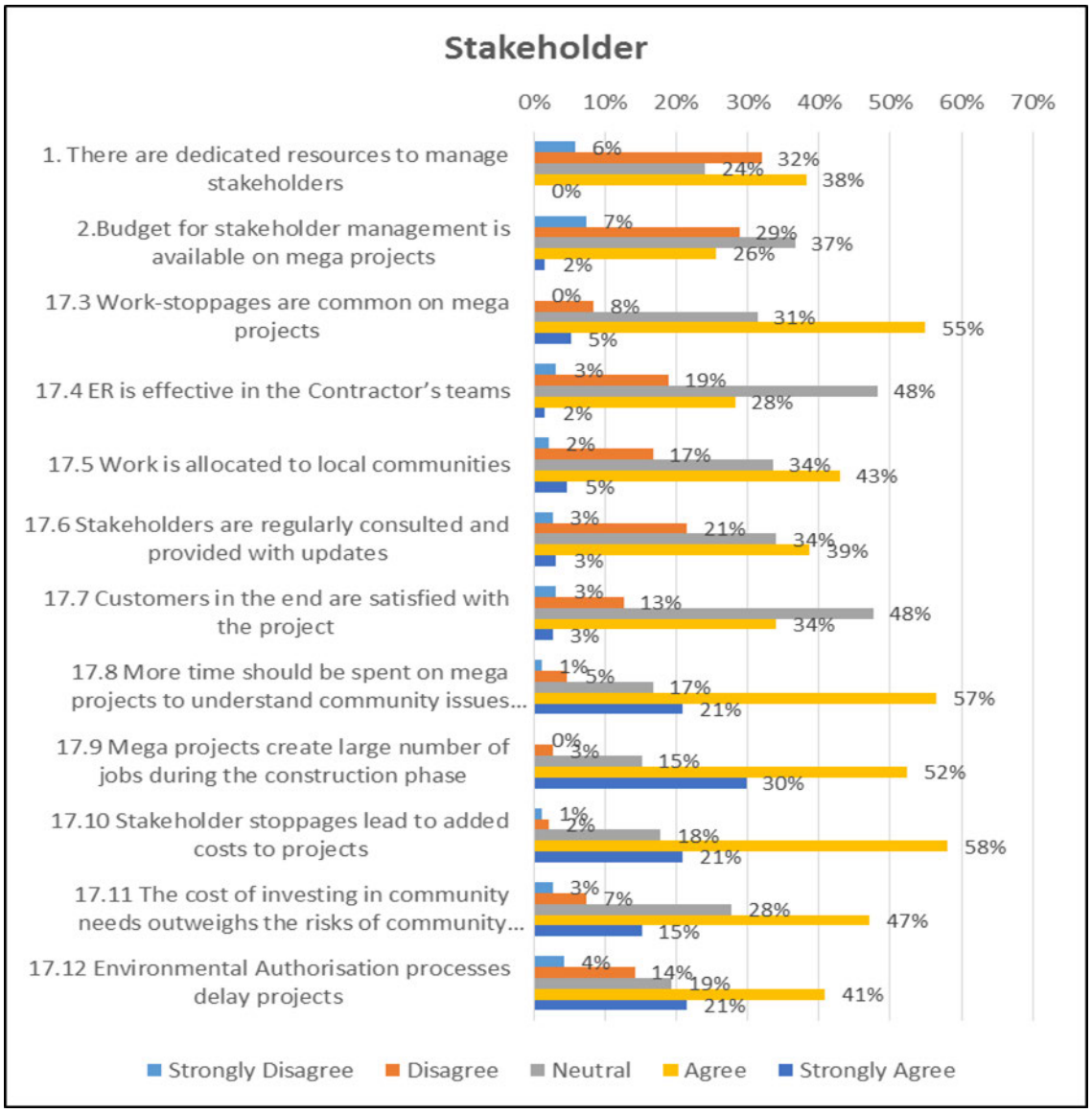
40%
16%
15.7 It is difficult to manage all risks in mega projects
6%
32%
14%
39%
9%
Strongly Disagree
Disagree
Neutral
Agree
Strongly Agree


Procurement
0% 5% 10% 15% 20% 25% 30% 35% 40% 45% 50%
16.1 Procurement processes are too long
1% 10% 13% 35% 41%
16.2 There are too many work packages on mega projects
2% 16% 20% 44% 18%
16.3 Contract strategies are aligned to transformation requirements
5% 11% 35% 35% 14%
16.4 Transformation requirements are easily met by Contractors
13% 29% 32% 23% 3%
16.5 The appropriate suite of Contracts are applied to mega projects
7% 12% 42% 31% 8%
16.6 Contract administration is a nightmare on mega projects
3% 21% 27% 31% 19%
16.7 Disputes are easily resolved
18% 34% 37% 10% 1%
16.8 BEE contractors have good support from Transnet
7% 15% 29% 41% 8%
16.9 Transnet tenders requirements are well supported by BEE contractors
5% 16% 38% 35% 6%
16.10 Transnet Project Managers have the appropriate level of DOA to efficiently managers
9% 24% 35% 27% 5%
16.11 Contractors are effectively managed by TCP
11% 29% 25% 31% 4%
16.12 Good Contractor performance is rewarded
12% 27% 39% 19% 3%
16.13 Contractors have the right teams to manage construction work
5% 25% 36% 31% 3%
16.14 There is sufficient contingencies in mega project budgets
8% 27% 32% 29% 3%
16.15 The design team plays a meaningful role in the selection of construction contractors
6% 30% 29% 30% 5%
16.16 TCP has the right skill levels to manage Contractors
10% 30% 21% 33% 6%
16.17 Clients team responds efficiently to contractor queries
7% 29% 36% 26% 2%
16.18 Contractor / Client conflict is hampering mega project delivery
1% 17% 35% 39% 9%
16.19 Procurement processes are too long
3% 11% 16% 37% 33%
16.20 Contractors are effectively managed by TCP's EPCM's
9% 30% 29% 28% 4%
Strongly Disagree
Disagree
Neutral
Agree
Strongly Agree


Stakeholder
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10%
20%
30%
40%
50%
60%
70%
1. There are dedicated resources to manage stakeholders
6%
32%
24%
38%
0%
2.Budget for stakeholder management is available on mega projects
7%
29%
37%
26%
2%
17.3 Work-stoppages are common on mega projects
0%
8%
31%
55%
5%
17.4 ER is effective in the Contractor's teams
3%
19%
48%
28%
2%
17.5 Work is allocated to local communities
2%
17%
34%
43%
5%
17.6 Stakeholders are regularly consulted and provided with updates
3%
21%
34%
39%
3%
17.7 Customers in the end are satisfied with the project
3%
13%
48%
34%
3%
17.8 More time should be spent on mega projects to understand community issues...
1%
5%
17%
57%
21%
17.9 Mega projects create large number of jobs during the construction phase
0%
3%
15%
52%
30%
17.10 Stakeholder stoppages lead to added costs to projects
1%
2%
18%
58%
21%
17.11 The cost of investing in community needs outweighs the risks of community...
3%
7%
28%
47%
15%
17.12 Environmental Authorisation processes delay projects
4%
14%
19%
41%
21%
Strongly Disagree
Disagree
Neutral
Agree
Strongly Agree

# ANNEXURE E: GATEKEEPER'S APPROVAL

Transnet SOC Ltd
Registration
Number
1990/000900/30

Queens Warehouse
237 Mahatma
Gandhi Road
Durban

P.O. Box 1045
Durban
South Africa, 4001
T +27 31 347 [illegible]

TRANSNET

**To:** Mr Herbert Msagala, Chief Executive, Transnet Capital Projects

**From:** Rajan Chetty, Project Director, Transnet Capital Projects

**Date:** 18 October 2015

**SUBJECT:** **Gate-Keepers Approval to Proceed with PhD Study & Employee Survey: Rajan Chetty**

## PURPOSE

1. The purpose of this submission is to seek Gate-Keeper's approval for Rajan Chetty to proceed with a PhD study and approval is granted to undertake an employee survey in TCP.

## BACKGROUND

2. Early last year I was privileged to be awarded a scholarship by the University of KwaZulu Natal (UKZN) to undertake a PhD study.

3. Thus far I have successfully completed the pre-requisite module on Advanced Research Methodologies. I have also presented a research proposal 'Challenges facing the delivery of Mega Projects in TCP' to UKZN which was subsequently approved. Thus far I have also done substantial literature review on this topic and I am now ready to undertake a survey to understand specific challenges facing TCP.

4. Academia have a keen interest in this Topic and they to understand and positively contribute knowledge that assists in rapidly growing regions such as South Africa and the African continent.

5. I am open to engage further with the relevant TCP offices, if necessary, to clarify/refine the study topic, research approach and any other matters around sensitivities, disclosures etc.

**6. Benefits of the Study**

- Organisations need to continually assess its environment and craft strategies and processes (Hough et al, 2008) for continual improvement hence this study will contribute the business's strategic dimensions.

[redacted]

- This study is aimed at critically assessing the challenges facing the delivery of mega projects at TCP and positively contributing to continuous improvements in Transnet and the industry at large
- Project Researchers, practitioners and stakeholders will benefit from the learnings of mega infrastructure project delivery at Transnet.
- It will also recommend new strategies and innovations for continuous improvements in the delivery of mega-projects in the public sector.
- There is very little written on mega projects from an African scenario perspective. Our continent is unique and our challenges are also unique. This study will contribute to adding knowledge on mega projects for the African continent.
- TCP will continue to develop its staff and contribute to the industry at large

7. **Working Time**

This study is being undertaken on a part-time basis. No lectures are required. Should the need arise for any time-off for any reason, the Researcher will request leave via the normal request procedures.

The proposed survey to be undertaken within TCP will be conducted using electronic media. Respondents will be requested to complete the survey after hours.

The Researcher has no plans to undertake a survey via group meetings during work time. Should such a need arise, permission will be sought from TCP.

8. **Ethical Clearance**

- Special care will be taken to ensure that UKZN ethical guidelines are adhered to. A submission will be made to UKZN Ethics Committee to obtain the necessary approvals to proceed further with the study.
- TCP will be provided with the guideline containing the conditions under which the survey will be undertaken. The final report will be provided to TCP.
- All survey Respondents will participate with informed consent. All measures will be taken to ensure that respondents remain anonymous and that their privacy is respected.
- Information collected will remain confidential
- The researcher will not transgress any UKZN rules and guidelines pertaining to plagiarism, copy right or intellectual property.

**FINANCIAL IMPLICATION**

9. The Study is sponsored by the University of Kwa Zulu Natal. TCP is not required to make any financial contributions for this study.

**BUDGET IMPLICATION**

10. The study is sponsored by the University of Kwa Zulu Natal. TCP is not required to make any budgets available for this study.

[redacted]

**RECOMMENDATION**

11. It is recommended that TCP Chief Executive approves this Gate-Keeper submission for the PhD study and approves an Employee Survey to be undertaken by Rajan Chetty.

**Compiled by:**

[redacted]

**Rajan Chetty**
**Project Director**
**Transnet Capital Projects**
**Date:** 23/09/2015

**Recommended / ~~Not recommended~~ by:**

[redacted]

**Velile Sikhosana**
**Project Director : Manganese**
**Transnet Capital Projects**
**Date:** 26/10/2015

**Recommended / ~~Not recommended~~ by:**

[redacted]

**Oupa Radise**
**General Manager : Human Capital**
**Transnet Capital Projects**
**Date:** 26/10/2015

**Approved / Not approved by:**

[redacted]

**Herbert Msagala**
**Chief Executive**
**Transnet Capital Projects**
**Date:** 02/11/2015

## ANNEXURE F: EDITOR'S DECLARATION

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12 January 2018

**Declaration of professional edit**

**Challenges Facing the Delivery of Mega Projects in Transnet Capital Projects (TCP)**
by
Rajan Chetty

I declare that I have edited and proofread this thesis. My involvement was restricted to language usage and spelling, completeness and consistency, referencing style and formatting of headings, captions and Tables of Contents. I did no structural re-writing of the content.

I am qualified to have done such editing, being in possession of a Bachelor's degree with a major in English, having taught English to matriculation, and having a Certificate in Copy Editing from the University of Cape Town. I have edited more than 100 Masters and Doctoral theses, as well as articles, books and reports.

As the copy editor, I am not responsible for detecting, or removing, passages in the document that closely resemble other texts and could thus be viewed as plagiarism. I am not accountable for any changes made to this document by the author or any other party subsequent to my edit.

Sincerely,

*Signature withheld for security reasons*
Dr Jacqueline Baumgardt
Member, Professional Editors Guild