FACTORS AFFECTING TIME AND COST OVERRUNS IN ROAD CONSTRUCTION PROJECTS IN A METROPOLITAN MUNICIPALITY OF THE FREE STATE PROVINCE

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A field study submitted to the UFS Business School in the Faculty of Economic and Management Sciences in partial fulfilment of the requirements for the degree

Magister in Business Administration

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Date: 20 November 2020

DECLARATION

I declare that the Field Study hereby submitted for the Magister in Business Administration at the UFS Business School, University of the Free State, is my own independent work and that I have not previously submitted this work, either as a whole or in part, for a qualification at another university or at another faculty at this university.

I also hereby cede copyright of this work to the University of the Free State.

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DEDICATION

I would like to dedicate this work to the following persons:

- My late mother, who is the source of my inspiration. She is the one who planted this seed in me but could not live long enough to enjoy the harvest. She will forever remain special in my heart, and I am hopeful that she is smiling wherever she is.
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- My Father and siblings, who have been supportive of me during both dark and bright days of my life. I would forever appreciate their love and sacrifice for my life. I am hopeful that this success would inspire them as well.

ABSTRACT

Time and cost overruns in construction projects remain a significant challenge facing the construction industry worldwide. The purpose of this study was, therefore, to assess the most significant factors affecting time and cost overruns in road construction projects in a metropolitan municipality of the Free State Province to facilitate the formulation of comprehensive mechanisms to enhance project performance.

The study employed a quantitative research approach and cross-sectional research design. A structured questionnaire was developed from 61 factors identified in existing literature as the leading causes of time and cost overruns in construction projects. The questionnaire was reviewed by the study supervisor and industry experts to guarantee the face validity of the study and thereafter piloted with five industry practitioners before distribution. The final questionnaire was disseminated to 66 purposively nominated participants classified into three groups, namely, client (12), consultant (21), and contractor (33). The respondents were nominated based on their direct participation in 47 selected road projects completed between July 2014 and March 2020. The response rate for the valid questionnaires was 56% (37 out of 66). The empirical data were analysed using the Relative Importance Index (RII), Importance Index (IMPI), and weighted RII and IMPI methods to identify the hierarchical order of importance of the 61 variables on the performance of the road construction projects in the municipality. The Spearman's rank correlation coefficient was employed to assess the degree of correlations of perceptions between the respondent groups on the subject. Cronbach's alpha was used to evaluate the reliability of the survey instrument.

The study found that 83% (39 out of 47) of the selected projects experienced time overruns, with an average overrun percentage of 107.33%. Out of the sample projects, 44.68% (21 out of 47) experienced cost overruns with an average overrun percentage of 24.48%. Using the weighted RII and IMPI methods, the study identified the top ten variables contributing to the poor performance of projects from the collective responses of all the participants to be: appointment of contractors with political clout; contractor's cash flow; community disruptions; labour unrest; corruption; delays in progress payments; subcontracting challenges (dispute and performance); under-pricing of the

work due to strategic misrepresentation; under-pricing of the work due to overconfidence in own ability; and appointment of consultants with political clout. The Spearman's rank correlation results indicated an overall high agreement between the client and consultant groups (0.79), consultant and contractor groups (0.75), and client and contractor groups (0.68) for the weighted RII and IMPI indexes. The questionnaire was found to be reliable with a Cronbach's alpha value of 0.97.

The study recommends the following key measures to improve the performance of projects at the municipality: vetting bidders and supply chain management practitioners; appointing qualified and competent staff with integrity; developing a comprehensive financial plan by contractors; introducing payment guarantee clauses in contracts for advance payments and delayed progress payments; conducting a comprehensive risk assessment during the bidding process; blacklisting service providers caught practising bribery; conducting adequate public participation; introducing capacity development programmes; paying wages in line with BCCEI and standardising wages among all the contractors working in a site; ring-fencing the project budget; limiting subcontracting to projects equal to or above R30 million; appointing experienced subcontractors that are registered with the CIDB; implementing cession payments for subcontractors; and appointing competent cost estimators by the contractors.

Keywords: time overruns; cost overruns; Relative Importance Index (RII); Importance Index (IMPI); mitigation measures; road construction projects; project management; municipality; Free State Province, South Africa

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DEFINITION OF KEY TERMS

Cost overrun: the extra cost incurred above the contract price.

Cross-sectional design: a study that entails the collection of quantifiable data for a specific phenomenon at a single point in time.

Fruitless and wasteful expenditure: “expenditure that was made in vain and would have been avoided had reasonable care been exercised” (Municipal Finance Management Act No. 56 of 2003, Section 1).

Time overrun: the period by which the construction programme slips beyond the scheduled completion date agreed in the contract.

LIST OF ABBREVIATIONS AND ACRONYMS

AFDB:	African Development Bank
AGSA:	Auditor-General of South Africa
BCCEI:	Bargaining Council for the Civil Engineering Industry
CIDB:	Construction Industry Development Board
CLO:	Community liaising officer
ECSA:	Engineering Council of South Africa
EPWP:	Expanded Public Works Programme
GCC:	General Conditions of Contract
GDP:	Gross domestic product
IMPI:	Importance Index
MFMA:	Municipal Finance Management Act, Act No. 56 of 2003
MMM:	Mangaung Metropolitan Municipality
NDP:	National Development Plan
OECD:	Organization for Economic Cooperation and Development
RII:	Relative Importance Index
RSA:	Republic of South Africa
UFS:	University of the Free State

CHAPTER 1. INTRODUCTION

1.1 BACKGROUND

Even after the advent of technology and modern project management techniques, time and cost overruns in infrastructure projects remain a significant challenge bedevilling the construction industry worldwide.

Rahman, Memon, Nagapan and Latif (2012) assessed the performance of construction projects in the southern and central part of the peninsula in Malaysia and found that 92% and 89% of the projects overran their contract time and cost, respectively. A similar study conducted on transportation infrastructure projects in the western Maharashtra region in India by Patil, Gupta, Desai and Sajane (2013) concluded that 72% of the projects surveyed had overrun their scheduled completion time. In the United Arab Emirates, a study conducted by Faridi and EL-Sayegh (2006) revealed that 50% of the construction projects were not completed on time. Kholif (2015) studied 102 educational building projects in Egypt and concluded that 29 and 33 of the projects overran their contractual time and cost, respectively. A study by Assaf and Al-Hejji (2006) concluded that 70% of the large construction projects in Saudi Arabia experienced time overrun.

Time and cost overruns in projects often lead to frequent disputes, claims and lawsuits (Alaghbari, Kadir, Salim & Ernawati, 2007). Seboru (2015) argues that time and cost overruns in public sector projects lead to the waste of public funds. Azhar, Farooqui and Ahmed (2008:499) contended that “time and cost overrun in the construction industry is a worldwide phenomenon that is more pronounced in the developing countries”, which results in the wastage of taxpayer’s money.

Despite the fact that it is a global problem, the government of the Republic of South Africa (RSA) cannot afford to continue to turn a blind eye to challenges causing time and cost overruns in public sector infrastructure projects. Time and cost overruns have the potential to exacerbate the government’s untenable fiscal position even further.

According to the National Treasury Supplementary Budget Speech of 2020, the consolidated budget deficit is projected to reach 14.6% and 15.00% of the gross domestic product (GDP) in 2020/21 and 2022/23, respectively (National Treasury,

2020: trading economics, 2020). The debt-to-GDP ratio is expected to rise to 81.8% and 87.8% in 2020/21 and 2023/24, respectively (ibid). These figures call for the elimination of all financial leakages across the entire service-delivery value chain in the public sector. The failure to curb time and cost overruns in infrastructure projects will lead to the wastage of billions of rands, more so as the government is planning to spend trillions of rands on the provision of public infrastructure to achieve its macroeconomic objectives of stimulating inclusive economic growth, reducing unemployment, and reducing the income inequality gap and poverty.

The RSA is faced with a plethora of challenges that include, inter alia, high levels of poverty and an inequality gap. To address these challenges, the government crafted Vision 2030. The National Development Plan (NDP) was adopted in 2012 as a strategic planning document to guide the government in achieving Vision 2030. The overarching objectives of the NDP (2012) are to eliminate abject poverty and reduce the income inequality gap by 2030. According to the NDP (2012), the gross fixed capital formation would be raised to 30% of GDP by 2030, with public infrastructure spending reaching 10% of GDP. The Consulting Engineers South Africa Bi-Annual Economic and Capacity Survey Report of March 2019 and the Construction Industry Development Board (CIDB) construction monitor report of April 2019 respectively stated that: the gross fixed capital formation averaged at 8.9% of GDP in 2018 and the construction industry accounted for 4% of GDP in the same period.

The government views infrastructure investment as the required stimulus for sustained, inclusive economic growth that would yield socioeconomic transformation. The NDP (2012) proposes a blended financing model comprising both public and private sector investment to achieve the targeted infrastructure spending of 10% of GDP by 2030. Likewise, the CIDB annual report of 2017/2018 revealed that the public sector infrastructure budget according to the Medium Term Expenditure Framework was expected to be R834.1 billion and that the construction industry accounted for 11% of GDP in 2017. The NDP (2012) states that transport, energy and water service infrastructure will be prioritised for funding by the government.

Despite the great strides made by the government in addressing the challenge of poverty and the inequality gap through massive investment in infrastructure, the public sector, unfortunately, continues to waste billions of rands through incurring fruitless

and wasteful expenditure. The Municipal Finance Management Act (MFMA), No. 56 of 2003 section 1 defines fruitless and wasteful expenditure as “expenditure that was made in vain and would have been avoided had reasonable care been exercised”. Put differently; money was wasted, or no value was realised through such expenditure.

The office of the Auditor-General of South Africa (AGSA) has raised concerns regarding increasing expenses of irregular, fruitless and wasteful nature in the public sector. The 2018/2019 consolidated audit outcomes of national and provincial government indicate that R4.6 billion was incurred as fruitless and wasteful expenditure over a five-year period. The MFMA consolidated general report on the local government audit outcomes of the 2018/2019 financial year indicated that R2.07 billion and R4.27 billion of public funds were lost through fruitless and wasteful expenditure in the 2018/19 financial year and over the past three years, respectively. Mangaung Metropolitan Municipality (MMM) incurred R26 424 686.68 and R8 958 981 fruitless and wasteful expenditure during 2017/18 and 2018/19 financial years, respectively (AGSA, 2020; MMM AFS, 2019).

Fruitless and wasteful expenditure derails government efforts of addressing socioeconomic problems. Reducing such expenses should, therefore, be prioritised by all public sector institutions. Although a sizeable reduction of fruitless and wasteful expenditure was achieved during the 2018/19 financial year, these expenses remained high in terms of National Treasury norms. The National Treasury MFMA Circular No. 71 of 2014 states that expenses of “Irregular; Fruitless and Wasteful; and Unauthorised nature expressed as a percentage of the Total Operating Expenditure must be zero; and that any percentage exceeding zero must be investigated and acted upon” (National Treasury, 2014: 16). AGSA (2020:22) cautioned in a media statement that the “government could not afford to continue losing monies due to poor decision making, neglect and inefficiencies”.

Infrastructure projects are one of the main contributors to fruitless and wasteful expenses in the public sector. In MMM particularly, 70% of the aggregated R43 762 693.08 fruitless and wasteful expenses reported by the AGSA for financial years 2014/15 to 2018/19 were attributed to infrastructure projects (AGSA, 2015; 2016; 2017; 2018; 2019). Such expenditure is mainly caused by construction delays, also known as time-overrun, that leads to cost overrun. Time overrun can be defined as the period

by which the construction programme slips beyond the scheduled completion date agreed in the contract (Assaf & Al-Hejji, 2006; Memon, 2014). It can be expressed as follows: time overrun = actual completion date – contract completion date. Cost overrun can be defined as the extra cost incurred above the contract price, commonly referred in the General Conditions of Contract (GCC) 2015 as the contract sum, and it can be expressed in mathematical terms as follows: cost overrun = actual cost – contract estimate (Amoa-Abban & Allotey, 2014).

It is evident from the available literature that many studies on the subject have been conducted across the world; however, there are limited publications related to the South African context (Mulalo, Ibrahimu & Nwobodo-Anyadiegwu, 2019). The factors affecting project performance in the construction industry are “not homogeneous; they vary both in nature and magnitude along with project types, geographical location, project size, and project scope” (Le-Hoai, Lee & Lee, 2008:368). It is imperative to identify the key factors contributing to time and cost overruns on projects implemented in a local government environment to formulate effective solutions.

Therefore, the purpose of this study is to identify the main factors contributing to the time and cost overruns in construction road projects in a metropolitan municipality of the Free State Province.

1.2 PROBLEM STATEMENT

The completion of a project within the three golden indicators, namely, contract time, contract cost and specified quality, remains the fundamental indicator of project efficiency measurement, according to the Project Management Institute’s *Project Management Body of Knowledge* (PMBOK®, 2017). A project must be completed within the agreed time, cost estimate and quality to be regarded as successful.

MMM, just like other local authorities in South Africa, continues to face ubiquitous challenges in terms of time and cost overruns as well as the poor quality of the finished product (Mulenga & Bekker, 2015). The analysis of the project sampled for the study mentioned reveals that 83% and 44.68% of the projects exceeded their contract time and contract budget, respectively. The average time and cost overruns experienced in the surveyed projects were 107.33% and 24.48%, respectively. In addition, the MMM annual report for the 2018/19 financial year shows that 57% of the capital projects

budgeted for that financial year did not meet both their financial and non-financial performance targets (MMM Service Delivery Budget Implementation Plan, 2019).

Time and cost overruns in construction projects have adverse effects on the parties concerned, viz. clients, consultants and contractors, if they are not adequately controlled. They lead to “conflict, adversarial relationships, litigations, distrust and apprehension among the parties” (Desai & Bhatt, 2013:762). Furthermore, construction delays and cost overruns in the local government sector in South Africa contribute to high expenses of fruitless and wasteful nature. This loss of conditional infrastructure development grants derails the government’s infrastructure delivery programme aimed at stimulating inclusive local economic growth to address challenges of poverty and the income inequality gap (NDP, 2012). MMM incurred R25 866 875 expenditure of fruitless and wasteful nature and lost R459 078 487 of the unspent conditional infrastructure grant to the national fiscal during the 2018/19 financial year (AGSA, 2019 & Mangaung Metropolitan Municipality Annual Financial Statements for the year ended 30 June 2019).

Over the same period, the Free State Province's official unemployment rate rose to 34.4% compared to the national unemployment rate of 29%; and MMM, being the provincial capital of the Free State, was the most significant contributor to this unemployment rate (Stats SA Quarterly Labour Force Survey, Quarter 2: 2019). The Free State unemployment rate worsened to 38.4% at the end of the first quarter in 2020 (Stats SA, 2020).

A replete of studies on time and cost overruns in infrastructure projects exist across the globe. However, it is evident from the literature reviewed that the studies conducted in the South African local government sector are scant. Therefore, it is necessary to identify factors and possible solutions to problems of time and cost overruns in construction road projects in a metropolitan municipality of the Free State Province. As mentioned earlier, the failure to address time and cost overruns in the local government sector has the potential to stymie RSA government efforts to stimulate economic growth and, hence, undermine the efforts to address the triple challenge of eradicating poverty, unemployment and income inequality.

1.3 RESEARCH OBJECTIVES

This section discusses the research objectives and the related questions that need to be answered in addressing the study objectives.

1.3.1 Primary research objective

The primary research objective of this study is to assess the key factors affecting time and cost overruns in road construction projects to facilitate the formulation of comprehensive mechanisms to improve the performance of road projects in a metropolitan municipality of the Free State Province.

1.3.2 Secondary research objectives

The secondary objectives of this study are to:

i. Identify key factors in the literature that contribute to the problem of time and cost overruns in the implementation of construction projects worldwide;
ii. Identify the measures proposed in the literature to reduce time and cost overruns of construction projects across the world;
iii. Empirically rank the identified factors contributing to time and cost overruns in road construction projects in a metropolitan municipality of the Free State Province;
iv. Identify, through literature, theories embedded in the factors affecting time and cost overruns in road construction projects of a metropolitan municipality in the Free State Province;
v. Empirically identify the most prevalent factors among the respondent groups regarding the causes of time and cost overruns in road construction projects in a metropolitan municipality of the Free State Province; and
vi. Formulate recommendations based on literature and empirical study to improve project time and cost performance in a metropolitan municipality of the Free State Province.

1.3.3 Research questions

The researcher framed the following questions to fulfil the study objectives:

i. What are the main factors identified in the literature that affect time and cost overruns in the implementation of infrastructure projects worldwide?
ii. What solutions are proposed in the literature to reduce time and cost overruns of construction projects across the world?
iii. Which factors that affect time and cost overruns as identified in the literature are applicable to road projects in a metropolitan municipality of the Free State Province?
iv. What are the theories embedded in the identified factors that affect time and cost overruns in road construction projects in a metropolitan municipality of the Free State Province?
v. What are the most prevalent factors amongst the respondent groups that influence time and cost overruns in road projects in a metropolitan municipality of the Free State Province?
vi. How best can project time and cost performance be improved in a metropolitan municipality of the Free State Province?

1.4 RESEARCH METHODOLOGY

The research methodology section of the report discusses the study paradigm, a comprehensive framework used for the collection and analysis of the data, and ethical issues related to the research project. The following seven subsections discuss the methods employed in this study.

1.4.1 Research philosophy

The philosophical positions underpinning this study are objectivism and positivism. The researcher believes that the construction industry is highly regulated and standardised, which is a reality that is independent of personnel involved. The researcher further subscribes to the view that observable facts can be proven scientifically. Hence, objectivism and positivism are adopted as ontological and epistemological positions of this study.

1.4.2 Research approach

This study adopted a quantitative approach. Quantifiable data were collected to test the relevance and applicability of the theories found on construction project time and cost overruns in a metropolitan municipality of the Free State Province.

1.4.3 Research design

The study adopted a cross-sectional research design method. Existing literature was reviewed to identify theories on and emerging patterns of time and cost overruns in construction projects. A survey questionnaire was formulated from the literature findings and administered to the participants to collect quantifiable, empirical data for statistical analysis and qualitative data for formulating solutions to address time and cost overruns.

1.4.4 Sampling strategy

Participants were identified from 47 road projects completed between July 2014 and March 2020 using the purposive sampling technique. Participants comprised of a total population of 12 client project managers, 21 consultant representatives and 33 contractor site managers who were directly involved in the 47 road projects chosen for the study.

1.4.5 Data collection methods

A structured, self-administered questionnaire was formulated, reviewed and approved by industry experts and the study supervisor and piloted to five industry practitioners before distribution to the respondents. The web-based questionnaire was distributed to 66 participants by MMM Corporate Services Department via an email that included the web link: https://www.surveymonkey.com/r/BKTGPL6. The questionnaire contained 187 closed-ended questions divided into Section A, Section B and Section C with varying Likert rating scales of 1 to 5 and 1 to 6. It also contained one (1) open-ended question under Section D.

Section A contained four questions that captured the demographic data of participants. Section B had 61 questions related to the factors affecting time and cost overruns. Section C contained 61 questions related to the degree of impact and 61 questions

related to the frequency of occurrence of factors affecting time and cost overruns. Section D had one question that solicited advice from the respondents on ways to manage time and cost overruns in road projects.

The estimated time for the completion of the questionnaire was 35 minutes, and respondents were given four weeks, from 2 July 2020 to 7 August 2020, to return the completed questionnaire. Reminders to complete the questionnaire were sent on a fortnightly basis to the participants.

1.4.6 Data analysis

The quantitative data collected were analysed using the Relative Importance Index (RII), the Importance Index (IMPI), and the weighted RII and IMPI methods to rank the importance of the factors affecting time and cost overruns in the metropolitan municipality. The correlation of the respondent group's views was analysed using Spearman's rank correlation coefficient, and Cronbach's alpha was employed to test the reliability of the questionnaire used for the study.

1.4.7 Ethical considerations

The ethical principles addressed in this study included, inter alia, obtaining permission for the study from both the company and university (permission obtained), getting consent from the participants and industry experts or practitioners (informed consent), giving participants the right to accept or decline to participate in the study (voluntary participation), protection of the participant's information (anonymity and confidentiality), protecting the researcher and participants from any harm resulting from their participation in the study (no harm), tackling power differential, and addressing conflicts of interest.

1.5 DEMARCATION OF STUDY

The study focused on identifying, capturing and ranking critical factors causing time and cost overruns in the implementation of roads using statistical methods. Correlation of perceptions between the relevant role-players, i.e., contractors, consultants and clients, was tested using Spearman's rho. Respondents of the study comprised of the

consultants, contractors and project managers of MMM that were directly involved in the road projects completed between July 2014 and March 2020.

The study was conducted in MMM, which is located in the Free State Province of South Africa. Its boundary is depicted in Figure 1.1. The Metro's jurisdiction covers an area of 9 899 km^2 and contains seven towns, namely: Bloemfontein, which is the judiciary "capital of South Africa and the provincial capital of the Free State Province, Botshabelo, Thaba Nchu, Dewetsdorp, Wepener, Van Stadensrus and Soutpan" (Mangaung Metro, Integrated Development plan 2020/21:21-22). According to the Community Survey of 2016, MMM has a population of 787,930, of which 63% resides in the Bloemfontein area; 24% in Botshabelo; 9% in Thaba Nchu; 1.5% in Dewetsdorp; 1.5% in Wepener; 0.8% in Soutpan and 0.2% in Van Stadensrus (Stats SA, 2016).

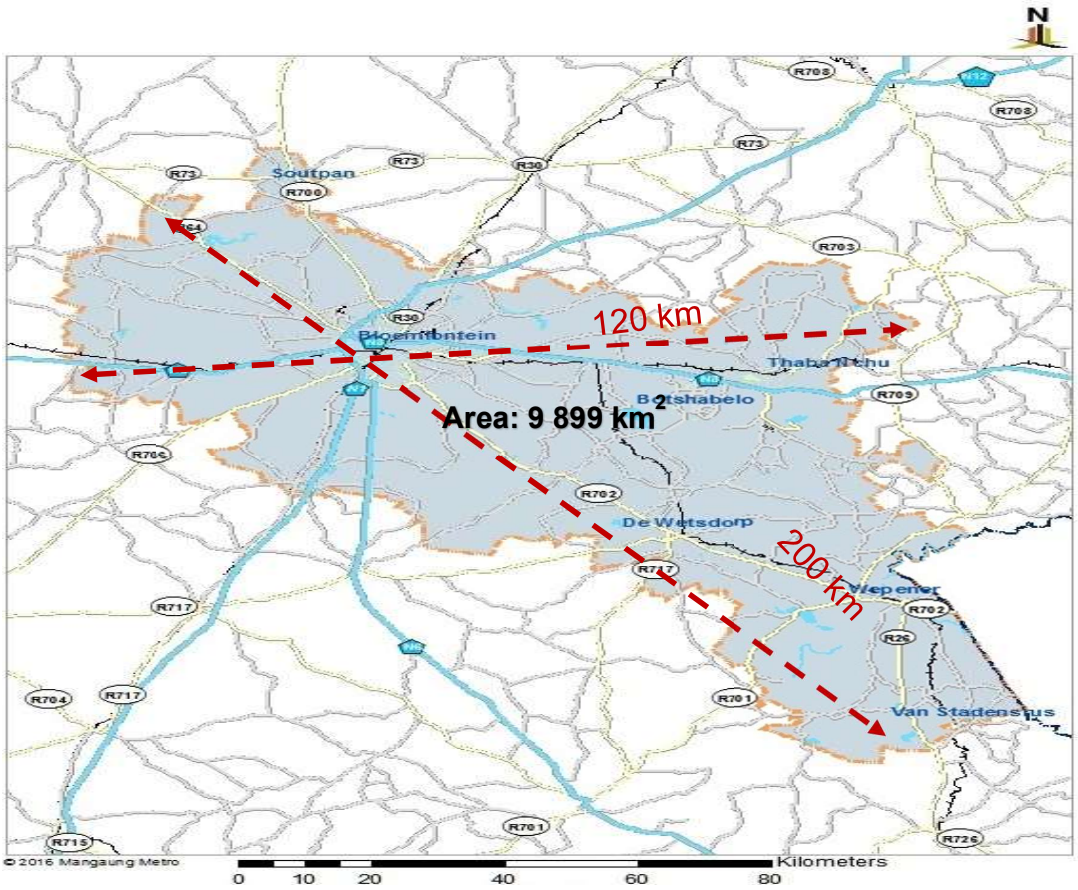

Figure 1.1: Mangaung Metropolitan Municipality spatial reflection (MMM, Integrated Development Plan 2020/21:21)

The field of study for this research is project management. Time and cost indicators are some of the main indicators used in project management to measure project implementation efficiency. A project is considered successful if it is completed within the estimated time and cost. This study assessed and ranked factors affecting time and cost overruns in road projects. Solutions were proposed to mitigate the impact of the factors identified.

1.6 CHAPTER LAYOUT

Chapter 1 demarcates the problem and aim of the study in a particular research area.

Chapter 2 deals with the review of the existing literature on time and cost overruns in infrastructure projects. The review focused on discussing the following: an overview of infrastructure project performance across the world in terms of time and cost indicators, fundamental theories on time and cost overruns in infrastructure projects and how these theories evolved over time, methodologies used in previous similar studies, and existing gaps on the subject.

Chapter 3 describes the research design. The discussion centres around the following: research philosophy, research approaches, rationale of the study method, setting of the study, sampling size, sampling strategy, data collection instruments, data analysis techniques, and ethical considerations.

Chapter 4 presents the collected quantitative data and the analysis thereof.

Chapter 5 discusses the study findings, implications of the findings on the research questions, recommendations of the study, assumptions of the study, limitations of the research, suggestions on the implications of the findings on the subject, and proposed areas for further research based on the findings.

1.7 CONCLUSION

A quantitative study was conducted in MMM. The study focused on identifying and ranking factors affecting time and cost overruns in road projects. Mitigation measures were formulated based on the findings of the study. The study sample was restricted to road projects completed from July 2014 to March 2020 in the metropolitan municipality. Participants included contractors, consultants and client project managers who were directly involved in the completed projects.

CHAPTER 2. LITERATURE REVIEW

2.1 CHAPTER INTRODUCTION

Chapter 2 examines the literature on the theories and factors affecting time and cost overruns in construction projects to evaluate their relevance and applicability to a metropolitan municipality environment in the Free State province.

The chapter addresses secondary research objectives (i), (ii) and (iv), which are to:

- Identify key factors in the literature that contribute to the problem of time and cost overruns in the implementation of construction projects worldwide;
- Identify the measures proposed in the literature to reduce time and cost overruns of construction projects across the world; and
- Identify, through literature, theories embedded in the factors affecting time and cost overruns in road construction projects of a metropolitan municipality in the Free State Province.

The chapter partially addresses the secondary research objective (vi) by discussing plausible solutions for improving project time and cost performances in the metropolitan municipality as found in the literature.

The chapter also discusses various research methodologies employed in previous similar studies, which forms the basis of Chapter 3 (Research Methodology) of this study. It concludes with a discussion of the research gaps on the subject matter identified.

2.2 PROJECT DESCRIPTION, PHASES AND PERFORMANCE MEASUREMENT

2.2.1 Project description

A wide variety of definitions of a project are found in the literature. It is unsurprising; “project” is a multidisciplinary word, and definitions align with their respective disciplines. This section quotes some of the definitions found in the literature.

The PMBOK® (2017: 4) defines a project as a "temporary endeavour undertaken to create a unique product, service or result". Furthermore, it is stated that a project is undertaken to fulfil objectives by producing deliverables or milestones. Conversely, Kisavi (2019:10) describes a road construction project as an "undertaking of building roads by the use of materials and machine to make the ground firm and easily passable by motorists and *oth*er road users".

Instead of defining a project, some scholars opt to describe a project in terms of its characteristics. For example, Nicholas and Steyn (2008:22) identify seven key characteristics of a project as follows:

- "having a single, definable goal or purpose and well-defined end-items or deliverables, usually specified in terms of the iron triangle (cost, time and quality);
- being unique, every project requires something completely different from the other;
- being somewhat or largely unfamiliar and risky;
- utilising skills and talents from different professions and organisations;
- being a temporary activity, requires ad hoc organisation of the resources to achieve a specific goal, and once the goal is achieved, the ad hoc organisation is disbanded;
- having something at stake for the organisation; and
- being the process of working toward a goal. It contains several distinct stage gates in the process of achieving a goal".

2.2.2 Project phases

A project is usually broken down into distinct manageable milestones during its execution. These milestones are often referred to as phases or stage gates. The PMBOK® (2017: 18) defines a project phase as a "collection of logically related activities that culminates in the completion of one or more deliverables".

Broadly speaking, a project consists of four phases, namely initiation, planning, execution and closure (Chileshe & Berko, 2010). Nevertheless, the Engineering Council of South Africa (ECSA) divides engineering projects into the following seven stages, namely, "Feasibility; Inception; Concept and Viability (also termed Preliminary Design); Design Development (also termed Detail Design); Documentation and Procurement; Contract Administration and Inspection, and Close-out" (ECSA, 2015: 9-14). Similarly,

the National Treasury developed a seven-stage framework for infrastructure delivery and procurement management (FIDPM) for the public sector. The framework ensures uniformity in infrastructure delivery across all organs of the state (National Treasury, 2019). The seven stages identified by National Treasury are initiation, concept, design development, design documentation, works, handover, and close-out (ibid).

An in-depth discussion on the deliverables or outcomes of the ECSA and National Treasury stage gates of a project is presented in the following seven paragraphs.

2.2.2.1 Stage 0: Feasibility stage

According to ECSA, this stage entails the following deliverables: “Collation of information; Reporting on options and technical and financial feasibility and related implications; List of consents and approvals; and Schedule of required surveys, test, analyses, site and other investigations” (ECSA, 2015:9).

2.2.2.2 Stage 1: Inception stage

The deliverables of this stage in terms of the ECSA gazette encompass:

> Agreed services and scope of work; Signed agreement; Report on project, site and functional requirements; Schedule of required surveys, tests, analyses, site and other investigations; and Schedule of consent and approvals and related lead times (ECSA, 2015:10).

Stage one is called the initiation stage in the National Treasury FIDPM document. The deliverable of this stage is the initiation report or pre-feasibility report. The initiation report defines the project objectives, needs, acceptance criteria, organisation’s priorities and aspirations, and procurement strategies (National Treasury, 2019). The pre-feasibility report is “required for mega projects to determine whether or not to proceed to the feasibility stage” (ibid:12).

The outcomes of the FIDPM document for stage one are comparable to the outcomes of stages zero and one of the ECSA gazette.

2.2.2.3 Stage 2: Concept and viability stage (preliminary design stage)

“Concept design; Schedule of required surveys, tests and other investigations and related reports; Process design; Preliminary design; and Cost estimates as required” are the deliverables of this stage as per ECSA guidelines (ECSA, 2015:11).

Likewise, the deliverables for this stage in terms of the FIDPM document is the concept report or feasibility report for mega projects. The information contained in the concept report encompasses, amongst others:

- Initial design criteria, cost plan, design options and the selection of the preferred design option, or the methods and procedures required to maintain the condition of infrastructure for the project;
- Detailed brief, scope, scale, form and cost plan for the project, including, where necessary, the obtaining of site studies and construction and specialist advice;
- An indication of a schedule for documentation and construction or maintenance services, associated with the project;
- The site development plan, or other suitable schematic layouts of the works;
- Statutory permissions, funding approvals and utility approvals required to proceed with the works associated with the project;
- Baseline risk assessment for the project, and a health and safety plan, which is a requirement of the Construction Regulations, issued in terms of the Occupational Health and Safety Act; and
- Risk report linked to the need for further surveys, tests, other investigations and consents and approvals, if any, during subsequent stages and identified health, safety and environmental risk (National Treasury, 2019).

On the other hand, the feasibility report covers the following:

- Details regarding the preparatory work covering needs and demand analysis with output specifications, and options analysis;
- Viability evaluation covering financial analysis and economic analysis, if necessary;
- Risk assessment and sensitivity analysis;

- A professional analysis covering technology options assessment, environmental impact assessment, and regulatory due diligence; and
- Implementation readiness assessment covering institutional capacity, and procurement plan (National Treasury, 2019).

2.2.2.4 Stage 3: Design development stage (detailed design stage)

The outcomes of this stage encompass: “Design development drawings; Outline specifications; Local and other authority submission drawings and reports; and Detailed estimates of construction costs” (ECSA, 2015:15).

Similarly, to the ECSA outcomes for this stage, the FIDPM deliverable for this stage is the design development report. The design development report covers inter alia:

- The approved concept for the finalisation the design and definition criteria;
- The detailed form, character, function and costings;
- All components in terms of overall size, typical detail, performance and outline specification:
- The description on how infrastructure or elements or components thereof are to function, how they are to be safely constructed, how they are to be maintained and how they are to be commissioned; and
- Confirmation that the project scope will be completed within the budget or propose a revision to the budget (National Treasury, 2019).

2.2.2.5 Stage 4: Documentation and procurement

“Specifications; Services co-ordination; Working drawings; Budget construction cost; Tender documentation; Tender recommendations; and Priced contract documentation” are the deliverables of this stage as per ECSA guidelines (ECSA, 2015:15). Likewise, the deliverable in terms of the FIDPM document for this stage is the design documentation report, which covers:

- The production information that details performance definition, specification, sizing and positioning of all systems and components that would enable construction; and

- The manufacturing, fabrication and construction information for specific components of the work informed by the production information (National Treasury, 2019).

2.2.2.6 Stage 5: Contract administration and inspection stage

The deliverables for this stage encompass:

> Schedules of predicted cash flow; Construction documentation; Drawings register; Estimates for proposed variations; Contract instructions; Financial control reports; Valuations for payment certificates; Progressive and draft final account(s); Practical completion and defects list; and All statutory certification and certificates of compliance as required by the Local and other Statutory Authorities. (ECSA, 2015:16-17).

The above ECSA outcomes are comparable to the combined stages five and six of the FIDPM document. According to the National Treasury FIDPM document, the deliverables for stage five (works) and stage six (handover) are:

- The certification of the completed works or goods and associated services in accordance with the provisions of the contract;
- The finalisation and assembling of record information which accurately reflects the infrastructure that is acquired, rehabilitated, refurbished or maintained;
- The handing over the works and record information to the user organisation and if necessary, the training end-user staff in the operation of the works (National Treasury, 2019).

2.2.2.7 Stage 6: Close-out

According to the ECSA guidelines, this stage marks the last phase of an engineering project, and its deliverables encompass the following: “Valuations for payment certificates; Works and final completion lists; Operations and maintenance manuals, guarantees and warranties; As-built drawings and documentation; and Final accounts” (ECSA, 2015:17).

Similarly, to the ECSA gazette, the close-out stage is the last phase of an infrastructure project in terms of the FIDPM. However, according to the FIDPM document, the close-out phase falls under stage number seven, not six as per the ECSA gazette. The deliverables of the close-out stage in terms of the FIDPM are:

- The archiving of record information;
- Issuing of defects certificates and certificates of final completion in terms of the contract;
- Preparation and certification of the final amount due to the contractor in terms of the contract; and
- The preparation and approval of the close-out report by the Implementer and the client department, respectively (National Treasury, 2019).

In conclusion, the ECSA gazette and National Treasury FIDPM document deliverables per stage show that engineering project activities are interconnected across the whole value chain of the project. Hence, this study acknowledges that factors causing delays and additional cost at different phases of the project life cycle might have a domino effect that can contribute to overall time and cost overruns.

However, this research is limited to the contract administration and inspection stage of the project, referred to as the construction stage in this study, as acknowledged and justified in Chapter 5.

2.2.3 Project performance measurement

The PMBOK® (2017: 34) holds that project success measures must move away from the traditional project management metrics of "time, cost, scope and quality" and focus on the "consideration towards the achievement of the project objectives". At present, however, time, cost, and quality variables remain the golden triangle of project performance measurement, as is evident from the project success definitions given in the next paragraph.

Kisavi (2019:10) defines project success as an "indication or measure of how well the project is being or has been undertaken to meet its target objectives of attaining quality standards, meeting set budgets and being completed within the specified time". Similarly, Abedi, Faithi and Mohammad (2011:2) state that:

> [a] construction project is commonly acknowledged as successful when the aim of the project is achieved in terms of predetermined objectives that are mainly completed the project on time [sic.], within budget and specified quality in accordance with the specifications and to stakeholder's satisfaction.

This study focused on time and cost performance indicators. These two variables are henceforth the subject of discussion on project performance in this report.

2.2.3.1 Time overruns

Various scholars have provided different definitions of time overruns, sometimes called delays. However, common denominators in all the definitions are the concepts of estimated time and actual completion time. Two such definitions deemed relevant for this study are presented below.

Bansal (2019:13) defines a delay as:

> the time overrun or extension of time to complete the project due to deviation in the construction schedule and by other various factors like unproductivity of manpower and resources, improper project planning and scheduling, and others.

Likewise, Aibinu and Jagboro (2002: 593) define a project delay as a "situation when the contractor and the project owner jointly or severally contribute to the non-completion of the project within the original, or the stipulated or agreed contract period".

As mentioned earlier, for the purpose of this study, time overrun or delay is defined as the period by which the construction programme extends beyond the scheduled completion date agreed in the contract. It can be expressed as: time overrun = actual completion date – contract completion date.

Scholars and practitioners have classified construction delays into four primary groups, namely: critical or non-critical delays, excusable or non-excusable delays, compensable or non-compensable delays, and concurrent or non-concurrent delays (Ravisankar, Kumar & Krishnamoorthy, 2014; Jongo, Tesha, Kasonga, Teyanga & Lyimo, 2019). The classification and apportioned responsibilities for the delays are depicted in Figure 2.1.

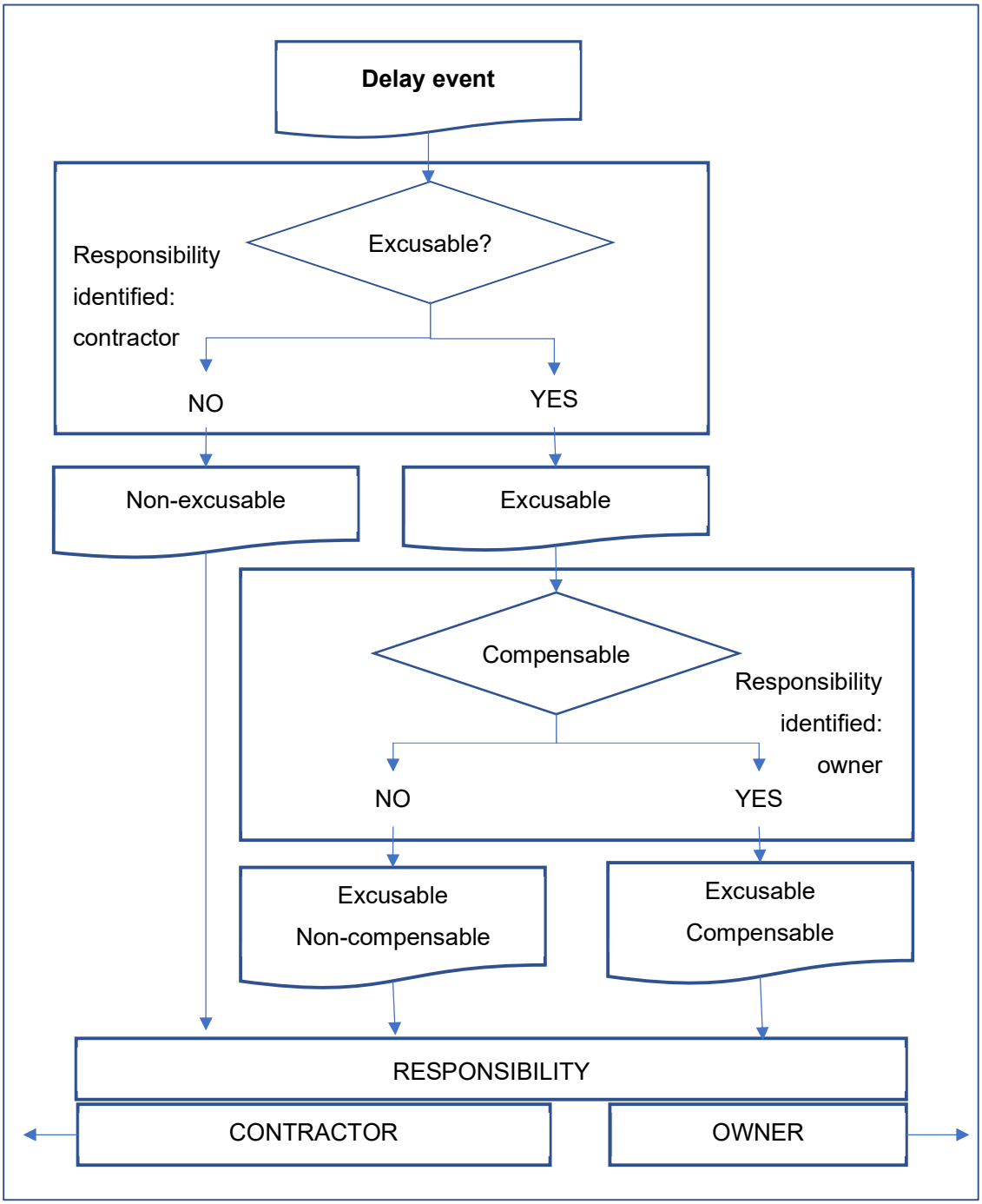

Figure 2.1. Delay classification process (adapted from Kao & Yang, 2009)

A) Critical versus non-critical delays

Critical delays occur in activities on the critical path of the project executor's programme of works and with the inevitable consequence of causing project completion delay or a delay in the milestone date. In contrast, non-critical delays do not have a negative effect on the project schedule until they exhaust their float such

that they affect the project completion or milestone date (Ravisankar et al., 2014; Jongo et al., 2019).

B) Excusable versus non-excusable delays

Excusable delays are beyond the project executor's control (ibid). These delays may include but are not limited to vis major or force majeure (act of God), abnormal conditions, the amount and nature of additional work, and any disruptions that cannot be attributed to the contractor/project executor. Non-excusable delays result through the fault of the contractor or project executor, are within their control, and are foreseeable (ibid).

C) Compensable versus non-compensable delays

Compensable delays are those for which the contractor or project executor is entitled to claim an extension of time and additional compensation (ibid). Excusable delays are normally compensable in construction contracts. Non-compensable delays are those for which the contractor or project executor is not entitled to claim an extension of time or damages, even if the delay is excusable (ibid).

D) Concurrent versus non-concurrent delays

Concurrent delays occur simultaneously, while non-concurrent delays occur at different times (ibid). In the event of concurrent delays, the following remedy is applicable (ibid):

- In the event of excusable and non-excusable delays occurring concurrently, the contractor or project executor will be granted an extension of time;
- The contractor/project executor shall be entitled to an extension of time in case of excusable delays with compensation and excusable delays without compensation occurring simultaneously; and
- In the event of two or more excusable delays with compensation occurring at the same time, the contractor or project executor will be entitled to the extension of time and damages.

The description of different classifications of delays above shows that some delays, such as critical ones, inevitably require an extension of time and that excusable delays with compensation result in the incurring of the additional cost. Consequently, the

extension of time and the additional cost lead to project time and cost overruns, respectively.

2.2.3.2 Cost overruns

As for time overruns, various scholars have provided different definitions of cost overruns. However, the estimated or original cost and the actual or final cost are common denominators in all the definitions. Two such definitions deemed relevant for this study are presented below.

Cost overrun is:

> measured as actual out-turn costs minus estimated costs as a percentage of estimated costs, where; actual costs are defined as real, accounted construction costs determined at the time of project completion; and estimated costs as the budgeted or forecasted construction costs determined at the time of the decision to build. (Cantarelli, Flyvbjerg, Molin & Wee, 2010:4)

In concert, Invernizzi, Locatelli and Brookes (2017) define cost overrun as the "proportion of the difference between actual cost which may be defined as the cost determined at the completion of the project and initial cost which is the original estimated cost".

For this study, cost overrun is defined as the extra cost incurred above the contract price, commonly referred to in the GCC 2015 as the contract sum. Cost overrun can be expressed as follows: cost overrun = actual cost – contract estimated cost.

2.3 OVERVIEW OF THE MAGNITUDE OF TIME AND COST OVERRUNS IN INFRASTRUCTURE PROJECTS

2.3.1 Projects implemented globally

Construction delays and cost overruns are a universal phenomenon (Desai & Bhatt, 2013).

A study conducted by Braeckman, Disselhoff and Kirchherr (2019) on the cost and schedule overruns in 214 large hydropower dams (Africa = 36, Asia = 89, Europe = 19, North America = 11 and South America = 59) concluded that the projects completed before 2000 experienced an average of 46% and 37% cost and time

overruns respectively. Those that were completed after 2000 recorded an average cost overrun of 34% and time overrun of 18%.

A report presented by PricewaterhouseCoopers in April 2013 on the financial performance of six nuclear plants and 47 mega-projects implemented across the globe indicate that the projects had an average cost overrun of 157% and 88%, respectively. One of the major refinery projects in this study was budgeted to cost $4 billion but was completed at the cost of $12 billion, a 200% cost overrun.

In Qatar, an investigation carried out by Senouci, Ismail and Eldin (2016) on the delay and cost overrun in 122 public construction projects comprising roads, buildings and drainage projects completed between 2000 and 2013 concluded that 54% and 72% of the projects overran their budgets and contract periods respectively.

In Jordan, an average cost overrun of 214% and time overrun of 226% were determined by Al-Hazim, Salem and Ahmad (2017) on their investigation of cost and time overruns in 40 public construction projects completed between 2000 and 2008. A similar study conducted by Sweis (2013) in Jordan, concluded that 65% of the projects exceeded their construction schedule and that municipality projects contributed 30% to the overall time overruns.

Saudi Arabia has not been spared from time and cost overruns in construction projects either. An investigation carried out by Assaf and Al-Hejji (2006) on the causes of delays in large construction projects revealed that 70% of the projects surveyed exceeded their contract time by a margin of 10% to 30%.

In Malaysia, Rahman et al. (2012) reported that 92% and 89% of the construction projects surveyed experienced both cost and time overruns of 5% to 10%.

2.3.2 Projects implemented in Africa

Africa, like the rest of the world, face challenges of not finishing construction projects within the approved budget and agreed contract period. Moreover, it is argued in some of the literature that this phenomenon is more prevalent in developing countries. A review of the studies conducted in the African continent and summarised in this section reveals the pervasiveness of time and cost overruns in construction projects implemented in Africa.

The African Development Bank (AFDB) commissioned a study in 2011 to analyse the unit costs and cost overruns in road infrastructure projects completed in 26 African countries. Completed in 2014, it determined that 54% and 33% of projects for the construction or upgrading of paved roads and the rehabilitation of paved roads, respectively, exceeded their initial project cost. In contrast, projects for the periodic maintenance of paved roads and re-gravelling of unpaved roads were both completed within their schedule. The study also found that seven of the projects (Cameroon = 1, Swaziland = 3, Lesotho = 1, Ghana = 1 and Tanzania =1) exceeded their original budget by more than 20%. The study found that small projects were more susceptible to cost overruns compared to large projects.

A study conducted by Kassa (2020) between 2014 and 2018 on federal road and railway construction projects in Ethiopia concluded that the time overrun was 88% for road projects and 100% for railway projects. The cost overrun for road projects was 80% compared to 100% for railway projects.

Secondary data mined and analysed by Ampadu-Asiamah and Ampadu-Asiamah (2013) and Frimpong, Oluwoye and Crawford (2003) on Ghana's completed government-funded public building projects and groundwater projects revealed that 73% of building projects overran their construction programme and 75% of groundwater projects exceeded both their original project schedules and budgets.

The studies above highlight two conclusions: that no type or size of construction project is immune to time and cost overruns and that, similarly to projects outside Africa, the problem of time and cost overruns in construction projects is rife in Africa.

2.3.3 Projects implemented in South Africa

Previous studies focused mainly on identifying factors contributing to time and cost overruns in construction projects in South Africa based on the views of industry role players. Quantification of the magnitude of this phenomenon has not been extensively reported.

One study by Mulenga and Bekker (2015) provided a quantification of the magnitude of cost overruns on a project completed between 2010 and 2015 at the OR Tambo district municipality and funded by the Municipality Infrastructure Grant (MIG).

According to the authors, 93% of the water- and sanitation-related projects completed at the OR Tambo district municipality overran their budget by 5% to 60% and 1% to 46% respectively. The authors argued that cost overruns for MIG-funded projects are widespread across the country's municipalities.

South Africa's famous World Cup 2010 stadia, arguably the largest infrastructure project to be implemented in the country, could not escape time and cost overrun challenges either. Its initial budget of R11.667 billion increased to R16.426 billion on completion of the projects, an additional cost of 41% (Baloyi & Bekker, 2011).

2.4 REVIEW OF THE THEORIES APPLICABLE TO TIME AND COST OVERRUNS IN CONSTRUCTION PROJECTS

This section discusses a theoretical framework for explanations of time and cost overruns in infrastructure projects. From the outset, it is prudent to depart from the premises of providing an understanding of what a theory is. Saunders, Lewis and Thornhill (2012:683) define a theory as a "formulation regarding the cause and effect relationships between two or more variables, which may or may not have been tested". After having defined the theory, the report discusses the theoretical review of the subject.

According to Lucia and Lepsigner (2009), theoretical review process encompasses "identifying a set of statements or principles devised to explain a group of facts or phenomena that has been tested repeatedly or is widely accepted". Cantarelli et al. (2010) assert that a sound understanding of the underlying theories on a phenomenon helps in the formulation of comprehensive appropriate cures. It is therefore important to understand the fundamental theories that support the explanations of time and cost overruns in road projects to develop appropriate solutions to address the significant variables identified in this study.

The literature examined reveals a tangential discourse between scholars Love and Ahiaga-Dagbui (2018) and Flyvbjerg, Ansar, Budzier, Buhl, Cantarelli, Garbuio, Glenting, Holm, Lovallo, Lunn, Molin, Rønnest, Stewart and Wee (2018) on the root causes of cost and time overruns in road construction projects. The former argues that the root causes of cost and time overruns in projects are genuine errors stemming from scope changes, complexity and other factors. Their evolutionist theory, as it is termed,

proposes alternative procurement methods as a solution to solving cost and time problems. However, the latter group postulates that scope changes, complexity and such factors are manifestations of underestimation during planning, emanating from psychological and political bias on the part of the decision-makers. As a solution, they propose a “de-biasing cost estimate using the reference class forecasting or similar methods based on behavioural science to establish reliable, de-biased estimates of cost and time that fit the client’s appetite for risk”.

Flyvbjerg et al. (2018:12) simplify the theory of time and cost overrun as a causality chain: “it starts with human bias, which leads to an underestimation of the scope during planning which leads to unaccounted for scope changes during delivery which leads to overrun”. From the vantage of behavioural science, the mechanisms of scope changes, complexity and mitigation measures are known to planners. However, these are “often underestimated due to overconfidence bias, planning fallacy and strategic misrepresentation”, resulting in the failure to curb time and cost overruns in projects.

Flyvbjerg et al. (2018) rebut the evolutionist theory of Love and Ahiaga-Dagbui (2018) based on the argument that mechanisms of time and cost deviations together with mitigation measures are known to the planners. The theory is flawed as it does not question the accuracy of the initial estimates. The scholars caution that the continual use of errors rather than human bias as the basis for defining the root causes of time and cost overruns will result in continual failure to curb this phenomenon. They argue that the real problem is time and cost underestimation rather than overruns.

Professor Bent Flyvbjerg is a renowned scholar on this subject in the field of project management. His views with that of his colleagues above seem to resonate with many scholars.

Cantarelli et al. (2010) conducted an extensive review of previous studies on the theories underlying time and cost overruns in transportation infrastructure projects. They encapsulated the findings as portrayed in Table 2.1.

Table 2.1: Theories explaining causes of time and cost overruns in infrastructure projects (adapted from Cantarelli et al., 2010:11 & 13)

Explanation	Causes	Embedded theory
Technical	• Forecasting errors including price rises, poor project design, and incompleteness of estimations • Scope changes • Uncertainty • Inappropriate organisational structure • Inadequate decision-making process • Inadequate planning process	• Forecasting • Planning • Decision-making
Economical	• Deliberate underestimation due to: ○ lack of incentives, ○ lack of resources, ○ inefficient use of resources ○ dedicated funding process ○ poor financing/contract management ○ strategic behaviour	• Neoclassical economics • Rational choice
Psychological	• Optimism bias among local officials • The cognitive bias of people • Cautious attitudes towards risk	• Planning fallacy & optimism bias • Prospect • Rational choice
Political	• Deliberate cost underestimation • Manipulation of forecasts • Private information	• Machiavellianism • Agency • Ethical

2.4.1 Forecasting theory

According to Cantarelli et al. (2010:14), forecasting theory studies the "understanding of the forecasting process at large and aims to clarify how and why the various successes and failures come about". The forecasting models are used to "gain a better

understanding of the problems with errors in forecasting techniques or inappropriate forecasting approaches that lead to poor cost estimate and unrealistic schedule".

Morris, Pinto and Söderlund (2013) affirm the assertion of Cantarelli et al. (2010) that cognitive bias is present in human forecasting. They support the use of forecasting models such as Reference Class Forecasting to minimise inaccuracies and biases. The Reference Class Forecasting model employs an external view that uses the real output records of similar projects completed in the past in a specified reference class, providing an objective point of reference for cost estimates (Flyvbjerg, 2006).

2.4.2 Planning theory

Poor planning is one of the root causes of time and cost overruns in projects. Cantarelli et al. (2010:14) postulate that "inappropriate planning process, poor design and implementation of projects" can lead to the poor performance of construction projects.

2.4.3 Decision-making theory

Decision-making theory "considers government and politics as a series of decisions taken by people and institutions that make rational decisions in light of their interests and circumstances under which they operate". "[I]nappropriate institutional arrangements" may cause time and cost overruns in projects (Cantarelli et al., 2010: 14).

2.4.4 Neoclassical economic theory

Neoclassical economic theory provides a framework for "understanding the allocation of scarce resources among alternatives" (Cantarelli et al., 2010: 14). According to the theory, incentives and cost play an important role in the decision-making process.

Cantarelli et al. (2010:15) argue that the notion of incentives and cost is intertwined with cost overruns. "[D]edicated funding causes little incentives to produce accurate figures because accurate figures decrease the chance of receiving part of the funding". They also argue that neoclassical economics can also be used to explain the tendency to misrepresent the information deliberately.

2.4.5 Rational choice theory

Rational choice theory assumes that “actions of individuals are fundamentally rational and people calculate the costs and benefits of an action, recognising their preference functions and constraints facing them before taking a decision”. It underlies the explanation that it is “economically rational to underestimate costs because it will increase the likelihood of revenue and profit” (Cantarelli et al. (2010:15).

2.4.6 Planning fallacy and optimism bias theory

Optimism bias theory is the “cognitive disposition to evaluate future events in a fairer light than they might be in reality” (Friedman, 2017:35). Cantarelli et al. (2010:15) opine that the “cognitive biases of forecasters such as scenario thinking, anchoring estimates and extrapolation of current trends result in a tendency to be overly optimistic”, consequently causing time and cost overruns in projects.

Planning fallacy is the “tendency to underestimate the time, costs, and risks of future actions and at the same time overestimate the benefits of the same actions” (Cantarelli et al., 2010). Morris et al. (2013) provide a similar explanation of planning fallacy: “managers make decisions based on delusional optimism rather than on rational weighting gains, losses and probabilities”.

Cantarelli et al. (2010) contend that the link between optimism bias and cost overrun is much stronger than the link between planning fallacy and cost overrun. Hence, they prefer optimism bias as a psychological explanation for time and cost overruns. However, planning fallacy cannot be dismissed. A study conducted by Love, Ika and Sing (2019) on infrastructure projects worth US$6.5 billion in Hong Kong concluded that 57% of the cost overruns experienced in these projects could be attributed to planning fallacy.

2.4.7 Prospect theory

Prospect theory epitomises the process of “making decisions based on likely gains and loss rather than the actual outcome of the decision” (Ahiaga-Dagbui & Smith, 2014:16). The theory provides a “comprehensive model for psychological explanations incorporating uncertainty and risks in addition to optimistic forecasts” (Cantarelli et al., 2010:15).

2.4.8 Machiavellianism theory

Machiavellianism theory refers to strategic misrepresentation where:

> promoters, politicians, planners and project champions deliberately and strategically overestimate the benefits and underestimate the costs of the project in order to increase the likelihood that their project, and not their competitors gain approval and funding. (Flyvbjerg, Garbuio & Lovallo, 2009:6)

This concept is often used to explain cost overruns emanating from “competition among parties for government funding or to get projects going” (Cantarelli et al., 2010:16).

In South Africa, the contraction of the economy in recent years has put more pricing pressure on construction service providers, prompting them to give an unrealistic discount. This practice results in the abandonment of the project and/or replacement of service providers at the cost of time and budget. This conduct is prevalent in the public sector, hence the applicability of the Machiavellianism theory in this study.

2.4.9 Agency theory

The principal-agent theory assumes that “people act unreservedly in their own narrowly defined self-interest with, if necessary, guile and deceit” (Cantarelli et al., 2010:16). The theory can be employed “in the context of possible institutional set-ups between parties to guide the decision-making on projects”. Furthermore, agents can “take strategic advantage of the asymmetric information to set-up the funding process to deliberately under-budget their projects in order to see them realised”.

2.4.10 Ethical theory

Ethical theory studies the behaviour of people and groups, focusing mainly on their values, customs and responsibility. The application of this theory in explaining cost overrun is that “costs are underestimated because of a lack of loyalty or responsibility to the agent or to a lack of values in a forecaster’s mind to produce accurate figures” (Cantarelli et al., 2010:16).

2.5 EMPIRICAL STUDIES ON FACTORS AFFECTING TIME AND COST OVERRUNS IN CONSTRUCTION PROJECTS

2.5.1 Projects implemented globally

A comprehensive review of seven scholarly studies conducted in Malaysia by Ullah, Abdullah, Nagapan, Sohu and Khan (2017) on the causes of construction time and cost overruns yielded 38 causative factors. These causes were categorised into contractor's causes, consultant's causes, client's causes and others' or external causes, as depicted in Table 2.2.

Table 2.2: Summary of causes of construction time and cost overruns in Malaysia (Ullah et al., 2017:3 & 5)

Main category	**Causes/factors**
Contractor	Inappropriate planning; improper project management; lack of contractor experience; financial difficulties faced by contractors; relationship between management & labour; incorrect scheduling by contractors; errors during construction; extension of time; incompetent subcontractors; unsuitable construction equipment; improper construction methods; and poor financial control on site.
Consultant	Poor contract management; mistake in design; underestimate project duration; slowdown in design preparation; delay in approval of design changes; lack of cost plan/monitoring; inadequate project preparations; lack of co-ordination at the design phase; incomplete design at tendering stage; and lack consultant team's experience.
Client	Financial problems faced by the owner; practice of assigning a contract to the lowest bidder; lack of communication with a consultant; changes in client requirements; delay in payment; and re-measurement of the provisional sum.
Others/external	The high cost of machinery; fluctuation in the price of raw materials; unforeseen site conditions; shortage of site workers; delay in material procurement; unpredictable weather conditions; poor labour productivity; unskilled labour; equipment failure; and labour Absenteeism.

Similar findings were made in Saudi-Arabia. An investigation conducted by Alsuliman (2019:6) on the "causes of delays in public construction projects" determined twenty main causes of construction delays to be:

> focus on financial analysis and awarding the lowest bidder; awarding contractors projects beyond their financial and technical potential; selection of contractors who have other faltering projects; ministries are not interested in the development of the engineering sector; government entities are late in giving financial rights to contractors; weakness of the financial and technical capabilities of some contractors; government entities do not withdraw the delayed projects from the faltering contractor; weak technical analysis of the competitors; lack of interest in timetables and updating them constantly; expanding the use of subcontractors who are not qualified; poor salaries and financial incentives for engineers lead to a lack of interest in study and supervision; variations in orders occur during the project period; lack of accuracy in the studying of quantities, specifications, and drawings; the weakness of coordination between service providers that is related to project sites and project works; the weakness of experience of some engineers in studies and supervision; the use of non-qualified consultant offices; the weakness of training and development of engineers and engineering departments; weak efficiency and experience of the Technical Supervision Department of the government entity; weak information bases at ministries and companies on infrastructure; and lack of planning by government entities.

In Singapore, Ayudhya (2011) formulated questionnaires with 35 factors causing construction project delays pre-identified based on a literature review. The questionnaire was administered to 74 industry practitioners encompassing owners, consultants and contractors. The study concluded that:

> progress payment by the owner, adverse weather conditions, main contractor financial problems, evaluation of completed works, and the act of God were the main factors causing severe delays in building construction projects. (Ibid:1027)

Ahbab, Daneshvar and Çelik (2019: 8942-8944) identified 66 variables causing time and cost overruns in large road projects in Cyprus through literature review. From the 66 variables, the authors ranked the top twenty and top ten factors causing time and cost overruns. The top twenty factors causing time overrun were:

> long-period between the time of bidding and contract award; delay in mobilization by the contractor; severe weather problems (heat, cold, snow, rain, cyclone); poor procurement procedure; design changes; poor performance of contractor; slowness of the owner's decision-making process; increase in quantity of work (additional works); poor project management, construction management and supervision; increase or change in scope of the project; delay in land acquisition; slow or delayed material or equipment delivery to project site; inaccurate initial project scope and cost estimate; delay in the appointment of consultant; delay in approval of feasibility study, drawings and material; complicated administrative and governmental procedures (institutional problems); financial difficulties of owner/client; political issues-changes; poor and unforeseen site conditions (location, ground, geological, events, security, etc.); and unavailability or shortage of required materials in the local market on time.

The top ten factors causing cost overrun were:

> fluctuation and escalation in prices; change in the exchange rate; underestimated and inaccurate appraisal; increase or change in scope of the project; increase in the amount of land acquisition, price, and compensation; design changes; inaccurate initial project scope and cost estimate; increase in the quantity of work (additional works); poor and unforeseen site conditions (location, ground, geological, events, security); additional project management, consultancy and administration costs.

A PwC report from April 2013 identified the main contributors to cost overruns in construction projects to be:

> ineffective project governance, management and oversight, unanticipated site conditions, late design/poor project definition, inadequate communications and slow decision making, weak/ambiguous contract terms and lack of incentives to control costs, ineffective decision-making process, poor risk identification, management and response strategy, imposed cash constraints and delayed payment, skilled labour availability, inexperienced management team, design errors and omissions leading to scope growth and/or re-work, poor project controls (cost & schedule) and insufficient planning and inaccurate estimating.

This conclusion was reached based on a comprehensive analysis of the performance of 975 light and heavy industrial projects in the company's database.

2.5.2 Projects implemented in Africa

A striking similarity of factors affecting time and cost overruns on the African continent and those outside the continent can be observed from the examined studies. Seboru (2015:151) investigated the factors causing delays in road construction projects in Kenya and found that the major causes of delays were "payment by the client, slow decision making and bureaucracy in the client organisation, inadequate planning and scheduling, and rain" (Ibid:151). A similar study conducted in Ethiopia by Kassa (2020:102) concluded that the top five causes of delays in the road and railway projects were "incomplete study before project approval, poor project management and coordination, the right of way issues, inaccurate forecasting of schedule, psychological biases and political interests"; whereas the key factors contributing to cost overruns were "inflation of material cost; the scope change with the change order; incomplete study project approval; poor bill of quantity and design, and poor project performance monitoring".

In Uganda, Alinaitwe, Apolot and Tindiwensi (2013) identified 22 factors causing time and cost overruns in public sector construction projects. They ranked the factors

according to their frequency, severity and importance indexes. The top five ranked factors were: “changes to the scope of work, delayed payments, poor monitoring and control, the high cost of capital, and political insecurity and instability” (Alinaitwe et al., 2013:33).

Jongo et al. (2019:81) studied the mitigation measures of dealing with delays and cost overruns in public building projects in Dar-Es-Salaam, Tanzania. They concluded that the most efficient delay and cost reduction measures in public building projects were:

> Effective project planning and scheduling; design change should be controlled; effective coordination and communication between parties; client, promptly paying the parties progressively; having accurate cost estimates; appoint competent site and project manager; comprehensive contract administration; ensuring prompt resolution in design change queries, issues and authorisation report; the efficient and effective planning schedule for material procurement delivery process; developing effective strategic planning for solving identified risks; and ensuring on the timely availability of finance.

2.5.3 Projects implemented in South Africa

Mukuka, Aigbavboa, Welling and Thwala (2015) investigated the effects of schedule overruns for construction projects in Gauteng Province, South Africa. Their study revealed that:

> extension of time, cost overruns, loss of profit, disputes, poor quality of work due to hurrying the project, creates stress to the client, acceleration losses, bad reputation with contraction team, claims and delay in getting profit by the client were the major effects of construction projects schedule overruns in Gauteng, South Africa. (ibid:1690)

In another study, increases in the material cost and design-related factors were determined to be the main contributors of time and cost overruns in South Africa’ 2010 FIFA World Cup stadia (Baloyi & Bekker, 2011).

Mulalo et al. (2019:1263) pointed out that the major factors affecting project cost overruns at the Johannesburg metropolis, South Africa, were:

> poor planning, fluctuation of prices of project materials, high-interest rates by bankers, inflationary pressure, cost of labour, poor coordination between agents of construction, on-site poor financial management and inadequate local production of raw materials.

Likewise, in a similar study conducted in the Gauteng province of South Africa, the core factors influencing the performance of construction projects in Gauteng were found to be:

> cash flow, dispute management (client and professionals), leadership skills of the project manager, speedy and reliability of service to the client, dispute management (labour and supervisor), learning from best practice and experience of others, review of failures and solving them and availability of personnel with high experience and qualification. (Sibiya, Aigbavboa & Thwala, 2015:222)

The CIDB Construction Industry Indicators Summary Results of 2015 affirms that contractors experience cash flow challenges. It states that 60% of their payment certificates were paid after the 30 days stipulated by the government of RSA.

2.6 OVERVIEW OF THE METHODOLOGIES USED IN PREVIOUS STUDIES

2.6.1 Research approaches

Studies employ one of three research approaches: quantitative, qualitative or mixed (Creswell, 2003). This literature review took note of which approach was used in the studies examined.

A mixed research method, i.e. a combination of quantitative and qualitative research methods, was employed for the assessment of factors causing time and cost overrun in construction projects in Malaysia, Ethiopia, Tanzania and South Africa, and for the formulation of mitigation measures to improve project time and cost project performances (Rahman et al., 2012; Kassa, 2020; Jongo et al., 2019; Mulalo et al., 2019). The scholars identified potential factors contributing to time and cost overruns in construction projects through literature reviews and employed a combination of structured questionnaires to collect quantitative data and semi-structured interviews to collect qualitative data. Their questionnaires contained close-ended and open-ended questions. The structured questionnaire used a 5-point Likert scale. Focus group interviews were used to collect qualitative data on mitigation measures against delays and cost overrun.

Other studies only employed the quantitative method. Motlhatlhedi and Nel (2019) used the quantitative method in their investigation of project delay in construction projects in the South African rail industry. Similarly, Adugna (2015), Mashwama, Mushatu and Aigbavboa (2018), as well as Sibiya et al. (2015) employed the quantitative method in their studies on the causes of time and cost overruns in construction projects at the eThekwini Municipal Area, Gauteng Province and South Africa, respectively.

2.6.2 Research design

Jongo et al. (2019:86) posited that:

> [case studies] bring an understanding of a complex issue or object, and extend experience or add strength to what is already known through previous research, and it emphasises detailed contextual analysis of a limited number of events or conditions and their relationships.

Hence, the authors employed this method in their study of mitigation measures in dealing with delays and cost overrun in public building projects in Dar-Es-Salaam, Tanzania. Likewise, Anish, Kiruthiga and Vinoth (2019:901) conducted a case study to explore the causes of time delay and cost overrun in road construction.

Conversely, Sibiya et al. (2015), Mashwama et al. (2018), Seboru (2015), Shimete and Wall (2016), Ayudhya (2011), Mukuka et al. (2015), Mulenga and Bekker (2015), and Kamanga and Steyn (2013) employed cross-sectional design methods in their studies of time and cost overruns in construction projects.

2.6.3 Sampling strategy

Kikwasi (2012) employed mixed sampling techniques (purposive and random) to select participants to study the causes and effects of delays and disruptions in construction projects in Tanzania. The data were collected through questionnaires and interviews.

Shimete and Wall (2016) used the convenient sampling strategy for their investigation of the factors that contributed to time and cost overruns in road construction projects in Namibia between 2008 to 2013. Convenience and high return rate were the reasons advanced by the researchers for adopting the strategy. Mulalo et al. (2019:1263) adopted the same strategy in their study, titled “Project Cost Overrun in the South African Construction Sector: A Case Study of Johannesburg Metropolis”.

Kassa (2020) preferred the purposive sampling technique to explore delays and cost escalations of road construction projects in Ethiopia. The researcher opined that:

> Purposive sampling was a useful method that allows a researcher to get information from a sample of the population that one thinks knows most about the subject matter of the road and railway construction projects delay and cost escalation problems. (ibid:113)

The random sampling method was employed by Sibiya et al. (2015) to select participants in their study that assessed the performance of construction projects in South Africa.

2.6.4 Data analysis methods

Various scholars employed different analysis methods on previous similar studies. Some of these methods are discussed in this section.

Desai and Bhatt (2013) ranked 59 factors causing delays in residential construction projects in India using RII and IMPI methods. Other studies also analysed their quantitative data collected through structured questionnaire surveys using the RII and Spearman's rank (Seboru, 2015; Kassa, 2020; Anish et al., 2019) as well as the IMPI (Prasad, Vasugi, Venkatesan & Bhat, 2018; Alinaitwe et al., 2013; Frimpong et al., 2003).

Another method used to rank variables contributing to time and cost overruns in construction projects is the mean item score. It was used by scholars such as Mulalo et al. (2019) and Mukuka et al. (2015).

Lastly, Kassa (2020), and Shimete and Wall (2016) used Cronbach's alpha to test the reliability of the survey instrument used for their study.

2.7 OVERVIEW OF PROPOSED SOLUTIONS TO ADDRESS TIME AND COST OVERRUNS IN CONSTRUCTION PROJECTS

Literature abounds with proposals of measures to address the challenges of time and cost overruns in construction projects. The examined solutions address both the causes (manifests that are visible) and the root causes (underlying theories) as argued by Flyvbjerg et al. (2018).

Jongo et al. (2019:85-86) identified 57 mitigation measures proposed by various scholars and practitioners to address various causes of time and cost overruns in construction projects. These measures summarised are:

> accurate cost estimation; allocate adequate contingency allowances; adopt clear information and communication channel; adopt effective and efficient material procurement system; allocate sufficient time and finance (money); application of professional construction management; appointment of competent site manager;

> appropriate scope definition; approval projects from relevant parties; choose experienced subcontractor with a good reputation; close monitoring; competent architectural and engineering designs; competent project manager; comprehensive contract administration; conducting a process mapping exercise; contractors should improve their project management skills and articulate their resources; control the design change; design changes should be adequately highlighted and updated on all relevant project documentation; designing the project to great detail at the onset whenever possible; develop a strategy for solving identified risk; developing project programme based on experienced planners; development of comprehensive financial plan and cash flow; development of cost monitoring and periodic reporting of critical and long lead items; developing good monitoring and controlling system; develops realistic planning and scheduling for the project; effective coordination between parties involved; effective financial management and control; effective planning and scheduling; enough number of labour; ensure there adequate time to complete the work; ensure design changes are reasonable [sic.] timed when possible; ensuring prompt resolution to design change quarries, issues and authorization; ensuring the time and cost implication of design change are always determined and agreed; having a design manager to responsible for the design changes; having enough resources to deal with the complexity; hire competent labour; incentive schemes; making the risk register is a live document that is updated regularly; must ensure the timely availability of required finance; advance thought on permission from law enforcement agencies to beef up on site security; plan a time schedule for delivery process; producing design document at time; progress payment of subcontractor/suppliers must be made on time; promote open communication; promote team building communication process; prompt progress payment from clients; proper motivation and safety system; provide training to unskilled workers based on the scope of work; quick design approval; quickly informed relevant parties when unforeseen circumstances affect the programme/ lead-in time; reliable contractor; safety and health programme; select experienced and cable subcontractor; selecting a consultant who has sufficient experiences in similar nature of works and has good reputation; team work between the client (owner) and architects in completing the design drawings before project estimate are prepared or the contract is awarded; subcontractor with enough experience and capability in dealing with the project complexity; and efficient management of site and supervision of the project.

A report compiled by PwC in April 2013 proposes, among others, the following plausible corrective measures to get projects back on course are:

> taking a time-out to regroup; seeking outside help; balancing cost, quality, and time; layering in transparency and accountability; building penalties into the process; seeking experienced project managers; maintaining a comprehensive audit trail. (PwC 2013:11-13)

2.8 DISCUSSION OF LITERATURE FINDINGS AND GAPS IDENTIFIED

The literature examined is replete with studies on the subject matter across the globe, but not many studies have been done in a South African context, more particularly in a local government environment.

The findings from previous studies reveal a wide range of different opinions on the main causes of time and cost overruns in construction projects. These opinions differ

at the project and geographical level. Building on previous research and gaps identified, this study aims at providing an understanding of various factors affecting time and cost overruns in construction projects in a metropolitan municipality environment in South Africa using RII, IMPI, and weighted RII and IMPI statistical methods.

As argued by Cantarelli et al. (2010), a deeper understanding of the theories that underlie a phenomenon helps in the formulation of the appropriate cure. However, previous studies focused more on the symptoms than the root cause. Many previous studies focused on identifying causes (manifests that can be visible) of time and cost overruns and developing preventative and corrective measures based on these manifests. Studies that focus on a more in-depth understanding of underlying theories behind time and cost overruns are scant, viewed as a significant gap in the literature.

The interrelationship of different factors causing time and cost overruns in construction projects has not been studied extensively. It has the potential to limit the formulation of comprehensive solutions to improve project efficiencies. It is one of the major gaps in the subject that need further research.

Desai and Bhatt (2013) stratified the data they collected using the RII and IMPI methods and determined that the two methods yielded different results. This finding has not been validated by other studies. It was, therefore, also identified as one of the gaps in the literature.

2.9 CHAPTER SUMMARY

This chapter discussed the factors affecting time and cost overruns in construction projects, and the theories that underlay those factors. The chapter addressed the secondary research objectives (i), (ii) and (iv), and partially addressed secondary research objective (vi).

Table 2.3 summarises the factors affecting time and cost overruns in construction projects as obtained from the examined literature that effectively addresses the secondary research objective (i).

Table 2.3 Factors affecting time and cost overruns in construction projects

Main group	Factors/causes
Client related	Lack of project funding; delays in progress payments; client interference; slow decision making; unresolved land ownership; appointment of incompetent service providers; increase in scope and/or change of specification; bureaucracy in client administration; interest charged on overdue claims; change in the material specification; increase in the scope of work; and escalation due to delays in site handover after the appointment
Consultant related	Incomplete design information; design mistakes and/or changes; poor quality of information; delay in issuing approvals on-site (tests and inspections); inflexibility (rigid) consultant; failure to give expeditious and practical solutions on-site; unrealistic contract duration estimate; inaccurate bill of quantities; and slow decision making
Contractor related	Labour unrest; subcontracting; contractor' cashflow; lack of site management and supervision; construction mistakes; poor planning and scheduling of work; lack of experience on similar work; under-pricing of the work; outdated construction methods; appointment of contractors with political clout; under-pricing of the project; and termination of contract and appointing another contractor to complete the work
Resources related	Shortage of skilled labourers; productivity of the unskilled and skilled labour force; shortage of materials; delay in material delivery; shortage of equipment; low productivity and efficiency of equipment; material price increases; equipment rate increases; increase in labour rates; and high cost of skilled labour
Externally related	Community disruptions; environmental issues; inclement weather; regulatory changes; unforeseen site condition; accident during construction; and corruption
Contract related	Errors, discrepancies and omissions in contract document; contract dispute and negotiations; change of specifications; penalties ineffective and/or not administered; poor communication; and contract claims

In agreement with the postulation of Cantarelli et al. (2010), this study argues that the factors identified in Table 2.3 can be explained technically, economically, psychologically and politically. The theories embedded in these explanations encompass the following: “Forecasting; Planning; Decision-making; Neoclassical economics; Rational choice; Planning fallacy and optimism bias; Prospect; Rational choice; Machiavellianism; Agency; and Ethical theories” (Cantarelli et al., 2010:16). This finding effectively addresses the secondary research objective (iv) of the study.

The chapter discussed the methodologies used in the previous similar studies, the abundance of plausible mitigation measures to address the time and cost overruns in construction projects, and the literature gaps identified, addressing secondary research objective (ii) of the study.

CHAPTER 3. RESEARCH METHODOLOGY

3.1 CHAPTER INTRODUCTION

Chapter 3 discusses the data collection, processing and analysis strategies of the study. It begins with a discussion of the research philosophies followed by the study's research approaches, including the rationale for those choices. It goes on to discuss the research design, sampling strategy, data collection methods, data analysis and ethical considerations. It concludes by summarising the key points discussed in this chapter.

3.2 RESEARCH PHILOSOPHY

Tuli (2011) contend that every researcher works from some philosophical school of thought, whether consciously or not, which guides the researcher in clarifying the theoretical framework. Therefore, the purpose of this section is to clarify the philosophical principles and theoretical assumptions underpinning this study.

Saunders et al. (2012:128) define research philosophy as "an assumption of the researcher about how the researcher views the world"; it relates to the "development of knowledge and the nature of that knowledge". Spirkin (1983, cited by Moon & Blackman, 2014:3-4) provides a more comprehensive explanation of research philosophy by stating that it provides "the general principles of theoretical thinking, a method of cognition, perspective and self-awareness; all of which are used to obtain knowledge of reality and to design, conduct, analyse and interpret research and its outcomes".

According to Moon and Blackman (2014:2), a clearly stated philosophy makes the research more "meaningfully and appropriately interpreted when the reader is provided with sufficient understanding of the embedded philosophical principles and theoretical assumptions". In concert, Thorpe, Jackson and Jaspersen (2018:60) argue that researchers have an "obligation to understand the philosophical foundations underpinning their research in order to have a clear sense of their reflexive role in research methods".

It is against this background that the researcher positioned this study within the philosophical realm to guide the methodological choices adopted for the research. The two main branches of research philosophy, ontology and epistemology (Saunders et al., 2012:128; Moon and Blackman, 2014), are discussed in detail in the following two subsections.

3.2.1 Ontology

Ontology can be defined as “basic assumptions that the researcher makes about the nature of reality” (Thorpe et al., 2018:60). Ontology helps the researcher to “recognise how certain they can be about the nature and existence of objects they are studying” (Moon & Blackman, 2014:4). Two types of ontological positions, objectivism and subjectivism, as identified by Saunders et al. (2012), are discussed below.

3.2.1.1 Objectivism

Objectivism represents the ontological position that “asserts that social entities exist in reality external to, and independent of social actors concerned with their existence” (Saunders et al., 2012:676). To give a practical explanation of objectivism, Saunders et al. (2012:131) offers a hypothetical example of an organisation that replaced its top management with new managers without “changing the roles, job duties and procedures”. Saunders et al. (2012:131) argued that the management of the hypothetical organisation had a “reality that was separate from the managers who inhabit that reality”.

3.2.1.2 Subjectivism

As opposed to objectivism, subjectivism refers to the ontological position that “asserts that entities are created from perceptions and consequent actions of those social actors responsible for their creation” (Saunders et al., 2012:682). In the hypothetical example discussed above, Saunders et al. (2012:131) posit that a subjective argument could be advanced when the researcher decides to “put less emphasis on the objective aspects of the management and high emphasis on the way the managers attach their meanings to their jobs and the way they think those jobs should be performed”.

3.2.2 Epistemology

Epistemology is:

> concerned with all aspects of the validity, scope and methods of acquiring knowledge, such as, with what constitutes a knowledge claim; how can knowledge be acquired or produced; and how the extent of its applicability can be determined. (Moon & Blackman 2014:5)

Moon and Blackman (2014:5) argue that epistemology is important in research because it "influences how researchers frame their research in their attempts to discover knowledge". The three types of epistemological positions, positivism, interpretivism and realism (Bryman, Bell, Hirschsohn, Dos Santos, Du Toit, Masenge, Van Aardt & Wagner, 2014; Saunders et al., 2012), are discussed below.

3.2.2.1 Positivism

Positivism is an "epistemological position that advocates for the application of the methods of the natural sciences (experiments, statistics and others) to the study of social reality and beyond" (Bryman et al., 2014:381). This position prefers the "collection of data about an observable reality and searching for regularities and casual relationship in the data to create law-like generations" (Saunders et al., 2012:628). It entails the development of hypotheses from existing theory and subjecting it to scientific tests to "confirm, in whole or part, or refute" existing theory, leading to the development of new theory (Saunders et al., 2009; Bryman et al., 2014; Thorpe et al., 2018).

3.2.2.2 Interpretivism

Interpretivism, sometimes called social constructionism by scholars, refers to an "idea that reality is determined by people rather than by objective and external factors, and hence it is most important to appreciate the way people make sense of their experience" (Thorpe et al., 2018:69). In advocacy of this viewpoint, Saunders et al. (2012:137) contend that we "loose insights of the complex world if we reduce such complexity entirely to a series of law-like generalisations".

3.2.2.3 Realism

Realism refers to an "epistemological position that acknowledges a reality independent of the senses that are accessible to the researcher's tools and theoretical speculations" (Bryman et al., 2014:382).

3.2.3 Rationale for the study's philosophical choices

3.2.3.1 Ontology

After assessing the ontological options discussed above, the researcher adopted the objectivism position for this study.

In concert with the argument raised by Saunders et al. (2012) on the hypothetical organisation, discussed earlier, it can be argued that the procurement and implementation framework of construction projects in South Africa is objective. It is highly regulated and follows well-defined standardised procedures, processes and practices. These procedures, processes and practices are prescribed by the CIDB in terms of the CIDB Act 38 of 2000 read together with regulation 24 of the Construction Industry Development Regulations of 2004 and the gazetted ECSA fee guidelines for respective engineering disciplines. Moreover, the industry uses nominate contracts, namely the GCC, JBCC,[*] NEC[†] and FIDIC[‡], and CIDB Standard Professional Services (1015) for contracting contractors and consultants (sometimes refereed as Professional Service Providers), respectively. Therefore, the project and contract management processes, practices and procedures of construction projects would remain the same.

In the eyes of the researcher, this reality is independent of the personnel involved, hence the adoption of the objectivism ontological position in this study.

[*] JBCC - Joint Building Contracts Committee

[†] NEC - New Engineering Contract

[‡] FIDIC - Fédération Internationale des Ingénieurs – Conseils

3.2.3.2 Epistemology

The literature examined in Chapter 2 reveals an abundance of theories on the causes of time and cost overrun in construction projects. Hence, in this study, the researcher saw more value in testing the relevance and applicability of the existing theories rather than in developing new theories.

Furthermore, the researcher subscribes to the belief that credible theories can be derived from an observable phenomenon, a belief heavily influenced by the researcher's scientific background. In this study, the researcher is concerned with the collation of observable facts that can be quantifiable for scientific verification rather than the feelings and attitudes of personnel involved in projects, as they can hardly be "seen, measured or modified" (Saunders et al., 2012:134).

The epistemological position suited to the researcher's viewpoint of how the knowledge can be acquired is positivism, and hence it was adopted for this research.

3.3 RESEARCH APPROACH

Research approach can be defined as a "broad orientation to business and management research" (Bryman et al., 2014:382). According to Creswell (2003:21), the choice of research approach to be adopted for any study depends on three key factors, namely "the research problem, the personal experiences of the researcher, and the audience(s) for whom the report will be written". Likewise, Yin (1994, cited in Amaratunga, Sarshar, Baldry and Newton, 2002:20) opined that a "research strategy should be chosen as a function of the research situation".

Quantitative and qualitative research approaches are the two widely employed research approaches in social science studies. The following subsections defining these approaches, comparing and contrasting their characteristics, and discuss their pros and cons. This information guided the researcher to choose the most appropriate approach to fulfil the objectives of the study.

3.3.1 Definitions of quantitative and qualitative research

Quantitative research approach can be defined as a method of collecting numerical data using data collection instruments such as experiments and surveys, and the

analysis of the numerical data using techniques such as graphs and statistics (Creswell, 2003; Saunders et al., 2012). The method can be employed to determine trends and averages, make predictions, test causality relationships between variables, and generalise the findings from a sample to the larger population group (ibid).

Similarly to the above definition, Bryman et al. (2014:31) describe the quantitative research approach as an approach that "entails the collection of numerical data, regards the relationship between theory and research as deductive, prefers science approach in general (positivism), and adopts an objectivist conception of social reality".

By contrast, qualitative research can be defined as the method of collecting non-numerical data using instruments such as interviews, and the analysis of the gathered non-numerical data using techniques such as the categorisation (Creswell, 2003; Saunders et al., 2012).

In the same vein, Bryman et al. (2014:382) argue that a qualitative research approach "emphasises words rather than quantification in the collection and analysis of data; and it is inductivist, constructivist, and interpretivist as a research strategy".

3.3.2 The main characteristics of quantitative and qualitative research

Uche (2010) extensively studied the main characteristics of quantitative and qualitative research approaches and summarised the findings, as depicted in Table 3.1:

Table 3.1: Summary table on quantitative versus qualitative research (adapted from Uche, 2010)

QUANTITATIVE RESEARCH	**QUALITATIVE RESEARCH**
Approach	**Approach**
• Begins with hypothesis and theories	• Ends with the hypothesis and grounded theory
• Manipulation and control	• Emergence and portrayal
• Use of formal instruments	• Researcher as instrument
• Experimentation	• Naturalistic
• Deductive	• Inductive

QUANTITATIVE RESEARCH	QUALITATIVE RESEARCH
• All aspects of the study are carefully designed before data is collected • Component analysis • Seeks consensus, the norm • Reduces data to numerical indices • Abstract language in the write-up • Procedures are standard, and replication is assumed	• The design emerges as the study unfolds • Searches for patterns • Seeks pluralism, complexity • Makes minor use of numerical indices • Descriptive write-up • Research procedures are particular, and replication are very rare
• Measures are systematically created before data collection and are standardised • The inquiry is value-free • Objective – seeks precise measurement and analysis of target concepts • The theory is mostly causal and deductive	• Measures are created in an ad hoc manner and are specific to the individual researcher • Inquiry is value-laden • Subjective – individual's interpretation of events is important • Theory can be causal and non-causal
Tools	**Tools**
The researcher uses tools such as questionnaires to collect numerical data	The researcher is the data-gathering instrument
Nature of data	**Nature of data**
• Data in the form of numbers and statistics • Data are efficient but may miss contextual details	• Data in the form of words, pictures or objects • Data are rich, time–consuming, and less generalisable
Researcher role	**Researcher role**
• Detachment and impartiality • Objective portrayal	• Personal Involvement and partiality • Empathic understanding
Assumptions	**Assumptions**
• Social facts have objective reality • Primacy of method	• Reality is socially constructed • The primacy of subject matter

QUANTITATIVE RESEARCH	QUALITATIVE RESEARCH
• Variables can be identified, and relationships measured • Reality is single • Etic (outsider's point of view)	• Variables are complex, interwoven and difficult to measure • Reality is multiple • Emic (insider's point of view)
Purpose/aim	**Purpose/aim**
• The aim is to classify features, cut them and construct statistical models in an attempt to explain what is observed • Generalisability	• The aim is a complete, detailed description • Contextualisation
• Prediction • Causal explanations	• Interpretation • Understanding actors' perspectives
Advance knowledge on an inquest	**Advance knowledge on an inquest**
• The researcher knows clearly in advance what he/she is looking for	• The researcher may only know roughly in advance what he/she is looking for

3.3.3 Pros and cons of quantitative and qualitative research

Uche (2010) and Amaratunga, et al. (2002) summarised the main advantages and disadvantages of quantitative and qualitative as depicted in Table 3.2:

Table 3.2: Advantages and disadvantages of quantitative and qualitative research approaches (adapted from Uche, 2010 & Amaratunga, et al., 2002)

ADVANTAGES	**DISADVANTAGES**
Qualitative Research	**Qualitative Research**
• Data gathering methods seem more natural than artificial • Ability to look at the change process over time • Ability to understand people's meaning • Ability to adjust to new issues and ideas as they emerge • Contribute to theory generation	• Data collection can be tedious and require more resources • Analysis and interpretation of data may be more difficult • Harder to control the pace, progress and endpoints of the research process • Policymakers may give low credibility to the results from the qualitative approach
Quantitative Research	**Quantitative Research**
• It can provide wide coverage of the range of situations • It can be fast and economical • Where statistics are aggregated from large samples, it may show considerable relevancy to policy decisions • The researcher tends to remain objectively separated from the subject matter • Precise measurement and hypothesis testing, which are fundamental • The quantitative approach enhances the appreciation of causal linkages and generalisability of findings ○ Comparison and replication are allowable ○ Reliability and validity may be determined more objectively than with qualitative techniques.	• The method used tend to be rather inflexible and artificial • They are not very effective in understanding the processes or significance that people attach to actions • Not helpful in generating theories • Because it focuses on what is, or what has been recent, it makes it hard for policymakers to infer what changes and actions should take place in the future

3.3.4 Rationale for the choice of research approach

After examining the characteristics as well as the pros and cons of the quantitative and qualitative approaches, it was concluded that the quantitative approach is the most appropriate research approach for this study's main objective: to test the relevance and applicability of the existing theories on project time and cost overruns in the metropolitan municipality. As mentioned, because it was found that literature is replete with theories on the causes of time and cost overruns in construction, this study focused on testing the existing theories in the literature rather than developing new theories.

The literature examined revealed that the quantitative research approach had been used successfully in similar studies, for example in the studies of Mashwama et al. (2018), Mukuka et al. (2015) and Seboru (2015) on time and cost overruns in construction projects.

The quantitative method also offered the advantages of being economical and offering ease of measuring and presenting outcomes. These advantages assisted in overcoming the study's time constraints (Bryman et al., 2014).

3.4 RESEARCH DESIGN

Research design is defined by Saunders et al. (2012:680) as:

> [a] framework for the collection and analysis of the data to answer the research question and meet research objectives providing reasoned justification for the choice of data sources, collection methods and analysis techniques.

The five types of research designs are "experimental design, cross-sectional design, longitudinal design, case study design and comparative design" (Bryman et al., 2014:100). The choice of research design employed in a research study depends on the importance attached to various dimensions of research, such as:

> how to express casual connections between variables; whether and how the results can be generalised to a larger group of individuals or organisations than those forming part of the investigation; how to understand and explain behaviour in its specific context; and how to explain social phenomena, their interconnections and changes over time. (ibid)

A cross-sectional research design was adopted for this study. According to Bryman et al. (2014:376), a cross-sectional design entails:

> [the] collection of data more than one case and at a single point in time in order to collect a body of quantitative or quantifiable data in connection with two or more variables, which are then examined to detect patterns of association.

Shaughnessy, Zechmeister and Zechmeister (2012) contend that cross-sectional surveys are well suited for a descriptive study. Because this research was descriptive in nature, and it aimed at exploring causal relationships between variables, a cross-sectional design was chosen.

Relevant literature in the form of books, conference papers, journals, articles, annual reports, circulars, acts, regulations and circulars was gathered and reviewed to identify existing concepts and theories on the subject. The literature review informed the questionnaire, showed the research gaps to be addressed by the study, provided insight into methods and strategies employed in previous studies, and highlighted inconsistencies in the findings of previous studies.

The structured questionnaire prepared based on the literature findings was shared with industry experts and refined for survey purposes. The questionnaire was administered to the target groups (contractors, consultants and clients) to collect quantitative empirical data. This data was stratified and analysed through scientific methods to answer research questions (iii) and (v).

3.5 SAMPLING STRATEGY

Thorpe et al. (2018:104) describe a sampling strategy as a criterion adopted by a researcher to select a “subset (or sample) from a wider population of individuals, organisations, industries or whatever unit of analysis that is being investigated”. According to Saunders et al. (2012), a sample provides a valid alternative to the census in cases where it is impractical to survey the whole population because of budget and time constraints. These authors argue that the choice of sampling technique to be adopted for research is “dependent on the feasibility and sensibility of collecting data to answer the research question(s) and to address objective(s) from the entire population” (Saunders et al., 2012:291).

The sampling techniques employed in social sciences are broadly divided into probability techniques (viz. simple random, systematic random, stratified random & random cluster) and non-probability techniques (viz. convenience, snowball, quota &

purposive) (Saunders et al., 2012; Bryman et al., 2014). In probability sampling, each unit in the population has known probability of being selected and is always greater than zero. In non-probability sampling, the probability of a unit being selected is unknown, and there is more likelihood of some units being selected than others (Saunders et al., 2012; Bryman et al., 2014).

The sampling technique adopted for this study is purposive sampling, a form of non-probability sampling. Purposive sampling is defined by Thorpe et al. (2018:109) as:

> [a] form of non-probability sampling design where the criteria for inclusion in a sample are defined, and units are first screened to see whether they meet the criteria for inclusion, and those that meet the criteria are included in the sample.

A sample was preferred over the whole population for this study to overcome time and cost constraints. The respondents identified for the study were selected based on their specific knowledge and experience on the subject matter.

A total of 47 road projects, reported in Appendix D, were selected for this research. The rationale of limiting the project sample to a period range of July 2014 to March 2020 was based on the assumption that it would be difficult to trace and locate relevant personnel that worked on the sampled projects, mainly due to the high turnover of personnel in the construction industry.

The study's questionnaire was distributed to 66 role players from the selected road projects. The role players were client project managers (12), consultant representatives (21) and contractor site managers (33) that were representative of the total population of the respondent groups. The distribution of the questionnaire was limited to role players who are located within the Republic of South Africa.

The sampling strategy employed in this study was similar to similar studies found in the literature. For example, Awosina (2017) and Seboru (2015) also employed the purposive sampling technique and selected the same type of respondents.

3.6 DATA COLLECTION METHODS

Data collection is the "process of gathering the basic information that the researcher will use to draw conclusions from" (Bryman et al., 2014:376). From among the four data collection methods, namely, secondary sources, observation, interviews and

questionnaire, Saunders et al. (2012) opine that questionnaires are most suited for descriptive or explanatory research. As previously discussed, this research was descriptive in nature; hence, its use of a questionnaire.

According to Saunders et al. (2012:420), the choice of questionnaire employed for a study depends on the research questions and objectives. They list the following particulars to consider:

> characteristics of the respondents from whom you wish to collect data; the importance of reaching a particular person as respondent; the importance of respondent's answers not being contaminated or distorted; the size of the sample you require for analysis, taking into account the likely response rate; types of question you need to ask to collect your data; and the number of questions you need to ask to collect your data.

Among the questionnaire survey choices at the researcher's disposal, namely web-based, postal, delivery and collection, telephone interview and structured interview (Bryman et al., 2014), the researcher employed a web-based self-administered questionnaire for this study. A web-based self-administered questionnaire was chosen because of its inherent advantages-such as "cost-effectiveness, relative ease and speed in administering; absence of interviewer effects; no interviewer variability and its convenience to the respondents" (Bryman et al., 2014:192).

Participants were sent emails with a SurveyMonkey website link (https://www.surveymonkey.com/r/BKTGPL6) by the MMM Corporate Services Department of MMM. The email contained an information leaflet with information on the title of the research project, the primary research objective, the estimated time to complete the questionnaire, which was 20 to 35 minutes; advice to complete the questionnaire during their own time; a statement that informed the participants that they were likely to incur unrecoverable internet data cost; timelines to respond to the questionnaire, which was four weeks (from 2 July 2020 to 7 August 2020); explanations on ethical consideration as discussed in Section 3.9; and contact details for clarity-seeking questions. Additionally, a consent letter to be signed by the participants was attached to the email, and the participants were sent reminders to complete the questionnaire on a fortnightly basis.

The questionnaire composed of four sections as detailed in Table 3.3 and Appendix C: It contained a total of 187 closed-ended questions with 6-point and 5-point Likert rating scales employed for RII and IMPI methods, respectively. The ratings 1 to 6 and

1 to 5 represented ratings for the predetermined variables. It also included one (1) open-ended question aimed at soliciting the participant's views on managing time and cost overruns. A neutral point was omitted on the questionnaire to obtain the respondent's opinion on the subject matter. Table 3.3 encapsulates the contents of the questionnaire employed for the study, attached as Appendix C.

Table 3.3: Abridged *Questionnaire Information*

Section no.	Section description	No. of questions	Typical questions	Likert scale	Analysis method
A	Demographic information	4	Organisation, experience, qualification & professional status	None	General information
B	Factors affecting time and cost overruns in road projects at MMM	61	To what extent do you agree with the following statement? Please indicate your answers using the 6-point Likert scale.	1 to 6 See Section 3.7.1 for details.	RII
C	Degree of impact of the factors affecting time and cost overruns in road projects at MMM	61	What is the degree of impact/severity of the following factors on the time and cost overruns in road construction projects? Please indicate your answers using the 5-point Likert scale.	1 to 5 See Table 3.4 for details.	IMPI
C	Frequency of occurrence of the factors affecting time and cost overruns in road projects at MMM	61	What is the frequency of occurrence of the following factors on the time and cost overruns in road construction projects? Please indicate your answers using the 5-point Likert scale.	1 to 5 See Table 3.4 for details.	IMPI

Section no.	Section description	No. of questions	Typical questions	Likert scale	Analysis method
D	Advice on managing time and cost overruns	1	If you were to advise the management of MMM on the three (3) most important issues to address in order to manage time and cost overruns, what would it be?	None	Proposed solutions

Amri and Marey-Perez (2020:94) contend that "[c]lose-ended questionnaires are used to collect data for quantitative data, whereas open-ended questionnaires are commonly used for qualitative data". Closed-ended questions enable "ease of coding, entering and analysing quantitative data in respective statistical software" (ibid). In the same vein, Saunders et al. (2012) argue that close-ended questions are easier to complete for participants and guarantees a higher response rate. Responses are also simpler to process and easier to compare. Because of these advantages, this study preferred closed-ended questions. The one open-ended question at the end was included to solicit respondent's views on plausible measures of managing time and cost overruns in road projects to include factors not covered in the close-ended questions.

The participants recorded their answers online. Answers were stored in the database and later downloaded for statistical analysis.

3.7 DATA ANALYSIS

3.7.1 Relative Importance Index and Importance Index

The collected data were analysed to fulfil the secondary objectives (iii) and (v). The collected data were used to rank the factors affecting time and cost overruns in construction road projects in a metropolitan municipality using the RII, IMPI, and weighted RII and IMPI methods. The methods helped in identifying the factors that the respondents viewed as critical for the success of road projects.

The RII method can be expressed in a mathematical relationship as follows:

$$RII = \Sigma W*i/A*N$$

where W = weight given to each variable by the respondents and varying from 1 to 6 (1 = strongly disagree, 2 = disagree, 3 = somewhat disagree, 4 = somewhat agree, 5 = agree and 6 = strongly agree); A = highest weight (6); and N = total number of respondents (Bekker & Mashaba, 2018). The values of RII varies from 0 to 1, where the highest value of 1 represents the factor that is perceived by respondents as the most important of all. In contrast, the lowest value of 0 represents the least important factor.

The IMPI is a product of frequency index (FI) and severity index (SI), where:

- FI = {(ΣW*F)/(A*N)};
- SI = {(ΣW*F)/(A*N)};
- W = weight assigned to each response from 1 to 5 as depicted in Table 3.4;
- F = frequency of each response given to each factor;
- A = highest weight (6); and
- N = total number of responses.

The IMPI method was used for this study because it recognises the importance of the combined effect of frequency and severity of each factor that causes time and cost overruns in projects.

Table 3.4: *Likert scale weights (adapted from Seboru, 2015).*

Weight	**Degree of impact/severity**	**Frequency of occurrence**
1	None (N)	Never (N)
2	Minor (Mi)	Rarely, around 20% (R)
3	Moderate (Mo)	Occasionally, around 50% (Oc)
4	High (H)	Often, around 80% (Of)
5	Very High (VH)	Always (A)

The computed results of the RII and IMPI methods were compared and contrasted to assess the degree of agreement or disagreement according to the two methods used to rank the importance of the factors.

3.7.2 Spearman's rank correlation coefficient

Bivariate analysis was undertaken to measure and compare the correlation of views on the ranking of factors affecting time and cost overruns in road construction projects between clients and contractors, clients and consultants, and contractors and consultants using Spearman's coefficient of rank correlation. Bansal (2019:39) defines Spearman's coefficient of rank correlation as:

> [a] non-parametric test used to measure rank correlations; it assesses the depth of the relationship between two different variables, and it can use the monotonic function to describe this relationship among variable.

Spearman's coefficient of rank correlation is expressed in a mathematical relationship as follows:

{rs = 1 - [6Σd^2/(n^3-n)]}

where rs = Spearman's rank correlation coefficient, d = the difference in the ranking between any two parties, and n = number of factors. It varies between +1 and -1 (Bansal, 2019).

Various scholars have provided an interpretation of the computed Spearman's coefficient of rank correlation. Kamanga and Steyn (2013:80) state that a "Spearman's rank correlation coefficient value of +1 implies a perfect positive relationship (agreement) between two different parties, while the value of -1 implies a perfect negative relationship (disagreement)". Likewise, Assaf and Al-Hejji (2006:351) provide the following interpretation: "Sample estimates of a value close to unity in magnitude imply a good correlation, while values near zero indicate little or no correlation". Bansal (2019) provides a more detailed interpretation, as depicted in Table 3.5.

Table 3.5: Value of correlation coefficient with its significance (adapted from Bansal, 2019)

Sign of correlation coefficient	Strong	Moderate	Weak	Very weak or none
Positive value signifies a positive relationship	0.5 to 1.0	0.3 to 0.49	0.1 to 0.29	0 to 0.09
Negative value signifies a negative relationship	-1.0 to -0.5	-0.49 to -0.3	-0.29 to -0.1	-0.09 to 0

Ayudhya (2011:1030) argued that the Spearman's rank correlation coefficient was advantageous for the study of common delay causes on construction projects in Singapore as the method did not require the "normality assumption or homogeneity of variance assumption". Similarly to that of Ayudhya, this study assesses the factors affecting time and cost overrun in construction projects, hence the adoption of the Spearman's rank correlation coefficient method.

3.7.3 Validation of the study

Harriman (1980, cited in Tjale, 2005:70) defines the validity of a study as "the degree to which a psychological test or measure predicts the criterion or whatever it is intended to measure".

This study was validated through face validity. Saunders et al. (2012:670) define face validity as "agreement that a question, scale, or measure appears logically to reflect accurately what it was intended to measure".

To achieve face validity of the data collection instruments, the structured questionnaire was formulated using findings from previous studies on the factors affecting time and cost overruns in infrastructure projects. The questionnaire was also shared with industry experts and the study supervisor to assess whether it adequately covered the domain. The process was iterative until a final draft was produced.

Once the questionnaire was finalised, it was piloted on a sample of five industry practitioners to test the representativeness and suitability of the questions. Martins (2010:288) holds that:

> pretesting of a questionnaire is essential in testing face validity and it may be conducted on a small sample or on five to ten experienced researchers or experts in the field, or subjects from the same population as that for which the eventual survey is intended.

Likewise, Saunders et al. (2012:677) contend that:

> [the testing of a] questionnaire, interview checklist or observation schedule helps to minimise the likelihood of respondents having problems in answering the questions and of data recording problems as well as to allow assessment of the question's validity and the reliability of the data that will be collected.

3.7.4 Reliability of the study

Reliability is defined as:

> the extent to which data collection technique or techniques will yield consistent findings, similar observations would be made, or conclusions reached by other researchers or there is transparency in how sense was made from raw data. (Saunders et al., 2012:680)

The reliability of the questionnaire used for the study was checked using Cronbach's alpha. The method tests the internal consistency of questionnaire results when it is administered more than once. A Cronbach's alpha value greater than 0.7 implies that the instrument is acceptable.

Cronbach's alpha is usually computed as follows:

$$\text{Alpha} = \{(N*C)/[v+(N-1)*C]\}$$

where N = number of items, v = average variance, and C = average inter-item covariance (Alinaitwe et al., 2013:40). George and Mallery (2003) provide a more detailed rule of thumb interpretation of Cronbach's alpha values, as depicted in Table 3.6.

Namdeo and Rout (2016) caution that the use of a longer set of items, that is, items greater than 20, could lead to the overestimation of the alpha value, regardless of whether the test is homogeneous or not. The alpha values greater than 0.95 may suggest an overestimation of the internal consistency due to redundancies or duplication of items (ibid, 2016). Peterson and Kim (2013) argue that the lower bound value of the Cronbach's alpha method has a tendency to underestimate the actual reliability and propose other alternative methods such as composite reliability.

Table 3.6: Interpretation of Cronbach's alpha values *(adapted from George & Mallery, 2003: 231)*

Reliability Test	Cronbach's alpha value (α)
Unacceptable	$\alpha < 0.5$
Poor	$0.5 \leq \alpha < 0.6$
Questionable	$0.6 \leq \alpha < 0.7$
Acceptable	$0.7 \leq \alpha < 0.8$
Good	$0.8 \leq \alpha < 0.9$
Excellent	$0.9 \leq \alpha$

3.8 ETHICAL CONSIDERATIONS

Research ethics refers to the "standards of behaviour that guide the researcher's conduct about the rights of those who become the subjects of the study or are affected by it" (Saunders et al., 2012:226). Research ethics are influenced by social norms and different philosophical foundations. The deontological view advocates for the confinement of the researcher's act of conduct to a set of predetermined rules, while the teleological view advocates for the justification of the act of conduct of the researcher based on the net benefit of that act (Saunders et al., 2012). To overcome the conundrum created by different social norms and philosophies, many organisations formulate a code of ethics that outlines the ethical principles and standards that must be observed in anticipation and navigation of issues and potential risks to avoid conflict and harm (Saunders et al., 2012).

The ethical considerations of this research are in line with the ethical guidelines of the UFS. They are categorised into permission obtained, informed consent, voluntary participation, anonymity and confidentiality, no harm and conflicts of interest, as discussed below.

3.8.1 Permission obtained

The researcher applied and was granted permission by MMM to perform this study as attached in Appendix A. Permission included access to and use of the information on

the relevant road projects for this study and possible publication purposes as well as to conduct a questionnaire survey with the project stakeholders. The research project was also ethically cleared by UFS General Human Research Ethics Committee (approval number UFS-HSD 2020/0591/3006) before the fieldwork commenced. The clearance certificate is attached as Appendix B.

3.8.2 Informed consent

Informed consent is described by Diener and Crandall (1978:151) as a "set of procedures in which individuals choose whether to participate in an investigation after being informed of facts that would be likely to influence their decision". Dawson (2002, cited in Madziwanzira, 2018:45) explains the importance of informed consent as follows:

> the success of a research project is dependent upon the assistance rendered by its participants; therefore, the respondents need to be adequately informed and consent to participate in the study and must also be treated with honesty and respect.

Likewise, Saunders et al. (2012:231) argue that research participants must be provided with:

> sufficient information and assurances about taking part in research to allow individuals to understand the implications of their participation and to reach a fully informed, considered and freely given decision about whether or not to do so, without the exercise of any pressure or coercion.

The researcher obtained informed consent by including the following information in the information leaflet attached to the invitation email sent to the participants:

- a detailed description of the title of the research project;
- the primary research objective;
- the estimated questionnaire completion time, which was 20 to 35 minutes;
- advice to the participants to complete the questionnaire during their own time;
- a statement that informed the participants that they were likely to incur unrecoverable internet data cost;

- the timelines for responding to the questionnaire, which was four weeks (from 2 July 2020 to 7 August 2020); and
- a statement that informed the respondents that returning the completed questionnaire would be interpreted as the respondent's consent to participate in the study.

As mentioned previously, the draft questionnaire was also circulated and reviewed by industry experts or practitioners to address the face validity of the study and to determine the appropriate time needed to complete the questionnaire. The experts were part of the researcher's professional network. Their invitation and consent happened telephonically before the draft questionnaire was shared with them. They subsequently provided guidance on the content and indicated what time participants realistically needed to complete the questionnaire.

3.8.3 Voluntary participation

According to Saunders et al. (2012:231), the voluntary ethical principle dictates that participants must be given:

> [the] right to determine how they will participate in the data collection process, including rights: not to answer any question, or set of questions; not to provide any data requested; to modify the nature of their consent; to withdraw from participation; possibly to withdraw data they provided.

The researcher complied with the ethical principle of voluntary participation by including a statement in the information leaflet sent to the respondents explaining the following:

- The research was voluntary.
- The participants reserved the right to accept or decline to participate in the study without any penalty or loss of benefit for non-participation.
- The participants needed to sign a written consent form once they had chosen to participate.
- The participants reserved the right to withdraw their participation in the study after the initial acceptance.

- It would not be possible to withdraw information once it has been submitted.

3.8.4 Anonymity and confidentiality

Saunders et al. (2012:231) state that participants in research, which include individuals, organisations and others, must remain "anonymous and the data they provide must be processed to make it non-attributable unless there is explicit agreement to attribute the comments". Bryman et al. (2014:122) concur with the above assertion by maintaining that:

> care must be taken when findings are published to ensure that individuals and organisations are not identified or identifiable unless they permit for data to be passed on in a form that allows them to be identified.

The following actions were taken to comply with the ethical principle of anonymity and confidentiality.

The researcher signed an agreement with MMM before getting the clearance certificate attached as Appendix A. The agreement regulates, among others, the communication of research findings and the extent of the usage of the data accessed for the study.

Furthermore, the survey questionnaire, attached as Appendix C was formulated to exclude the collation of personal information, such as full names of participants, physical addresses, and organisational names, that would have made the identification of the participants easier. The data collected was reported in aggregate form for anonymisation purposes. The researcher coded the projects used in the study, as attached in Appendix D, to minimise the possibility of identifying the stakeholders involved.

The researcher stored the electronic information collected through the questionnaire survey on a password-protected computer and a backup gadget to which only the researcher has access for five years for future research or academic purposes. The information is double protected by a combination of a password-protected folder and a file-specific password generated on Windows Explorer.

3.8.5 No harm

Diener and Crandall (1978:19) explain that research might expose both the researcher and participants to “physical harm, harm to participants’ development or self-esteemed, stress, harm to career prospects or future employment, and inducing subjects to perform reprehensible acts”. South Africa’s Human Sciences Research Council’s Code of Research Ethics stipulates that the welfare of research participants must be protected at all material times (Bryman et al., 2014).

To protect the researcher against any possible harm, the researcher excluded personal information such as home address and mobile phone number in all communications regarding the research project. The study participants included subordinates and acquaintances of the researcher. To avoid the temptation to pressure them to cooperate and to mitigate the power differential, the researcher outsourced the data collation to an independent third party, namely MMM’s Corporate Services Department, which distributed the questionnaire under the pseudonym of the researcher.

3.8.6 Conflicts of interest

Conflicts of interest can be defined as “circumstances that create a risk that professional judgments or actions regarding a primary interest will be unduly influenced by a secondary interest” (Lo & Field, 2009:6). The primary interest includes the promotion and protection of the research’s integrity, and the secondary interest includes financial incentives, sponsorship, career advancement and recognition, meals, gifts and results manipulation (Lo & Field, 2009).

The researcher declares that he is employed by MMM under the Engineering Services Directorate, but the employer did not fund this study or influence its definement. The researcher further declares that there are no personal benefits to be derived from the study save for its contribution to the attainment of the academic qualification.

In addition, the researcher is a registered professional practitioner with the Engineering Council of South Africa. Abiding by the high standard of professional integrity as prescribed in the code of professional conduct, he reported the findings of this study objectively.

As mentioned previously, the respondents of this research included the subordinates of the researcher who participated in the sampled projects. The researcher declares this conflict of interest and that he upheld the undertaking of not coercing his subordinates to participate in this study. The researcher outsourced the dissemination of the survey questionnaire, the sending of the reminder emails, and the collection of the completed questionnaires to an independent third party, namely MMM's Corporate Services Department. The survey questionnaire contained only the researcher's pseudonym details. All the above actions were taken to insulate the researcher from knowing who has or has not responded to the survey and the subordinates from feeling pressured to participate, thus mitigating against a potentially coercive relationship between the researcher and his subordinates.

3.9 CHAPTER SUMMARY

For this study, objectivism and positivism were respectively adopted as ontological and epistemological positions. The study employed the quantitative approach and cross-sectional design using purposive sampling. Data was collected through a SurveyMonkey questionnaire distributed by a third party and consisting of Likert scales of 1 to 5 and 1 to 6. The methods employed for data analysis were IMPI, RII, Cronbach's alpha and Spearman's coefficient. The chapter discussed how the ethical issues related to the research project were addressed, particularly, permission obtained, informed consent, voluntary participation, anonymity and confidentiality, no harm and conflicts of interest were addressed.

Table 3.7 shows which research methods were used to address the secondary research objectives.

Table 3.7: Research methods used to address the secondary objectives

Secondary objective(s)	**Method(s) to address the objective(s)**
i) Identify key factors in the literature that contribute to the problem of time and cost overruns in the implementation of construction projects worldwide; ii) Identify the measures proposed in the literature to reduce time and cost overruns of construction projects across the world; iv) Identify, through literature, theories embedded in the factors affecting time and cost overruns in road construction projects of a metropolitan municipality in the Free State Province; and vi) Formulate recommendations based on literature and empirical study to improve project time and cost performance in a metropolitan municipality of the Free State Province.	Literature collection and review (books, conference papers, journals, articles, annual reports, circulars, acts, regulations and circulars)
iii) Empirically rank the identified factors contributing to time and cost overruns in road construction projects in a metropolitan municipality of the Free State Province; and vi) Formulate recommendations based on literature and empirical study to improve project time and cost performance in a metropolitan municipality of the Free State Province.	Purposive sampling, structure questionnaire, piloting of the questionnaire, Cronbach's alpha, RII and IMPI
v) Empirically identify the most prevalent factors among the respondent groups regarding the causes of time and cost overruns in road construction projects in a metropolitan municipality of the Free State Province.	RII and IMPI Spearman's coefficient

CHAPTER 4. DATA ANALYSIS AND INTERPRETATION

4.1 CHAPTER INTRODUCTION

Chapter 4 presents and discusses the findings of the empirical studies, namely, in sequential order:

- the sampled project information relating to the nature and magnitude of time and cost overruns in the projects;
- the participant's profile and the survey response rate;
- demographic information of the respondents;
- the main factors causing time and cost overruns in terms of the RII, IMPI, and weighted RII and IMPI methods;
- the contrast between the ranking results of the RII and IMPI methods;
- the correlation of views between the participant groups; and
- a discussion of the reliability and validity of this study.

The chapter ends by providing a summary of the main discussion points covered in the chapter.

The chapter comprehensively addresses secondary objective (iii), to empirically rank the identified factors contributing to time and cost overruns in road construction projects in a metropolitan municipality of the Free State Province, and secondary objective (v), to empirically identify the most prevalent factors among the respondent groups regarding the causes of time and cost overruns in road construction projects in a metropolitan municipality of the Free State Province.

4.2 PROJECT INFORMATION

The study sampled a total of 47 road construction projects completed between July 2014 and March 2020, as presented in Appendix D. The following five subsections examine the performance of selected projects in terms of time and cost indicators, focussing mainly on three characteristics, namely, the nature, frequency and

magnitude of the project overruns. Subsection 5 explores the nature of the relationship between time and cost overruns.

4.2.1 Classification of projects based on contract time

Table 4.1 depicts the performance of the selected projects in terms of the time indicator. The projects are categorised into three main groups based on different contract periods, namely:

- projects with a duration of less than 6 months;
- projects with a duration of 6 to 12 months; and
- projects with a duration of more than 12 months.

Table 4.1 shows that the problem of time overrun is present in all categories of the contract periods. However, the projects with a contract period of between 6 to 12 months were more susceptible to time overruns. Of the projects in this category, 88.57% experienced time overruns. Moreover, the projects in this category accounted for 79.49% of the total number of projects that experienced time overruns. Projects with a duration of less than 6 months experienced the second-highest frequency of overruns, with 80% of these projects experiencing time overruns. Of projects with a duration of longer than 12 months, 57.14% experienced time overruns. Overall, a total of 83% of the selected 47 projects for the study experienced time overruns with an average time overrun of 107.33%. Put differently; only 17% of the projects were completed within the contract period. This finding validates the argument in the body of knowledge that construction delays are a universal phenomenon.

Table 4.1 also shows that projects that lasted 6 to 12 months recorded the largest average percentage of time overrun at 117.19%, closely followed by projects that lasted less than 6 months at an average time overrun of 100.75%. Projects that lasted more than 12 months had an average time overrun of 37.5%. These results are in concert with those of Kholif (2015) who found that projects with a duration of 8 to 12 months experienced the largest average percentage overruns compared to both projects that lasted less than 8 months and those that lasted more than 12 months.

Table 4.1: *Classification of projects based on contract period*

Contract time grouping	Number of projects	Number of projects with time overrun	Percentage frequency of projects with time overrun (%)	Average percentage of time overrun per group (%)
Less than 6 months (180 days)	5	4	80%	100.75%
Between 6 to 12 months (180 to 365 days)	35	31	88.57%	117.19%
More than 12 months (365 days)	7	4	57.14%	37.5%
Total	**47**	**39**	**83.00%**	**107.33%**

Table 4.2 depicts the categorisation of the 47 projects in terms of the magnitude of their time overruns. Table 4.2 shows that the projects that had a time overran of 21% or more recorded the highest percentage (87.18%) of time overrun. The group also accounts for 72.34% of the total number of projects sampled for the study.

Table 4.1 and Table 4.2 together point out that the scale of the frequency of time overruns and their magnitudes are enormous at the municipality.

Table 4.2: Classification of projects based on the magnitude of time overrun

Percentage of time overrun	Frequency	Per cent (%) of total projects	Per cent (%) of projects with time overrun	Cumulative per cent (%) with time overrun
0%	8	17.02%	-	-
1% – 5%	2	4.26%	5.13%	5.13%
6% – 10%	0	0%	0%	5.13%
11% – 15%	1	2.13%	2.56%	7.69%
16% – 20%	2	4.26%	5.13%	12.82%
21% and above	34	72.34%	87.18%	100.00%

4.2.2 Classification of projects based on contract cost

Table 4.3 summarises the performance of the selected projects in terms of cost. The projects are categorised into four main groups based on their contract amounts:

- R1 – 5 million
- R5.1 – 10 million
- R10.1 – 15 million
- R15.1 million and above

As with contract period, Table 4.3 shows that the problem of cost overrun is present in all categories of contract amounts. Projects with a contract amount of R10.1 – 15 million are most susceptible to cost overrun. All the projects in this category, or 100%, experienced cost overruns. This category is followed in sequential order of magnitude of the frequency of cost overruns per group by the R15.1 million and above category with 71.43%, the R1 – 5 million category with 58.82%, and lastly, the R5.1 – 10 million category with 19.05%.

Considering the total number of projects that recorded cost overruns indicates that the R1 – 5 million category is the major contributor at 47.62%. It is followed by the R15.1 million and above category, which accounted for 23.81% of the total number of projects with cost overruns; the R5.1 – 10 million category, which accounted for 19.05% of the total number of the projects with cost overruns; and, lastly, the R10.1 – 15 million category, which contributed 9.52% to the total number of projects with cost overruns.

The R1 – 5 million group recorded the largest average percentage of cost overruns with a value of 33.2%. It is followed in a hierarchical order by the R15.1 million and above category, with an average percentage cost overrun of 25.4%, the R10.1 – 15 million category, with an average percentage cost overrun of 10.5%, and the R5.1 – 10 million group, with an average cost overrun percentage of 8.5%. A total of 44.68% of the projects f selected or this study experienced cost overruns, and the average cost overrun was 24.48%. The average magnitude of cost overrun of 24.48% seems reasonable compared to the time overrun average value of 107.33%. However, any overrun in projects is undesirable in terms of project management principles.

The findings of this study corroborate the respective assertions in the AFDB (2014) report and the study by Mulenga and Bekker (2015) that small projects are more susceptible to cost overruns compared to large projects and that cost overrun is a widespread challenge at South African municipalities.

Table 4.3: Classification of projects based on contract amount

Contract cost grouping	Number of projects	Number of projects with cost overrun	Percentage of total projects with cost overrun (%)	Percentage of projects per group with cost overrun (%)	Average percentage cost overrun per group
R1m – 5m	17	10	47.62%	58.82%	33.2%
R5.1m – 10m	21	4	19.05%	19.05%	8.5%
R10.1m – 15m	2	2	9.52%	100%	10.5%
R15.1m plus	7	5	23.81%	71.43%	25.4%
Total	**47**	**21**	**100.00%**	**44.68%**	**24.48%**

Table 4.4 portrays the classification of the 47 projects in terms of the magnitude of their cost overrun. Similar to Table 4.2, it can be observed from Table 4.4 that the projects falling within the category of 21% and above registered the highest percentage of cost overrun, with an absolute value of 33.34%. However, in contrast to Table 4.2, this value represents only 14.90% of the total sample. The groups with the second and third highest percentages of cost overruns are 1 – 5% and 16 – 20%, with values of 28.57% and 23.81%, respectively. The three groups discussed above account for a combined total of 85.72% of the total number of projects that experienced cost overruns.

On a positive side, it can be noted that 55.32% of the projects were completed within budget, compared to only 17.02% that were completed within the contract period. It can, thus, be inferred from this observation that time overruns are a more significant problem for the municipality compared to cost overruns.

This finding collaborates the findings of Bordat, McCullouch, Labi and Sinha (2004) that time overruns were more predominant in construction highway projects than cost

overruns. The scholars found that 66% of the 224 surveyed highway projects experienced time overruns, but only 9.4% experienced cost overruns.

Table 4.4: *Classification of projects based on the magnitude of cost overrun*

Percentage of cost overrun	Frequency	Per cent (%) of total projects	Per cent (%) of projects with time overrun	Cumulative per cent (%) with time overrun
0%	26	55.32%	-	-
1 – 5%	6	12.77%	28.57%	28.57%
6 – 10%	2	4.26%	9.52%	38.09%
11 – 15%	1	2.13%	4.76%	42.85%
16 – 20%	5	10.64%	23.81%	66.66%
21% and above	7	14.90%	33.34%	100.00%

4.2.3 Impact of engineer estimate and bid amount on cost performance

Table 4.5 classifies the selected projects based on the magnitude of the difference between their cost estimate and contract amount. It indicates that the higher the percentage difference between the engineer estimate and the bid amount, the higher the likelihood that the project experienced cost overrun. This finding corroborates Rowland's (1981:36) contention that the "larger the difference between the engineer estimate and the bid amount (the low bid of the project), the greater the likelihood that the project will experience more change orders, and often, by extension, more cost overruns". On the contrary, Bordat et al. (2004:88) found that the "proportion of the difference between the winning bid and the engineer's estimate was not a significant variable for cost overruns".

Table 4.5 also indicates that time overruns are relatively high regardless of the magnitude of the difference between the engineer estimate and the contract amounts. All the categories registered a time overrun frequency of more than 75% per category, except for the 11 – 15% category with a frequency of 50%. Interestingly, the category of less than or equal to zero, which represents projects with a contract amount higher

than the engineer estimate, account for 38.38% of the total projects that experienced time overruns and 25.53% of those that experienced cost overruns.

The above observation calls into question the reliability and/or credibility of the engineer estimates in the municipality. Typically, it would be expected that the engineer estimate is a good indicator of the realistic project cost. It is assumed to be conducted by experienced professionals based on a call for their bids. Moreover, it would also be expected that projects with contract values less than the engineer estimates are likely to experience more cost overruns compared to those whose contract amount is higher than the engineer's estimate, which is not the case.

Table 4.5: *Classification of projects based on the magnitude of the percentage difference between the cost estimate and contract amount*

Percentage difference between engineer estimate and contract amount	Number of projects	Frequency of time overruns	Per cent (%) of total projects	Per cent (%) per group	Frequency of cost overruns	Per cent (%) of total projects	Per cent (%) per group
< = 0%	23	18	38.30%	78.26%	12	25.53%	52.17%
0 – 5 %	13	12	25.53%	92.31%	2	4.26%	15.38%
6 – 10 %	3	3	6.38%	100%	2	4.26%	60%
11 – 15 %	2	1	2.13%	50%	0	0	0%
16 – 20 %	2	2	4.26%	100%	1	2.13%	50%
21% and above	4	3	6.38%	75%	4	8.51%	100%

4.2.4 Impact of competition on time and cost performance

Table 4.6 classifies the selected projects based on the level of competition according to the number of bid documents received for that project. It shows that projects with a higher level of competition, i.e. a high number of responses, experienced a higher frequency of cost overruns compared to bids that received fewer responses. Projects

with the following number of bids received experienced a high percentage of cost overruns: 11 to 20 (61%), 31 to 40 (60%), and 21 to 30 (40%). These three categories accounted for 90.47% of the total number of projects that experienced cost overruns.

This finding corroborates the assertion of Bordat et al. (2004:36) that:

> [the] higher the level of competition, the more competitive the bidding, and consequently the higher the number of change orders, and the greater the likelihood of the cost overrun and time delay to be experienced in the contract.

However, time overruns cut across all the different categories, with a minimum of 60% of projects experiencing time overruns for the category of projects that had 31 to 40 bidders. The two categories with the lowest number of responses, i.e., projects with 0 to 10 and 11 to 20 bids, account for approximately 70% of the total number of projects that experienced time overruns.

Table 4.6: *Classification of projects based on the level of competition*

Number of bid documents received	Number of projects	Frequency of time overruns	Per cent (%) of total projects with time overruns	Per cent (%) per group	Frequency of cost overruns	Per cent (%) of total projects with cost overruns	Per cent (%) per group
0 – 10	14	14	35.90	100%	2	9.52%	14.29%
11 – 20	18	13	33.33	72%	11	52.38%	61%
21 – 30	5	5	12.82	100%	2	9.52%	40%
31 – 40	9	6	15.38	60%	6	28.57%	60%
41 and above	1	1	2.56	100%	0	0%	0%

4.2.5 Scatter diagram of time and cost overruns

Figure 4.1 depicts a scatter plot developed for the analysis of the bivariate relationship between time overrun and cost overrun for the projects selected. The calculated R^2- and R-values for the graph are 0.024 and 0.15, respectively. The R^2 value indicates that the regression equation can explain only 24% of the cost overruns based on time

overrun, and the R-value indicates that there is a positive correlation between time and cost overruns in the sample (Render, Stair, Hanna & Hale, 2018). In a previous similar study, Shrestha, Burns and Shields (2013) found a positive correlation of 0.356 between time and cost overruns for public work projects.

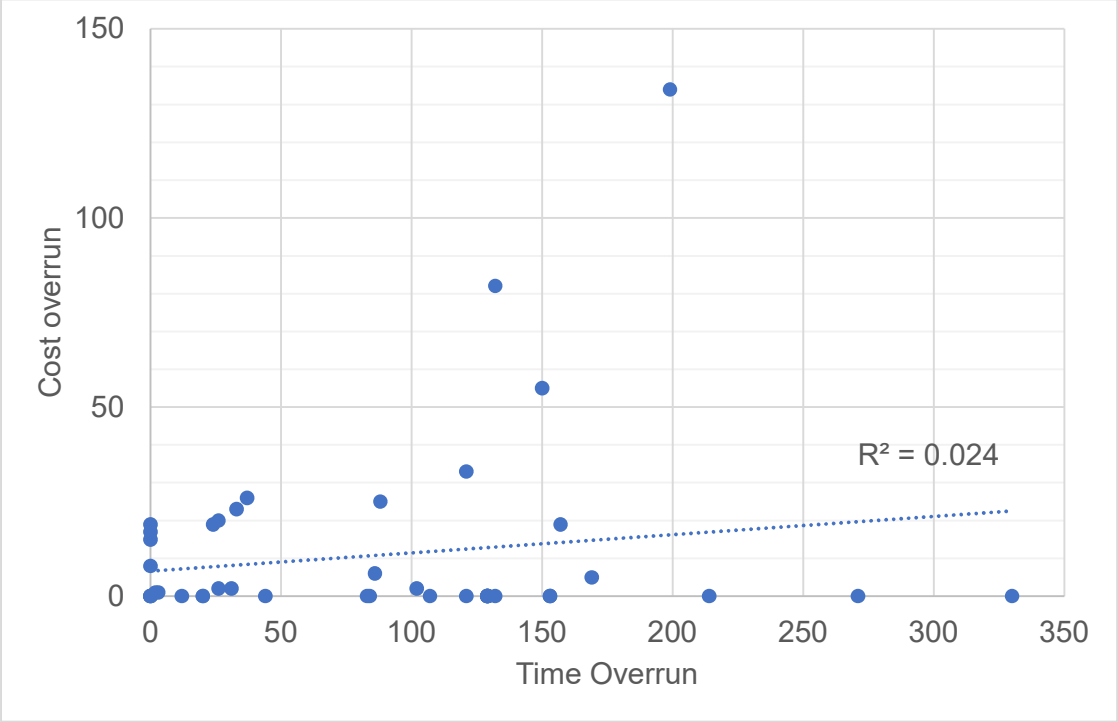

Figure 4.1: Scatter plot of time and cost overruns for the sampled projects

4.3 QUESTIONNAIRE RESPONSE RATE

As shown in Table 4.7, the questionnaire was disseminated to a total of 66 respondents (12 to clients' project managers, 21 to consultants, and 33 to contractors). A total of 37 questionnaires, which represent 56% of the sample, were returned completed – and, therefore, accepted as valid for the study. Twelve (12) questionnaires representing 18% of the sample were discarded as they were incomplete. Seventeen (17) questionnaires representing 26% of the sample were not returned by the participants. The consultant group had the highest response rate of 71% (15 out of 21), followed by the client group with a response rate of 67% (8 out 12) and the contractor group with a response rate of 42% (14 out of 33). The consultant group accounted for 40.54% of the aggregate number of questionnaires received, followed by the contractor group with 37.84% the client group with 21.62%.

The moderate response rate can be attributed to the very long questionnaire, with a total of 188 questions. Access was also an issue as some of the respondents were still on lockdown due to the coronavirus pandemic.

However, the response rate exceeded 50%, and the quantum of responses in absolute figures exceeded 30. Hence, according to Cohen, Manion and Morrison (2007), these figures were adequate for the researcher to conduct the study and draw conclusions from it. Likewise, Moser and Kalton (1993) contend that a response rate of 40% and above is acceptable to warranty the reliability and validity of the findings of a study. Therefore, the findings and conclusions of this study can be treated as reliable and valid.

Table 4.7: *Questionnaire distribution and response*

Type of organisation	**Questionnaires distributed**	**Questionnaires returned**	**Returned questionnaires as percentage of distributed**	**Questionnaires accepted**	**Accepted return rate (%)**
Client	12	9	75%	8	67%
Consultant	21	17	81%	15	71%
Contractor	33	23	70%	14	42%
Total	**66**	**49**	**74%**	**37**	**56%**

4.4 DEMOGRAPHIC INFORMATION

This section discusses the demographic profile of the participants in terms of their relevant work experience in the construction industry, their academic qualifications and their professional registration status.

4.4.1 Respondents' work experience in the construction industry

Figure 4.2 shows the profile of those respondents' work experience whose feedback was accepted for the study. A total of 89% of the respondents had more than five years' work experience in the construction industry, and 67% had more than ten years' experience. Furthermore, some of the respondents had experience in multiple projects

implemented at MMM. It can, therefore, be inferred that the data collected from the survey are of high credibility as it is gleaned from highly experienced and qualified practitioners.

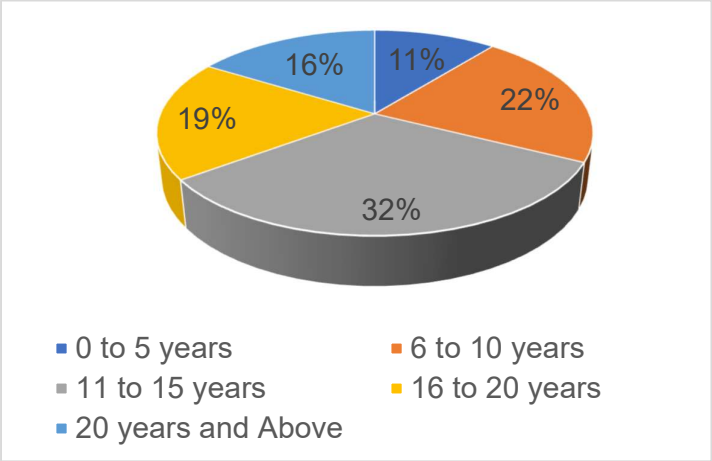

Figure 4.2: *Profile of respondents' work experience in the construction industry*

4.4.2 Respondent's level of highest academic qualification

Figure 4.3 shows that 76% of the respondents had a built environment bachelor's degree and above. The high number of graduates can be attributed to the high standard of specifications set by the client for functionality/quality criteria on the bid documents. Based on the percentage number of respondents with a bachelors degree and above, it can be reasonably deduced that the participants have relevant knowledge of both the theoretical and practical aspects of road construction. Hence, the data collected for the study can be assumed to be highly credible.

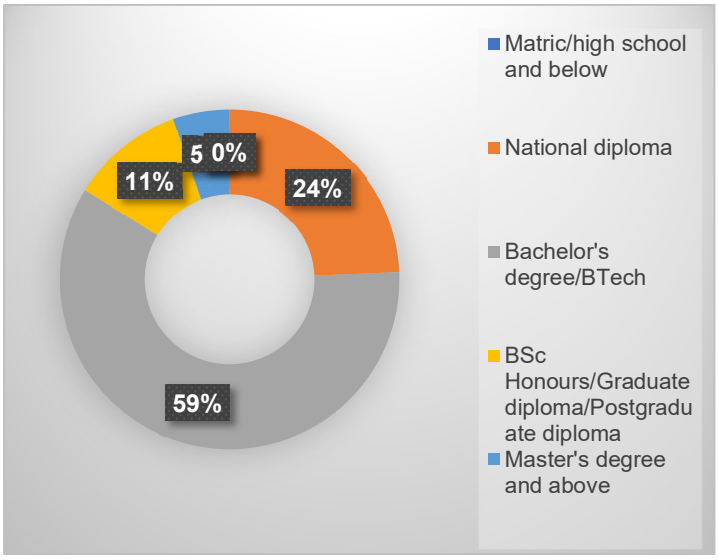

Figure 4.3: Profile of respondents' highest level of academic qualification

4.4.3 Respondent's professional registration status

Figure 4.4 shows that 52% of the participants were registered with built environment bodies as professional practitioners. Registered professionals in the built environment are compelled by their respective codes of conduct to act at all material times with high levels of honesty and integrity. This finding further reinforces the credibility of the data collected for the study.

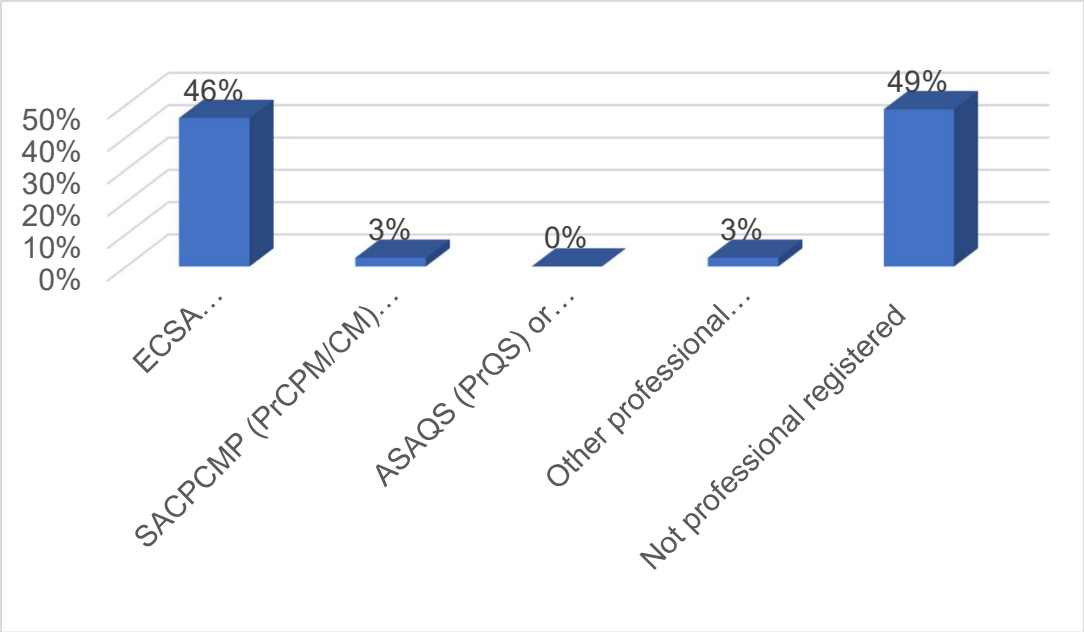

Figure 4.4: Respondents' professional registration status

4.5 FACTORS AFFECTING TIME AND COST OVERRUN BASED ON RII METHOD

Table 4.8 summarises the detailed computations performed on the hierarchical assessment of the factors contributing to the time and cost overruns in road construction projects in a metropolitan municipality based on the RII method. It is reported in full in Appendix E.

Four factors were ranked among the top ten factors causing time and cost overruns by all the respondent groups. These factors are:

- community disruptions;
- labour unrest;
- the appointment of contractors with political clout; and
- poor cost planning, monitoring and control.

The following four subsections present and discuss the hierarchical assessment of the top ten factors computed from the responses of the different participant groups.

4.5.1 Top ten combined perceptions of all respondent groups

The aggregate views of the participants as depicted in Table 4.8 suggest that the appointment of contractors with political clout (RII = 0.892) is the main cause of time and cost overruns in road construction projects. The second-ranking factor is community disruptions (RII = 0.887); the third-ranking factor is labour unrest (RII = 0.878); two factors are ranked as fourth, namely, subcontracting challenges (dispute and performance, RII = 0.865) and contractor's cash flow (RII = 0.865); the sixth-ranking factor is poor cost planning, monitoring and control (RII = 0.829); two factors are tied at the seventh position, namely, the under-pricing of the work due to overconfidence in own ability (RII = 0.815) and corruption (RII = 0.815); the ninth-ranking factor is unproductivity of the labour force (RII = 0.811); and lastly, under-pricing of the work due to strategic misrepresentation (RII = 0.806) was ranked tenth.

The presence of factors such as the appointment of contractors with political clout, subcontracting challenges, and corruption in the top ten are not surprising findings. These factors are underpinned by a widespread societal problem of political patronage and endemic corruption. The cadre deployment system being practised in South Africa in general results in political appointments which then becomes enablers within the system. According to the transparency international report of 2019, South Africa was ranked number 70 out of 180 of the least corrupt nations, and its corruption index was relatively high at 44 out of 100, where 100 represents a very clean score (Trading Economics, 2020).

Dolage and Rathnamali (2013) argue that contractors' cash flow challenges are partly emanating from clients' tendency of overlooking the financial status or rating of contractors and focusing only on the bid price during the tendering period. Cash flow challenges are further compounded by the client's failure to pay contractors on time, hence, slowing progress on-site (ibid, 2013). The delayed payment of interim certificates was identified in this study as one of the critical variables causing delays.

Generally, these findings collaborate the results of Sibiya et al. (2015), Mashwama et al. (2018), Seboru (2015), Shimete and Wall (2016) and Ayudhya (2011). These studies all found that contractor's cash flow, community disruptions, subcontracting challenges and progress payments were some of the leading causes of time and cost overruns in construction projects. Conversely, the results contradict the findings of

Mukuka et al. (2015), Mulenga and Bekker (2015), and Kamanga and Steyn (2013) who found a completely different set of ten crucial variables.

Closer inspection of the results reported in Table 4.8 makes clear that contractor-related factors constituted 70% (7 out of 10) of the ten top factors identified in this subsection, followed by externally related factors at 20% (2 out of 10), and resources-related factors at 10% (1 out of 10). In concert with the above finding, Akogbe, Feng and Zhou (2013) concluded that contractor-related factors constituted 50% of the main factors identified in their evaluation of factors causing construction projects delays in Benin. In contrast, Baloyi and Bekker (2011) found that client-related factors were the main contributors of time and cost overruns in World Cup stadia projects in South Africa.

4.5.2 Top ten factors as perceived by the client group

The data presented in Table 4.8 shows that the project managers of the clients perceive community disruptions (RII = 0.938) to be the main cause of the poor performance of projects. It is followed by two factors in second place: labour unrest (RII = 0.875) and subcontracting challenges (dispute and performance, RII = 0.875). The fourth rank is occupied by contractor's cash flow (RII = 0.854). The fifth rank is shared by two factors: bureaucracy in client's administration (RII = 0.813) and appointment of contractors with political clout (RII = 0.813). The seventh rank is also occupied by two factors: poor cost planning, monitoring and control (RII = 0.792) and contract claims (RII = 0.792). Finally, three factors share the ninth ranking position: delays in progress payments (RII= 0.771), the appointment of incompetent service providers (RII = 0.771) and unproductivity of labour force (RII = 0.771). Because of the three-way tie at ninth place, the top ten factors for this category include an extra factor. Contractor-related factors constitute 45.45% (5 out of 11) of the ten top factors identified in this subsection, followed by client-related factors at 27.27% (3 out of 11), and resources-related, externally related and contract-related factors each at 9.09% (1 out of 11).

It can be conjectured that some of the above-reported factors are manifest of the prevailing economic hardships in the country. A further inference can be made based on the MMM audit report of 2018/19; namely, that the delays in progress payments are

caused by the financial distress and/or misappropriation of capital grants to fund operational activities (AGSA, 2019).

The findings for this group collaborate the results of Mukuka et al. (2015), Dolage and Rathnamali (2013), and Adugna (2015), who identified contractor's cash flow, labour unrest, unproductivity of the labour force, and delays in progress payments by the client as some of the main reasons causing poor performance of projects.

4.5.3 Top ten factors as perceived by the consultant group

Table 4.8 reveals that the top ten factors contributing cost and time overruns for the consultant group include five of the same factors as for the client group. These are contractor's cash flow; the appointment of contractors with political clout; labour unrest, community disruptions; and poor cost planning, monitoring and control. However, in contrast to the perceptions of the client group, contractor's cash flow (RII = 0.967) is ranked as the most significant factor affecting the performance of the road projects for the consultant group.

Contractor's cashflow factor is followed in the second rank by the appointment of contractors with political clout (RII = 0.933). Labour unrest (RII = 0.922), community disruptions (RII = 0.922) and the lack of experience on similar work (RII = 0.922) jointly occupy the third-ranking position. The under-pricing of work due to overconfidence in own ability (RII = 0.911) and corruption (RII = 0.911) are jointly ranked the sixth most important factors. The eighth rank is jointly occupied by poor planning and scheduling of work (RII = 0.900) and unproductivity of the labour force (RII = 0.900). Lastly, poor cost planning, monitoring and control (RII = 0.889) was ranked tenth.

Similar to the findings for all responders and the client group, contractor-related factors contributed the highest number of factors with a total percentage 70% (7 out of 10), followed by externally related factors at 20% (2 out of 10) and resources-related factors with 10% (1 out of 10).

The findings for this group are in concert with the results found by Seboru (2015), Adugna (2015) and Assaf and Al-Hejji (2006), who concluded that contractor's cash flow, progress payment by the client, subcontracting challenges, and unproductivity of the labour force were among the top ten significant factors identified by consultants.

However, these findings are not consistent with the findings of Al-Najjar (2008) that major disputes and negotiations, delay of material delivery to site, and poor site management were the main factors identified by consultants.

4.5.4 Top ten factors as perceived by the contractor group

From the top ten factors according to the contractor group, five factors match those of the client group, and six factors match those of the consultant group, albeit with a different hierarchical order. As per Table 4.8, the contractor group ranked the top ten factors as follows: the appointment of contractors with political clout (RII = 0.893) was ranked in the number one position; subcontracting challenges (dispute and performance, RII = 0.845) was ranked in the second position; appointment of consultants with political clout (RII = 0.833) and labour unrest (RII = 0.833) were jointly ranked in the third position; the fifth-ranking position is jointly occupied by community disruptions (RII = 0.821) and corruption (RII = 0.821); the under-pricing of work due to strategic misrepresentation (RII = 0.810) and poor communication and co-ordination between parties (RII = 0.810) are jointly ranked seventh; slow decision making by client (RII = 0.798) is ranked ninth; and, finally, the three factors jointly ranked the tenth most important factors are delays in progress payments (RII = 0.786), under-pricing of the work due to overconfidence in own ability (RII = 0.786), and poor cost planning, monitoring and control (RII = 0.786).

The contractor-related factors, just like in the client group, contributed 50% to the ten top crucial factors identified, followed by client-related factors at 25%, externally related factors at 17%, and contract-related factors at 8%.

Similarly to the consultant group, the findings for the contractor group are congruent with those of Seboru (2015), Adugna (2015), and Assaf and Al-Hejji (2006) in terms of contractors' views on project delays and budget overspending.

Table 4.8: Ranking of factors affecting time and cost overruns based on RII

Factor code	Factors causing time and cost overrun	Aggregate		Client		Consultant		Contractor	
		RII	Rank	RII	Rank	RII	Rank	RII	Rank
Client-related group									
1.1	Lack of project funding (budget)	0.577	55	0.542	49	0.589	56	0.583	57
1.2	Delays in progress payments	0.797	11	0.771	9	0.822	14	0.786	10
1.3	Client interference	0.626	49	0.646	24	0.556	58	0.69	35
1.4	Slow decision making by client	0.752	19	0.688	18	0.744	27	0.798	9
1.5	Unresolved land ownership	0.559	59	0.479	58	0.622	51	0.536	59
1.6	Appointment of incompetent service providers	0.766	17	0.771	9	0.811	19	0.714	29
1.7	Interest payment on overdue claims	0.518	61	0.521	53	0.533	60	0.5	61
1.8	Increase in scope of work	0.667	41	0.667	20	0.7	35	0.631	50
1.9	Bureaucracy in client's administration	0.784	15	0.813	5	0.822	14	0.726	25
1.10	Delays in handing over site	0.617	52	0.604	35	0.678	39	0.56	58
1.11	Change of specifications	0.631	48	0.604	35	0.667	43	0.607	54

Factor code	Factors causing time and cost overrun	Aggregate		Client		Consultant		Contractor	
		RII	Rank	RII	Rank	RII	Rank	RII	Rank
Consultant-related group									
2.1	Incomplete design information at tender stage	0.707	27	0.646	24	0.689	37	0.762	16
2.2	Design mistakes	0.68	37	0.625	30	0.622	51	0.774	13
2.3	Design changes	0.703	31	0.708	17	0.7	35	0.702	33
2.4	Delay in issuing approvals on site (tests and inspections)	0.617	52	0.542	49	0.6	54	0.679	38
2.5	Inflexibility (rigid) consultant	0.613	54	0.438	61	0.667	43	0.655	43
2.6	Failure to give practical solutions on site	0.658	43	0.479	58	0.667	43	0.75	19
2.7	Unrealistic contract duration estimate	0.671	40	0.604	35	0.644	47	0.738	21
2.8	Inaccurate bill of quantities	0.707	27	0.625	30	0.689	37	0.774	13
2.9	Slow decision-making	0.716	25	0.604	35	0.722	31	0.774	13
2.10	Incomplete designs at the start of construction stage	0.68	37	0.583	44	0.678	39	0.738	21
2.11	Inexperience consultant’s team	0.644	44	0.583	44	0.633	50	0.69	35
2.12	Appointment of consultant with political clout	0.788	14	0.604	35	0.844	13	0.833	3

Factor code	Factors causing time and cost overrun	Aggregate		Client		Consultant		Contractor	
		RII	Rank	RII	Rank	RII	Rank	RII	Rank
Contractor-related group									
3.1	Labour unrest	0.878	3	0.875	2	0.922	3	0.833	3
3.2	Subcontracting challenges (dispute and performance)	0.865	4	0.875	2	0.878	11	0.845	2
3.3	Contractor's cashflow	0.865	4	0.854	4	0.967	1	0.762	16
3.4	Lack of site management and supervision	0.748	20	0.729	16	0.822	14	0.679	38
3.5	Re-work due to errors during construction	0.725	24	0.75	12	0.778	20	0.655	43
3.6	Poor planning and scheduling of work	0.793	12	0.75	12	0.9	8	0.702	33
3.7	Lack of experience on similar work	0.793	12	0.646	24	0.922	3	0.738	21
3.8	Under-pricing of the work due to overconfidence in own ability	0.815	7	0.688	18	0.911	6	0.786	10
3.9	Outdated construction methods	0.626	49	0.583	44	0.6	54	0.679	38
3.10	Appointment of contractors with political clout	0.892	1	0.813	5	0.933	2	0.893	1
3.11	Under-pricing of the work due to strategic misrepresentation	0.806	10	0.667	20	0.878	11	0.81	7
3.12	Poor cost planning, monitoring and control	0.829	6	0.792	7	0.889	10	0.786	10
3.13	Termination of contract and appointment of another contractor to finish the work	0.766	17	0.75	12	0.822	14	0.714	29

Factor code	Factors causing time and cost overrun	Aggregate		Client		Consultant		Contractor	
		RII	Rank	RII	Rank	RII	Rank	RII	Rank
Contractor-related group continued…									
3.14	Contractor's ownership of the critical construction equipment for work continuity	0.743	21	0.646	24	0.778	20	0.762	16
Resources-related group									
4.1	Shortage of skilled labourers	0.694	32	0.604	35	0.756	26	0.679	38
4.2	Unproductivity of labour force	0.811	9	0.771	9	0.9	8	0.738	21
4.3	Shortage of materials	0.689	34	0.604	35	0.778	20	0.643	49
4.4	Delay in material and equipment delivery	0.707	27	0.625	30	0.778	20	0.679	38
4.5	Shortage of equipment	0.694	32	0.646	24	0.778	20	0.631	50
4.6	Low productivity of equipment	0.689	34	0.646	24	0.744	27	0.655	43
4.7	Material price increases	0.635	46	0.521	53	0.644	47	0.69	35
4.8	Equipment rental rate increases	0.626	49	0.542	49	0.644	47	0.655	43
4.9	Increase in labour rates	0.572	57	0.521	53	0.567	57	0.607	54
4.10	High cost of skilled labour	0.554	60	0.5	57	0.544	59	0.595	56

Factor code	Factors causing time and cost overrun	Aggregate		Client		Consultant		Contractor	
		RII	Rank	RII	Rank	RII	Rank	RII	Rank
Externally related group									
5.1	Community disruptions	0.887	2	0.938	1	0.922	3	0.821	5
5.2	Environmental issues	0.635	46	0.583	44	0.667	43	0.631	50
5.3	Inclement weather	0.64	45	0.667	20	0.611	53	0.655	43
5.4	Regulatory changes	0.568	58	0.542	49	0.522	61	0.631	50
5.5	Unforeseen site condition	0.716	25	0.667	20	0.711	33	0.75	19
5.6	Accident during construction	0.577	55	0.479	58	0.678	39	0.524	60
5.7	Corruption	0.815	7	0.625	30	0.911	6	0.821	5
Contract-related group									
6.1	Errors	0.689	34	0.521	53	0.744	27	0.726	25
6.2	Discrepancies and omissions in contract document	0.68	37	0.604	35	0.678	39	0.726	25
6.3	Contract dispute and negotiations	0.707	27	0.583	44	0.767	25	0.714	29
6.4	Change of specifications	0.667	41	0.604	35	0.711	33	0.655	43
6.5	Penalties ineffective and/or not administered	0.73	23	0.75	12	0.722	31	0.726	25
6.6	Poor communication and co-ordination between parties	0.775	16	0.625	30	0.822	14	0.81	7
6.7	Contract claims	0.743	21	0.792	7	0.744	27	0.714	29

4.6 FACTORS AFFECTING TIME AND OVERRUN BASED ON IMPI METHOD

Table 4.9 summarises the detailed computations performed on the hierarchical assessment of the factors contributing to the time and cost overruns in road construction projects in a metropolitan municipality using the IMPI method. It is reported in full in Appendix F.

In-depth scrutiny of Table 4.9 indicates that a total of seven factors (70%) were ranked among the top ten factors affecting projects' performance for all the groups. These factors are community disruptions, labour unrest, the appointment of contractors with political clout, contractor's cash flow, delays in progress payments, subcontracting challenges (dispute and performance), and corruption. The results indicate a high degree of consensus between the groups. On the contrary, a similar study conducted by Adugna (2015) at eThekwini Municipal Area found that only three factors (30%) were common among the respondent groups.

The four subsections that follow discuss the hierarchical order of the top ten factors as identified by different respondent groups.

4.6.1 Top ten combined perceptions of all respondent groups

The combined perceptions of the participants as portrayed in Table 4.9 indicate that delays in progress payments (IMPI = 0.661) is ranked as the most significant factor causing unsatisfactory performance in construction projects. It is followed, in descending order of importance, by: contractor's cash flow (IMPI = 0.660), corruption (IMPI = 0.648), the appointment of contractors with political clout (IMPI = 0.643), community disruptions (IMPI = 0.612), subcontracting challenges (dispute and performance, IMPI = 0.593), labour unrest (IMPI = 0.588), under-pricing of the work due to strategic misrepresentation (IMPI = 0.556), the appointment of incompetent service providers (IMPI = 0.531), and, finally, the appointment of consultants with political clout.

In a similar study, Adugna (2015) also found three of these top ten factors to be crucial variables contributing to time and cost overruns at the eThekwini municipal area. These three factors are delays in progress payments, contractor's cash flow, and subcontracting challenges. These findings also corroborate the findings of Mashwama

et al. (2018) on the performance of the construction projects in the Gauteng Province and the findings of Sibiya et al. (2015) for South Africa broadly.

Similarly to the RII method, the contractor-related factors constitute 50% (5 out of 10) of the ten top factors identified in this subsection, followed by client-related and externally related factors each at 20% (2 out of 10) and consultant-related factors at 10% (1 out of 10). The findings of this study confirm the findings of Akogbe et al. (2013) that contractor-related factors are the main contributors to the unsatisfactory performance of construction projects.

4.6.2 Top ten factors as perceived by the client group

The analysis of the data presented in Table 4.9 reveals that the client group perceives contractor's cash flow (IMPI = 0.489) as the main factor contributing to the poor performance of road projects. It is followed in descending order of importance by the following factors: delays in progress payments (IMPI= 0.473), labour unrest (IMPI = 0.471), community disruptions (IMPI = 0.455), bureaucracy in client's administration (IMPI = 0.453), subcontracting challenges (dispute and performance, IMPI = 0.438), corruption (IMPI = 0.405), penalties ineffective and/or not administered (IMPI = 0.391), appointment of contractors with political clout (IMPI = 0.390), and lastly, unproductivity of the labour force (IMPI = 0.374).

It can be observed from Table 4.9 that contractor-related factors contribute the majority of the factors at 40% (4 out of 10), followed by client-related and externally related factors each with 20% (2 out of 10), and resources-related and contract-related factors each with 10% (1 out of 10).

These findings are comparable to those of studies conducted by Dolage and Rathnamali (2013), Alinaitwe et al. (2013) and Adugna (2015), who also identified contractor's cash flow, labour unrest and unproductivity of the labour force as reasons for poor performance.

4.6.3 Top ten factors as perceived by the consultant group

Of the top ten factors as rated by the consultant group, 80% (8 out 10) were also included in the top ten of the client group, though in a different hierarchical order of importance. As for the client group, the first raking for the consultant group is also

contractor's cash flow (IMPI = 0.736). It is followed in descending order of importance by: the appointment of contractors with political clout (IMPI = 0.715), corruption (IMPI = 0.679), delays in progress payments (IMPI = 0.670), community disruptions (IMPI = 0.631), under-pricing of the work due to strategic misrepresentation (IMPI = 0.618), labour unrest (IMPI = 0.582), unproductivity of labour force (IMPI = 0.578), under-pricing of the work due to overconfidence in own ability (IMPI = 0.564), and lastly subcontracting challenges (dispute and performance, IMPI = 0.555).

The data presented in Table 4.9 indicate that contractor-related factors constitute 60% (6 out of 10) of the ten top factors identified in this subsection, followed by externally-related factors at 20% (2 out of 10), and client-related and resources-related factors each with 10% (1 out of 10).

Studies conducted by Assaf and Al-Hejji (2006), Kassa (2020), Jongo et al. (2019) and Adugna (2015) also found that contractor's cash flow, delays in progress payment, unproductivity of the labour force, and subcontracting challenges were some of the prime factors affecting the performance of construction projects according to consultants. In contrast, the findings of the study do not agree with those obtained by Mukuka et al. (2015) in their study to assess the effects of construction project overruns in the Gauteng Province of South Africa. Mukuka et al. (2015) concluded that contract disputes, poor quality of work due to hurrying the project, and contract claims were the most significant factors causing overruns in construction projects according to the consultant group.

4.6.4 Top ten factors as perceived by the contractor group

Seventy per cent (7 out of 10) of the top ten factors identified by the client group and eighty per cent (8 out of 10) identified by the consultant group were also identified by the contractor group as the main cause of time and cost overruns in road projects. For the contractor group, delays in progress payments (IMPI = 0.772) and corruption are jointly ranked as the number one factors contributing to the poor performance of projects. They are followed in descending order of importance by: subcontracting challenges (dispute and performance, IMPI = 0.734) and appointment of contractors with political clout (IMPI = 0.734); appointment of consultants with political clout (IMPI = 0.721); community disruptions (IMPI = 0.687); contractor's cash flow (IMPI = 0.685);

and, lastly, three factors jointly in the eighth position, namely, labour unrest (IMPI = 0.663), under-pricing of the work due to strategic misrepresentation (IMPI = 0.663), and poor communication and co-ordination between parties (IMPI = 0.663).

The contractors identified contractor-related factors as the main cause of poor project performance. A total of five factors in the top ten identified factors belong to the contractor-related category. It is followed by externally related factors at 20% (2 out of 10), and client-, consultant- and contract-related factors each at 10% (1 out of 10). In accordance with the observations made for the RII method, the perceptions of contractors examined using the IMPI method yields similar results to the findings of studies conducted by Dolage and Rathnamali (2013), Assaf and Al-Hejji (2006), and Adugna (2015).

Table 4.9: *Ranking of factors affecting time and cost overruns based on IMPI*

Factor code	Factors causing time and cost overrun	Aggregate		Client		Consultant		Contractor	
		IMPI	Rank	IMPI	Rank	IMPI	Rank	IMPI	Rank
Client-related group									
1.1	Lack of project funding (budget)	0.481	16	0.302	20	0.469	18	0.617	14
1.2	Delays in progress payments	0.661	1	0.473	2	0.67	4	0.772	1
1.3	Client interference	0.382	27	0.236	35	0.352	32	0.519	17
1.4	Slow decision making by client	0.508	13	0.36	11	0.517	14	0.592	15
1.5	Unresolved land ownership	0.178	61	0.114	61	0.2	57	0.188	61
1.6	Appointment of incompetent service providers	0.531	9	0.358	12	0.546	11	0.627	11
1.7	Interest payment on overdue claims	0.22	57	0.214	42	0.178	61	0.272	56
1.8	Increase in scope of work	0.316	39	0.249	32	0.329	37	0.341	46
1.9	Bureaucracy in client's administration	0.525	11	0.453	5	0.518	13	0.572	16
1.10	Delays in handing over site	0.236	56	0.249	32	0.199	58	0.266	57
1.11	Change of specifications	0.282	48	0.27	26	0.284	47	0.284	52

Factor code	Factors causing time and cost overrun	Aggregate		Client		Consultant		Contractor	
		IMPI	Rank	IMPI	Rank	IMPI	Rank	IMPI	Rank
Consultant-related group									
2.1	Incomplete design information at tender stage	0.328	35	0.263	27	0.299	40	0.398	35
2.2	Design mistakes	0.315	40	0.225	38	0.284	47	0.406	32
2.3	Design changes	0.315	40	0.276	25	0.29	44	0.362	42
2.4	Delay in issuing approvals on site (tests and inspections)	0.287	47	0.191	45	0.258	51	0.377	39
2.5	Inflexibility (rigid) consultant	0.247	54	0.13	60	0.213	56	0.36	43
2.6	Failure to give practical solutions on site	0.292	45	0.14	58	0.308	38	0.382	37
2.7	Unrealistic contract duration estimate	0.406	22	0.289	22	0.287	45	0.626	13
2.8	Inaccurate bill of quantities	0.363	29	0.213	44	0.365	29	0.463	23
2.9	Slow decision-making	0.401	24	0.191	45	0.451	21	0.496	20
2.10	Incomplete designs at the start of construction stage	0.328	35	0.238	34	0.298	43	0.414	29
2.11	Inexperience consultant’s team	0.383	26	0.25	29	0.355	31	0.496	20
2.12	Appointment of consultant with political clout	0.528	10	0.345	13	0.464	19	0.721	5

Factor code	Factors causing time and cost overrun	Aggregate		Client		Consultant		Contractor	
		IMPI	Rank	IMPI	Rank	IMPI	Rank	IMPI	Rank
Contractor-related group									
3.1	Labour unrest	0.588	7	0.471	3	0.582	7	0.663	8
3.2	Subcontracting challenges (dispute and performance)	0.593	6	0.438	6	0.555	10	0.734	3
3.3	Contractor's cashflow	0.66	2	0.489	1	0.736	1	0.685	7
3.4	Lack of site management and supervision	0.442	18	0.344	14	0.51	16	0.43	25
3.5	Re-work due to errors during construction	0.392	25	0.289	22	0.443	23	0.4	34
3.6	Poor planning and scheduling of work	0.416	19	0.316	17	0.512	15	0.375	40
3.7	Lack of experience on similar work	0.377	28	0.214	42	0.491	17	0.364	41
3.8	Under-pricing of the work due to overconfidence in own ability	0.512	12	0.261	28	0.564	9	0.627	11
3.9	Outdated construction methods	0.256	51	0.131	59	0.343	33	0.253	58
3.10	Appointment of contractors with political clout	0.643	4	0.39	9	0.715	2	0.734	3
3.11	Under-pricing of the work due to strategic misrepresentation	0.556	8	0.302	20	0.618	6	0.663	8
3.12	Poor cost planning, monitoring and control	0.48	17	0.344	14	0.538	12	0.505	18
3.13	Termination of contract and appointment of another contractor to finish the work	0.295	44	0.236	35	0.334	35	0.284	52
3.14	Contractor's ownership of the critical construction equipment for work continuity	0.409	20	0.25	29	0.451	21	0.469	22

Factor code	Factors causing time and cost overrun	Aggregate		Client		Consultant		Contractor	
		IMPI	Rank	IMPI	Rank	IMPI	Rank	IMPI	Rank
Resources-related group									
4.1	Shortage of skilled labourers	0.408	21	0.316	17	0.44	24	0.429	26
4.2	Unproductivity of labour force	0.503	14	0.374	10	0.578	8	0.503	19
4.3	Shortage of materials	0.339	34	0.17	52	0.381	28	0.408	30
4.4	Delay in material and equipment delivery	0.322	37	0.18	50	0.412	25	0.323	48
4.5	Shortage of equipment	0.359	30	0.226	37	0.409	26	0.388	36
4.6	Low productivity of equipment	0.291	46	0.191	45	0.342	34	0.297	51
4.7	Material price increases	0.277	50	0.18	50	0.307	39	0.307	49
4.8	Equipment rental rate increases	0.244	55	0.16	55	0.239	53	0.3	50
4.9	Increase in labour rates	0.22	57	0.159	56	0.199	58	0.282	54
4.10	High cost of skilled labour	0.25	53	0.15	57	0.236	54	0.333	47

Factor code	Factors causing time and cost overrun	Aggregate		Client		Consultant		Contractor	
		IMPI	Rank	IMPI	Rank	IMPI	Rank	IMPI	Rank
Externally related group									
5.1	Community disruptions	0.612	5	0.455	4	0.631	5	0.687	6
5.2	Environmental issues	0.252	52	0.191	45	0.259	50	0.276	55
5.3	Inclement weather	0.311	42	0.25	29	0.299	40	0.357	44
5.4	Regulatory changes	0.198	60	0.169	54	0.188	60	0.219	59
5.5	Unforeseen site condition	0.34	33	0.303	19	0.299	40	0.403	33
5.6	Accident during construction	0.204	59	0.17	52	0.217	55	0.202	60
5.7	Corruption	0.648	3	0.405	7	0.679	3	0.772	1
Contract-related group									
6.1	Errors	0.344	32	0.181	49	0.358	30	0.437	24
6.2	Discrepancies and omissions in contract document	0.317	38	0.225	38	0.287	45	0.408	30
6.3	Contract dispute and negotiations	0.296	43	0.225	38	0.261	49	0.379	38
6.4	Change of specifications	0.281	49	0.223	41	0.256	52	0.347	45
6.5	Penalties ineffective and/or not administered	0.402	23	0.391	8	0.388	27	0.422	28
6.6	Poor communication and co-ordination between parties	0.501	15	0.331	16	0.46	20	0.663	8
6.7	Contract claims	0.357	31	0.289	22	0.333	36	0.427	27

4.7 COMPARISON OF RII AND IMPI RANKING RESULTS

According to the IMPI method (Table 4.9), the top ten factors for the different respondent groups have a total of seven factors (70%) in common. However, according to the RII method (Table 4.9), the top ten factors for the different groups only share four factors. The appointment of contractors with political clout was identified as the most critical factor by all respondents using the RII method, whereas the IMPI method identified delays in progress payments as the main cause of time and cost overruns.

When the collective views of all respondents are considered, the RII and IMPI methods yield 70% (7 out of 10) similar factors. These factors are contractor's cash flow, corruption, the appointment of contractors with political clout, community disruptions, subcontracting challenges (dispute and performance), labour unrest, and under-pricing of the work due to strategic misrepresentation. When comparing the rankings for the client group, the two methods produce eight factors in common (80% similarity). These factors are contractor's cash flow, delays in progress payments, labour unrest, community disruptions, bureaucracy in client's administration, subcontracting challenges (dispute and performance), the appointment of contractors with political clout, and unproductivity of labour force.

For the consultant group, contractor's cash flow was ranked number one and the appointment of contractors with political clout was ranked second using both the RII and IMPI methods. In addition, when both methods are employed independently, 70% (7 out of 10) of the factors are similar for the consultant group, and 90% (9 out of 10) are similar for the contractor group.

The RII and IMPI were compared from the viewpoint of inferential statistics using the Spearman's rank correlation coefficient. The results, depicted in Table 4.10, were rs = 0.86, 0.81, 0.82, & 0.79, with a significance level/critical value of 0.213. It suggests that there is a statistically significant strong positive relationship between the two methods across all the respondent groups. Put differently; the results indicate that there is 95% certainty of a relationship between the two methods. Hence sound conclusions can be drawn from these findings. The detailed computations of the Spearman's rank correlation coefficients for the two methods are presented in Appendix G.

The above findings are similar to those of Desai and Bhatt (2013), who found that the RII and IMPI methods produced 60% (6 out of 10) similar results. They also found that the correlation between the two methods was 0.633, signifying a significant strong positive relationship between the two methods.

Table 4.10: Correlation of the ranking of variables between RII and IMPI methods

Item description	**Aggregate**	**Client**	**Consultant**	**Contractor**	**Significance level/critical value α = 0.05**
	RII vs IMPI				
Spearman's rank correlation coefficient (rs)	0.86	0.81	0.82	0.79	0.213

4.8 WEIGHTED RII AND IMPI RANKING RESULTS

The combined rankings of the factors that affect time and cost overruns were obtained by averaging the indexes of both the RII and IMPI methods. The following four subsections present the hierarchical order of the top ten factors obtained by averaging the RII and IMPI indexes for the different respondent groups.

4.8.1 Top ten combined perceptions of all respondent groups

The combined perceptions of the participants as shown in Table 4.11 indicate that the appointment of contractors with political clout (RII + IMPI = 0.768) was ranked by all the parties as the most significant factor causing poor performance of construction projects. Contractor's cash flow (RII + IMPI = 0.763) was ranked second; community disruptions (RII + IMPI = 0.750) third; labour unrest (RII + IMPI = 0.733) fourth; corruption (RII + IMPI = 0.732) fifth; delays in progress payments (RII + IMPI = 0.729) and subcontracting challenges (dispute and performance, RII + IMPI = 0.593) jointly sixth; under-pricing of work due to strategic misrepresentation (RII + IMPI = 0.681) eighth; under-pricing of the work due to overconfidence in own ability (RII + IMPI = 0.664) ninth; and appointment of consultants with political clout (RII + IMPI = 0.658) tenth.

The consolidated aggregate results of the top ten factors obtained by averaging the indexes of the RII and IMPI methods as shown in Table 4.11 are 80% and 90% similar to the individual results of the RII method depicted in Table 4.8 and the IMPI method depicted in Table 4.9. Contractor-related factors account for 60% (6 out of 10) of the top ten factors identified in this section, followed by externally related factors at 20%, client-related and consultant-related factors at 10% each, and resources-related and contract-related with zero each.

4.8.2 Top ten factors as perceived by the client group

Table 4.11 shows that the client group perceived community disruptions (RII + IMPI = 0.697) as the most critical factor causing unsatisfactory project performance in the municipality. It is followed in descending order of importance by labour unrest (RII + IMPI = 0.673), contractor's cashflow (RII + IMPI = 0.672), subcontracting challenges (dispute and performance, RII + IMPI = 0.657), bureaucracy in client's administration (RII + IMPI = 0.633), delays in progress payments (RII + IMPI = 0.622), appointment of contractor's with political clout (RII + IMPI = 0.602), unproductivity of the labour force (RII + IMPI = 0.573), penalties ineffective and/or not administered (RII + IMPI = 0.571), and, lastly, poor cost planning, monitoring and control (RII + IMPI = 0.568).

The client group's perceptions of the top ten factors obtained by averaging the indexes of the RII and IMPI methods, as shown in Table 4.11, are 90% similar to both the independent results of the RII method depicted in Table 4.8 and the IMPI method depicted in Table 4.9. Contractor-related factors account for 50% (5 out of 10) of the top ten factors identified in this subsection, followed by client-related factors at 20%, and resources-related, externally related and contract-related factors each at 10% (1 out of 10).

4.8.3 Top ten factors as perceived by the consultant group

According to the weighted RII and IMPI ranking, contractor's cash flow (RII + IMPI = 0.852) was the top variable affecting project performance for the consultant group. It is followed in descending order of importance by: the appointment of contractors with political clout (RII + IMPI = 0.824), corruption (IMPI = 0.795), community disruptions (RII + IMPI = 0.777), labour unrest (RII + IMPI = 752), under-pricing of the work due to

strategic misrepresentation (RII + IMPI = 0.748), delays in progress payments (RII + IMPI = 0.746), unproductivity of the labour force (RII + IMPI = 0.739), under-pricing of the work due to overconfidence in own ability (RII + IMPI = 0.738), and subcontracting challenges (dispute and performance, RII + IMPI = 0.717).

The perceptions of the consultant group obtained by averaging the indexes of the RII and IMPI methods, as shown in Table 4.11, are 70% similar to the independent results of the RII depicted in Table 4.8 and 100% similar to the results of the IMPI method depicted in Table 4.9. Contractor-related factors in this section account for 60% (6 out of 10) of the top ten factors, followed by externally related factors at 20%, and client-related and resources-related factors each with 10% (1 out of 10).

4.8.4 Top ten factors as perceived by the contractor group

The weighted RII and IMPI, as presented in Table 4.11, ranks the appointment of contractors with political clout (RII + IMPI = 0.814) as the number one cause of poor project performance for the contractor group. It is followed in descending order of importance by: corruption (RII + IMPI = 0.797), subcontracting challenges (dispute and performance, RII + IMPI = 0.790), delays in progress payments (RII + IMPI = 0.779), appointment of consultants with political clout (RII + IMPI = 0.777), community disruptions (RII + IMPI = 0.754), labour unrest (RII + IMPI = 0.748), under-pricing of the work due to strategic misrepresentation (RII + IMPI = 0.737), poor communication and co-ordination between parties (RII + IMPI = 0.737), and contractor's cash flow (RII + IMPI = 0.724).

The rankings for the contractor's group according to the weighted RII and IMPI are 90% similar to the independent results of the RII method depicted in Table 4.8 and 100% similar to the results of the IMPI depicted in Table 4.9. As for the client group, contractor-related factors account for 50% (5 out of 10) of the top ten factors identified in this subsection, followed by externally related factors at 20%, and client-related, consultant-related and contract-related factors each at 10%.

Table 4.11: *Ranking of factors affecting time and cost overruns based on weighted RII and IMPI*

Factor code	Factors causing time and cost overruns	Aggregate		Client		Consultant		Contractor	
		RII & IMPI	Rank	RII & IMPI	Rank	RII & IMPI	Rank	RII & IMPI	Rank
Client-related group									
1.1	Lack of project funding (budget)	0.529	29	0.422	37	0.529	32	0.6	22
1.2	Delays in progress payments	0.729	6	0.622	6	0.746	7	0.779	4
1.3	Client interference	0.504	38	0.441	31	0.454	50	0.6045	21
1.4	Slow decision making by client	0.63	16	0.524	15	0.6305	19	0.695	12
1.5	Unresolved land ownership	0.3685	61	0.2965	60	0.411	57	0.362	61
1.6	Appointment of incompetent service providers	0.6485	14	0.5645	11	0.6785	14	0.6705	14
1.7	Interest payment on overdue claims	0.369	60	0.3675	49	0.3555	60	0.386	59
1.8	Increase in scope of work	0.4915	43	0.458	27	0.5145	34	0.486	49
1.9	Bureaucracy in client's administration	0.6545	12	0.633	5	0.67	15	0.649	15
1.10	Delays in handing over site	0.4265	55	0.4265	35	0.4385	55	0.413	58
1.11	Change of specifications	0.4565	48	0.437	32	0.4755	44	0.4455	55

Factor code	Factors causing time and cost overruns	Aggregate		Client		Consultant		Contractor	
		RII & IMPI	Rank	RII & IMPI	Rank	RII & IMPI	Rank	RII & IMPI	Rank
Consultant-related group									
2.1	Incomplete design information at tender stage	0.5175	32	0.4545	28	0.494	38	0.58	26
2.2	Design mistakes	0.4975	42	0.425	36	0.453	51	0.59	24
2.3	Design changes	0.509	37	0.492	19	0.495	37	0.532	38
2.4	Delay in issuing approvals on site (tests and inspections)	0.452	50	0.3665	50	0.429	56	0.528	39
2.5	Inflexibility (rigid) consultant	0.43	54	0.284	61	0.44	54	0.5075	43
2.6	Failure to give practical solutions on site	0.475	46	0.3095	59	0.4875	41	0.566	32
2.7	Unrealistic contract duration estimate	0.5385	26	0.4465	30	0.4655	47	0.682	13
2.8	Inaccurate bill of quantities	0.535	27	0.419	38	0.527	33	0.6185	19
2.9	Slow decision-making	0.5585	22	0.3975	46	0.5865	25	0.635	17
2.10	Incomplete designs at the start of construction stage	0.504	38	0.4105	43	0.488	40	0.576	28
2.11	Inexperience consultant’s team	0.5135	36	0.4165	40	0.494	38	0.593	23
2.12	Appointment of consultant with political clout	0.658	10	0.4745	23	0.654	17	0.777	5

Factor code	Factors causing time and cost overruns	Aggregate		Client		Consultant		Contractor	
		RII & IMPI	Rank	RII & IMPI	Rank	RII & IMPI	Rank	RII & IMPI	Rank
Contractor-related group									
3.1	Labour unrest	0.733	4	0.673	2	0.752	5	0.748	7
3.2	Subcontracting challenges (dispute and performance)	0.729	7	0.6565	4	0.7165	10	0.7895	3
3.3	Contractor's cashflow	0.7625	2	0.6715	3	0.8515	1	0.7235	10
3.4	Lack of site management and supervision	0.595	18	0.5365	13	0.666	16	0.5545	33
3.5	Re-work due to errors during construction	0.5585	22	0.5195	16	0.6105	21	0.5275	40
3.6	Poor planning and scheduling of work	0.6045	17	0.533	14	0.706	13	0.5385	37
3.7	Lack of experience on similar work	0.585	19	0.43	34	0.7065	12	0.551	35
3.8	Under-pricing of the work due to overconfidence in own ability	0.6635	9	0.4745	23	0.7375	9	0.7065	11
3.9	Outdated construction methods	0.441	52	0.357	51	0.4715	46	0.466	52
3.10	Appointment of contractors with political clout	0.7675	1	0.6015	7	0.824	2	0.8135	1
3.11	Under-pricing of the work due to strategic misrepresentation	0.681	8	0.4845	21	0.748	6	0.7365	8
3.12	Poor cost planning, monitoring and control	0.6545	13	0.568	10	0.7135	11	0.6455	16
3.13	Termination of contract and appointment of another contractor to finish the work	0.5305	28	0.493	18	0.578	27	0.499	47

Factor code	Factors causing time and cost overruns	Aggregate		Client		Consultant		Contractor	
		RII & IMPI	Rank	RII & IMPI	Rank	RII & IMPI	Rank	RII & IMPI	Rank
Contractor-related group continued…									
3.14	Contractor's ownership of the critical construction equipment for work continuity	0.576	20	0.448	29	0.6145	20	0.6155	20
Resources-related group									
4.1	Shortage of skilled labourers	0.551	24	0.46	25	0.598	22	0.554	34
4.2	Unproductivity of labour force	0.657	11	0.5725	8	0.739	8	0.6205	18
4.3	Shortage of materials	0.514	35	0.387	47	0.5795	26	0.5255	41
4.4	Delay in material and equipment delivery	0.5145	34	0.4025	45	0.595	23	0.501	45
4.5	Shortage of equipment	0.5265	31	0.436	33	0.5935	24	0.5095	42
4.6	Low productivity of equipment	0.49	44	0.4185	39	0.543	30	0.476	51
4.7	Material price increases	0.456	49	0.3505	55	0.4755	44	0.4985	48
4.8	Equipment rental rate increases	0.435	53	0.351	53	0.4415	53	0.4775	50
4.9	Increase in labour rates	0.396	57	0.34	56	0.383	59	0.4445	56
4.10	High cost of skilled labour	0.402	56	0.325	57	0.39	58	0.464	53

Factor code	Factors causing time and cost overruns	Aggregate		Client		Consultant		Contractor	
		RII & IMPI	Rank	RII & IMPI	Rank	RII & IMPI	Rank	RII & IMPI	Rank
Externally related group									
5.1	Community disruptions	0.7495	3	0.6965	1	0.7765	4	0.754	6
5.2	Environmental issues	0.4435	51	0.387	47	0.463	48	0.4535	54
5.3	Inclement weather	0.4755	45	0.4585	26	0.455	49	0.506	44
5.4	Regulatory changes	0.383	59	0.3555	52	0.355	61	0.425	57
5.5	Unforeseen site condition	0.528	30	0.485	20	0.505	36	0.5765	27
5.6	Accident during construction	0.3905	58	0.3245	58	0.4475	52	0.363	60
5.7	Corruption	0.7315	5	0.515	17	0.795	3	0.7965	2
Contract-related group									
6.1	Errors	0.5165	33	0.351	54	0.551	29	0.5815	25
6.2	Discrepancies and omissions in contract document	0.4985	41	0.4145	41	0.4825	43	0.567	31
6.3	Contract dispute and negotiations	0.5015	40	0.404	44	0.514	35	0.5465	36
6.4	Change of specifications	0.474	47	0.4135	42	0.4835	42	0.501	45
6.5	Penalties ineffective and/or not administered	0.566	21	0.5705	9	0.555	28	0.574	29
6.6	Poor communication and co-ordination between parties	0.638	15	0.478	22	0.641	18	0.7365	8
6.7	Contract claims	0.55	25	0.5405	12	0.5385	31	0.5705	30

4.9 RANKING OF RELATED FACTORS

Each factor in the survey was grouped with related factors that share the same cause. These related factors were grouped as client-related, consultant-related, contractor-related, resources-related, externally related and contract-related.

The importance indexes for each of these related groups were calculated by taking an average of all indexes of subfactors in that group. The results of the group indexes according to the RII, IMPI, and weighted RII and IMPI methods are discussed in the following three subsections.

4.9.1 Ranking of related factors according to RII

Table 4.12 presents a summary of the ranking of the factor groups computed using the RII method. Contractor-related factors are ranked as the leading cause of the poor performance of projects in the municipality overall and independently for all respondent groups. Contract-related factors (RII = 0.713) are second, followed in descending rank order by externally related factors (RII = 0.691), consultant-related factors (RII = 0.682), resources-related factors (RII = 0.667), and client-related factors (RII = 0.663). These findings are inconsistent with the results of Assaf and Al-Hejji (2006), and Yusuf (2019), who all concluded that client-related factors were the main contributors to the poor performance of construction projects.

As per Table 4.12, the ranking for the remaining related factors according to the client perspective is, in descending order of importance: client-related factors (RII = 0.646), externally related factors (RII = 0.643), contract-related factors (RII = 0.640), resources-related factors (RII = 0.598), and consultant-related factors (RII = 0.587). This finding also rebuts the assertion of Assaf and Al-Hejji (2006) that resources-related factors are the most significant variables causing the unsatisfactory performance of construction projects according to the client perspective.

For the consultant group, contractor-related factors are followed by contract-related factors (RII = 0.741), externally related factors (RII = 0.717), resources-related factors (RII = 0.713), client-related factors (RII = 0.686), and consultant-related factors (RII = 0.680. Conversely, for the contractor perspective, consultant-related factors are ranked second (RII = 0.739), contract-related factors third (RII = 0.724), externally related

factors fourth (RII = 0.690), resources-related factors fifth (RII = 0.657), and client-related factors sixth (RII = 0.648).

The finding for the consultant perspective affirms the findings of Assaf and Al-Hejji (2006) that contractor-related factors are ranked first by this group. However, the perceptions of the contractors in this study refute the findings of Assaf and Al-Hejji (2006) that owner-related factors are the most important in terms of contractors' views. This study's findings for the contractor perspective is consonant of that of Assaf and Al-Hejji (2006) in that consultant-related factors are the second most important group of related factors that affect project performance.

Table 4.12: Ranking of related factors based on RII

Factor group	Aggregate		Client		Consultant		Contractor	
	RII	Rank	RII	Rank	RII	Rank	RII	Rank
Client-related	0.663	6	0.646	2	0.686	5	0.648	6
Consultant-related	0.682	4	0.587	6	0.680	6	0.739	2
Contractor-related	0.796	1	0.744	1	0.857	1	0.760	1
Resources-related	0.667	5	0.598	5	0.713	4	0.657	5
Externally related	0.691	3	0.643	3	0.717	3	0.690	4
Contract-related	0.713	2	0.640	4	0.741	2	0.724	3

4.9.2 Ranking of related factors according to IMPI

Table 4.13 encapsulates the rankings of the groups of related factors computed using the IMPI method. Similarly to the RII method, contractor-related factors are ranked as the main factors contributing to the unsatisfactory performance of projects in the metro overall and independently for all respondent groups. Likewise, client-related factors are ranked second place for all participant groups.

For the combined views of the respondent groups, externally related factors (IMPI = 0.366) are ranked third, followed in descending rank order by contract-related factors (IMPI = 0.357), consultant-related factors (IMPI = 0.349), and resources-related factors (IMPI = 0.321). The findings of this research for the aggregate views of the participants are in concert with the conclusion reached by Dolage and Rathnamali (2013) that

contractor-related factors have the prime influence on project performance. Conversely, Adugna (2015) concluded that resources-related factors were perceived by all parties as the prime influencer of the lacklustre performance of projects.

For the client group, the descending rank order of importance are externally related factors (IMPI = 0.278), contract-related factors (IMPI = 0.266), consultant-related factors (IMPI = 0.229), and resources-related factors (IMPI = 0.211). As for the combined views of the respondents mentioned in the previous paragraph, the finding for the client group in this study affirms the findings of Dolage and Rathnamali (2013) and rebuts those of Adugna (2015). According to Adugna (2015), the client group identified resources-related factors as the prime cause of the unsatisfactory performance of construction projects.

For the consultant perspectives, externally related factors are ranked third important (IMPI = 0.367), resources-related factors fourth (IMPI = 0.354), contract-related factors fifth (IMPI = 0.335), and consultant-related factors last (IMPI = 0.323). According to the contractor perspective, however, consultant-related factors are third (IMPI = 0.458), contract-related factors fourth (IMPI = 0.440), externally related factors fifth (IMPI = 0.417), and resources-related factors sixth (IMPI = 0.357). The findings for the consultant perspective agrees with the conclusions of Dolage and Rathnamali (2013), while the findings for the contractor perspective in this study diverge from theirs. They concluded that externally-related factors were the prime cause of the unsatisfactory performance of projects according to the contractor perspective.

Table 4.13: Ranking of related factors based on IMPI

Factor group	Aggregate		Client		Consultant		Contractor	
	IMPI	Rank	IMPI	Rank	IMPI	Rank	IMPI	Rank
Client-related	0.393	2	0.298	2	0.387	2	0.459	2
Consultant-related	0.349	5	0.229	5	0.323	6	0.458	3
Contractor-related	0.473	1	0.320	1	0.528	1	0.513	1
Resources-related	0.321	6	0.211	6	0.354	4	0.357	6
Externally related	0.366	3	0.278	3	0.367	3	0.417	5
Contract-related	0.357	4	0.266	4	0.335	5	0.440	4

4.9.3 Ranking of related factors according to weighted RII and IMPI

Table 4.14 summarises the ranking of related factors computed by averaging the indexes of the RII and IMPI methods. Contractor-related factors are yet again ranked in the first position for each participant group and for the aggregated responses.

For the aggregated responses, contract-related factors are ranked second (RII + IMPI = 0.535), followed in descending rank order by externally related factors (RII + IMPI = 0.529), client-related factors (RII + IMPI = 0.528), consultant-related factors (RII + IMPI = 0.516), and resources-related factors (RII + IMPI = 0.494).

For the client perspective, contractor-related factors are followed in descending rank order of importance by client-related factors (RII + IMPI = 0.472), externally related factors (RII + IMPI = 0.460), contract-related factors (RII + IMPI = 0.453), consultant-related factors (RII + IMPI = 0.408), and resources-related factors (RII + IMPI = 0.404).

For the consultant perspective, contractor-related factors are followed by externally related factors (RII + IMPI = 0.542), contract-related factors (RII + IMPI = 0.538), client-related factors (RII + IMPI = 0.537), resources-related factors (RII + IMPI = 0.534), and consultant-related factors (RII + IMPI = 0.501).

For the contractor perspective, consultant-related factors are ranked second (RII + IMPI = 0.599), contract-related factors third (RII + IMPI = 0.582), client-related factors and externally related factors jointly fourth (RII + IMPI = 0.544), and resources-related factors sixth (RII + IMPI = 0.507).

Table 4.14: Ranking of related factors based on weighted RII and IMPI

Factor group	Aggregate		Client		Consultant		Contractor	
	RII & IMPI	Rank	RII & IMPI	Rank	RII & IMPI	Rank	RII & IMPI	Rank
Client-related	0.528	4	0.472	2	0.537	4	0.554	4
Consultant-related	0.516	5	0.408	5	0.501	6	0.599	2
Contractor-related	0.634	1	0.532	1	0.693	1	0.637	1
Resources-related	0.494	6	0.404	6	0.534	5	0.507	6

Factor group	Aggregate		Client		Consultant		Contractor	
	RII & IMPI	Rank	RII & IMPI	Rank	RII & IMPI	Rank	RII & IMPI	Rank
Externally related	0.529	3	0.460	3	0.542	2	0.554	4
Contract related	0.535	2	0.453	4	0.538	3	0.582	3

4.10 RANKING OF FACTORS WITHIN RELATED GROUPS OF FACTORS

4.10.1 Client-related factors

The data presented in Table 4.15 shows that there is substantial agreement across respondent groups that delays in progress payments, bureaucracy in client's administration, the appointment of incompetent service providers, and slow decision making by the client are the top four client-related factors influencing time and cost overruns in road construction projects at the municipality. For all participant groups, delays in progress payments are ranked as the most important client-related factor. It emphasises the importance of timeous payment of interim certificates to improve project cash flow. As argued previously, the root cause of inconsistent payment to service providers is the dire liquidity profile of the municipality caused by, among others, a poor collection rate and misuse of conditional grants (AGSA, 2019).

According to the AGSA management report of 2019, MMM's financial ratios for debtors' days and creditors' days were, respectively, 314 days and 181 days (AGSA, 2019). It means that it takes MMM 181 days to pay its creditors, which is well above the National Treasury norm of 30 days in terms of the MFMA Circular No. 71. Delays in the payment of creditors impact their cash flow and the progress on site. As a result of this weak liquidity position, the municipality was downgraded twice by Moody's rating Agency in 2019 and put under Administration in terms of Section 139 (5) (a) and (c) of CoRSA.

Delays in progress payment of service providers seem to be a widespread South African problem. The study conducted by Mukuka et al. (2015) in the Gauteng Province also concluded that delays in progress payments were the dominant client-related variable affecting the performance of construction projects. The challenge of payment delays is also not peculiar to South Africa. In Uganda and Ethiopia, Alinaitwe et al.

(2013) and Kassa (2020), respectively, found that delays in the payment of the service providers were one of the factors contributing to the poor performance of projects.

Table 4.15: Ranking of client-related factors

Client-related factors	Aggregate			Client			Consultant			Contractor		
	RII	IMPI	RII+IMPI	RII	IMPI	RII+IMPI	RII	IMPI	RII+IMPI	RII	IMPI	RII+IMPI
Lack of project funding (budget)	9	5	5	9	5	9	9	5	5	8	3	6
Delays in progress payments	1	1	1	2	1	2	1	1	1	2	1	1
Client interference	7	6	6	6	9	6	10	6	8	5	6	5
Slow decision making by client	4	4	4	4	3	4	4	4	4	1	4	2
Unresolved land ownership	10	11	11	11	11	11	8	9	10	10	11	11
Appointment of incompetent service providers	3	2	3	2	4	3	3	2	2	4	2	3
Interest payment on overdue claims	11	10	10	10	10	10	11	11	11	11	9	10
Increase in scope of work	5	7	7	5	7	5	5	7	6	6	7	7
Bureaucracy in client's administration	2	3	2	1	2	1	1	3	3	3	5	4
Delays in handing over site	8	9	9	7	7	8	6	10	9	9	10	9
Change of specifications	6	8	8	7	6	7	7	8	7	7	8	8

4.10.2 Consultant-related factors

Table 4.16 shows that the appointment of consultants with political clout was overwhelming identified as the main consultant-related factor influencing time and cost overruns in projects. The other two factors identified by different respondent groups to be among the top three consultant-related factors are inaccurate bill of quantities and slow decision-making.

The appointment of politically connected consultants can be linked to corrupt activities, identified previously to be among the overall top ten factors contributing to poor project performance. In addition, it can be inferred that the inaccurate bill of quantities can be influenced by the appointment of an incompetent consultant by the client, a client-related factor identified which heavily influences the delivery of the project within the contract terms. According to the Project Management Institute (2008), inaccuracies in project documentation and/or scoping can lead to an increase in project cost and contract period.

Table 4.16: *Ranking of consultant-related factors*

Consultant-related factors	**Aggregate**			**Client**			**Consultant**			**Contractor**		
	RII	**IMPI**	**RII+IMPI**	**RII**	**IMPI**	**RII+IMPI**	**RII**	**IMPI**	**RII+IMPI**	**RII**	**IMPI**	**RII+IMPI**
Incomplete design information at tender stage	3	6	5	2	4	3	4	6	5	5	8	7
Design mistakes	6	8	9	3	7	5	11	10	10	2	7	6
Design changes	5	8	7	1	3	1	3	8	4	9	11	10
Delay in issuing approvals on site (tests and inspections)	11	11	11	10	9	10	12	11	12	11	10	11
Inflexibility (rigid) consultant	12	12	12	12	12	12	7	12	11	12	12	12
Failure to give practical solutions on site	9	10	10	11	11	11	7	5	8	6	9	9

Consultant-related factors	Aggregate			Client			Consultant			Contractor		
	RII	IMPI	RII+IMPI	RII	IMPI	RII+IMPI	RII	IMPI	RII+IMPI	RII	IMPI	RII+IMPI
Unrealistic contract duration estimate	8	2	3	5	2	4	9	9	9	7	2	2
Inaccurate bill of quantities	3	5	4	3	8	6	4	3	3	2	5	4
Slow decision-making	2	3	2	5	9	9	2	2	2	2	3	3
Incomplete designs at the start of construction stage	6	6	8	8	6	8	6	7	7	7	6	8
Inexperience consultant's team	10	4	6	8	5	7	10	4	5	10	3	5
Appointment of consultant with political clout	1	1	1	5	1	2	1	1	1	1	1	1

4.10.3 Contractor-related factors

Table 4.17 shows that the appointment of contractors with political clout, labour unrest, subcontracting challenges (dispute and performance), and contractor's cashflow factors are ranked as the top four contractor-related factors affecting the performance of projects in this study.

The cash flow challenges experienced by contractors can be linked to delays in progress payments by the client, a factor previously identified as one of the significant client-related factors affecting projects. In addition, Dolage and Rathnamali (2013) argue that cash flow challenges in some construction projects are caused by the appointment of contractors with a poor financial rating, which is further aggravated by delays in progress payment.

According to CIDB (2015:12), as much as 95% of the labour unrest in the construction industry is caused by wage disputes, which normally emanate from the "perceptions of increased company profits, exorbitant executive pay scales, and increased cost of

living". Other factors causing labour unrest encompasses local politics involving the interference of the ward councillor and community liaising officer (CLO) on the project, wage discrepancies between the labourers of the contractor and subcontractor, the delayed payment of wages, "working conditions, disciplinary action, grievances, and retrenchments" (ibid:12).

The appointment of politically connected contractors can be associated with corruption and political patronage, as argued previously under the discussion of the consultant-related factors.

The findings of this study on the contractor-related factors corroborate the results of Mukuka et al. (2015). That study also found that contractor-related factors such as the cash flow of the contractor, subcontracting challenges, and poor communication between stakeholders are some of the main factors in this group that have a significant effect on project efficiency.

Table 4.17: R*anking of contractor-related factors*

Contractor-related factors	**Aggregate**			**Client**			**Consultant**			**Contractor**		
	RII	**IMPI**	**RII+IMPI**	**RII**	**IMPI**	**RII+IMPI**	**RII**	**IMPI**	**RII+IMPI**	**RII**	**IMPI**	**RII+IMPI**
Labour unrest	2	4	3	1	2	1	3	4	3	3	4	3
Subcontracting challenges (dispute and performance)	3	3	4	1	3	3	8	6	6	2	1	2
Contractor's cashflow	3	1	2	3	1	2	1	1	1	7	3	5
Lack of site management and supervision	11	8	9	9	5	6	10	9	10	12	9	9
Re-work due to errors during construction	13	11	12	6	9	8	12	12	12	14	10	12
Poor planning and scheduling of work	8	9	8	6	7	7	6	8	9	11	11	11
Lack of experience on similar work	8	12	10	12	13	13	3	10	8	9	12	10

Contractor-related factors	Aggregate			Client			Consultant			Contractor		
	RII	IMPI	RII+IMPI	RII	IMPI	RII+IMPI	RII	IMPI	RII+IMPI	RII	IMPI	RII+IMPI
Under-pricing of the work due to overconfidence in own ability	6	6	6	10	10	11	5	5	5	5	6	6
Outdated construction methods	14	14	14	14	14	14	14	13	14	12	14	14
Appointment of contractors with political clout	1	2	1	4	4	4	2	2	2	1	1	1
Under-pricing of the work due to strategic misrepresentation	7	5	5	11	8	10	8	3	4	4	4	4
Poor cost planning, monitoring and control	5	7	7	5	5	5	7	7	7	5	7	7
Termination of contract and appointment of another contractor to finish the work	10	13	13	6	12	9	10	14	13	10	13	13
Contractor's ownership of the critical construction equipment for work continuity	12	10	11	12	11	12	12	11	11	7	8	8

4.10.4 Resources-related factors

The information presented in Table 4.18 shows that the unproductivity of the labour force was identified by all participant groups as the main resources-related factor having a major influence on project performance. It is not a surprising finding, as South

Africa is ranked very low compared to other countries in terms of labour productivity. According to the Organization for Economic Cooperation and Development ([OECD], 2019b), South Africa is ranked third from the bottom (39 out of 41 member states) with a labour productivity rate of 24.54 in terms of GDP per hour worked.

The other resources-related factors identified by different respondent groups to have a significant influence on projects are the shortage of equipment and skilled labourers. The shortage of equipment can be attributed to the lack of ownership of the critical equipment needed to execute the work. Many contractors rely on plant hire for critical equipment, which is sometimes not readily available.

The shortage of skilled labourers can be attributed to the lower percentage of adults with post-upper-secondary qualification in South Africa. According to the OECD (2019a), the percentage of the working population (15 to 64 years) in South Africa who attained upper-level secondary and tertiary (post-secondary) education is 59% and 7%, respectively. South Africa is ranked the lowest among all G20 countries and OECD member states in terms of the percentage of people with a tertiary qualification (ibid, 2019). Dolage and Rathnamali (2013) contend that some contractors strategically misrepresent the qualifications of their staff during the tender stage of the project; upon award, they appoint unqualified site staff, which inevitably affects the performance of the projects.

The findings of this study are comparable with the results of Mulalo et al. (2019). That study also found that the shortage of both equipment and skilled labourers, as well as unproductivity of the workforce were some of the key resources-related factors affecting the efficiency of the implementation of construction projects.

Table 4.18: Ranking of resources-related factors

Resources-related factors	**Aggregate**			**Client**			**Consultant**			**Contractor**		
	RII	**IMPI**	**RII+IMPI**	**RII**	**IMPI**	**RII+IMPI**	**RII**	**IMPI**	**RII+IMPI**	**RII**	**IMPI**	**RII+IMPI**
Shortage of skilled labourers	3	2	2	5	2	2	5	2	2	3	2	2

Resources-related factors	Aggregate			Client			Consultant			Contractor		
	RII	IMPI	RII+IMPI	RII	IMPI	RII+IMPI	RII	IMPI	RII+IMPI	RII	IMPI	RII+IMPI
Unproductivity of labour force	1	1	1	1	1	1	1	1	1	1	1	1
Shortage of materials	5	4	5	5	7	6	2	5	5	7	3	3
Delay in material and equipment delivery	2	5	4	4	5	5	2	3	3	3	6	5
Shortage of equipment	3	3	3	2	3	3	2	4	4	8	4	4
Low productivity of equipment	5	6	6	2	4	4	6	6	6	5	9	8
Material price increases	7	7	7	8	5	8	7	7	7	2	7	6
Equipment rental rate increases	8	9	8	7	8	7	7	8	8	5	8	7
Increase in labour rates	9	10	10	8	9	9	9	10	10	9	10	10
High cost of skilled labour	10	8	9	10	10	10	10	9	9	10	5	9

4.10.5 Externally related factors

Table 4.19 shows that the top three externally related factors influencing the poor performance of projects for the different respondent groups are community disruptions, unforeseen site conditions, and corruption.

Community disruptions are caused by unrealistic expectations, local politics involving ward councillors, the appointment of CLOs, the appointment of labourers, and the appointment of subcontractors in projects (CIDB, 2015). Additionally, it can be argued that the other cause of community disruptions is the different interpretations by different parties of the geographic delineation of local labour as well as the business forum that demands a 30% share of all capital under the disguise of rapid economic transformation. The municipality tends to define local labour during the bidding stage

as the jurisdiction area of the municipality. However, at the implementation phase, the community tends to define local labour on a micro-level based on wards or sections. This misunderstanding of local labour creates problems during the recruitment process, leading to disruptions.

Community disruptions cause unplanned stoppages in projects. These unplanned stoppages that cannot be attributed to the contractor and/or force majeure are classified as compensable delays (Ravisankar et al., 2014; Jongo et al., 2019). They trigger contractor claims for the extension of time, which, in turn, carry financial implications, called time-related costs in terms of the GCC 2015. The extension of time and the consequent time-related costs contribute to project time and cost overruns.

Community disruptions featured prominently in some of the previous studies conducted in South Africa, for example, those by Mashwama et al. (2018), Sibiya et al. (2015) and Mulalo et al. (2019). This widespread finding suggests that this challenge might be underpinned by macro conditions. For example, in Ethiopia, Kassa (2020) found that the political environment fuelled community disruptions, which caused critical delays that required both time and cost compensation and, thus, lead to time slippage and cost escalation of projects.

Unforeseen site conditions might emanate from incomprehensive investigations conducted during the planning and design phases of projects. Unescapably, inadequate investigations result in a high number of stoppages on site. These stoppages, like those caused due to community disruptions, carry cost implications and lead to time and cost overruns.

Mulalo et al. (2019) also found that corruption was rampant at the Johannesburg Metropolis, which, consequently, affected the performance of the capital projects that were being implemented the metro. As argued previously in this report, the challenge of corruption is a bigger societal issue that needs national intervention.

Table 4.19: *Ranking of externally related factors*

Externally related factors	Aggregate			Client			Consultant			Contractor		
	RII	IMPI	RII+IMPI	RII	IMPI	RII+IMPI	RII	IMPI	RII+IMPI	RII	IMPI	RII+IMPI
Community disruptions	1	2	1	1	1	1	1	2	2	1	2	2
Environmental issues	5	5	5	5	5	5	5	5	4	5	5	5
Inclement weather	4	4	4	2	4	4	6	3	5	4	4	4
Regulatory changes	7	7	7	6	7	6	7	7	7	5	6	6
Unforeseen site condition	3	3	3	2	3	3	3	3	3	3	3	3
Accident during construction	6	6	6	7	6	7	4	6	6	7	7	7
Corruption	2	1	2	4	2	2	2	1	1	1	1	1

4.10.6 Contract-related factors

Table 4.20 summarises the rankings of the contract-related factors affecting project performance. It can be observed across the respondent groups that poor communication and co-ordination between parties, penalties ineffective and/or not administered, and contract claims are the main contract-related factors identified as causing poor performance of the projects in the municipality.

Poor communication and co-ordination can result from the lack of a sound communication plan. Ineffective communication delays the decision-making process, leading to delays which later affect the contract period and cost. Poor communication and co-ordination are not unique to MMM. Mulalo et al. (2019) found it to be one of the main contributors to the unsatisfactory performance of projects at the Johannesburg metropolis. Likewise, Kassa (2020) and Alinaitwe et al. (2013) found that poor communication and co-ordination among the project team was one of the causes of time and cost overruns in construction projects implemented in Ethiopia and Uganda.

The Auditor-General of South Africa raised a serious concern about MMM's failure to enforce penalties on non-performing contracts as required in terms of the MFMA and

GCC 2015 (ASGA, 2019). This failure to enforce penalties and/or ineffective penalties cultivates a laissez-faire culture among contracting role players, which inevitably leads to time overruns.

Lastly, contract claims are interrelated to some of the factors discussed earlier in this report, such as community disruptions, labour unrest, and unforeseen site conditions. In terms of the GCC 2015, compensable contract claims affect the budget and/or contract period, which result in possible overspending of the budget and slippage of the contract period. These claims contribute to the fruitless and wasteful expenditure at this municipality, which, as argued previously in this report, is very high in terms of National Treasury norms.

Table 4.20: *Ranking of contract-related factors*

Contract-related factors	**Aggregate**			**Client**			**Consultant**			**Contractor**		
	RII	**IMPI**	**RII+IMPI**	**RII**	**IMPI**	**RII+IMPI**	**RII**	**IMPI**	**RII+IMPI**	**RII**	**IMPI**	**RII+IMPI**
Errors	5	4	4	7	7	7	3	3	3	2	2	2
Discrepancies and omissions in contract document	6	5	6	4	4	4	7	5	7	2	5	5
Contract dispute and negotiations	4	6	5	6	4	6	2	6	5	5	6	6
Change of specifications	7	7	7	4	6	5	6	7	6	7	7	7
Penalties ineffective and/or not administered	3	2	2	2	1	1	5	2	2	2	4	3
Poor communication and co-ordination between parties	1	1	1	3	2	3	1	1	1	1	1	1
Contract claims	2	3	3	1	3	2	3	4	4	5	3	4

4.11 PERCEPTIONS OF RESPONDENT GROUPS ON FACTORS AFFECTING TIME AND COST OVERRUN

The Spearman's rank correlation coefficient method was employed to compute the strength and direction of the monotonic relationship between respondent groups. The detailed calculations are presented in Appendix G. This section examines the correlation of the perceptions of the respondent groups on the influence of different categories of factors on the performance of road construction projects. Furthermore, the section contrasts the top ten factors identified by different groups using different ranking methods.

4.11.1 Correlation of perceptions of respondent groups

4.11.1.1 Client-related factors

Table 4.21 illustrates that the perceptions of different participant groups independently analysed using the RII, IMPI, and weighted RII and IMPI methods produce Spearman's rank (rs) values ranging from 0.75 to 0.93. These values are all greater than the critical value of 0.618 (Bansal, 2019) computed using the significance level value of 0.05. These values mean that there is a statistically significant strong positive relationship (ibid) between the different respondent groups for the client-related factors and that there is 95% certainty that the observed relationship exists.

This study's finding regarding the correlation between the client and consultant groups are comparable to the findings of Al-Najjar (2008) and Dolage and Rathnamali (2013). In contrast, those two studies found a moderate agreement between the perceptions of the client and contractor groups, and the consultant and contractor groups.

4.11.1.2 Consultant-related factors

Table 4.21 points out that there is a strong positive relationship between the perceptions of the client and the contractor groups based on the computed correlation value of 0.53 for both the RII and IMPI ranking methods. The 0.53 value falls between the 0.5 to 1.0 range, which, according to Bansal (2019), indicates a strong positive relationship. For the weighted RII and IMPI methods, the results (rs = 0.47) point to a moderate positive relationship between the parties. However, all the correlation values

mentioned above are less than the critical value of 0.587 shown in Table 4.21, implying that it cannot be concluded with certainty whether there is indeed a relationship between the parties. Put differently: there is no statistically significant relationship between the client and consultant views on the influence of consultant-related factors.

The RII (rs = 0.42) and IMPI (rs = 0.29) in Table 4.21 suggest that there is, respectively, a moderate and weak positive relationship between the client and consultant groups for the effect of consultant-related factors in projects. Similar than for the client and contractor groups, however, there is no statistically significant relationship between the client and consultant groups. In contrast, for the weighted RII and IMPI methods, the results (rs = 0.62) do suggest a statistically significant strong relationship between the parties.

There is a statistically significant strong positive relationship between the consultant and contractor groups for the IMPI (rs = 0.93) and the weighted RII and IMPI (rs = 0.61) methods. On the contrary, the same groups have a moderate agreement when using the RII (rs = 0.46) method. In addition, the RII correlation value of 0.46 indicates that there is no statistically significant relationship between the parties.

The findings of previous work conducted by Al-Najjar (2008) and Dolage and Rathnamali (2013) are generally consistent with the results of this study, save for the correlation between the client and consultant. These studies found a strong positive agreement between the client and consultant, whereas the findings of this study indicate a weak to a moderate agreement.

4.11.1.3 Contractor-related factors

Table 4.21 shows a statistically significant strong positive relationship between the consultants and contractors for the RII (rs =0.58), IMPI (rs = 0.87), and weighted RII and IMPI (rs = 0.89) methods. The above values are higher than the critical value of 0.53, which therefore implies a 95% certainty of the observed relationship.

Similar to the observations made in the foregoing paragraph, the client and consultant groups, and the client and contractor groups, respectively, have correlation values of 0.76 and 0.78 when IMPI rankings are employed and 0.62 and 0.63 when combined rankings of RII and IMPI methods are used. This observation points to a statistically

significant strong positive relationship between the parties. In contrast, when the rankings are performed using the RII method, the correlation values of 0.49 and 0.44 are obtained for the client and consultant groups, and the client and contractor groups, respectively. The observed figures suggest a moderate positive relationship between the parties, which is statistically insignificant.

The findings above have a high degree of compatibility with the results obtained by Al-Najjar (2008) and Dolage and Rathnamali (2013) in previous, similar studies.

4.11.1.4 Resources-related factors

The data presented in Table 4.21 shows that there is a statistically significant strong positive relationship between the client and consultant groups on the importance of resources-related factors on road construction projects. The correlation value for the RII method is 0.81, whereas, for the IMPI, it is 0.88. These values are all greater than the critical value of 0.648, depicted in Table 4.21, which portrays a statistically significant relationship.

The correlation of perceptions of the client and consultant groups and the consultant and contractor groups when using the IMPI rankings produce correlation values of 0.56 and 0.77, respectively. The critical value corresponding to the significance level of 5%, as shown in Table 4.21, is 0.648. It means that there is a statistically significant strong positive relationship between the consultant and contractor groups. Although there is a strong positive relationship between the client and consultant groups, there is no statistically significant relationship between them.

The correlation values between the client and consultant groups, and the consultant and contractor groups using the RII rankings are 0.42 for both cases. It suggests a moderate positive relationship between the parties. However, similar to the client and consultant group discussed in the previous paragraph, there is no statistically significant relationship between the parties in both cases.

The correlation values for the client and consultant, client and contractor, and consultant and contractor groups using the rankings of the weighted RII and IMPI methods are, respectively, 0.92, 0.81 and 0.92. These figures are higher than the

critical value of 0.648 mentioned previously; therefore, it can be inferred that there is a statistically significant strong relationship across all the respondent groups.

4.11.1.5 Externally related factors

The data presented in Table 4.21 suggest that there is a strong positive relationship across the different respondent groups, apart from the client and consultant groups, which produced a correlation value of 0.45 when RII rankings are employed. The client and consultant group therefore only have a moderate positive relationship (Bansal, 2019).

The correlation values between different groups using the IMPI rankings are all greater than 0.786, pointing to a statistically significant relationship across all the respondent groups. In contrast, the correlation values computed using the RII rankings are all less than the critical value of 0.786, which suggest a statistically insignificant relationship between all different respondent groups. The correlation values for client and consultant, client and contractors, and consultant and contractors are, respectively, 0.89, 0.96 and 0.93 when computed using the ranking for the weighted RII and IMPI methods. These figures are greater than the critical value of 0.786, inferring that there is a statistically significant strong relationship across all the respondent groups.

Similar to the observations made under contractor-related factors, the findings of this study on externally related factors indicate a high degree of agreement with the results obtained by Al-Najjar (2008) and Dolage and Rathnamali (2013) in previous, similar studies. This observation suggests that externally related factors have the same effect on the construction projects, regardless of the geographical region in which the projects are implemented.

4.11.1.6 Contract-related factors

Unlike the other groupings of factors discussed above, this category shows only one statistically significant strong positive relationship, which is between the consultant and contractor groups based on IMPI ranking and weighted RII and IMPI ranking. Most of the correlation values presented in Table 4.21 points to a weak to moderate positive relationship that is statistically insignificant. The correlation values computed from the RII rankings for the client and consultant groups, and client and contractor groups

indicate a statistically insignificant very weak to weak negative relationship between the parties (Bansal, 2019).

The findings regarding contract-related factors above are different from the results found by Al-Najjar (2008) for all the correlations between different respondent groups.

4.11.1.7 Total of all factors

The correlation values presented in Table 4.21 for all the variables suggest that there is a statistically significant strong positive relationship among the perceptions of different participant groups as all the correlation values are greater than the critical value of 0.213. As explained previously, it can be concluded with 95% certainty that there exists a positive relationship among the perceptions of all the groups. This finding also suggests that sound conclusions can be drawn from the responses collected.

Contrary to the findings for the contract-related factors, the findings of this study based on the total view of all the factors affecting construction are in strong agreement with the results of previous studies such as those conducted by Al-Najjar (2008), Kamanga and Steyn (2013), Dolage and Rathnamali (2013), Ayudya (2011), and Assaf and Al-Hejji (2006). This observation indicates the commonality of the challenges affecting construction projects worldwide.

Table 4.21: *Correlation of perceptions between respondent groups*

Group description	Client vs consultant			Client vs contractor			Consultant vs contractor			Significance level/ critical value
	RII (rs)	IMPI (rs)	RII+IMPI (rs)	RII (rs)	IMPI (rs)	RII+IMPI (rs)	RII (rs)	IMPI (rs)	RII+IMPI (rs)	α = 0.05
Client-related	0.87	0.85	0.86	0.88	0.81	0.86	0.75	0.93	0.91	0.618
Consultant-related	0.42	0.29	0.51	0.53	0.53	0.47	0.46	0.93	0.61	0.587
Contractor-related	0.49	0.76	0.62	0.44	0.78	0.63	0.58	0.87	0.89	0.538
Resources-related	0.81	0.88	0.92	0.42	0.56	0.81	0.42	0.77	0.92	0.648
Externally related	0.45	0.95	0.89	0.73	0.93	0.96	0.68	0.95	0.93	0.786
Contract-related	-0.11	0.55	0.36	-0.05	0.27	0.25	0.13	0.89	0.86	0.786
Overall	0.73	0.74	0.79	0.57	0.76	0.68	0.63	0.81	0.75	0.213

4.11.2 Comparison of the top ten factors in common between respondent groups

Table 4.22 presents the comparison of the perceptions of the different respondent groups on the top ten factors causing project delays and budget overspending as identified using different statistical methods. It can be observed that there is a consensus across all respondents and ranking methods that community disruptions, labour unrest, and appointment of contractors with political clout are among the top ten variables having an impact on the performance of municipal projects. The following three subsections provide an in-depth discussion of the degree of agreement of perceptions between different parties regarding the main factors affecting the performance of road projects.

4.11.2.1 Comparison between the client and consultant groups

As shown in Table 4.22, the degree of agreement between the client and consultant group on the top ten factors is 60% (6 out of 10) for the RII method, 80% (8 out of 10) for the IMPI method, and 70% (7 out of 10) for the weighted RII + IMPI methods.

The six factors identified using the RII ranking method are community disruptions, labour unrest, the appointment of contractors with political clout, contractor's cash flow, unproductivity of the labour force, and poor cost planning, monitoring and control. The eight factors identified using the IMPI method are community disruptions, labour unrest, the appointment of contractors with political clout, contractor's cash flow, delays in progress payments, subcontracting challenges (dispute and performance), corruption, and unproductivity of the labour force. The seven factors identified by weighting the RII and IMPI methods are community disruptions, labour unrest, appointment of contractors with political clout, delays in progress payments, subcontracting challenges (dispute and performance), contractor's cash flow, and unproductivity of the labour force.

The above findings are comparable to the findings of Adugna (2015) that client and consultant groups shared five common factors from a list of ten most significant variables affecting time and cost overruns in construction projects implemented in the eThekwini municipal area.

4.11.2.2 Comparison between the client and contractor groups

The data presented in Table 4.22 indicate that the level of agreement between the client and contractor groups on the top ten factors is 60% (6 out of 10) for the RII method, 70% (7 out of 10) for the IMPI method, and 60% (6 out of 10), for the weighted RII + IMPI methods.

The six factors identified using the RII ranking method are community disruptions, labour unrest, the appointment of contractors with political clout, subcontracting challenges (dispute and performance), delays in progress payments, and poor cost planning, monitoring and control. The seven factors identified using the IMPI method are community disruptions, labour unrest, the appointment of contractors with political clout, contractor's cash flow, delays in progress payments, subcontracting challenges (dispute and performance), and corruption. The six factors identified by weighting the RII and IMPI methods are community disruptions, labour unrest, the appointment of contractors with political clout, delays in progress payments, subcontracting challenges (dispute and performance), and contractor's cash flow.

The findings of this study are in contrast with the conclusions drawn by Adugna (2015), on the common variables independently identified by the client and contractor groups. That study found that only one factor (10%), changes in scope, was identified independently by both the client and contractor groups as one of the top ten most important factors influencing the efficiency of projects in the eThekwini municipal area.

4.11.2.3 Comparison between the consultant and contractor groups

As shown in Table 4.22, the degree of agreement between the consultant and contractor groups on the top ten factors is 60% (6 out of 10) for the RII method, 80% (8 out of 10) for the IMPI method, and 70% (7 out of 10), for the weighted RII + IMPI methods.

The six factors identified using the RII ranking method are community disruptions, labour unrest, the appointment of contractors with political clout, corruption, under-pricing of the work due to overconfidence in own ability, unproductivity of the labour force, and poor cost planning, monitoring and control. The eight factors identified using the IMPI method are community disruptions, labour unrest, the appointment of

contractors with political clout, contractor's cash flow, delays in progress payments, subcontracting challenges (dispute and performance), corruption, and under-pricing of the work due to strategic misrepresentation. The seven factors identified by weighting the RII and IMPI methods are community disruptions, labour unrest, the appointment of contractors with political clout, delays in progress payments, subcontracting challenges (dispute and performance), contractor's cash flow, and under-pricing of the work due to strategic misrepresentation.

As for the correlation between the perceptions of the client and contractor groups discussed in the previous subsection, the findings of this study contradict the results of Adugna (2015) in the eThekwini municipal area. According to Adugna (2015), only one factor (10%), delays in progress payments, was identified by both groups as one of the top ten most significant variables affecting project performance.

Table 4.22: *Comparison of top ten factors in common for respondent groups*

Client vs consultant	**Client vs contractor**	**Consultant vs contractor**
RII + IMPI ranking method		
Community disruptions	Community disruptions	Community disruptions
Labour unrest	Labour unrest	Labour unrest
Appointment of contractors with political clout	Appointment of contractors with political clout	Appointment of contractors with political clout
Delays in progress payments	Delays in progress payments	Delays in progress payments
Subcontracting challenges (dispute and performance)	Subcontracting challenges (dispute and performance)	Subcontracting challenges (dispute and performance)
Contractor's cashflow	Contractor's cashflow	Contractor's cashflow
Unproductivity of labour force		Under-pricing of the work due to strategic misrepresentation
Total = $\frac{7}{10} = 70\%$	**Total =** $\frac{6}{10} = 60\%$	**Total =** $\frac{7}{10} = 70\%$

Client vs consultant	Client vs contractor	Consultant vs contractor
RII ranking method		
Community disruptions	Community disruptions	Community disruptions
Labour unrest	Labour unrest	Labour unrest
Appointment of contractors with political clout	Appointment of contractors with political clout	Appointment of contractors with political clout
Contractor's cashflow	Subcontracting challenges (dispute and performance)	Under-pricing of the work due to overconfidence in own ability
Unproductivity of labour force	Delays in progress payments	Corruption
Poor cost planning, monitoring and control	Poor cost planning, monitoring and control	Poor cost planning, monitoring and control
Total = $\frac{6}{10} = 60\%$	**Total =** $\frac{6}{10} = 60\%$	**Total =** $\frac{6}{10} = 60\%$

Client vs consultant	Client vs contractor	Consultant vs contractor
IMPI ranking method		
Community disruptions	Community disruptions	Community disruptions
Labour unrest	Labour unrest	Labour unrest
Appointment of contractors with political clout	Appointment of contractors with political clout	Appointment of contractors with political clout
Contractor's cashflow	Contractor's cashflow	Contractor's cashflow
Delays in progress payments	Delays in progress payments	Delays in progress payments
Subcontracting challenges (dispute and performance)	Subcontracting challenges (dispute and performance)	Subcontracting challenges (dispute and performance)
Corruption	Corruption	Corruption
Unproductivity of labour force		Under-pricing of the work due to strategic misrepresentation
Total = $\frac{8}{10} = 80\%$	**Total =** $\frac{7}{10} = 70\%$	**Total =** $\frac{8}{10} = 80\%$

4.12 RELIABILITY AND VALIDITY OF THE STUDY

4.12.1 Reliability of the questionnaire

The reliability of the survey instrument was checked using Cronbach's alpha, which was computed using R software. The outputs of the R software are presented in Appendix H and summarised in Table 4.23. The aggregate alpha values for each distinct category or group as presented in Table 4.23 ranges from 0.71 to 0.93, save for the frequency index of the externally related factors, which was determined to be 0.66. The overall alpha for the entire questionnaire, which contained 183 rated questions, was found to be 0.97.

According to George and Mallery (2003), alpha values equal to or greater than 0.7 are considered acceptable, and those that are equal to or greater than 0.9 are considered to be excellent. However, Namdeo and Rout (2016) caution that an alpha value greater than 0.95 for a long set of items greater than 20 may suggest an overestimation of the internal consistency due to redundancies or duplication of items. The assertion by Namdeo and Rout (2016) might explain the high overall alpha value of 0.97 for the entire questionnaire, as depicted in Table 4.23.

Peterson and Kim (2013) argue that the lower bound value of Cronbach's alpha has a tendency to underestimate the actual reliability. They propose other alternative methods such as composite reliability. This argument was affirmed in this study as the factor analysis conducted on the externally related factors measuring the frequency index was determined to be 0.73 compared to the alpha value of 0.66. The alpha value of 0.66, although considered questionable in terms of the criterion of George and Mallery (2003), was considered acceptable for this study. The acceptance of the value of 0.66 and above was based on two reasons: the questionability of the accuracy of Cronbach's alpha as method, discussed above, and the realisation that the value of 0.66 is very close to the acceptable threshold of 0.7.

In conclusion, it can be inferred from the Cronbach's alpha values depicted in Table 4.23 and the observations made above that the questionnaire used for this study was reliable, and, thus, that it measured the intended constructs. Furthermore, it can be concluded that sound conclusions can be drawn from the responses collected.

Table 4.23: *Cronbach's alpha values for the questionnaire*

Ranking method	Group code	Research variable/factors	Number of questions/ items	Cronbach's alpha co-eff values	Degree of reliability
Relative Importance Index (RII)	1.0	Client-related	11	0.77	Acceptable
	2.0	Consultant-related	12	0.91	Excellent
	3.0	Contractor-related	14	0.85	Good
	4.0	Resources-related	10	0.89	Good
	5.0	Externally related	7	0.73	Acceptable
	6.0	Contract-related	7	0.81	Good
Severity Index (SI)	1.0	Client-related	11	0.85	Good
	2.0	Consultant-related	12	0.93	Excellent
	3.0	Contractor-related	14	0.90	Excellent
	4.0	Resources-related	10	0.90	Excellent
	5.0	Externally related	7	0.81	Good
	6.0	Contract-related	7	0.86	Good
Frequency Index (FI)	1.0	Client-related	11	0.71	Acceptable
	2.0	Consultant-related	12	0.89	Good
	3.0	Contractor-related	14	0.81	Good
	4.0	Resources-related	10	0.90	Excellent
	5.0	Externally related	7	0.66	Questionable
	6.0	Contract-related	7	0.82	Good
Combined total			**183**	**0.97**	**Excellent**

4.12.2 Validity of the study

The study was validified using the face validation technique. The draft questionnaire was reviewed by the study supervisor and industry experts and subsequently piloted on five industry practitioners to ensure that the domain was adequately covered.

4.13 STRATEGIES PROPOSED BY RESPONDENTS TO ENHANCE PROJECT PERFORMANCE

Table 4.24 portrays the respondents' proposed efficiency mechanisms to improve the performance of the delivery of road construction projects at the municipality. The collective respondents proposed a total of 25 measures. The top three measures proposed are the appointment of competent service providers, with a frequency of 21 out of 37 (56.76%); the payment of service providers within the prescribed 30-day period, with a frequency of 16 out of 37 (43.24%); and minimising political interference in projects, with a frequency of 7 out of 37 (18.92%). The above measures commensurate with the significant factors causing unsatisfactory performance of projects identified in this study.

Table 4.24: Enhancement strategies proposed by respondents

Proposed measures	**Frequency**	**Frequency percentage**
Standardisation of the system of managing projects to improve decision making in the project	1	2.70%
Subcontracting must be limited to projects with a value greater or equal to R30 million as prescribed in the Preferential Procurement Policy Framework Act, 2000: Preferential Procurement Regulations, 2017	1	2.70%
Appointment of competent service providers	21	56.76%
Payment of service providers within the prescribed 30-day period	16	43.24%
Minimise political interference in projects	7	18.92%
Issuing approvals timeously	1	2.70%
Ensure sufficient public participation before the commencement of the project	1	2.70%
Establish an internal project management committee	1	2.70%
Appoint qualified and competent site personnel and client project managers	3	8.1%
Improve decision making by the client	4	10.81%

Proposed measures	Frequency	Frequency percentage
Effective communication between the parties	6	16.22%
Contractors must adhere to the cash flow of the project and avoid cross financing of other projects	6	16.22%
Improve the time and cost estimate of the projects	4	10.81%
Regular evaluation of the performance of the service providers as prescribed in the MFMA and enforcement of penalties on non-performing service providers	4	10.81%
Enhancing the capacity of the contract management division by appointing personnel with sound knowledge of construction contracts	2	5.41%
Ensure that comprehensive specifications and designs are completed at the tender stage and the commencement of construction	3	8.11%
Effective site management and supervision	4	10.81%
Minimise scope and specification changes	1	2.70%
Ring-fencing of the project budget at the start of the project	2	5.41%
Conducting comprehensive investigations during the planning phase to limit scope changes	1	2.70%
Effective and timeous resolution of community unrest	4	10.81%
Addressing corruption challenges and eliminating political appointments	2	5.41%
Effective planning	2	5.41%
Effective project and contract management	4	10.81%
Efficient subcontracting system	2	5.41%

4.14 CHAPTER SUMMARY

This chapter presented and discussed the findings of the study. A total of 47 road projects were selected for the study, and 66 participants from these projects were invited to participate in the study. Their roles were client (12), consultant (21) and contractor (33). The valid survey response rate for this study was 56%, a sufficient figure for drawing conclusions for the study.

Examination of the project information revealed that projects with a duration of 6 to 12 months recorded a high proportion (79.49%) of projects that experienced time overruns. More than 70% of the projects recorded time overrun magnitudes of 21% and above. The highest proportion of projects that experienced cost overruns fell within those with a contract value of R1–5 million. The highest proportion of cost overruns, at 33.34%, were recorded for projects with cost overrun magnitudes of 21% and above.

Analysing the project data based on the magnitude of the difference between the engineer estimate and the accepted bid amount shows that the higher the magnitude of difference between the values, the more susceptible the project was to cost overruns. The category with a magnitude of difference of 21% and above recorded the highest proportion, 40%, of projects that experienced cost overruns. Likewise, the data show that projects whose bids received the highest response rate were more likely to experience cost overruns compared to projects with less competitive bids.

The biographic data show that 67% of the respondents have more than ten years of working experience in the industry. Additionally, 76% and 52% of the participants, respectively, had a minimum of a bachelor's degree and were registered as professional practitioners in one of the built environment bodies. The above observation gives credence to the data collated for the study.

The main variables causing time and cost overruns were determined using the RII, IMPI, and weighted RII and IMPI statistical methods. The main factors identified using the weighted RII and IMPI methods for the aggregated views of all respondent groups (client, consultant and contractor) were found to be the appointment of contractors with political clout, contractor's cash flow, community disruptions, labour unrest, corruption, delays in progress payments, subcontracting challenges (dispute and performance), under-pricing of the work due to strategic misrepresentation, under-pricing of the work

due to overconfidence in own ability, and appointment of consultants with political clout. When the RII and IMPI methods are independently examined, the results show that the top ten factors for the two methods yield 70% similar results. Contractor-related factors accounted for 60% of the top ten factors identified by weighting the RII and IMPI rankings.

Spearman's rank correlation coefficient was employed to measure the degree of agreement between the perceptions of the respondent groups on the factors affecting time and cost overruns in road projects. The study found that, for the weighted RII and IMPI methods, the overall agreement was the highest between the client and consultant groups (0.79), followed by the consultant and contractor groups (0.75), and, lastly, the client and contractor groups (0.68).

The reliability of the study instrument was tested using Cronbach's alpha co-efficient. The Cronbach's alpha values for the distinct questions and the entire questionnaire were acceptable.

The study was validated using face validity. The supervisor of the study and industry experts reviewed the questionnaire before subsequently piloting it to five industry experts to ensure that the domain was adequately covered.

Chapter 5 draws conclusions and provides recommendations based on the findings of the study.

CHAPTER 5. CONCLUSION AND RECOMMENDATIONS

5.1 CHAPTER INTRODUCTION

This research aimed at evaluating the main factors affecting time and cost overruns in road construction projects to facilitate the formulation of comprehensive mechanisms to improve the performance of road projects in the metropolitan municipality.

The study's aims were reached through the combination of a literature review (Chapter 2) and empirical research. The empirical research involved the dissemination, collection and processing of a structured questionnaire. The study respondents comprised the client's project managers (12), the consultant's representatives (21), and the contractors' contracts managers (33). Chapter 4 presented the empirical research findings and the interpretation thereof.

Chapter 5 discusses the conclusions that can be drawn based on the literature study discussed in Chapter 2 and the findings of the empirical study presented in Chapter 4. It also provides recommendations to improve time and cost overruns in road construction projects based on the findings of the study. The chapter discusses the research assumptions, the research limitations, the practical implications of the study, suggestions for further research, and concludes the discussion in this document.

5.2 CONCLUSIONS

This section demonstrates how the secondary research objectives formulated for this study were accomplished to achieve the aim of the study. It is informed from both the literature study and empirical research.

5.2.1 Secondary research objective (i): identify key factors in the literature that contribute to the problem of time and cost overruns in the implementation of construction projects worldwide

A total of 61 key factors causing time and cost overruns in the execution of construction projects worldwide were identified in the examination of the existing literature. The factors were categorised into six broad groups, namely:

- the client-related group, with eleven factors (lack of project funding; delays in progress payments; client interference; slow decision making; unresolved land ownership; appointment of incompetent service providers; increase in scope and/or change of specification; bureaucracy in client administration; interest charged on overdue claims; change in the material specification; increase in the scope of work; and escalation due to delays in site handover after the appointment)

- the consultant-related group, with twelve factors (incomplete design information; design mistakes and/or changes; poor quality of information; delay in issuing approvals on-site (tests and inspections); inflexibility (rigid) consultant; failure to give expeditious and practical solutions on-site; unrealistic contract duration estimate; inaccurate bill of quantities; and slow decision making)

- the contractor-related group, with fourteen factors (labour unrest; subcontracting; contractor's cashflow; lack of site management and supervision; construction mistakes; poor planning and scheduling of work; lack of experience on similar work; under-pricing of the work; outdated construction methods; appointment of contractors with political clout; under-pricing of the project; and termination of contract and appointing another contractor to complete the work)

- the resources-related group, with ten factors (shortage of skilled labourers; productivity of the unskilled and skilled labour force; shortage of materials; delay in material delivery; shortage of equipment; low productivity and efficiency of equipment; material price increases; equipment rate increases; increase in labour rates; and high cost of skilled labour)

- the externally related group, with seven factors (community disruptions; environmental issues; inclement weather; regulatory changes; unforeseen site condition; accident during construction; and corruption)

- the contract-related group, with seven factors (errors, discrepancies and omissions in contract document; contract dispute and negotiations; change of specifications; penalties ineffective and/or not administered; poor communication; and contract claims)

It was determined from the literature examined that the importance of each factor or group of factors varies depending on the geographical region, the project size and type, and the role-players involved.

5.2.2 Secondary research objective (ii): identify the measures proposed in the literature to reduce time and cost overruns of construction projects across the world

A total of 57 plausible corrective measures for addressing time and cost overruns in the execution of construction projects worldwide were identified during the literature review, and these measures are:

> accurate cost estimation; allocate adequate contingency allowances; adopt clear information and communication channel; adopt effective and efficient material procurement system; allocate sufficient time and finance (money); application of professional construction management; appointment of competent site manager; appropriate scope definition; approval projects from relevant parties; choose experienced subcontractor with a good reputation; close monitoring; competent architectural and engineering designs; competent project manager; comprehensive contract administration; conducting a process mapping exercise; contractors should improve their project management skills and articulate their resources; control the design change; design changes should be adequately highlighted and updated on all relevant project documentation; designing the project to great detail at the onset whenever possible; develop a strategy for solving identified risk; developing project programme based on experienced planners; development of comprehensive financial plan and cash flow; development of cost monitoring and periodic reporting of critical and long lead items; developing good monitoring and controlling system; develops realistic planning and scheduling for the project; effective coordination between parties involved; effective financial management and control; effective planning and scheduling; enough number of labour; ensure there adequate time to complete the work; ensure design changes are reasonable [sic.] timed when possible; ensuring prompt resolution to design change quarries, issues and authorization; ensuring the time and cost implication of design change are always determined and agreed; having a design manager to responsible for the design changes; having enough resources to deal with the complexity; hire competent labour; incentive schemes; making the risk register is a live document that is updated regularly; must ensure the timely availability of required finance; advance thought on permission from law enforcement agencies to beef up on site security; plan a time schedule for delivery process; producing design document at time; progress payment of subcontractor/suppliers must be made on time; promote open communication; promote team building communication process; prompt progress payment from clients; proper motivation and safety system; provide training to unskilled workers based on the scope of work; quick design approval; quickly informed relevant parties when unforeseen circumstances affect the programme/ lead-in time; reliable contractor; safety and health programme; select experienced and cable subcontractor; selecting a consultant who has sufficient experiences in similar nature of works and has good reputation; team work between the client (owner) and architects in completing the design drawings before project estimate are prepared or the contract is awarded; subcontractor with enough experience and capability in dealing with the

project complexity; and efficient management of site and supervision of the project (Jongo et al., 2019:85-86).

5.2.3 Secondary research objective (iii): empirically rank the identified factors contributing to time and cost overruns in road construction projects in a metropolitan municipality of the Free State Province

The RII method, which measures the importance of a variable on time and cost overruns, and the IMPI method, which measures the combined effect of frequency and severity (or degree of impact) on time and cost overruns in projects, were employed to identify the main factors causing time and cost overruns in road construction from a total of 61 factors gleaned from the literature. In addition, the RII and IMPI indexes were weighted and graded to identify a combined list based on both methods of the top ten variables contributing to the unsatisfactory performance of projects in the metro. The findings of the empirical study are discussed in the following eleven subsections.

5.2.3.1 Combined perceptions of respondent groups

A) Top-ranked factors based on the weighted RII and IMPI methods

The RII and IMPI values were averaged to obtain the combined indexes for the two methods. The top ten factors identified by all respondents using the combined indexes are: the appointment of contractors with political clout (index = 0.768; rank = 1), contractor's cash flow (index = 0.763; rank = 2), community disruptions (index = 0.750; rank = 3), labour unrest (index = 0.733; rank = 4), corruption (index = 0.732; rank = 5), delays in progress payments (index = 0.729; rank = 6), subcontracting challenges (dispute and performance) (index = 0.729; rank = 6), under-pricing of the work due to strategic misrepresentation (index = 0.681; rank = 8), under-pricing of the work due to overconfidence in own ability (index = 0.664; rank = 9), and, lastly, the appointment of consultants with political clout (index = 0.658; rank = 10).

B) Top-ranked factors based on the RII method

The collective responses of the participants identified the following top ten variables in descending hierarchical order of importance based on the RII method: the appointment of contractors with political clout (index = 0.892; rank = 1), community disruptions

(index = 0.887; rank = 2), labour unrest (index = 0.878; rank = 3), subcontracting challenges (dispute and performance) (index = 0.865; rank = 4), contractor's cashflow (index = 0.865; rank = 4), poor cost planning, monitoring and control (index = 0.829; rank = 6), under-pricing of the work due to overconfidence in own ability (index = 0.815; rank = 7), corruption (index = 0.815; rank = 7), unproductivity of labour force (index = 0.811; rank = 9), and, lastly, the under-pricing of the work due to strategic misrepresentation (index = 0.806; rank = 10).

The above findings were found to corroborate the results of Sibiya et al. (2017), Mashwama et al. (2018), Seboru (2015), Shimete and Wall (2016), and Ayudhya (2011). Conversely, the results contradicted the findings of some previous studies, such as those of Mukuka et al. (2015), Mulenga and Bekker (2015), and Kamanga and Steyn (2013).

C) Top-ranked factors based on the IMPI method

The following factors were identified by all participants as the top ten contributors to poor performance of road projects using the IMPI method: delays in progress payments (index = 0.661; rank = 1), contractor's cash flow (index = 0.660; rank = 2), corruption (index = 0.648; rank = 3), appointment of contractors with political clout (index = 0.643; rank = 4), community disruptions (index = 0.612; rank = 5), subcontracting challenges (dispute and performance; index = 0.593; rank = 6), labour unrest (index = 0.588; rank = 7), under-pricing of the work due to strategic misrepresentation (index = 0.556; rank = 8), appointment of incompetent service providers (index = 0.531; rank = 9), and, finally, the appointment of consultants with political clout (index = 0.528; rank = 10).

These findings agree with previous studies by Adugna (2015), Mashwama et al. (2018), and Sibiya et al. (2015).

D) Comparison between RII and IMPI methods

The two methods produced 70% (7 out of 10) similar findings. The seven factors found to be common between the two methods are contractor's cash flow, corruption, the appointment of contractors with political clout, community disruptions, subcontracting challenges (dispute and performance), labour unrest, and under-pricing of the work due to strategic misrepresentation. Using the criterion of Bansal (2019), the two

methods were found to have a statistically significant strong positive relationship with a Spearman's alpha value of 0.86.

The above findings are similar to the findings of Desai and Bhatt (2013) for whose study the two methods yielded 60% compatible results, with a Spearman's alpha value of 0.633, which implied a statistically significant strong positive relationship.

5.2.3.2 Perceptions of the client respondent group

A) Top-ranked factors based on the weighted RII and IMPI methods

The client group identified community disruptions, with an average index score of 0.697, as the most critical factor causing unsatisfactory performance of projects in the municipality. This factor was followed in descending order of importance by labour unrest (index = 0.673; rank = 2), contractor's cashflow (index = 0.672; rank = 3), subcontracting challenges (dispute and performance; index = 0.657; rank = 4), bureaucracy in client's administration (index = 0.633; rank = 5), delays in progress payments (index = 0.622; rank = 6), appointment of contractors with political clout (index = 0.602; rank = 7), unproductivity of the labour force (index = 0.573; rank = 8), penalties ineffective and/or not administered (index = 0.571; rank = 9), and, lastly, poor cost planning, monitoring and control (index = 0.568; rank = 10).

B) Top-ranked factors based on the RII method

The hierarchical order of importance of the factors identified by the client group using the RII method comprise of the following: community disruptions (index = 0.938; rank = 1), labour unrest (index = 0.875; rank = 2), subcontracting challenges (dispute and performance; index = 0.875; rank = 2), contractor's cashflow (index = 0.854; rank = 4), bureaucracy in client's administration (index = 0.813; rank = 5), appointment of contractors with political clout (index = 0.813; rank = 5), poor cost planning, monitoring and control (index = 0.792; rank = 7), contract claims (index = 0.792; rank = 7), delays in progress payments (index = 0.771; rank = 9), appointment of incompetent service providers (index = 0.771; rank = 9), and unproductivity of labour force (index = 0.771; rank = 9).

The above findings are congruent with the results of previous studies undertaken by Mukuka et al. (2015), Dolage and Rathnamali (2013), and Adugna (2015).

C) Top-ranked factors based on the IMPI method

When using the IMPI ranking method, the client group identified contractor's cash flow (index = 0.489; rank = 1) as the main factor contributing to the poor performance of the road projects. It is followed in descending order of importance by the following factors: delays in progress payments (index = 0.473; rank = 2), labour unrest (index = 0.471; rank = 3), community disruptions (index = 0.455; rank = 4), bureaucracy in client's administration (index = 0.453; rank = 5), subcontracting challenges (dispute and performance; index = 0.438; rank = 6), corruption (index = 0.405; rank = 7), penalties ineffective and/or not administered (index = 0.391; rank = 8), appointment of contractors with political clout (index = 0.390; rank = 9), and, lastly, unproductivity of labour force (index = 0.374; rank = 10).

The above findings are comparable to the outcomes of studies conducted by Dolage and Rathnamali (2013), Alinaitwe el al. (2013) and Adugna et al. (2015).

D) Comparison between RII and IMPI methods

The two methods produced eight (80%) common factors for the client group, namely, contractor's cash flow, delays in progress payments, labour unrest, community disruptions, bureaucracy in client's administration, subcontracting challenges (dispute and performance), the appointment of contractors with political clout, and unproductivity of labour force. Similar to the aggregate views of all parties, the perceptions of the client group based on the two methods were found to be statistically significant with a strong positive relationship (rs = 0.81).

5.2.3.3 Perceptions of the consultant respondent group

A) Top-ranked factors based on the weighted RII and IMPI methods

The hierarchical order of importance of factors causing time and cost overruns that were identified by the consultant group using the weighted RII and IMPI methods is as follows: contractor's cash flow (index = 0.852; rank = 1), appointment of contractors with political clout (index = 0.824; rank = 2), corruption (index = 0.795; rank = 3), community disruptions (index = 0.777; rank = 4), labour unrest (index = 752; rank = 5), under-pricing of the work due to strategic misrepresentation (index = 0.748; rank = 6), delays in progress payment (index = 0.746; rank = 7), unproductivity of labour force

(index = 0.739; rank = 8), under-pricing of the work due to overconfidence in own ability (index = 0.738; rank = 9), and, finally, subcontracting challenges (dispute and performance; index = 0.717; rank = 10).

B) Top-ranked factors based on the RII method

Contractor's cash flow (index = 0.967; rank = 1) is ranked the most significant factor affecting the performance of the road projects for the consultant group based on the RII method. It is followed in descending order of importance by the appointment of contractors with political clout (index = 0.933; rank = 2), labour unrest (index = 0.922; rank = 3), community disruptions (index = 0.922; rank = 3), lack of experience on similar work (index = 0.922; rank = 3), under-pricing of the work due to overconfidence in own ability (index = 0.911; rank = 6), corruption (index = 0.911; rank = 6), poor planning and scheduling of work (index = 0.900;rRank = 8), unproductivity of labour force (index = 0.900; rank = 8), and ,lastly, poor cost planning, monitoring and control (index = 0.889; rank = 10).

These findings of this study are in concert with the results of Seboru (2015), Adugna (2015), and Assaf and Al-Hejji (2006). The above findings are inconsistent with the results of Mukuka et al. (2015).

C) Top-ranked factors based on the IMPI method

The hierarchical order of the top ten factors affecting the performance of projects based on the consultant responses using the IMPI method is as follows: contractor's cash flow (index = 0.736; rank = 1), appointment of contractors with political clout (index = 0.715; rank = 2), corruption (index = 0.679; rank = 3), delays in progress payment (index = 0.670; rank = 4), community disruptions (index = 0.631; rank = 5), under-pricing of the work due to strategic misrepresentation (index = 0.618; rank = 6), labour unrest (index = 0.582; rank = 7), unproductivity of labour force (index = 0.578 ; rank = 8), under-pricing of the work due to overconfidence in own ability (index = 0.564; rank = 9), and, lastly, subcontracting challenges (dispute and performance; index = 0.555; rank = 10).

These findings have a high degree of agreement with previous work conducted by Assaf and Al-Hejji (2006), Kassa (2020), Jongo et al. (2019), and Adugna (2015). They are not in line with the outcomes obtained by Mukuka et al. (2015).

D) Comparison between RII and IMPI methods

The top ten factors for the two methods have a similarity percentage of 70% (7 out of 10). For both methods, contractor's cash flow and the appointment of contractors with political clout are ranked the first and second most significant factors that cause the poor performance of projects, respectively. The analysis of the overall correlation of perceptions produced a high rs value of 0.82, implying that there is a statistically significant strong positive relationship between the two methods.

5.2.3.4 Perceptions of the contractor respondent group

A) Top-ranked factors based on the weighted RII and IMPI methods

The top ten factors affecting performance of the projects in the metro according to the contractor group based on the weighted RII and IMPI methods are: appointment of contractors with political clout (index = 0.814; rank = 1), corruption (index = 0.797; rank = 2), subcontracting challenges (dispute and performance; index = 0.790; rank = 3), delays in progress payments (index = 0.779; rank = 4), appointment of consultants with political clout (index = 0.777; rank = 5), community disruptions (index = 0.754; rank = 6), labour unrest (index = 0.748; rank = 7), under-pricing of the work due to strategic misrepresentation (index = 0.737; rank = 8), poor communication and co-ordination between parties (index = 0.737; rank = 9), and, lastly, contractor's cash flow (index = 0.724; rank = 10).

B) Top-ranked factors based on the RII method

Using the RII method, the top ten factors affecting project performance according to the contractor group are: the appointment of contractors with political clout (index = 0.893; rank = 1); subcontracting challenges (dispute and performance; index= 0.845; rank = 2); appointment of consultants with political clout (index = 0.833; rank = 3), labour unrest (index = 0.833; rank = 3), community disruptions (index = 0.821; rank = 5), corruption (index = 0.821; rank = 5), under-pricing of the work due to strategic misrepresentation (index = 0.810; rank = 7), poor communication and co-ordination between parties (index = 0.810; rank = 2), slow decision making by client (index = 0.798; rank = 9), delays in progress payments (index = 0.786; rank = 10), under-pricing

of the work due to overconfidence in own ability (index = 0.786; rank = 10), and poor cost planning, monitoring and control (index = 0.786; rank = 10).

The above findings corroborate the results of previous studies conducted Seboru (2015), Adugna (2015), and Assaf and Al-Hejji (2006).

C) Top-ranked factors based on the IMPI method

The top ten factors affecting the performance of projects identified by the contractor group based on the IMPI ranking method are as follows: delays in progress payments (index = 0.772; rank = 1), corruption (index = 0.772; rank = 1), subcontracting challenges (dispute and performance; index = 0.734; rank = 3), appointment of contractors with political clout (index = 0.734; rank = 3), appointment of consultants with political clout (index = 0.721; rank = 5), community disruptions (index = 0.687; rank = 6), contractor's cash flow (index = 0.685; rank = 7), labour unrest (index = 0.663; rank = 8), under-pricing of the work due to strategic misrepresentation (index = 0.663; rank = 8), and poor communication and co-ordination between parties (index = 0.663; rank = 8).

The above findings are consistent with the outcomes of previous studies conducted by Dolage and Rathnamali (2013), Assaf and Al-Hejji (2006), and Adugna (2015).

D) Comparison between RII and IMPI methods

The comparison of the top ten factors between the two methods indicated a similarity percentage of 90% (9 out of 10). Both methods ranked contractor's cash flow and the appointment of contractors with political clout the first and second most significant factors causing the poor performance of projects, respectively. The analysis of the overall correlation of perceptions produced a high rs value of 0.79, implying that there is a statistically significant strong positive relationship between the two methods.

5.2.3.5 Group of factors influencing time and cost overruns

From among the six different groupings of factors, all the respondent groups collectively and independently using all the ranking methods, that is, the RII, IMPI, and weighted RII and IMPI methods, identified contractor-related factors as the primary

influence on the unsatisfactory performance of road projects in the municipality. The above finding is inconsistent with those of Assaf and Al-Hejji (2006) and Yusuf (2019).

5.2.3.6 Top-ranked client-related factors

This study found a strong agreement across respondent groups that delays in progress payments, bureaucracy in client's administration, the appointment of incompetent service providers, and slow decision making by the client are among the top four client-related factors influencing time and cost overruns in road construction projects at the municipality. These findings corroborate the outcomes of previous studies conducted by Mukuka et al. (2015), Alinaitwe et al. (2013) and Kassa (2020).

5.2.3.7 Top-ranked consultant-related factors

The participant groups overwhelmingly identified the appointment of consultants with political clout as the main consultant-related factor having an influence on time and cost overruns in projects. The other top factors in this group identified by different respondent groups are inaccurate bill of quantities and slow decision-making. These findings are inconsistent with the results of previous work conducted by Mukuka et al. (2015) and Al-Najjar (2008).

5.2.3.8 Top-ranked contractor-related factors

The appointment of contractors with political clout, labour unrest, subcontracting challenges (dispute and performance), and contractor's cashflow were identified collectively and/or severally by different respondent groups to be among the top four contractor-related factors affecting the performance of projects in the metro. It corroborates the previous findings of Mukuka et al. (2015) and Al-Najjar (2008).

5.2.3.9 Top-ranked resources-related factors

The unproductivity of the labour force was identified by all participant groups collectively and/or independently as the main resources-related factor influencing project delays and cost overruns in projects implemented at the municipality. The other prime factors identified in this category by different respondent groups are shortages of equipment and skilled labourers.

5.2.3.10 Top-ranked externally related factors

The top three externally related factors identified by different respondent groups as having an impact on the performance of municipal projects are community disruptions, unforeseen site conditions, and corruption. These findings have a high degree of agreement with the results obtained by Al-Najjar (2008) and Dolage and Rathnamali (2013) in their previous, similar studies.

5.2.3.11 Top-ranked contract-related factors

The general consensus among the respondent groups was that poor communication and co-ordination between parties, penalties ineffective and/or not administered, and contract claims are the main contract-related factors causing poor performance of municipal projects. These findings are different from the results of Al-Najjar (2008) regarding the most crucial contract-related factors influencing the efficiency of delivering construction projects.

5.2.4 Secondary research objective (iv): Identify, through literature, theories embedded in the factors affecting time and cost overruns in road construction projects of a metropolitan municipality in the Free State Province

The theories embedded in the factors affecting time and cost overruns in construction projects as found in the literature comprise of “Forecasting theory; Planning theory; Decision-making theory; Neoclassical economics theory; Rational choice theory; Planning fallacy; optimism bias theory; Prospect theory; Machiavellianism theory; Agency theory; and Ethical theories” (Cantarelli et al., 2010).

An in-depth understanding of the underlying theories would assist with a deeper understanding of the causes of time and cost overruns in construction projects. Additionally, ta deeper understanding of the root causes of overruns will assist in the formulation of relevant and effective mitigation mechanisms to prevent project delays and overspending of the contract budget.

5.2.5 Secondary research objective (v): empirically identify the most prevalent factors among the respondent groups regarding the causes of time and cost overruns in road construction projects in a metropolitan municipality of the Free State Province

Spearman's rank correlation coefficient was used to measure the degree of agreement or disagreement between the respondent groups, namely, the clients, consultants, and contractors. The most pertinent factors causing time and cost overruns for the different respondent groups were identified using the RII, IMPI, and weighted RII and IMPI methods. This section summarises the main findings of the computations conducted using the statistical methods mentioned above.

The results of the study suggest that there is a statistically significant strong positive relationship between the different respondent groups. The correlation values for all the ranking methods, that is, RII, IMPI, and weighted RII and IMPI, were determined to be in the range of 0.57 to 0.79, which are all greater than the critical value of 0.213. Community disruptions, labour unrest, and appointment of contractors with political clout were found to be the most common factors among the respondent groups, regardless of the ranking method employed for analysis.

A strong agreement was found between the client and the consultant groups that the contractor's cash flow and unproductivity of the labour were among the top ten variables affecting project performance regardless of the ranking method used. Likewise, the client and contractor groups strongly agreed that subcontracting challenges (dispute and performance) and delays in progress payment were among the top ten factors affecting project performance.

The IMPI rankings revealed a consensus between different respondent groups that subcontracting challenges (dispute and performance), contractor's cash flow, delays in progress payment, and corruption were among the top ten prime factors contributing to the unsatisfactory performance of the projects. Similarly, the RII method identified a consensus among all the participant groups on the inclusion of poor cost planning, monitoring and control among the top ten main factors.

5.3 RECOMMENDATIONS

The purpose of this section is to answer secondary research objective (vi), which is to formulate recommendations based on literature and empirical study to improve project time and cost performance in a metropolitan municipality of the Free State Province.

The study confirmed that time and cost overruns in road construction projects are indeed a persistent problem at the municipality. The study identified key drivers of this phenomenon using the RII, IMPI, and weighted RII and IMPI statistical methods. The following strategic measures are proposed to improve the implementation efficiency of road construction projects based on the findings of this study.

5.3.1 Appointment of service providers (contractors and consultants) with political clout

This report posits that the root cause of the political appointment of service providers is the cadre deployment system that enables these types of appointments to be made, including by legal means. It is, therefore, recommended that a transparent recruitment system that produces qualified and competent administrative appointees with integrity be adopted by the municipality. Furthermore, the report proposes the continuous vetting of all supply chain practitioners as contemplated in the National Strategic Intelligence Act 39 of 1994.

5.3.2 Contractor's cash flow

Based on the findings of this study, it is recommended that contractors should develop a comprehensive financial plan with effective controls to ensure compliance with the plan and avoid cross-financing of different projects. Formulating and adhering to a financial plan will ensure sound financial management, which, in turn, will guarantee cash flow stability and, consequently, improve the performance of projects.

This study noted that the GCC 2015 advocates for advance payments to emerging contractors to the tune of 10% to 20% of the contract sum to improve the contractor's cash flow. However, the proposal is subject to an agreement between the contracting parties. It is, therefore, recommended that the parties should consider including this advance payment clause in their contract. The client can secure the payment by

requesting a payment guarantee from a recognised bank or any other financial institution.

The client should also consider conducting a financial risk assessment by including the financial or bank rating of bidders as part of the evaluation criterion for functionality or quality in the bid document.

5.3.3 Community disruptions

It is recommended for the parties to ensure that adequate public participation is conducted before the commencement of a project. Moreover, the appointed project steering committee should be all-encompassing to cater for all the different interests of the community. Issues such as the geographical delineation of local labour should be clearly explained during public engagement. In doing so, the parties are more likely to avert any potential community disruptions that can cause overextending of the contract period and budget overspending.

It is further recommended for the parties to establish a project structure or capacitate the project steering committee to be able to deal effectively and timeously with community disruptions to minimise work stoppages, which, in turn, would minimise time and cost overruns.

The study recommends that the parties create a budget within the contract for community development initiatives to address local skills shortages and minimise the importation of labour, which causes animosity between various groups. In doing so, the parties are likely to garner trust and respect within the community for the benefit of all concerned.

5.3.4 Labour unrest

The study recommends that contractors pay their labourers on time and improve industrial relations within the company or the site. Contractors are recommended to pay their labourers at least the minimum wages determined by the Bargaining Council for the Civil Engineering Industry (BCCEI).

In the event of Expanded Public Works Programme (EPWP) projects, it is recommended that the client should pay the wage gap between the EPWP and BCCEI

rates. Typically, the EPWP projects are exempted from paying BCCEI wages, which leads to a wage discrepancy between EPWP projects and non-EPWP projects within the same municipality. This wage difference is one of the primary sources of labour unrest in EPWP-related projects.

Another source of labour unrest is different salaries between various contractors on the same site. The study recommends the standardisation of wages among all contractors working on a site to mitigate against any potential labour protest triggered by wage disparities.

Finally, CLOs should be appointed through a robust, transparent process to ensure that they discharge their duties without fear and/or favour.

5.3.5 Corruption

The study recommends that the client considers the vetting of all bidders and all supply chain management practitioners before the appointment as prescribed in the National strategic intelligence Act 39 of 1994. In addition, the client is advised to set up structures and instruments to detect and combat all forms of corruption in construction projects and to blacklist all service providers caught practising bribery.

5.3.6 Delays in progress payments

The client is advised to ring-fence the project budget at the beginning of the project to ensure that service providers are paid timeously, that is, within the 30-day period prescribed in terms of clause 65 (2) (e) of the MFMA. The timeous payments of interim certificates will contribute positively to the contractor's cash flow, and, hence, lead to efficient output on-site.

It is further recommended that the client develops effective financial management controls to ensure that conditional grant payments are expended in line with the prescribed conditions of that grant.

Lastly, the report recommends that the parties should include a payment guarantee clause in the contract to enable service providers to claim from the guarantor in case of delayed payment by the client. This measure would improve the contractor's cash flow and consequently enhance progress on site.

5.3.7 Subcontracting challenges (dispute and performance)

The client is advised to limit subcontracting to projects with a value of R30 million and above, as prescribed in the Preferential Procurement Policy Framework Act: Regulations of 2017.

Also, a transparent procurement system of subcontractors as prescribed in the CIDB Practice Note 7 should be complied with to minimise potential dissatisfaction that may escalate to site disruptions.

The contracting parties are further advised to jointly appoint competent subcontractor(s) that are registered with the CIDB and have an excellent track record in order to minimise the magnitude of potential re-works by the main contractor to fix subcontractor(s) defects.

Lastly, contractors are advised to pay their subcontractors timeously. If the main contractor is making erratic payments to subcontractors, it is recommended that a payment cession be drawn up to enable the client to pay subcontractors directly.

5.3.8 Under-pricing of the work due to strategic misrepresentation

It is recommended that the client should abandon the practice of awarding projects to the lowest bidder and, instead, also consider other risks during the evaluation stage, such as financial risks, technical risks, level of overcommitment, and others.

Financial risk can be assessed by prescribing a minimum financial or bank rating in the bid document and by conducting due diligence on tendered rates based on competitive market rates supplied by a competent consultant. The engineer’s estimate should be used with great caution as their reliability has been questioned in this study.

A risk bracket or range that the client is comfortable with can be included in the tender document for consideration during the evaluation stage. It would assist in detecting and disqualifying suspect bids that have the potential to result in incomplete projects or walkaway by the contractor.

5.3.9 Under-pricing of the work due to overconfidence in own ability

The study recommends the appointment of qualified and competent cost estimators to produce a realistic and competitive offer. In doing so, the contractor will minimise reputational damages and financial risk likely to occur due to prolonged periods and potential penalties for delays.

5.4 ASSUMPTIONS OF THE STUDY

Leedy and Ormrod (2015:23) define an assumption as “a condition that is taken for granted, without which the research project would be pointless”.

The respondents in this study were guaranteed anonymity and confidentiality. Based on this condition, it was assumed that the participants responded to the survey honestly and candidly, which guarantees the credibility and reliability of the collated data.

Secondly, it was assumed that there was homogeneity in the project management techniques and the productivity of the equipment and labour used in the surveyed projects. Any differences in project performance due to the non-homogeneity of these factors were not considered.

5.5 LIMITATIONS OF THE STUDY

Although this research aimed at contributing comprehensively to the body of knowledge on the main factors causing time and cost overruns in the implementation of infrastructure projects in a local government environment, the study has some limitations. Leedy and Ormrod (2015:65) describe research limitations as the weaknesses of the study, mentioning factors such as the “sample size, data-collection environment, measurement techniques, and personal biases”. Such limitations have the potential to cast shadows of doubt on the findings and conclusions of the study, and they present opportunities for future studies.

Limiting the sample to road projects completed between July 2014 and March 2020 and limiting the survey responses to the ones received within the specified timeframe due to time and funding constraints potentially limit the generalisability of the findings of this study. The use of a large and diversified sample could assist with identifying all inherent institutional challenges hampering the successful implementation of such

projects and minimise the potential skewness of the study results. Some key factors are likely not to have been amplified because of the small sample size used for the study.

The research was conducted in MMM, and it potentially limits the generalisability of the findings to other local municipalities in South Africa. In addition, due to time constraints, the study excluded the evaluation of the interrelationship of factors influencing time and cost overruns in road projects. Hamilton (1997) argues from a systems theory paradigm that the singular cause identification approach misses the identification of aspects related to the interrelatedness and interdependency of various factors. The argument is that the "subsystem loses some of its properties when separated from the system, and the system equally so, loses some of its essential properties when dismantled" (ibid: 12). This observed limitation has the potential to affect the formulation of comprehensive solutions for the study.

Another possible limitation that can impact the credibility of the findings of this study stems from the restriction of the research to the construction phase of the projects due to time constraints. The construction phase of a project falls under stage five of the six stages of the project life cycle as per the guidelines of the Engineering Council of South Africa (ECSA, 2015). Factors stemming from the other project stages that directly influenced the completion time and cost for the project could have been missed.

Finally, this study used a structured questionnaire to overcome cost and time constraints. A mixed-method approach could have provided more in-depth information for a better understanding of the subject matter.

5.6 PRACTICAL IMPLICATIONS OF THE STUDY

The study contributes to a better understanding of the main factors contributing to time and cost overruns in the local government environment in South Africa. This better understanding of these factors can enable the crafting of substantive mechanisms to enhance project implementation performance in the public sector. In turn, the efficient execution of infrastructure projects in the public sector can be used by the government as a lever to stimulate inclusive economic growth to address overarching challenges such as abject poverty, the income inequality gap, and unemployment as envisioned in the NDP document of 2012.

5.7 AREAS FOR FURTHER RESEARCH

Future studies on the subject area can focus on the shortcomings of this research, as acknowledged under section 5.4. Specifically, the research can be expanded to all 258 municipalities in South Africa to capture a comprehensive distribution of the views of the role players to be able to generalise the findings to the entire local government sector.

Future studies can also incorporate the systems theory approach by expanding the research to cover all the interrelated and interdependent subsystems (project phases or stages) within the value chain of the projects to ensure that all areas of disconnect are detected and addressed. Furthermore, the systems theory approach can aid in providing a better understanding of the interrelationship and interdependency of the identified variables as they were treated to be acting severally in this study.

Lastly, future studies can focus on providing an in-depth understanding of the theories underlying the identified factors, also termed the manifests by Cantarelli et al. (2010). A better understanding of these theories will enable the formulation of substantive solutions to address the root causes rather than the manifests, namely time and cost overruns.

5.8 CONCLUSION

The study aimed to assess the most significant factors affecting time and cost overruns in road construction projects in a metropolitan municipality of the Free State Province. The study intended to provide an in-depth understanding of this phenomenon in a local government environment in South Africa to facilitate the formulation of comprehensive mechanisms to address this challenge.

A total of 47 road projects completed between July 2014 and March 2020 were sampled for the study. A detailed analysis of the projects showed that 83% (39 out of 47) of the projects experienced time overruns, with an average overrun percentage of 107.33%. Furthermore, 44.68% (21 out of 47) of the sampled projects experienced cost overruns, with an average overrun percentage of 24.48%.

The study employed a quantitative research approach and a cross-sectional research design. A structured questionnaire was formulated from 61 variables gleaned from the

existing literature examined. The questionnaire was distributed to 66 purposively selected respondents categorised into three groups, namely, client (12), consultant (21) and contractor (33). The response rate for valid questionnaires was 56% (37 out of 66), and it was accepted as adequate for the researcher to draw sound conclusions from the findings.

The collected data from the survey were analysed using the RII, IMPI, and weighted RII and IMPI statistical methods to identify the hierarchical order of importance of the 61 variables in terms of their influence on the performance of road construction projects in the municipality. The top ten variables identified from the aggregate responses of all the participants using the weighted RII and IMPI methods were found to be the appointment of contractors with political clout, contractor's cash flow, community disruptions, labour unrest, corruption, delays in progress payments, subcontracting challenges (dispute and performance), under-pricing of the work due to strategic misrepresentation, under-pricing of the work due to overconfidence in own ability, and appointment of consultants with political clout.

The reliability of the survey instrument and validity of the study were, respectively, checked using the Cronbach's alpha method and face validity. The questionnaire was found to reliable with an overall value of 0.97; hence the conclusions drawn from this research can be considered credible and reliable. The draft questionnaire was reviewed by the study supervisor and industry experts to ascertain that the study domain was adequately covered. The questionnaire was also subsequently piloted to five industry practitioners before distribution.

The report identified the limitations of the study and suggested areas for further research. The limitations identified include the limited sample size of 47 projects completed between July 2014 and March 2020, the survey responses (56%) that were limited to a cut off time due to time constraints, the geographical delineation of the study, and the singular approach to analysing the factors which meant that the interdependences and interrelatedness of the variables were not assessed. The study was also limited to the construction phase of the project, meaning that it could have missed other factors emanating from the planning and design stages that have a domino effect on the performance of projects. Another limitation relates to using only a structured questionnaire to collect responses from participants.

The study recommends that future studies expand the research to cover all 258 municipalities in South Africa, employ the system approach theory to understand the interdependences and interrelatedness of the variables affecting time and cost overruns, and focus on understanding the theories underlying time and cost variables.

The study provided recommendations on comprehensive strategic measures to mitigate the effect of the critical drivers of time and cost overruns in road construction projects in a local government environment in South Africa identified in this study. The key measures proposed are:

- the vetting of bidders and supply chain management practitioners;
- the appointment of qualified and competent staff with integrity;
- the development of a comprehensive financial plan by contractors;
- introducing payment guarantee clauses in contracts for advance payments and delayed progress payments;
- conducting a comprehensive risk assessment during the bidding process;
- blacklisting service providers caught practising bribery;
- conducting adequate public participation;
- introducing capacity development programmes;
- payment of wages in line with BCCEI and standardisation of wages among all the contractors working at a site;
- ring-fencing of the project budget by the client;
- limiting subcontracting to projects equal or above R30 million;
- appointing experienced subcontractors that are registered with the CIDB;
- cession payments for subcontractors; and
- appointment of qualified and competent cost estimators by contractors.

The NDP document of 2012 identified infrastructure projects as one of the pillars to support sustainable inclusive economic growth in South Africa to eradicate abject poverty and income inequality. However, this benefit cannot be realised if infrastructure projects are executed inefficiently. Implementing the recommendations of the study would contribute to the efficient execution of infrastructure projects in the public sector and, in turn, to the achievement of sustainable inclusive economic growth in South Africa.

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APPENDIX A: LETTER OF PERMISSION FROM THE EMPLOYER

ADV. MZWAKHE MOFOKENG
ADMINISTRATOR
17 -04- 2020
MANGAUNG METROPOLITAN MUNICIPALITY

MANGAUNG
METRO MUNICIPALITY
METRO MUNISIPALITEIT
LEKGOTLA LA MOTSE
DIRECTORATE CORPORATE SERVICES

DATE: 17/04/2020

MR. M NDLOVU
MASTERS OF BUSINESS ADMINISTARTION
UNIVERSITY OF THE FREE STATE

MR.

REQUEST FOR PERMISSION TO ACCESS AND UTILISE ROAD PROJECTS INFORMATION AND DISTRIBUTE STRUCTURED QUESTIONAIRES TO SELECTED OFFICIALS AT ENGINNERING SERVICES DIRECTORATE OF THE MANGAUNG METRO MUNICIPALITY AND CONTRACTED SERVICE PROVIDERS FOR ACADEMIC AND/OR POSSIBLE PUBLICATION PURPOSES ONLY.

I have pleasure to confirm that the Administrator has granted you permission to access and use road projects data and distribute structured questionnaires to selected officials at Engineering Services Directorate of the Mangaung Metro Municipality and contracted service providers for academic and/or possible publication purposes only.

During this research project, you will be provided with confidential information from respondents participating in your project and in this regard, I want to stress the importance of safeguarding the confidentiality of the information received from respondents.

As you may be aware and depending on how this information is handled, this position of confidentiality may be violated leading to irreversible damage the image of the Municipality and the may also result in legal action instituted by these respondents against the employer for not guaranteeing their confidential responses.

I trust you realise the great responsibility placed on you and the significance of safeguarding the confidentiality of the information your respondent will give. Further, that we can rely on your positive contribution in this regard.

If we are in agreement on this matter, please acknowledge the receipt of this letter in writing by signing annexure A (**Acknowledgement of Letter Permission**) and annexure B **(Non- Disclosure and Confidentiality Agreement)** attached hereto and sign the enclosed indemnity letter and return same to the designated officials indicated on annexure A.

Yours sincerely

M. M 17 April 2020

ADV. M MOFOKENG
ADMINISTRATOR

PO Box 3704, Bloemfontein 9300 Room 640, 6th floor, Bram Fischer Building, Cnr Nelson Mandela & Markgraaff Street
Tel: +27 51 405 8623 E-Mail: david.nkaiseng@mangaung.co.za Website: www.manguang.co.za

APPENDIX B: ETHICAL CLEARANCE LETTER FROM THE UNIVERSITY

UNIVERSITY OF THE FREE STATE
UNIVERSITEIT VAN DIE VRYSTAAT
YUNIVESITHI YA FREISTATA
UFS UV

GENERAL/HUMAN RESEARCH ETHICS COMMITTEE (GHREC)

01-Jul-2020

Dear Mr Mlondolozi Ndlovu

Application Approved

Research Project Title:
Factors affecting time and cost overruns in road construction projects in a metropolitan municipality of the Free State Province

Ethical Clearance number:
UFS-HSD2020/0591/3006

We are pleased to inform you that your application for ethical clearance has been approved. Your ethical clearance is valid for twelve (12) months from the date of issue. We request that any changes that may take place during the course of your study/research project be submitted to the ethics office to ensure ethical transparency. furthermore, you are requested to submit the final report of your study/research project to the ethics office. Should you require more time to complete this research, please apply for an extension. Thank you for submitting your proposal for ethical clearance; we wish you the best of luck and success with your research.

Yours sincerely

Dr Adri Du Plessis
Chairperson: General/Human Research Ethics Committee

Adri du Plessis
2020.07.01
17:19:22
+02'00'

205 Nelson Mandela Drive
Park West
Bloemfontein 9301
South Africa

P.O. Box 339
Bloemfontein 9300
Tel: +27 (0)51 401 9337
duplessisA@ufs.ac.za
www.ufs.ac.za

APPENDIX C: QUESTIONNAIRE

Section A: Demographic Information

1.1 Please indicate the type of organisation that you belong to:

Organisation	**Tick Applicable**
Metropolitan Municipality	
Consultant/Professional Service Provider	
Contractor	

1.2 Please indicate your years of work experience in the construction industry:

Years of work experience in the industry	**Tick Applicable**
0 to 5 years	
6 to 10 years	
11 to 15 years	
16 to 20 years	
20 years and Above	

1.3 Please indicate your level of highest qualification:

Highest Qualification	**Tick Applicable**
Matric/High school and below	
National Diploma	
Bachelors Degree/ BTech	
BSc Honours/Graduate Diploma/Post Graduate Diploma	
Masters and Above	
Other (Specify)	

1.4 Please indicate your professional registration status:

Professional Registration	**Tick Applicable**
ECSA (PrEng/PrTechEng/PrTechni) or equivalent	
SACPCMP (PrCPM/CM) or equivalent	

Professional Registration	Tick Applicable
ASAQS (PrQS) or equivalent	
Other Professional bodies (Specify)	
Not Professional registered	

Section B: Factors affecting time and cost overruns in road projects at Mangaung Metropolitan Municipality

This section explores the factors affecting the time and cost overruns on road construction projects in Mangaung Metro.

To what extent do you agree with the following statements? Please indicate your answers using the 6-point Likert scale where:

1. Strongly Disagree (SD)
2. Disagree (D)
3. Somewhat Disagree (SWD)
4. Somewhat Agree (SWA)
5. Agree (A)
6. Strongly Agree (SA)

Group	Code	The following factors are the main causes of time and cost overrun in road projects at MMM	SD	D	SWD	SWA	A	SA
Client related	1.1	Lack of project funding (budget)	1	2	3	4	5	6
	1.2	Delays in progress payments	1	2	3	4	5	6
	1.3	Client interference	1	2	3	4	5	6
	1.4	Slow decision making by client	1	2	3	4	5	6
	1.5	Unresolved land ownership	1	2	3	4	5	6
	1.6	Appointment of incompetent service providers	1	2	3	4	5	6

Group	Code	The following factors are the main causes of time and cost overrun in road projects at MMM	SD	D	SWD	SWA	A	SA
Client related continued	1.7	Interest payment on overdue claims	1	2	3	4	5	6
	1.8	Increase in scope of work	1	2	3	4	5	6
	1.9	Bureaucracy in client's administration	1	2	3	4	5	6
	1.10	Delays in handing over site	1	2	3	4	5	6
	1.11	Change of specifications	1	2	3	4	5	6

Group	Code	The following factors are the main causes of time and cost overrun in road projects at MMM	SD	D	SWD	SWA	A	SA
Consultant related	2.1	Incomplete design information at tender stage	1	2	3	4	5	6
	2.2	Design mistakes	1	2	3	4	5	6
	2.3	Design changes	1	2	3	4	5	6
	2.4	Delay in issuing approvals on site (tests and inspections)	1	2	3	4	5	6
	2.5	Inflexibility (rigid) consultant	1	2	3	4	5	6
	2.6	Failure to give practical solutions on site	1	2	3	4	5	6
	2.7	Unrealistic contract duration estimate	1	2	3	4	5	6
	2.8	Inaccurate bill of quantities	1	2	3	4	5	6
	2.9	Slow decision-making	1	2	3	4	5	6
	2.10	Incomplete designs at the start of construction stage	1	2	3	4	5	6
	2.11	Inexperience consultant's team	1	2	3	4	5	6

Group	**Code**	**The following factors are the main causes of time and cost overrun in road projects at MMM**	**SD**	**D**	**SWD**	**SWA**	**A**	**SA**
Consultant related continued	2.12	Appointment of consultant with political clout	1	2	3	4	5	6

Group	Code	The following factors are the main causes of time and cost overrun in road projects at MMM	SD	D	SWD	SWA	A	SA
Contractor related	3.1	Labour unrest	1	2	3	4	5	6
	3.2	Subcontracting challenges (dispute and performance)	1	2	3	4	5	6
	3.3	Contractor's cashflow	1	2	3	4	5	6
	3.4	Lack of site management and supervision	1	2	3	4	5	6
	3.5	Re-work due to errors during construction	1	2	3	4	5	6
	3.6	Poor planning and scheduling of work	1	2	3	4	5	6
	3.7	Lack of experience on similar work	1	2	3	4	5	6
	3.8	Under-pricing of the work due to overconfidence in own ability	1	2	3	4	5	6
	3.9	Outdated construction methods	1	2	3	4	5	6
	3.10	Appointment of contractors with political clout	1	2	3	4	5	6
	3.11	Under-pricing of the work due to strategic misrepresentation	1	2	3	4	5	6
	3.12	Poor cost planning, monitoring and control	1	2	3	4	5	6

Group	Code	The following factors are the main causes of time and cost overrun in road projects at MMM	SD	D	SWD	SWA	A	SA
Contractor related continued	3.13	Termination of contract and appointment of another contractor to finish the work	1	2	3	4	5	6
	3.14	Contractor's ownership of the critical construction equipment for work continuity	1	2	3	4	5	6

Group	Code	The following factors are the main causes of time and cost overrun in road projects at MMM	SD	D	SWD	SWA	A	SA
Resources related	4.1	Shortage of skilled labourers	1	2	3	4	5	6
	4.2	Unproductivity of labour force	1	2	3	4	5	6
	4.3	Shortage of materials	1	2	3	4	5	6
	4.4	Delay in material and equipment delivery	1	2	3	4	5	6
	4.5	Shortage of equipment	1	2	3	4	5	6
	4.6	Low productivity of equipment	1	2	3	4	5	6
	4.7	Material price increases	1	2	3	4	5	6
	4.8	Equipment rental rate increases	1	2	3	4	5	6
	4.9	Increase in labour rates	1	2	3	4	5	6
	4.10	High cost of skilled labour	1	2	3	4	5	6
Externally related	5.1	Community disruptions	1	2	3	4	5	6
	5.2	Environmental issues	1	2	3	4	5	6
	5.3	Inclement weather	1	2	3	4	5	6
	5.4	Regulatory changes	1	2	3	4	5	6
	5.5	Unforeseen site condition	1	2	3	4	5	6
	5.6	Accident during construction	1	2	3	4	5	6
	5.7	Corruption	1	2	3	4	5	6

Group	Code	The following factors are the main causes of time and cost overrun in road projects at MMM	SD	D	SWD	SWA	A	SA
Contract related	6.1	Errors	1	2	3	4	5	6
	6.2	Discrepancies and omissions in contract document	1	2	3	4	5	6
	6.3	Contract dispute and negotiations	1	2	3	4	5	6
	6.4	Change of specifications	1	2	3	4	5	6
	6.5	Penalties ineffective and/or not administered	1	2	3	4	5	6
	6.6	Poor communication and co-ordination between parties	1	2	3	4	5	6
	6.7	Contract claims	1	2	3	4	5	6

Section C: Degree of Impact and Frequency of Occurrence of the factors affecting time and cost overruns in road projects at Mangaung Metropolitan Municipality

This section assesses the degree of impact/severity and the frequency of occurrence of factors affecting the time and cost overruns on roads construction projects in Mangaung Metro.

What is the degree of impact/severity and frequency of occurrence of the following factors on the time and cost overruns in roads construction projects? Please indicate your answers using the 5-point Likert scale where:

Weight	**Degree of Impact/severity**	**Frequency of occurrence**
1	None (N)	Never (N)
2	Minor (Mi)	Rarely, around 20% (R)
3	Moderate (Mo)	Occasionally, around 50% (Oc)
4	High (H)	Often, around 80% (Of)
5	Very High (VH)	Always (A)

Group	Code	The following factors are the main causes of time and cost overrun in road projects at MMM	Degree of Impact/ Severity					Frequency of Occurrence				
			N	Mi	Mo	H	VH	N	R	Oc	Of	A
Client related	1.1	Lack of project funding (budget)	1	2	3	4	5	1	2	3	4	5
	1.2	Delays in progress payments	1	2	3	4	5	1	2	3	4	5
	1.3	Client interference	1	2	3	4	5	1	2	3	4	5
	1.4	Slow decision making by client	1	2	3	4	5	1	2	3	4	5
	1.5	Unresolved land ownership	1	2	3	4	5	1	2	3	4	5
	1.6	Appointment of incompetent service providers	1	2	3	4	5	1	2	3	4	5
	1.7	Interest payment on overdue claims	1	2	3	4	5	1	2	3	4	5
	1.8	Increase in scope of work	1	2	3	4	5	1	2	3	4	5
	1.9	Bureaucracy in client's administration	1	2	3	4	5	1	2	3	4	5
	1.10	Delays in handing over site	1	2	3	4	5	1	2	3	4	5
	1.11	Change of specifications	1	2	3	4	5	1	2	3	4	5
Consultant related	2.1	Incomplete design information at tender stage	1	2	3	4	5	1	2	3	4	5
	2.2	Design mistakes	1	2	3	4	5	1	2	3	4	5

Group	Code	The following factors are the main causes of time and cost overrun in road projects at MMM	Degree of Impact/ Severity					Frequency of Occurrence				
			N	Mi	Mo	H	VH	N	R	Oc	Of	A
Consultant related continued	2.3	Design changes	1	2	3	4	5	1	2	3	4	5
	2.4	Delay in issuing approvals on site (tests and inspections)	1	2	3	4	5	1	2	3	4	5
	2.5	Inflexibility (rigid) consultant	1	2	3	4	5	1	2	3	4	5
	2.6	Failure to give practical solutions on site	1	2	3	4	5	1	2	3	4	5
	2.7	Unrealistic contract duration estimate	1	2	3	4	5	1	2	3	4	5
	2.8	Inaccurate bill of quantities	1	2	3	4	5	1	2	3	4	5
	2.9	Slow decision-making	1	2	3	4	5	1	2	3	4	5
	2.10	Incomplete designs at the start of construction stage	1	2	3	4	5	1	2	3	4	5
	2.11	Inexperience consultant’s team	1	2	3	4	5	1	2	3	4	5
	2.12	Appointment of consultant with political clout	1	2	3	4	5	1	2	3	4	5

Group	Code	The following factors are the main causes of time and cost overrun in road projects at MMM	Degree of Impact/ Severity					Frequency of Occurrence				
			N	Mi	Mo	H	VH	N	R	Oc	Of	A
Contractor related	3.1	Labour unrest	1	2	3	4	5	1	2	3	4	5
	3.2	Subcontracting challenges (dispute and performance)	1	2	3	4	5	1	2	3	4	5
	3.3	Contractor's cashflow	1	2	3	4	5	1	2	3	4	5
	3.4	Lack of site management and supervision	1	2	3	4	5	1	2	3	4	5
	3.5	Re-work due to errors during construction	1	2	3	4	5	1	2	3	4	5
	3.6	Poor planning and scheduling of work	1	2	3	4	5	1	2	3	4	5
	3.7	Lack of experience on similar work	1	2	3	4	5	1	2	3	4	5
	3.8	Under-pricing of the work due to overconfidence in own ability	1	2	3	4	5	1	2	3	4	5
	3.9	Outdated construction methods	1	2	3	4	5	1	2	3	4	5
	3.10	Appointment of contractors with political clout	1	2	3	4	5	1	2	3	4	5
	3.11	Under-pricing of the work due to strategic misrepresentation	1	2	3	4	5	1	2	3	4	5

Group	Code	The following factors are the main causes of time and cost overrun in road projects at MMM	Degree of Impact/ Severity					Frequency of Occurrence				
			N	Mi	Mo	H	VH	N	R	Oc	Of	A
Contractor related continued	3.12	Poor cost planning, monitoring and control	1	2	3	4	5	1	2	3	4	5
	3.13	Termination of contract and appointment of another contractor to finish the work	1	2	3	4	5	1	2	3	4	5
	3.14	Contractor's ownership of the critical construction equipment for work continuity	1	2	3	4	5	1	2	3	4	5
Resources related	4.1	Shortage of skilled labourers	1	2	3	4	5	1	2	3	4	5
	4.2	Unproductivity of labour force	1	2	3	4	5	1	2	3	4	5
	4.3	Shortage of materials	1	2	3	4	5	1	2	3	4	5
	4.4	Delay in material and equipment delivery	1	2	3	4	5	1	2	3	4	5
	4.5	Shortage of equipment	1	2	3	4	5	1	2	3	4	5
	4.6	Low productivity of equipment	1	2	3	4	5	1	2	3	4	5
	4.7	Material price increases	1	2	3	4	5	1	2	3	4	5
	4.8	Equipment rental rate increases	1	2	3	4	5	1	2	3	4	5
	4.9	Increase in labour rates	1	2	3	4	5	1	2	3	4	5
	4.10	High cost of skilled labour	1	2	3	4	5	1	2	3	4	5

Group	Code	The following factors are the main causes of time and cost overrun in road projects at MMM	Degree of Impact/ Severity					Frequency of Occurrence				
			N	Mi	Mo	H	VH	N	R	Oc	Of	A
External related	5.1	Community disruptions	1	2	3	4	5	1	2	3	4	5
	5.2	Environmental issues	1	2	3	4	5	1	2	3	4	5
	5.3	Inclement weather	1	2	3	4	5	1	2	3	4	5
	5.4	Regulatory changes	1	2	3	4	5	1	2	3	4	5
	5.5	Unforeseen site condition	1	2	3	4	5	1	2	3	4	5
	5.6	Accident during construction	1	2	3	4	5	1	2	3	4	5
	5.7	Corruption	1	2	3	4	5	1	2	3	4	5
Contract related	6.1	Errors	1	2	3	4	5	1	2	3	4	5
	6.2	Discrepancies and omissions in contract document	1	2	3	4	5	1	2	3	4	5
	6.3	Contract dispute and negotiations	1	2	3	4	5	1	2	3	4	5
	6.4	Change of specifications	1	2	3	4	5	1	2	3	4	5
	6.5	Penalties ineffective and/or not administered	1	2	3	4	5	1	2	3	4	5
	6.6	Poor communication and co-ordination between parties	1	2	3	4	5	1	2	3	4	5
	6.7	Contract claims	1	2	3	4	5	1	2	3	4	5

Section D: Advice on managing time and cost overruns

If you were to advise the management of MMM on the three (3) most important issues to address in order to manage time and cost overruns, what would it be?

……
……
……
……

Would you please make sure that you have not skipped any of the questions in all sections?

I Thank You!!!

APPENDIX D: PROJECT SAMPLE

Project No.	Contract Time (days)	Actual Completion time (days)	Time Overrun (%)	Planned Contract Amount (Rands)	Final contract Cost (Rands)	Cost Overrun (%)	Engineer Estimate (Eng Est) (Rands	Difference between Eng Est and Planned Contract Amount (%)	Total Number of bidders
1	201	374	86	8,669,573.00	9,177,456.10	6	5,950,000.00	-46	7
2	191	352	84	7,585,602.99	6,970,443.50	0	5,459,483.50	-39	10
3	201	601	199	3,266,546.00	7,644,305.23	134	8,458,021.00	61	10
4	298	544	83	9,578,248.00	6,582,850.00	0	10,293,737.39	7	18
5	266	618	132	4,556,318.00	8,288,176.85	82	5,883,563.60	23	18
6	98	308	214	4,002,566.00	3,036,050.10	0	2,690,000.00	-49	4
7	153	184	20	4,108,859.04	3,443,224.87	0	3,801,812.50	-8	22
8	183	463	153	9,077,202.00	8,388,653.98	0	9,154,263.95	1	24
9	183	679	271	9,259,129.00	8,575,646.92	0	10,555,407.06	12	24
10	192	241	26	1,916,739.32	1,958,831.63	2	412,015.39	-365	16
11	192	255	33	2,275,450.21	2,810,015.05	23	489,558.11	-365	17
12	192	486	153	3,023,017.53	3,005,243.06	0	426,229.62	-609	17
13	192	241	26	2,140,733.50	2,572,130.16	20	456,517.09	-369	17
14	192	517	169	3,203,989.60	3,373,507.79	5	454,695.15	-605	17
15	192	192	0	2,250,483.58	2,429,341.28	8	440,648.03	-411	17

Project No.	Contract Time (days)	Actual Completion time (days)	Time Overrun (%)	Planned Contract Amount (Rands)	Final contract Cost (Rands)	Cost Overrun (%)	Engineer Estimate (Eng Est) (Rands	Difference between Eng Est and Planned Contract Amount (%)	Total Number of bidders
16	192	486	153	3,243,298.35	3,191,048.20	0	452,679.42	-616	17
17	192	192	0	1,980,590.51	2,282,632.58	15	429,288.10	-361	17
18	217	217	0	3,790,499.72	3,650,557.74	0	441,103.94	-759	17
19	221	302	37	1,485,667.44	1,873,519.02	26	340,220.69	-337	16
20	217	216	0	3,722,384.54	3,636,352.91	0	454,713.47	-719	17
21	120	116	0	1,969,627.88	2,295,011.49	17	2,083,538.10	5	32
22	208	299	44	7,755,078.67	5,510,085.47	0	6,023,418.00	-29	33
23	185	222	20	8,025,328.25	6,833,862.97	0	6,969,253.08	-15	41
24	750	731	0	35,456,021.64	35,457,161.64	0	29,469,000.00	-20	39
25	90	101	12	3,124,574.47	2,667,655.75	0	1,594,746.00	-96	19
26	650	633	0	15,559,824.72	18,575,850.21	19	23,199,000.00	33	36
27	214	280	31	6,190,447.20	6,341,660.49	2	7,765,665.72	20	38
28	387	400	3	8,786,199.21	8,901,128.44	1	6,223,917.50	-41	15
29	224	420	88	8,309,111.58	10,410,146.17	25	11,919,065.60	30	36
30	217	933	330	9,374,977.10	9,376,064.43	0	11,569,235.71	19	33
31	480	488	2	29,731,915.81	30,086,279.30	1	30,012,785.75	1	16

Project No.	Contract Time (days)	Actual Completion time (days)	Time Overrun (%)	Planned Contract Amount (Rands)	Final contract Cost (Rands)	Cost Overrun (%)	Engineer Estimate (Eng Est) (Rands	Difference between Eng Est and Planned Contract Amount (%)	Total Number of bidders
32	241	488	102	10,949,385.96	11,117,659.28	2	12,140,733.68	10	28
33	175	449	157	13,213,740.00	15,721,139.47	19	8,901,411.07	-48	40
34	585	415	0	20,915,143.33	21,015,167.21	0	23,792,665.96	12	17
35	881	1093	24	22,789,512.92	27,208,775.11	19	17,179,022.00	-33	33
36	358	894	150	16,420,245.59	25,420,245.59	55	16,104,322.30	-2	29
37	412	910	121	17,934,632.95	23,934,632.95	33	19,044,644.00	6	18
38	185	424	129	9,570,000.00	9,457,084.03	0	9,596,776.20	0	10
39	185	424	129	9,570,000.00	9,456,122.12	0	9,596,776.20	0	10
40	185	424	129	9,570,000.00	9,559,977.75	0	9,596,776.20	0	10
41	185	424	129	9,570,000.00	9,368,549.74	0	9,596,776.20	0	10
42	184	421	129	9,570,000.00	8,181,453.54	0	9,596,776.20	0	10
43	184	421	129	9,570,000.00	8,722,005.20	0	9,596,776.20	0	10
44	184	421	129	9,570,000.00	7,686,528.74	0	9,596,776.20	0	10
45	186	411	121	9,570,000.00	7,057,036.54	0	9,596,776.20	0	10
46	183	424	132	9,570,000.00	9,176,346.38	0	9,596,776.20	0	10
47	214	443	107	9,570,000.00	8,261,193.77	0	9,596,776.20	0	10

APPENDIX E: RELATIVE IMPORTANCE INDEX (RII) CALCULATIONS

TABLE E.1: RANKING OF FACTORS BASED ON AGGREGATE VIEWS OF ALL RESPONDENT GROUPS

Ranking of factors based on aggregate views of all respondent groups														
Factor Code	SD		D		SWD		SWA		A		SA		RII	Rank
	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight		
1.1	4	1	7	2	6	3	11	4	6	5	3	6	0.577	55
1.2	1	1	1	2	4	3	8	4	8	5	15	6	0.797	11
1.3	1	1	9	2	3	3	12	4	9	5	3	6	0.626	49
1.4	0	1	5	2	1	3	10	4	12	5	9	6	0.752	19
1.5	6	1	8	2	4	3	9	4	6	5	4	6	0.559	59
1.6	1	1	2	2	2	3	10	4	13	5	9	6	0.766	17
1.7	5	1	12	2	6	3	7	4	2	5	5	6	0.518	61
1.8	1	1	7	2	3	3	8	4	16	5	2	6	0.667	41
1.9	1	1	3	2	1	3	8	4	12	5	12	6	0.784	15
1.10	4	1	7	2	2	3	12	4	7	5	5	6	0.617	52
1.11	4	1	8	2	2	3	6	4	12	5	5	6	0.631	48
2.1	2	1	4	2	2	3	10	4	13	5	6	6	0.707	27
2.2	1	1	4	2	5	3	11	4	13	5	3	6	0.68	37
2.3	1	1	4	2	4	3	11	4	11	5	6	6	0.703	31
2.4	3	1	6	2	5	3	12	4	7	5	4	6	0.617	52

Ranking of factors based on aggregate views of all respondent groups														
Factor Code	SD		D		SWD		SWA		A		SA		RII	Rank
	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight		
2.5	2	1	6	2	10	3	6	4	10	5	3	6	0.613	54
2.6	2	1	4	2	6	3	10	4	12	5	3	6	0.658	43
2.7	2	1	7	2	3	3	8	4	10	5	7	6	0.671	40
2.8	1	1	5	2	3	3	8	4	15	5	5	6	0.707	27
2.9	1	1	5	2	2	3	9	4	14	5	6	6	0.716	25
2.10	3	1	4	2	4	3	9	4	10	5	7	6	0.68	37
2.11	2	1	5	2	4	3	14	4	9	5	3	6	0.644	44
2.12	1	1	1	2	3	3	10	4	9	5	13	6	0.788	14

Ranking of factors based on aggregate views of all respondent groups														
Factor Code	SD		D		SWD		SWA		A		SA		RII	Rank
	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight		
3.1	0	1	0	2	1	3	5	4	14	5	17	6	0.878	3
3.2	0	1	0	2	1	3	5	4	17	5	14	6	0.865	4
3.3	0	1	0	2	3	3	4	4	13	5	17	6	0.865	4
3.4	0	1	4	2	2	3	11	4	12	5	8	6	0.748	20
3.5	1	1	2	2	6	3	8	4	14	5	6	6	0.725	24
3.6	0	1	2	2	1	3	10	4	15	5	9	6	0.793	12
3.7	0	1	3	2	3	3	5	4	15	5	11	6	0.793	12
3.8	0	1	1	2	3	3	8	4	12	5	13	6	0.815	7
3.9	2	1	5	2	5	3	16	4	6	5	3	6	0.626	49
3.10	0	1	0	2	1	3	6	4	9	5	21	6	0.892	1
3.11	0	1	2	2	3	3	8	4	10	5	14	6	0.806	10
3.12	0	1	1	2	1	3	8	4	15	5	12	6	0.829	6
3.13	0	1	2	2	5	3	10	4	9	5	11	6	0.766	17
3.14	0	1	2	2	8	3	7	4	11	5	9	6	0.743	21
4.1	2	1	6	2	3	3	4	4	17	5	5	6	0.694	32
4.2	0	1	1	2	4	3	3	4	20	5	9	6	0.811	9

Ranking of factors based on aggregate views of all respondent groups														
Factor Code	SD		D		SWD		SWA		A		SA		RII	Rank
	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight		
4.3	0	1	3	2	11	3	9	4	6	5	8	6	0.689	34
4.4	0	1	3	2	7	3	12	4	8	5	7	6	0.707	27
4.5	0	1	5	2	6	3	13	4	4	5	9	6	0.694	32
4.6	0	1	4	2	8	3	10	4	9	5	6	6	0.689	34
4.7	0	1	7	2	9	3	8	4	10	5	3	6	0.635	46
4.8	2	1	4	2	8	3	13	4	7	5	3	6	0.626	49
4.9	3	1	9	2	7	3	8	4	7	5	3	6	0.572	57
4.10	2	1	13	2	7	3	4	4	8	5	3	6	0.554	60

Ranking of factors based on aggregate views of all respondent groups														
Factor Code	SD		D		SWD		SWA		A		SA		RII	Rank
	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight		
5.1	0	1	2	2	0	3	3	4	11	5	21	6	0.887	2
5.2	1	1	6	2	10	3	7	4	8	5	5	6	0.635	46
5.3	1	1	6	2	4	3	15	4	9	5	2	6	0.64	45
5.4	1	1	11	2	7	3	10	4	6	5	2	6	0.568	58
5.5	0	1	3	2	6	3	10	4	13	5	5	6	0.716	25
5.6	1	1	9	2	10	3	8	4	7	5	2	6	0.577	55
5.7	1	1	2	2	2	3	5	4	12	5	15	6	0.815	7
6.1	2	1	3	2	4	3	10	4	15	5	3	6	0.689	34
6.2	3	1	2	2	8	3	4	4	16	5	4	6	0.68	37
6.3	2	1	2	2	5	3	10	4	12	5	6	6	0.707	27
6.4	2	1	5	2	4	3	9	4	14	5	3	6	0.667	41
6.5	1	1	1	2	5	3	12	4	12	5	6	6	0.73	23
6.6	1	1	1	2	4	3	7	4	15	5	9	6	0.775	16
6.7	0	1	4	2	5	3	7	4	12	5	9	6	0.743	21

TABLE E.2: RANKING OF FACTORS BASED ON CLIENT GROUP

Ranking of factors based on client group														
Factor Code	SD		D		SWD		SWA		A		SA		RII	Rank
	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight		
1.1	2	1	1	2	1	3	2	4	1	5	1	6	0.542	49
1.2	0	1	0	2	1	3	3	4	2	5	2	6	0.771	9
1.3	0	1	3	2	0	3	2	4	1	5	2	6	0.646	24
1.4	0	1	3	2	0	3	1	4	1	5	3	6	0.688	18
1.5	2	1	1	2	1	3	4	4	0	5	0	6	0.479	58
1.6	0	1	1	2	1	3	1	4	2	5	3	6	0.771	9
1.7	2	1	2	2	0	3	2	4	1	5	1	6	0.521	53
1.8	1	1	1	2	0	3	1	4	5	5	0	6	0.667	20
1.9	0	1	1	2	0	3	1	4	3	5	3	6	0.813	5
1.10	1	1	1	2	0	3	5	4	0	5	1	6	0.604	35
1.11	1	1	1	2	0	3	4	4	2	5	0	6	0.604	35
2.1	0	1	2	2	1	3	2	4	2	5	1	6	0.646	24
2.2	0	1	2	2	1	3	2	4	3	5	0	6	0.625	30
2.3	0	1	1	2	1	3	2	4	3	5	1	6	0.708	17
2.4	1	1	1	2	2	3	3	4	1	5	0	6	0.542	49

Ranking of factors based on client group														
Factor Code	SD		D		SWD		SWA		A		SA		RII	Rank
	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight		
2.5	1	1	1	2	6	3	0	4	0	5	0	6	0.438	61
2.6	1	1	2	2	2	3	3	4	0	5	0	6	0.479	58
2.7	0	1	2	2	1	3	3	4	2	5	0	6	0.604	35
2.8	0	1	2	2	1	3	3	4	1	5	1	6	0.625	30
2.9	0	1	3	2	0	3	3	4	1	5	1	6	0.604	35
2.10	1	1	1	2	1	3	3	4	2	5	0	6	0.583	44
2.11	1	1	2	2	1	3	2	4	0	5	2	6	0.583	44
2.12	1	1	1	2	2	3	1	4	2	5	1	6	0.604	35

Ranking of factors based on client group														
Factor Code	SD		D		SWD		SWA		A		SA		RII	Rank
	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight		
3.1	0	1	0	2	0	3	1	4	4	5	3	6	0.875	2
3.2	0	1	0	2	0	3	0	4	6	5	2	6	0.875	2
3.3	0	1	0	2	1	3	1	4	2	5	4	6	0.854	4
3.4	0	1	0	2	1	3	3	4	4	5	0	6	0.729	16
3.5	0	1	0	2	1	3	3	4	3	5	1	6	0.75	12
3.6	0	1	0	2	1	3	3	4	3	5	1	6	0.75	12
3.7	0	1	1	2	2	3	2	4	3	5	0	6	0.646	24
3.8	0	1	1	2	2	3	1	4	3	5	1	6	0.688	18
3.9	0	1	1	2	3	3	3	4	1	5	0	6	0.583	44
3.10	0	1	0	2	1	3	2	4	2	5	3	6	0.813	5
3.11	0	1	1	2	3	3	0	4	3	5	1	6	0.667	20
3.12	0	1	1	2	0	3	1	4	4	5	2	6	0.792	7
3.13	0	1	1	2	0	3	3	4	2	5	2	6	0.75	12
3.14	0	1	0	2	4	3	1	4	3	5	0	6	0.646	24
4.1	0	1	3	2	1	3	0	4	4	5	0	6	0.604	35
4.2	0	1	0	2	1	3	1	4	6	5	0	6	0.771	9

Ranking of factors based on client group														
Factor Code	SD		D		SWD		SWA		A		SA		RII	Rank
	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight		
4.3	0	1	0	2	4	3	3	4	1	5	0	6	0.604	35
4.4	0	1	0	2	3	3	4	4	1	5	0	6	0.625	30
4.5	0	1	0	2	3	3	4	4	0	5	1	6	0.646	24
4.6	0	1	0	2	3	3	4	4	0	5	1	6	0.646	24
4.7	0	1	2	2	4	3	1	4	1	5	0	6	0.521	53
4.8	0	1	1	2	4	3	3	4	0	5	0	6	0.542	49
4.9	1	1	1	2	2	3	4	4	0	5	0	6	0.521	53
4.10	0	1	3	2	3	3	1	4	1	5	0	6	0.5	57

Ranking of factors based on client group														
Factor Code	SD		D		SWD		SWA		A		SA		RII	Rank
	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight		
5.1	0	1	0	2	0	3	0	4	3	5	5	6	0.938	1
5.2	0	1	2	2	3	3	1	4	1	5	1	6	0.583	44
5.3	0	1	0	2	1	3	6	4	1	5	0	6	0.667	20
5.4	0	1	2	2	3	3	2	4	1	5	0	6	0.542	49
5.5	0	1	1	2	3	3	1	4	1	5	2	6	0.667	20
5.6	0	1	3	2	3	3	2	4	0	5	0	6	0.479	58
5.7	1	1	1	2	1	3	2	4	2	5	1	6	0.625	30
6.1	1	1	3	2	0	3	2	4	2	5	0	6	0.521	53
6.2	1	1	1	2	2	3	1	4	2	5	1	6	0.604	35
6.3	1	1	1	2	1	3	4	4	0	5	1	6	0.583	44
6.4	1	1	1	2	0	3	4	4	2	5	0	6	0.604	35
6.5	0	1	0	2	1	3	4	4	1	5	2	6	0.75	12
6.6	1	1	0	2	2	3	2	4	3	5	0	6	0.625	30
6.7	0	1	1	2	0	3	2	4	2	5	3	6	0.792	7

TABLE E.3: RANKING OF FACTORS BASED ON CONSULTANT GROUP

Ranking of factors based on consultant group														
Factor Code	SD		D		SWD		SWA		A		SA		RII	Rank
	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight		
1.1	1	1	3	2	3	3	5	4	1	5	2	6	0.589	56
1.2	0	1	1	2	1	3	3	4	3	5	7	6	0.822	14
1.3	1	1	5	2	2	3	3	4	3	5	1	6	0.556	58
1.4	0	1	2	2	1	3	4	4	4	5	4	6	0.744	27
1.5	3	1	2	2	1	3	1	4	6	5	2	6	0.622	51
1.6	0	1	1	2	0	3	4	4	5	5	5	6	0.811	19
1.7	2	1	5	2	3	3	1	4	1	5	3	6	0.533	60
1.8	0	1	3	2	1	3	3	4	6	5	2	6	0.7	35
1.9	0	1	1	2	0	3	4	4	4	5	6	6	0.822	14
1.10	1	1	2	2	2	3	3	4	4	5	3	6	0.678	39
1.11	2	1	2	2	2	3	1	4	4	5	4	6	0.667	43
2.1	2	1	1	2	1	3	2	4	7	5	2	6	0.689	37
2.2	1	1	2	2	3	3	3	4	6	5	0	6	0.622	51
2.3	1	1	1	2	1	3	4	4	7	5	1	6	0.7	35
2.4	1	1	4	2	1	3	5	4	2	5	2	6	0.6	54

Ranking of factors based on consultant group														
Factor Code	SD		D		SWD		SWA		A		SA		RII	Rank
	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight		
2.5	0	1	4	2	1	3	3	4	5	5	2	6	0.667	43
2.6	1	1	2	2	2	3	3	4	5	5	2	6	0.667	43
2.7	2	1	3	2	1	3	1	4	5	5	3	6	0.644	47
2.8	1	1	3	2	0	3	2	4	7	5	2	6	0.689	37
2.9	1	1	2	2	0	3	2	4	8	5	2	6	0.722	31
2.10	2	1	2	2	0	3	2	4	7	5	2	6	0.678	39
2.11	1	1	2	2	2	3	4	4	6	5	0	6	0.633	50
2.12	0	1	0	2	0	3	5	4	4	5	6	6	0.844	13

Ranking of factors based on consultant group														
Factor Code	SD		D		SWD		SWA		A		SA		RII	Rank
	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight		
3.1	0	1	0	2	0	3	0	4	7	5	8	6	0.922	3
3.2	0	1	0	2	0	3	2	4	7	5	6	6	0.878	11
3.3	0	1	0	2	0	3	0	4	3	5	12	6	0.967	1
3.4	0	1	1	2	1	3	2	4	5	5	6	6	0.822	14
3.5	0	1	2	2	1	3	2	4	5	5	5	6	0.778	20
3.6	0	1	0	2	0	3	2	4	5	5	8	6	0.9	8
3.7	0	1	0	2	0	3	1	4	5	5	9	6	0.922	3
3.8	0	1	0	2	0	3	2	4	4	5	9	6	0.911	6
3.9	2	1	2	2	2	3	5	4	2	5	2	6	0.6	54
3.10	0	1	0	2	0	3	1	4	4	5	10	6	0.933	2
3.11	0	1	1	2	0	3	2	4	3	5	9	6	0.878	11
3.12	0	1	0	2	0	3	1	4	8	5	6	6	0.889	10
3.13	0	1	0	2	2	3	3	4	4	5	6	6	0.822	14
3.14	0	1	2	2	1	3	2	4	5	5	5	6	0.778	20
4.1	1	1	2	2	0	3	1	4	7	5	4	6	0.756	26
4.2	0	1	0	2	0	3	0	4	9	5	6	6	0.9	8

Ranking of factors based on consultant group														
Factor Code	SD		D		SWD		SWA		A		SA		RII	Rank
	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight		
4.3	0	1	1	2	1	3	5	4	3	5	5	6	0.778	20
4.4	0	1	0	2	3	3	3	4	5	5	4	6	0.778	20
4.5	0	1	1	2	2	3	4	4	2	5	6	6	0.778	20
4.6	0	1	1	2	3	3	3	4	4	5	4	6	0.744	27
4.7	0	1	3	2	2	3	5	4	4	5	1	6	0.644	47
4.8	1	1	1	2	2	3	7	4	3	5	1	6	0.644	47
4.9	1	1	5	2	3	3	1	4	3	5	2	6	0.567	57
4.10	1	1	7	2	1	3	1	4	3	5	2	6	0.544	59

Ranking of factors based on consultant group														
Factor Code	SD		D		SWD		SWA		A		SA		RII	Rank
	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight		
5.1	0	1	0	2	0	3	1	4	5	5	9	6	0.922	3
5.2	0	1	2	2	4	3	3	4	4	5	2	6	0.667	43
5.3	1	1	3	2	1	3	5	4	5	5	0	6	0.611	53
5.4	0	1	7	2	2	3	4	4	1	5	1	6	0.522	61
5.5	0	1	2	2	2	3	2	4	8	5	1	6	0.711	33
5.6	0	1	4	2	1	3	2	4	6	5	2	6	0.678	39
5.7	0	1	0	2	0	3	2	4	4	5	9	6	0.911	6
6.1	1	1	0	2	2	3	2	4	8	5	2	6	0.744	27
6.2	2	1	0	2	3	3	2	4	6	5	2	6	0.678	39
6.3	1	1	0	2	1	3	4	4	5	5	4	6	0.767	25
6.4	1	1	1	2	1	3	4	4	6	5	2	6	0.711	33
6.5	1	1	1	2	1	3	3	4	7	5	2	6	0.722	31
6.6	0	1	1	2	1	3	2	4	5	5	6	6	0.822	14
6.7	0	1	2	2	3	3	1	4	4	5	5	6	0.744	27

TABLE E.4: RANKING OF FACTORS BASED ON CONTRACTOR GROUP

Ranking of factors based on contractor group														
Factor Code	SD		D		SWD		SWA		A		SA		RII	Rank
	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight		
1.1	1	1	3	2	2	3	4	4	4	5	0	6	0.583	57
1.2	1	1	0	2	2	3	2	4	3	5	6	6	0.786	10
1.3	0	1	1	2	1	3	7	4	5	5	0	6	0.69	35
1.4	0	1	0	2	0	3	5	4	7	5	2	6	0.798	9
1.5	1	1	5	2	2	3	4	4	0	5	2	6	0.536	59
1.6	1	1	0	2	1	3	5	4	6	5	1	6	0.714	29
1.7	1	1	5	2	3	3	4	4	0	5	1	6	0.5	61
1.8	0	1	3	2	2	3	4	4	5	5	0	6	0.631	50
1.9	1	1	1	2	1	3	3	4	5	5	3	6	0.726	25
1.10	2	1	4	2	0	3	4	4	3	5	1	6	0.56	58
1.11	1	1	5	2	0	3	1	4	6	5	1	6	0.607	54
2.1	0	1	1	2	0	3	6	4	4	5	3	6	0.762	16
2.2	0	1	0	2	1	3	6	4	4	5	3	6	0.774	13
2.3	0	1	2	2	2	3	5	4	1	5	4	6	0.702	33
2.4	1	1	1	2	2	3	4	4	4	5	2	6	0.679	38

Ranking of factors based on contractor group														
Factor Code	SD		D		SWD		SWA		A		SA		RII	Rank
	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight		
2.5	1	1	1	2	3	3	3	4	5	5	1	6	0.655	43
2.6	0	1	0	2	2	3	4	4	7	5	1	6	0.75	19
2.7	0	1	2	2	1	3	4	4	3	5	4	6	0.738	21
2.8	0	1	0	2	2	3	3	4	7	5	2	6	0.774	13
2.9	0	1	0	2	2	3	4	4	5	5	3	6	0.774	13
2.10	0	1	1	2	3	3	4	4	1	5	5	6	0.738	21
2.11	0	1	1	2	1	3	8	4	3	5	1	6	0.69	35
2.12	0	1	0	2	1	3	4	4	3	5	6	6	0.833	3

Ranking of factors based on contractor group														
Factor Code	SD		D		SWD		SWA		A		SA		RII	Rank
	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight		
3.1	0	1	0	2	1	3	4	4	3	5	6	6	0.833	3
3.2	0	1	0	2	1	3	3	4	4	5	6	6	0.845	2
3.3	0	1	0	2	2	3	3	4	8	5	1	6	0.762	16
3.4	0	1	3	2	0	3	6	4	3	5	2	6	0.679	38
3.5	1	1	0	2	4	3	3	4	6	5	0	6	0.655	43
3.6	0	1	2	2	0	3	5	4	7	5	0	6	0.702	33
3.7	0	1	2	2	1	3	2	4	7	5	2	6	0.738	21
3.8	0	1	0	2	1	3	5	4	5	5	3	6	0.786	10
3.9	0	1	2	2	0	3	8	4	3	5	1	6	0.679	38
3.10	0	1	0	2	0	3	3	4	3	5	8	6	0.893	1
3.11	0	1	0	2	0	3	6	4	4	5	4	6	0.81	7
3.12	0	1	0	2	1	3	6	4	3	5	4	6	0.786	10
3.13	0	1	1	2	3	3	4	4	3	5	3	6	0.714	29
3.14	0	1	0	2	3	3	4	4	3	5	4	6	0.762	16
4.1	1	1	1	2	2	3	3	4	6	5	1	6	0.679	38
4.2	0	1	1	2	3	3	2	4	5	5	3	6	0.738	21

Ranking of factors based on contractor group														
Factor Code	SD		D		SWD		SWA		A		SA		RII	Rank
	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight		
4.3	0	1	2	2	6	3	1	4	2	5	3	6	0.643	49
4.4	0	1	3	2	1	3	5	4	2	5	3	6	0.679	38
4.5	0	1	4	2	1	3	5	4	2	5	2	6	0.631	50
4.6	0	1	3	2	2	3	3	4	5	5	1	6	0.655	43
4.7	0	1	2	2	3	3	2	4	5	5	2	6	0.69	35
4.8	1	1	2	2	2	3	3	4	4	5	2	6	0.655	43
4.9	1	1	3	2	2	3	3	4	4	5	1	6	0.607	54
4.10	1	1	3	2	3	3	2	4	4	5	1	6	0.595	56

Ranking of factors based on contractor group														
Factor Code	SD		D		SWD		SWA		A		SA		RII	Rank
	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight		
5.1	0	1	2	2	0	3	2	4	3	5	7	6	0.821	5
5.2	1	1	2	2	3	3	3	4	3	5	2	6	0.631	50
5.3	0	1	3	2	2	3	4	4	3	5	2	6	0.655	43
5.4	1	1	2	2	2	3	4	4	4	5	1	6	0.631	50
5.5	0	1	0	2	1	3	7	4	4	5	2	6	0.75	19
5.6	1	1	2	2	6	3	4	4	1	5	0	6	0.524	60
5.7	0	1	1	2	1	3	1	4	6	5	5	6	0.821	5
6.1	0	1	0	2	2	3	6	4	5	5	1	6	0.726	25
6.2	0	1	1	2	3	3	1	4	8	5	1	6	0.726	25
6.3	0	1	1	2	3	3	2	4	7	5	1	6	0.714	29
6.4	0	1	3	2	3	3	1	4	6	5	1	6	0.655	43
6.5	0	1	0	2	3	3	5	4	4	5	2	6	0.726	25
6.6	0	1	0	2	1	3	3	4	7	5	3	6	0.81	7
6.7	0	1	1	2	2	3	4	4	6	5	1	6	0.714	29

APPENDIX F: IMPORTANCE INDEX (IMPI) CALCULATIONS

TABLE F.1: RANKING OF FACTORS BASED ON AGGREGATE VIEWS OF ALL RESPONDENT GROUPS

Ranking of factors based on aggregate views of all respondent groups																						
Factor Code	Degree of Impact/Severity										Frequency of Occurrence										IMPI	Rank
	N		Mi		Mo		H		VH		N		R		Oc		Of		A			
	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight		
1.1	1	1	6	2	8	3	12	4	10	5	1	1	10	2	9	3	11	4	6	5	0.481	16
1.2	0	1	3	2	4	3	13	4	17	5	0	1	3	2	10	3	10	4	14	5	0.661	1
1.3	2	1	7	2	13	3	10	4	5	5	2	1	12	2	13	3	6	4	4	5	0.382	27
1.4	1	1	5	2	6	3	15	4	10	5	1	1	6	2	12	3	14	4	4	5	0.508	13
1.5	5	1	13	2	6	3	5	4	8	5	18	1	19	2	0	3	0	4	0	5	0.178	61
1.6	1	1	4	2	7	3	13	4	12	5	1	1	7	2	8	3	16	4	5	5	0.531	9
1.7	6	1	11	2	10	3	9	4	1	5	6	1	23	2	8	3	0	4	0	5	0.22	57
1.8	0	1	11	2	13	3	11	4	2	5	0	1	19	2	16	3	2	4	0	5	0.316	39
1.9	0	1	5	2	11	3	13	4	8	5	0	1	5	2	11	3	15	4	6	5	0.525	11
1.10	2	1	9	2	17	3	7	4	2	5	10	1	17	2	10	3	0	4	0	5	0.236	56
1.11	0	1	10	2	12	3	9	4	6	5	9	1	17	2	9	3	1	4	1	5	0.282	48

Ranking of factors based on aggregate views of all respondent groups																							
Factor Code	Degree of Impact/Severity										Frequency of Occurrence										IMPI	Rank
	N		Mi		Mo		H		VH		N		R		Oc		Of		A			
	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight		
2.1	1	1	6	2	16	3	9	4	5	5	5	1	13	2	16	3	2	4	1	5	0.328	35
2.2	1	1	12	2	6	3	12	4	6	5	3	1	20	2	11	3	2	4	1	5	0.315	40
2.3	0	1	9	2	16	3	9	4	3	5	4	1	16	2	13	3	3	4	1	5	0.315	40
2.4	3	1	9	2	11	3	11	4	3	5	7	1	15	2	10	3	5	4	0	5	0.287	47
2.5	3	1	12	2	10	3	10	4	2	5	11	1	15	2	6	3	5	4	0	5	0.247	54
2.6	3	1	6	2	15	3	10	4	3	5	5	1	17	2	13	3	1	4	1	5	0.292	45
2.7	1	1	7	2	12	3	13	4	4	5	2	1	12	2	9	3	10	4	4	5	0.406	22
2.8	1	1	8	2	8	3	13	4	7	5	1	1	17	2	15	3	3	4	1	5	0.363	29
2.9	1	1	5	2	12	3	16	4	3	5	2	1	10	2	14	3	10	4	1	5	0.401	24
2.10	1	1	8	2	11	3	9	4	8	5	4	1	16	2	15	3	2	4	0	5	0.328	35
2.11	1	1	7	2	11	3	7	4	11	5	2	1	15	2	13	3	6	4	1	5	0.383	26
2.12	2	1	3	2	9	3	12	4	11	5	2	1	7	2	7	3	11	4	10	5	0.528	10

Ranking of factors based on aggregate views of all respondent groups																							
Factor Code	Degree of Impact/Severity										Frequency of Occurrence										IMPI	Rank
	N		Mi		Mo		H		VH		N		R		Oc		Of		A			
	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight		
3.1	0	1	4	2	7	3	10	4	16	5	0	1	6	2	11	3	10	4	10	5	0.588	7
3.2	0	1	3	2	8	3	13	4	13	5	0	1	5	2	11	3	10	4	11	5	0.593	6
3.3	0	1	0	2	6	3	14	4	17	5	0	1	1	2	11	3	18	4	7	5	0.66	2
3.4	0	1	3	2	9	3	18	4	7	5	0	1	10	2	21	3	5	4	1	5	0.442	18
3.5	0	1	6	2	10	3	14	4	7	5	0	1	15	2	17	3	5	4	0	5	0.392	25
3.6	0	1	3	2	13	3	13	4	8	5	1	1	12	2	18	3	5	4	1	5	0.416	19
3.7	0	1	7	2	8	3	15	4	7	5	2	1	19	2	8	3	7	4	1	5	0.377	28
3.8	2	1	4	2	8	3	11	4	12	5	1	1	6	2	10	3	16	4	4	5	0.512	12
3.9	3	1	13	2	13	3	6	4	2	5	5	1	18	2	11	3	3	4	0	5	0.256	51
3.10	1	1	2	2	4	3	13	4	17	5	1	1	3	2	9	3	11	4	13	5	0.643	4
3.11	1	1	2	2	10	3	14	4	10	5	1	1	5	2	6	3	19	4	6	5	0.556	8
3.12	1	1	2	2	7	3	18	4	9	5	1	1	5	2	20	3	11	4	0	5	0.48	17
3.13	0	1	11	2	9	3	8	4	9	5	10	1	17	2	4	3	6	4	0	5	0.295	44
3.14	1	1	8	2	12	3	9	4	7	5	1	1	8	2	17	3	10	4	1	5	0.409	20

Ranking of factors based on aggregate views of all respondent groups																							
Factor Code	Degree of Impact/Severity										Frequency of Occurrence										IMPI	Rank
	N		Mi		Mo		H		VH		N		R		Oc		Of		A			
	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight		
4.1	0	1	7	2	9	3	18	4	3	5	1	1	12	2	14	3	8	4	2	5	0.408	21
4.2	0	1	1	2	9	3	17	4	10	5	0	1	6	2	20	3	10	4	1	5	0.503	14
4.3	2	1	9	2	9	3	10	4	7	5	3	1	15	2	15	3	3	4	1	5	0.339	34
4.4	1	1	8	2	10	3	13	4	5	5	3	1	20	2	11	3	2	4	1	5	0.322	37
4.5	1	1	7	2	11	3	10	4	8	5	2	1	19	2	10	3	4	4	2	5	0.359	30
4.6	2	1	11	2	8	3	11	4	5	5	9	1	15	2	8	3	3	4	2	5	0.291	46
4.7	1	1	11	2	12	3	11	4	2	5	3	1	25	2	5	3	4	4	0	5	0.277	50
4.8	2	1	13	2	12	3	7	4	3	5	4	1	27	2	4	3	2	4	0	5	0.244	55
4.9	2	1	13	2	12	3	8	4	2	5	8	1	24	2	5	3	0	4	0	5	0.22	57
4.10	4	1	14	2	8	3	8	4	3	5	6	1	17	2	13	3	1	4	0	5	0.25	53

Ranking of factors based on aggregate views of all respondent groups																							
Factor Code	Degree of Impact/Severity										Frequency of Occurrence										IMPI	Rank
	N		Mi		Mo		H		VH		N		R		Oc		Of		A			
	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight		
5.1	0	1	4	2	6	3	8	4	19	5	5.1	0	0	1	5	2	11	3	11	4	10	5
5.2	1	1	12	2	11	3	8	4	5	5	5.2	1	7	1	24	2	4	3	2	4	0	5
5.3	1	1	8	2	18	3	4	4	6	5	5.3	1	1	1	20	2	15	3	0	4	1	5
5.4	3	1	9	2	10	3	13	4	2	5	5.4	3	20	1	13	2	2	3	2	4	0	5
5.5	0	1	8	2	11	3	14	4	4	5	5.5	0	1	1	19	2	15	3	1	4	1	5
5.6	1	1	13	2	12	3	9	4	2	5	5.6	1	12	1	23	2	2	3	0	4	0	5
5.7	1	1	1	2	8	3	7	4	20	5	5.7	1	2	1	4	2	5	3	12	4	14	5
6.1	1	1	9	2	8	3	14	4	5	5	6.1	1	1	1	19	2	14	3	1	4	2	5
6.2	0	1	9	2	8	3	16	4	4	5	6.2	0	1	1	27	2	6	3	2	4	1	5
6.3	0	1	8	2	14	3	11	4	4	5	6.3	0	5	1	21	2	9	3	1	4	1	5
6.4	1	1	8	2	17	3	7	4	4	5	6.4	1	6	1	19	2	9	3	3	4	0	5
6.5	0	1	7	2	16	3	8	4	6	5	6.5	0	4	1	11	2	9	3	7	4	6	5
6.6	1	1	4	2	12	3	10	4	10	5	6.6	1	2	1	4	2	10	3	18	4	3	5
6.7	0	1	8	2	14	3	12	4	3	5	6.7	0	2	1	13	2	16	3	5	4	1	5

TABLE F.2: RANKING OF FACTORS BASED ON CLIENT'S GROUP VIEWS

Ranking of factors based on client's group views																						
Factor Code	Degree of Impact/Severity										Frequency of Occurrence										IMPI	RANK
	N		Mi		Mo		H		VH		N		R		Oc		Of		A			
	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight		
1.1	1	1	2	2	3	3	1	4	1	5	1	1	3	2	2	3	2	4	0	5	0.302	20
1.2	0	1	2	2	2	3	2	4	2	5	0	1	1	2	3	3	4	4	0	5	0.473	2
1.3	2	1	2	2	2	3	1	4	1	5	2	1	3	2	2	3	1	4	0	5	0.236	35
1.4	1	1	2	2	3	3	0	4	2	5	1	1	2	2	2	3	2	4	1	5	0.36	11
1.5	2	1	6	2	0	3	0	4	0	5	3	1	5	2	0	3	0	4	0	5	0.114	61
1.6	0	1	3	2	2	3	1	4	2	5	0	1	4	2	2	3	2	4	0	5	0.358	12
1.7	1	1	4	2	2	3	1	4	0	5	1	1	4	2	3	3	0	4	0	5	0.214	42
1.8	0	1	4	2	3	3	1	4	0	5	0	1	5	2	3	3	0	4	0	5	0.249	32
1.9	0	1	2	2	2	3	1	4	3	5	0	1	2	2	3	3	3	4	0	5	0.453	5
1.10	1	1	1	2	6	3	0	4	0	5	1	1	3	2	4	3	0	4	0	5	0.249	32
1.11	0	1	1	2	6	3	1	4	0	5	0	1	6	2	2	3	0	4	0	5	0.27	26

Ranking of factors based on client's group views																						
Factor Code	Degree of Impact/Severity										Frequency of Occurrence										IMPI	RANK
	N		Mi		Mo		H		VH		N		R		Oc		Of		A			
	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight		
2.1	1	1	2	2	4	3	1	4	0	5	1	1	2	2	5	3	0	4	0	5	0.263	27
2.2	1	1	3	2	3	3	1	4	0	5	1	1	4	2	3	3	0	4	0	5	0.225	38
2.3	0	1	3	2	5	3	0	4	0	5	0	1	3	2	5	3	0	4	0	5	0.276	25
2.4	2	1	2	2	4	3	0	4	0	5	2	1	3	2	3	3	0	4	0	5	0.191	45
2.5	2	1	4	2	2	3	0	4	0	5	3	1	5	2	0	3	0	4	0	5	0.13	60
2.6	3	1	2	2	3	3	0	4	0	5	3	1	4	2	1	3	0	4	0	5	0.14	58
2.7	1	1	2	2	3	3	2	4	0	5	1	1	2	2	4	3	1	4	0	5	0.289	22
2.8	0	1	6	2	1	3	0	4	1	5	1	1	5	2	2	3	0	4	0	5	0.213	44
2.9	1	1	4	2	3	3	0	4	0	5	1	1	5	2	2	3	0	4	0	5	0.191	45
2.10	1	1	3	2	3	3	1	4	0	5	1	1	3	2	4	3	0	4	0	5	0.238	34
2.11	1	1	3	2	3	3	1	4	0	5	1	1	3	2	3	3	1	4	0	5	0.25	29
2.12	1	1	2	2	2	3	3	4	0	5	1	1	2	2	2	3	2	4	1	5	0.345	13

Ranking of factors based on client's group views																						
Factor Code	Degree of Impact/Severity										Frequency of Occurrence										IMPI	RANK
	N		Mi		Mo		H		VH		N		R		Oc		Of		A			
	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight		
3.1	0	1	1	2	3	3	2	4	2	5	0	1	2	2	3	3	2	4	1	5	0.471	3
3.2	0	1	2	2	2	3	2	4	2	5	0	1	2	2	4	3	1	4	1	5	0.438	6
3.3	0	1	0	2	3	3	5	4	0	5	0	1	0	2	5	3	3	4	0	5	0.489	1
3.4	0	1	1	2	5	3	2	4	0	5	0	1	2	2	6	3	0	4	0	5	0.344	14
3.5	0	1	3	2	4	3	1	4	0	5	0	1	3	2	5	3	0	4	0	5	0.289	22
3.6	0	1	2	2	5	3	1	4	0	5	0	1	2	2	6	3	0	4	0	5	0.316	17
3.7	0	1	6	2	1	3	1	4	0	5	0	1	6	2	2	3	0	4	0	5	0.214	42
3.8	2	1	2	2	3	3	1	4	0	5	0	1	4	2	2	3	2	4	0	5	0.261	28
3.9	2	1	5	2	1	3	0	4	0	5	2	1	6	2	0	3	0	4	0	5	0.131	59
3.10	1	1	1	2	3	3	1	4	2	5	1	1	2	2	2	3	2	4	1	5	0.39	9
3.11	1	1	1	2	4	3	2	4	0	5	1	1	2	2	4	3	1	4	0	5	0.302	20
3.12	1	1	1	2	2	3	4	4	0	5	1	1	2	2	3	3	2	4	0	5	0.344	14
3.13	0	1	5	2	2	3	0	4	1	5	0	1	6	2	2	3	0	4	0	5	0.236	35
3.14	1	1	4	2	1	3	2	4	0	5	1	1	4	2	1	3	2	4	0	5	0.25	29

Ranking of factors based on client's group views																						
Factor Code	Degree of Impact/Severity										Frequency of Occurrence										IMPI	RANK
	N		Mi		Mo		H		VH		N		R		Oc		Of		A			
	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight		
4.1	0	1	4	2	1	3	3	4	0	5	0	1	5	2	0	3	3	4	0	5	0.316	17
4.2	0	1	1	2	4	3	3	4	0	5	0	1	2	2	5	3	1	4	0	5	0.374	10
4.3	2	1	3	2	3	3	0	4	0	5	2	1	4	2	2	3	0	4	0	5	0.17	52
4.4	1	1	4	2	3	3	0	4	0	5	1	1	6	2	1	3	0	4	0	5	0.18	50
4.5	1	1	3	2	4	3	0	4	0	5	1	1	4	2	2	3	1	4	0	5	0.226	37
4.6	2	1	3	2	2	3	1	4	0	5	2	1	3	2	3	3	0	4	0	5	0.191	45
4.7	1	1	4	2	3	3	0	4	0	5	1	1	6	2	1	3	0	4	0	5	0.18	50
4.8	2	1	4	2	2	3	0	4	0	5	1	1	6	2	1	3	0	4	0	5	0.16	55
4.9	2	1	3	2	3	3	0	4	0	5	2	1	5	2	1	3	0	4	0	5	0.159	56
4.10	2	1	4	2	2	3	0	4	0	5	2	1	5	2	1	3	0	4	0	5	0.15	57

Ranking of factors based on client's group views																						
Factor Code	Degree of Impact/Severity										Frequency of Occurrence										IMPI	RANK
	N		Mi		Mo		H		VH		N		R		Oc		Of		A			
	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight		
5.1	0	1	2	2	1	3	4	4	1	5	0	1	1	2	5	3	1	4	1	5	0.455	4
5.2	1	1	4	2	3	3	0	4	0	5	1	1	5	2	2	3	0	4	0	5	0.191	45
5.3	0	1	4	2	4	3	0	4	0	5	0	1	4	2	4	3	0	4	0	5	0.25	29
5.4	1	1	4	2	3	3	0	4	0	5	2	1	5	2	1	3	0	4	0	5	0.169	54
5.5	0	1	3	2	4	3	1	4	0	5	0	1	2	2	6	3	0	4	0	5	0.303	19
5.6	0	1	7	2	1	3	0	4	0	5	0	1	8	2	0	3	0	4	0	5	0.17	52
5.7	1	1	1	2	2	3	2	4	2	5	1	1	2	2	3	3	0	4	2	5	0.405	7
6.1	1	1	5	2	2	3	0	4	0	5	1	1	5	2	2	3	0	4	0	5	0.181	49
6.2	0	1	5	2	2	3	1	4	0	5	0	1	6	2	2	3	0	4	0	5	0.225	38
6.3	0	1	5	2	2	3	1	4	0	5	0	1	6	2	2	3	0	4	0	5	0.225	38
6.4	1	1	1	2	6	3	0	4	0	5	1	1	5	2	2	3	0	4	0	5	0.223	41
6.5	0	1	2	2	4	3	1	4	1	5	0	1	4	2	1	3	1	4	2	5	0.391	8
6.6	1	1	1	2	4	3	2	4	0	5	1	1	2	2	2	3	3	4	0	5	0.331	16
6.7	0	1	4	2	2	3	2	4	0	5	0	1	3	2	5	3	0	4	0	5	0.289	22

TABLE F.3: RANKING OF FACTORS BASED ON CONSULTANT'S GROUP VIEWS

Ranking of factors based on consultant's group views																						
Factor Code	Degree of Impact/Severity										Frequency of Occurrence										IMPI	RANK
	N		Mi		Mo		H		VH		N		R		Oc		Of		A			
	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight		
1.1	0	1	3	2	3	3	5	4	4	5	0	1	5	2	4	3	4	4	2	5	0.469	18
1.2	0	1	1	2	2	3	3	4	9	5	0	1	1	2	6	3	2	4	6	5	0.67	4
1.3	0	1	4	2	7	3	3	4	1	5	0	1	8	2	3	3	2	4	2	5	0.352	32
1.4	0	1	2	2	2	3	8	4	3	5	0	1	4	2	2	3	8	4	1	5	0.517	14
1.5	2	1	4	2	3	3	0	4	6	5	7	1	8	2	0	3	0	4	0	5	0.2	57
1.6	1	1	1	2	2	3	6	4	5	5	1	1	2	2	4	3	4	4	4	5	0.546	11
1.7	4	1	5	2	1	3	5	4	0	5	5	1	8	2	2	3	0	4	0	5	0.178	61
1.8	0	1	4	2	4	3	5	4	2	5	0	1	8	2	7	3	0	4	0	5	0.329	37
1.9	0	1	2	2	4	3	6	4	3	5	0	1	3	2	3	3	7	4	2	5	0.518	13
1.10	1	1	6	2	3	3	4	4	1	5	7	1	5	2	3	3	0	4	0	5	0.199	58
1.11	0	1	6	2	1	3	5	4	3	5	5	1	4	2	5	3	1	4	0	5	0.284	47

Ranking of factors based on consultant's group views																						
Factor Code	Degree of Impact/Severity										Frequency of Occurrence										IMPI	RANK
	N		Mi		Mo		H		VH		N		R		Oc		Of		A			
	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight		
2.1	0	1	2	2	7	3	4	4	2	5	4	1	7	2	2	3	1	4	1	5	0.299	40
2.2	0	1	6	2	1	3	5	4	3	5	2	1	10	2	2	3	1	4	0	5	0.284	47
2.3	0	1	4	2	5	3	5	4	1	5	3	1	7	2	3	3	2	4	0	5	0.29	44
2.4	1	1	3	2	3	3	6	4	2	5	4	1	9	2	1	3	1	4	0	5	0.258	51
2.5	1	1	3	2	4	3	6	4	1	5	7	1	6	2	2	3	0	4	0	5	0.213	56
2.6	0	1	1	2	8	3	5	4	1	5	1	1	9	2	5	3	0	4	0	5	0.308	38
2.7	0	1	4	2	5	3	4	4	2	5	1	1	10	2	4	3	0	4	0	5	0.287	45
2.8	1	1	1	2	3	3	8	4	2	5	0	1	9	2	4	3	2	4	0	5	0.365	29
2.9	0	1	1	2	5	3	8	4	1	5	1	1	2	2	6	3	6	4	0	5	0.451	21
2.10	0	1	4	2	2	3	5	4	4	5	3	1	9	2	2	3	1	4	0	5	0.298	43
2.11	0	1	3	2	3	3	3	4	6	5	1	1	9	2	4	3	1	4	0	5	0.355	31
2.12	1	1	1	2	3	3	4	4	6	5	1	1	5	2	3	3	5	4	1	5	0.464	19

Ranking of factors based on consultant's group views																						
Factor Code	Degree of Impact/Severity										Frequency of Occurrence										IMPI	RANK
	N		Mi		Mo		H		VH		N		R		Oc		Of		A			
	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight		
3.1	0	1	1	2	3	3	3	4	8	5	0	1	3	2	5	3	4	4	3	5	0.582	7
3.2	0	1	1	2	3	3	6	4	5	5	0	1	2	2	6	3	5	4	2	5	0.555	10
3.3	0	1	0	2	1	3	4	4	10	5	0	1	0	2	4	3	7	4	4	5	0.736	1
3.4	0	1	0	2	3	3	8	4	4	5	0	1	3	2	8	3	3	4	1	5	0.51	16
3.5	0	1	1	2	4	3	6	4	4	5	0	1	5	2	7	3	3	4	0	5	0.443	23
3.6	0	1	0	2	4	3	7	4	4	5	0	1	2	2	9	3	3	4	1	5	0.512	15
3.7	0	1	0	2	4	3	7	4	4	5	1	1	4	2	4	3	5	4	1	5	0.491	17
3.8	0	1	1	2	3	3	5	4	6	5	1	1	2	2	2	3	9	4	1	5	0.564	9
3.9	1	1	4	2	4	3	4	4	2	5	1	1	4	2	8	3	2	4	0	5	0.343	33
3.10	0	1	0	2	1	3	6	4	8	5	0	1	1	2	5	3	2	4	7	5	0.715	2
3.11	0	1	1	2	2	3	7	4	5	5	0	1	3	2	1	3	7	4	4	5	0.618	6
3.12	0	1	0	2	2	3	8	4	5	5	0	1	3	2	6	3	6	4	0	5	0.538	12
3.13	0	1	3	2	3	3	3	4	6	5	5	1	5	2	2	3	3	4	0	5	0.334	35
3.14	0	1	0	2	8	3	5	4	2	5	0	1	1	2	11	3	3	4	0	5	0.451	21

Ranking of factors based on consultant's group views																						
Factor Code	Degree of Impact/Severity										Frequency of Occurrence										IMPI	RANK
	N		Mi		Mo		H		VH		N		R		Oc		Of		A			
	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight		
4.1	0	1	2	2	4	3	6	4	3	5	0	1	3	2	9	3	3	4	0	5	0.44	24
4.2	0	1	0	2	2	3	6	4	7	5	0	1	2	2	6	3	7	4	0	5	0.578	8
4.3	0	1	3	2	4	3	3	4	5	5	1	1	6	2	6	3	2	4	0	5	0.381	28
4.4	0	1	1	2	3	3	8	4	3	5	0	1	7	2	6	3	2	4	0	5	0.412	25
4.5	0	1	1	2	4	3	5	4	5	5	1	1	7	2	4	3	3	4	0	5	0.409	26
4.6	0	1	4	2	3	3	5	4	3	5	3	1	6	2	3	3	2	4	1	5	0.342	34
4.7	0	1	4	2	6	3	3	4	2	5	1	1	10	2	1	3	3	4	0	5	0.307	39
4.8	0	1	6	2	7	3	1	4	1	5	2	1	10	2	2	3	1	4	0	5	0.239	53
4.9	0	1	8	2	3	3	2	4	2	5	5	1	9	2	1	3	0	4	0	5	0.199	58
4.10	2	1	7	2	2	3	3	4	1	5	3	1	6	2	5	3	1	4	0	5	0.236	54

Ranking of factors based on consultant's group views																						
Factor Code	Degree of Impact/Severity										Frequency of Occurrence										IMPI	RANK
	N		Mi		Mo		H		VH		N		R		Oc		Of		A			
	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight		
5.1	0	1	0	2	3	3	2	4	10	5	0	1	3	2	5	3	3	4	4	5	0.631	5
5.2	0	1	6	2	4	3	2	4	3	5	2	1	11	2	1	3	1	4	0	5	0.259	50
5.3	1	1	3	2	4	3	3	4	4	5	1	1	10	2	4	3	0	4	0	5	0.299	40
5.4	2	1	4	2	4	3	3	4	2	5	8	1	6	2	0	3	1	4	0	5	0.188	60
5.5	0	1	4	2	3	3	6	4	2	5	0	1	12	2	3	3	0	4	0	5	0.299	40
5.6	1	1	4	2	3	3	6	4	1	5	5	1	9	2	1	3	0	4	0	5	0.217	55
5.7	0	1	0	2	3	3	2	4	10	5	1	1	1	2	2	3	7	4	4	5	0.679	3
6.1	0	1	3	2	1	3	8	4	3	5	0	1	9	2	6	3	0	4	0	5	0.358	30
6.2	0	1	4	2	2	3	7	4	2	5	0	1	14	2	1	3	0	4	0	5	0.287	45
6.3	0	1	3	2	6	3	5	4	1	5	4	1	7	2	4	3	0	4	0	5	0.261	49
6.4	0	1	5	2	6	3	3	4	1	5	3	1	8	2	3	3	1	4	0	5	0.256	52
6.5	0	1	3	2	6	3	2	4	4	5	3	1	3	2	4	3	4	4	1	5	0.388	27
6.6	0	1	2	2	5	3	4	4	4	5	1	1	2	2	7	3	4	4	1	5	0.46	20
6.7	0	1	4	2	6	3	3	4	2	5	1	1	6	2	6	3	2	4	0	5	0.333	36

TABLE F.4: RANKING OF FACTORS BASED ON CONTRACTOR'S GROUP VIEWS

Ranking of factors based on contractor's group views																							
Factor Code	Degree of Impact/Severity										Frequency of Occurrence										IMPI	RANK
	N		Mi		Mo		H		VH		N		R		Oc		Of		A			
	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight		
1.1	0	1	1	2	2	3	6	4	5	5	0	1	2	2	3	3	5	4	4	5	0.617	14
1.2	0	1	0	2	0	3	8	4	6	5	0	1	1	2	1	3	4	4	8	5	0.772	1
1.3	0	1	1	2	4	3	6	4	3	5	0	1	1	2	8	3	3	4	2	5	0.519	17
1.4	0	1	1	2	1	3	7	4	5	5	0	1	0	2	8	3	4	4	2	5	0.592	15
1.5	1	1	3	2	3	3	5	4	2	5	8	1	6	2	0	3	0	4	0	5	0.188	61
1.6	0	1	0	2	3	3	6	4	5	5	0	1	1	2	2	3	10	4	1	5	0.627	11
1.7	1	1	2	2	7	3	3	4	1	5	0	1	11	2	3	3	0	4	0	5	0.272	56
1.8	0	1	3	2	6	3	5	4	0	5	0	1	6	2	6	3	2	4	0	5	0.341	46
1.9	0	1	1	2	5	3	6	4	2	5	0	1	0	2	5	3	5	4	4	5	0.572	16
1.10	0	1	2	2	8	3	3	4	1	5	2	1	9	2	3	3	0	4	0	5	0.266	57
1.11	0	1	3	2	5	3	3	4	3	5	4	1	7	2	2	3	0	4	1	5	0.284	52

Ranking of factors based on contractor's group views																						
Factor Code	Degree of Impact/Severity										Frequency of Occurrence										IMPI	RANK
	N		Mi		Mo		H		VH		N		R		Oc		Of		A			
	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight		
2.1	0	1	2	2	5	3	4	4	3	5	0	1	4	2	9	3	1	4	0	5	0.398	35
2.2	0	1	3	2	2	3	6	4	3	5	0	1	6	2	6	3	1	4	1	5	0.406	32
2.3	0	1	2	2	6	3	4	4	2	5	1	1	6	2	5	3	1	4	1	5	0.362	42
2.4	0	1	4	2	4	3	5	4	1	5	1	1	3	2	6	3	4	4	0	5	0.377	39
2.5	0	1	5	2	4	3	4	4	1	5	1	1	4	2	4	3	5	4	0	5	0.36	43
2.6	0	1	3	2	4	3	5	4	2	5	1	1	4	2	7	3	1	4	1	5	0.382	37
2.7	0	1	1	2	4	3	7	4	2	5	0	1	0	2	1	3	9	4	4	5	0.626	13
2.8	0	1	1	2	4	3	5	4	4	5	0	1	3	2	9	3	1	4	1	5	0.463	23
2.9	0	1	0	2	4	3	8	4	2	5	0	1	3	2	6	3	4	4	1	5	0.496	20
2.10	0	1	1	2	6	3	3	4	4	5	0	1	4	2	9	3	1	4	0	5	0.414	29
2.11	0	1	1	2	5	3	3	4	5	5	0	1	3	2	6	3	4	4	1	5	0.496	20
2.12	0	1	0	2	4	3	5	4	5	5	0	1	0	2	2	3	4	4	8	5	0.721	5

Ranking of factors based on contractor's group views																						
Factor Code	Degree of Impact/Severity										Frequency of Occurrence										IMPI	RANK
	N		Mi		Mo		H		VH		N		R		Oc		Of		A			
	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight		
3.1	0	1	2	2	1	3	5	4	6	5	0	1	1	2	3	3	4	4	6	5	0.663	8
3.2	0	1	0	2	3	3	5	4	6	5	0	1	1	2	1	3	4	4	8	5	0.734	3
3.3	0	1	0	2	2	3	5	4	7	5	0	1	1	2	2	3	8	4	3	5	0.685	7
3.4	0	1	2	2	1	3	8	4	3	5	0	1	5	2	7	3	2	4	0	5	0.43	25
3.5	0	1	2	2	2	3	7	4	3	5	0	1	7	2	5	3	2	4	0	5	0.4	34
3.6	0	1	1	2	4	3	5	4	4	5	1	1	8	2	3	3	2	4	0	5	0.375	40
3.7	0	1	1	2	3	3	7	4	3	5	1	1	9	2	2	3	2	4	0	5	0.364	41
3.8	0	1	1	2	2	3	5	4	6	5	0	1	0	2	6	3	5	4	3	5	0.627	11
3.9	0	1	4	2	8	3	2	4	0	5	2	1	8	2	3	3	1	4	0	5	0.253	58
3.10	0	1	1	2	0	3	6	4	7	5	0	1	0	2	2	3	7	4	5	5	0.734	3
3.11	0	1	0	2	4	3	5	4	5	5	0	1	0	2	1	3	11	4	2	5	0.663	8
3.12	0	1	1	2	3	3	6	4	4	5	0	1	0	2	11	3	3	4	0	5	0.505	18
3.13	0	1	3	2	4	3	5	4	2	5	5	1	6	2	0	3	3	4	0	5	0.284	52
3.14	0	1	4	2	3	3	2	4	5	5	0	1	3	2	5	3	5	4	1	5	0.469	22

Ranking of factors based on contractor's group views																						
Factor Code	Degree of Impact/Severity										Frequency of Occurrence										IMPI	RANK
	N		Mi		Mo		H		VH		N		R		Oc		Of		A			
	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight		
4.1	0	1	1	2	4	3	9	4	0	5	1	1	4	2	5	3	2	4	2	5	0.429	26
4.2	0	1	0	2	3	3	8	4	3	5	0	1	2	2	9	3	2	4	1	5	0.503	19
4.3	0	1	3	2	2	3	7	4	2	5	0	1	5	2	7	3	1	4	1	5	0.408	30
4.4	0	1	3	2	4	3	5	4	2	5	2	1	7	2	4	3	0	4	1	5	0.323	48
4.5	0	1	3	2	3	3	5	4	3	5	0	1	8	2	4	3	0	4	2	5	0.388	36
4.6	0	1	4	2	3	3	5	4	2	5	4	1	6	2	2	3	1	4	1	5	0.297	51
4.7	0	1	3	2	3	3	8	4	0	5	1	1	9	2	3	3	1	4	0	5	0.307	49
4.8	0	1	3	2	3	3	6	4	2	5	1	1	11	2	1	3	1	4	0	5	0.3	50
4.9	0	1	2	2	6	3	6	4	0	5	1	1	10	2	3	3	0	4	0	5	0.282	54
4.10	0	1	3	2	4	3	5	4	2	5	1	1	6	2	7	3	0	4	0	5	0.333	47

Ranking of factors based on contractor's group views																						
Factor Code	Degree of Impact/Severity										Frequency of Occurrence										IMPI	RANK
	N		Mi		Mo		H		VH		N		R		Oc		Of		A			
	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight	No. of respondents	Weight		
5.1	0	1	2	2	2	3	2	4	8	5	0	1	1	2	1	3	7	4	5	5	0.687	6
5.2	0	1	2	2	4	3	6	4	2	5	4	1	8	2	1	3	1	4	0	5	0.276	55
5.3	0	1	1	2	10	3	1	4	2	5	0	1	6	2	7	3	0	4	1	5	0.357	44
5.4	0	1	1	2	3	3	10	4	0	5	10	1	2	2	1	3	1	4	0	5	0.219	59
5.5	0	1	1	2	4	3	7	4	2	5	1	1	5	2	6	3	1	4	1	5	0.403	33
5.6	0	1	2	2	8	3	3	4	1	5	7	1	6	2	1	3	0	4	0	5	0.202	60
5.7	0	1	0	2	3	3	3	4	8	5	0	1	1	2	0	3	5	4	8	5	0.772	1
6.1	0	1	1	2	5	3	6	4	2	5	0	1	5	2	6	3	1	4	2	5	0.437	24
6.2	0	1	0	2	4	3	8	4	2	5	1	1	7	2	3	3	2	4	1	5	0.408	30
6.3	0	1	0	2	6	3	5	4	3	5	1	1	8	2	3	3	1	4	1	5	0.379	38
6.4	0	1	2	2	5	3	4	4	3	5	2	1	6	2	4	3	2	4	0	5	0.347	45
6.5	0	1	2	2	6	3	5	4	1	5	1	1	4	2	4	3	2	4	3	5	0.422	28
6.6	0	1	1	2	3	3	4	4	6	5	0	1	0	2	1	3	11	4	2	5	0.663	8
6.7	0	1	0	2	6	3	7	4	1	5	1	1	4	2	5	3	3	4	1	5	0.427	27

APPENDIX G: SPEARMAN'S RANK CORRELATION COEFFICIENT CALCULATIONS

TABLE G.1: OVERALL CORRELATION OF VIEWS BETWEEN RESPONDENTS GROUPS

Factor Code	The following factors are the main causes of time and cost overruns	CLIENT vs CONSULTANT						CLIENT vs CONTRACTOR						CONSULTANT vs CONTRACTOR					
		RII		IMPI		RII+IMPI		RII		IMPI		RII+IMPI		RII		IMPI		RII+IMPI	
		D	d2	D	d2	D	d2	D	d2	D	d2	D	d2	D	d2	D	d2	D	d2
Overall correlation of views between respondents groups																			
1.1	Lack of project funding (budget)	-7	49	2	4	5	25	-8	64	6	36	15	225	-1	1	4	16	10	100
1.2	Delays in progress payments	-5	25	-2	4	-1	1	-1	1	1	1	2	4	4	16	3	9	3	9
1.3	Client interference	-34	1156	3	9	-19	361	-11	121	18	324	10	100	23	529	15	225	29	841
1.4	Slow decision making by client	-9	81	-3	9	-4	16	9	81	-4	16	3	9	18	324	-1	1	7	49
1.5	Unresolved land ownership	7	49	4	16	3	9	-1	1	0	0	-1	1	-8	64	-4	16	-4	16
1.6	Appointment of incompetent service providers	-10	100	1	1	-3	9	-20	400	1	1	-3	9	-10	100	0	0	0	0
1.7	Interest payment on overdue claims	-7	49	-19	361	-11	121	-8	64	-14	196	-10	100	-1	1	5	25	1	1
1.8	Increase in scope of work	-15	225	-5	25	-7	49	-30	900	-14	196	-22	484	-15	225	-9	81	-15	225
1.9	Bureaucracy in client's administration	-9	81	-8	64	-10	100	-20	400	-11	121	-10	100	-11	121	-3	9	0	0
1.10	Delays in handing over site	-4	16	-26	676	-20	400	-23	529	-25	625	-23	529	-19	361	1	1	-3	9
1.11	Change of specifications	-8	64	-21	441	-12	144	-19	361	-26	676	-23	529	-11	121	-5	25	-11	121

Factor Code	The following factors are the main causes of time and cost overruns	CLIENT vs CONSULTANT						CLIENT vs CONTRACTOR						CONSULTANT vs CONTRACTOR					
		RII		IMPI		RII+IMPI		RII		IMPI		RII+IMPI		RII		IMPI		RII+IMPI	
		D	d2	D	d2	D	d2	D	d2	D	d2	D	d2	D	d2	D	d2	D	d2
Overall correlation of views between respondents groups																			
2.1	Incomplete design information at tender stage	-13	169	-13	169	-10	100	8	64	-8	64	2	4	21	441	5	25	12	144
2.2	Design mistakes	-21	441	-9	81	-15	225	17	289	6	36	12	144	38	1444	15	225	27	729
2.3	Design changes	-18	324	-19	361	-18	324	-16	256	-17	289	-19	361	2	4	2	4	-1	1
2.4	Delay in issuing approvals on site (tests and inspections)	-5	25	-6	36	-6	36	11	121	6	36	11	121	16	256	12	144	17	289
2.5	Inflexibility (rigid) consultant	18	324	4	16	7	49	18	324	17	289	18	324	0	0	13	169	11	121
2.6	Failure to give practical solutions on site	15	225	20	400	18	324	39	1521	21	441	27	729	24	576	1	1	9	81
2.7	Unrealistic contract duration estimate	-12	144	-23	529	-17	289	14	196	9	81	17	289	26	676	32	1024	34	1156
2.8	Inaccurate bill of quantities	-7	49	15	225	5	25	17	289	21	441	19	361	24	576	6	36	14	196
2.9	Slow decision-making	4	16	24	576	21	441	22	484	25	625	29	841	18	324	1	1	8	64
2.10	Incomplete designs at the start of construction stage	5	25	-9	81	3	9	23	529	5	25	15	225	18	324	14	196	12	144
2.11	Inexperience consultant's team	-6	36	-2	4	2	4	9	81	9	81	17	289	15	225	11	121	15	225
2.12	Appointment of consultant with political clout	22	484	-6	36	6	36	32	1024	8	64	18	324	10	100	14	196	12	144

Factor Code	The following factors are the main causes of time and cost overruns	CLIENT vs CONSULTANT						CLIENT vs CONTRACTOR						CONSULTANT vs CONTRACTOR					
		RII		IMPI		RII+IMPI		RII		IMPI		RII+IMPI		RII		IMPI		RII+IMPI	
		D	d2	D	d2	D	d2	D	d2	D	d2	D	d2	D	d2	D	d2	D	d2
Overall correlation of views between respondents groups																			
3.1	Labour unrest	-1	1	-4	16	-3	9	-1	1	-5	25	-5	25	0	0	-1	1	-2	4
3.2	Subcontracting challenges (dispute and performance)	-9	81	-4	16	-6	36	0	0	3	9	1	1	9	81	7	49	7	49
3.3	Contractor's cashflow	3	9	0	0	2	4	-12	144	-6	36	-7	49	-15	225	-6	36	-9	81
3.4	Lack of site management and supervision	2	4	-2	4	-3	9	-22	484	-11	121	-20	400	-24	576	-9	81	-17	289
3.5	Re-work due to errors during construction	-8	64	-1	1	-5	25	-31	961	-12	144	-24	576	-23	529	-11	121	-19	361
3.6	Poor planning and scheduling of work	4	16	2	4	1	1	-21	441	-23	529	-23	529	-25	625	-25	625	-24	576
3.7	Lack of experience on similar work	21	441	25	625	22	484	3	9	1	1	-1	1	-18	324	-24	576	-23	529
3.8	Under-pricing of the work due to overconfidence in own ability	12	144	19	361	14	196	8	64	17	289	12	144	-4	16	-2	4	-2	4
3.9	Outdated construction methods	-10	100	26	676	5	25	6	36	1	1	-1	1	16	256	-25	625	-6	36
3.10	Appointment of contractors with political clout	3	9	7	49	5	25	4	16	6	36	6	36	1	1	-1	1	1	1
3.11	Under-pricing of the work due to strategic misrepresentation	9	81	14	196	15	225	13	169	12	144	13	169	4	16	-2	4	-2	4
3.12	Poor cost planning, monitoring and control	-3	9	2	4	-1	1	-3	9	-4	16	-6	36	0	0	-6	36	-5	25
3.13	Termination of contract and appointment of another contractor to finish the work	-2	4	0	0	-9	81	-17	289	-17	289	-29	841	-15	225	-17	289	-20	400
3.14	Contractor's ownership of the critical construction equipment for work continuity	4	16	8	64	9	81	8	64	7	49	9	81	4	16	-1	1	0	0

Factor Code	The following factors are the main causes of time and cost overruns	CLIENT vs CONSULTANT						CLIENT vs CONTRACTOR						CONSULTANT vs CONTRACTOR					
		RII		IMPI		RII+IMPI		RII		IMPI		RII+IMPI		RII		IMPI		RII+IMPI	
		D	d2	D	d2	D	d2	D	d2	D	d2	D	d2	D	d2	D	d2	D	d2
Overall correlation of views between respondents groups																			
4.1	Shortage of skilled labourers	9	81	-7	49	3	9	-3	9	-9	81	-9	81	-12	144	-2	4	-12	144
4.2	Unproductivity of labour force	1	1	2	4	0	0	-12	144	-9	81	-10	100	-13	169	-11	121	-10	100
4.3	Shortage of materials	15	225	24	576	21	441	-14	196	22	484	6	36	-29	841	-2	4	-15	225
4.4	Delay in material and equipment delivery	10	100	25	625	22	484	-8	64	2	4	0	0	-18	324	-23	529	-22	484
4.5	Shortage of equipment	4	16	11	121	9	81	-26	676	1	1	-9	81	-30	900	-10	100	-18	324
4.6	Low productivity of equipment	-3	9	11	121	9	81	-19	361	-6	36	-12	144	-16	256	-17	289	-21	441
4.7	Material price increases	6	36	11	121	11	121	18	324	1	1	7	49	12	144	-10	100	-4	16
4.8	Equipment rental rate increases	2	4	2	4	0	0	6	36	5	25	3	9	4	16	3	9	3	9
4.9	Increase in labour rates	-4	16	-2	4	-3	9	-1	1	2	4	0	0	3	9	4	16	3	9
4.10	High cost of skilled labour	-2	4	3	9	-1	1	1	1	10	100	4	16	3	9	7	49	5	25

Factor Code	The following factors are the main causes of time and cost overruns	CLIENT vs CONSULTANT						CLIENT vs CONTRACTOR						CONSULTANT vs CONTRACTOR					
		RII		IMPI		RII+IMPI		RII		IMPI		RII+IMPI		RII		IMPI		RII+IMPI	
		D	d2	D	d2	D	d2	D	d2	D	d2	D	d2	D	d2	D	d2	D	d2
Overall correlation of views between respondents groups																			
5.1	Community disruptions	-2	4	-1	1	-3	9	-4	16	-2	4	-5	25	-2	4	-1	1	-2	4
5.2	Environmental issues	1	1	-5	25	-1	1	-6	36	-10	100	-7	49	-7	49	-5	25	-6	36
5.3	Inclement weather	-33	1089	-11	121	-23	529	-23	529	-15	225	-18	324	10	100	-4	16	5	25
5.4	Regulatory changes	-12	144	-6	36	-9	81	-1	1	-5	25	-5	25	11	121	1	1	4	16
5.5	Unforeseen site condition	-13	169	-21	441	-16	256	1	1	-14	196	-7	49	14	196	7	49	9	81
5.6	Accident during construction	19	361	-3	9	6	36	-2	4	-8	64	-2	4	-21	441	-5	25	-8	64
5.7	Corruption	24	576	4	16	14	196	25	625	6	36	15	225	1	1	2	4	1	1
6.1	Errors	26	676	19	361	25	625	28	784	25	625	29	841	2	4	6	36	4	16
6.2	Discrepancies and omissions in contract document	-4	16	-7	49	-2	4	10	100	8	64	10	100	14	196	15	225	12	144
6.3	Contract dispute and negotiations	19	361	-11	121	9	81	15	225	0	0	8	64	-4	16	11	121	-1	1
6.4	Change of specifications	2	4	-11	121	0	0	-8	64	-4	16	-3	9	-10	100	7	49	-3	9
6.5	Penalties ineffective and/or not administered	-19	361	-19	361	-19	361	-13	169	-20	400	-20	400	6	36	-1	1	-1	1
6.6	Poor communication and co-ordination between parties	16	256	-4	16	4	16	23	529	8	64	14	196	7	49	12	144	10	100
6.7	Contract claims	-20	400	-14	196	-19	361	-22	484	-5	25	-18	324	-2	4	9	81	1	1
	Σd^2		10046		9648		8082		16166		9014		12142		13828		6998		9300
	Rs		0.73		0.74		0.79		0.57		0.76		0.68		0.63		0.81		0.75

TABLE G.2: CORRELATION OF VIEWS BETWEEN RESPONDENTS GROUPS

Factor Code	The following factors are the main causes of time and cost overruns	CLIENT vs CONSULTANT						CLIENT vs CONTRACTOR						CONSULTANT vs CONTRACTOR					
		RII		IMPI		RII+IMPI		RII		IMPI		RII+IMPI		RII		IMPI		RII+IMPI	
		d	d2	D	d2	D	d2	D	d2	D	d2	D	d2	D	d2	d	d2	D	d2
Correlation of views between respondents groups for client-related group																			
1.1	Lack of project funding (budget)	0	0	0	0	3	4	16	1	2	4	3	9	1	1	2	4	-1	1
1.2	Delays in progress payments	1	1	0	0	1	1	1	0	0	0	1	1	-1	1	0	0	0	0
1.3	Client interference	-4	16	-3	9	1	-2	4	1	3	9	1	1	5	25	0	0	3	9
1.4	Slow decision making by client	0	0	1	1	2	0	0	9	-1	1	2	4	3	9	0	0	2	4
1.5	Unresolved land ownership	3	9	-2	4	0	1	1	1	0	0	0	0	-2	4	-2	4	-1	1
1.6	Appointment of incompetent service providers	-1	1	-2	4	0	1	1	4	2	4	0	0	-1	1	0	0	-1	1
1.7	Interest payment on overdue claims	-1	1	1	1	0	-1	1	1	1	1	0	0	0	0	2	4	1	1
1.8	Increase in scope of work	0	0	0	0	-2	-1	1	1	0	0	-2	4	-1	1	0	0	-1	1
1.9	Bureaucracy in client's administration	0	0	1	1	-3	-2	4	4	-3	9	-3	9	-2	4	-2	4	-1	1
1.10	Delays in handing over site	1	1	3	9	-1	-1	1	4	-3	9	-1	1	-3	9	0	0	0	0
1.11	Change of specifications	0	0	2	4	-1	0	0	0	-2	4	-1	1	0	0	0	0	-1	1
	Σd2		29		33		30		26		41		30		55		16		20
	Rs		0.87		0.85		0.86		0.88		0.81		0.86		0.75		0.93		0.91

Factor Code	The following factors are the main causes of time and cost overruns	CLIENT vs CONSULTANT						CLIENT vs CONTRACTOR						CONSULTANT vs CONTRACTOR					
		RII		IMPI		RII+IMPI		RII		IMPI		RII+IMPI		RII		IMPI		RII+IMPI	
		D	d2	D	d2	D	d2	D	d2	D	d2	D	d2	D	d2	D	d2	D	d2
Correlation of views between respondents groups for client-related group																			
2.1	Incomplete design information at tender stage	-2	4	2	4	-2	4	-3	9	-4	16	-4	16	-1	1	2	4	-2	4
2.2	Design mistakes	-8	64	3	9	-5	25	1	1	0	0	-1	1	9	81	0	0	4	16
2.3	Design changes	-2	4	5	25	-3	9	-8	64	-8	64	-9	81	-6	36	0	0	-6	36
2.4	Delay in issuing approvals on site (tests and inspections)	-2	4	2	4	-2	4	-1	1	-1	1	-1	1	1	1	0	0	1	1
2.5	Inflexibility (rigid) consultant	5	25	0	0	1	1	0	0	0	0	0	0	-5	25	-2	4	-1	1
2.6	Failure to give practical solutions on site	4	16	-6	36	3	9	5	25	2	4	2	4	1	1	0	0	-1	1
2.7	Unrealistic contract duration estimate	-4	16	7	49	-5	25	-2	4	0	0	2	4	2	4	2	4	7	49
2.8	Inaccurate bill of quantities	-1	1	-5	25	3	9	1	1	3	9	2	4	2	4	0	0	-1	1
2.9	Slow decision-making	3	9	-7	49	7	49	3	9	6	36	6	36	0	0	-2	4	-1	1
2.10	Incomplete designs at the start of construction stage	2	4	1	1	1	1	1	1	0	0	0	0	-1	1	0	0	-1	1
2.11	Inexperience consultant's team	-2	4	-1	1	2	4	-2	4	2	4	2	4	0	0	0	0	0	0
2.12	Appointment of consultant with political clout	4	16	0	0	1	1	4	16	0	0	1	1	0	0	-2	4	0	0
	Σd^2		167		203		141		135		134		152		154		20		111
	Rs		0.42		0.29		0.51		0.53		0.53		0.47		0.46		0.93		0.61

Factor Code	The following factors are the main causes of time and cost overruns	CLIENT vs CONSULTANT						CLIENT vs CONTRACTOR						CONSULTANT vs CONTRACTOR					
		RII		IMPI		RII+IMPI		RII		IMPI		RII+IMPI		RII		IMPI		RII+IMPI	
		D	d2	D	d2	D	d2	D	d2	D	d2	D	d2	D	d2	D	d2	D	d2
Correlation of views between respondents groups for contractor-related group																			
3.1	Labour unrest	-2	4	2	4	-2	4	-2	4	-2	4	-2	4	0	0	0	0	0	0
3.2	Subcontracting challenges (dispute and performance)	-7	49	3	9	-3	9	-1	1	2	4	1	1	6	36	5	25	4	16
3.3	Contractor's cashflow	2	4	0	0	1	1	-4	16	-2	4	-3	9	-6	36	-2	4	-4	16
3.4	Lack of site management and supervision	-1	1	4	16	-4	16	-3	9	-4	16	-3	9	-2	4	0	0	1	1
3.5	Re-work due to errors during construction	-6	36	3	9	-4	16	-8	64	-1	1	-4	16	-2	4	2	4	0	0
3.6	Poor planning and scheduling of work	0	0	1	1	-2	4	-5	25	-4	16	-4	16	-5	25	-3	9	-2	4
3.7	Lack of experience on similar work	9	81	-3	9	5	25	3	9	1	1	3	9	-6	36	-2	4	-2	4
3.8	Under-pricing of the work due to overconfidence in own ability	5	25	-5	25	6	36	5	25	4	16	5	25	0	0	-1	1	-1	1
3.9	Outdated construction methods	0	0	-1	1	0	0	2	4	0	0	0	0	2	4	-1	1	0	0
3.10	Appointment of contractors with political clout	2	4	-2	4	2	4	3	9	3	9	3	9	1	1	1	1	1	1
3.11	Under-pricing of the work due to strategic misrepresentation	3	9	-5	25	6	36	7	49	4	16	6	36	4	16	-1	1	0	0
3.12	Poor cost planning, monitoring and control	-2	4	2	4	-2	4	0	0	-2	4	-2	4	2	4	0	0	0	0
3.13	Termination of contract and appointment of another contractor to finish the work	-4	16	2	4	-4	16	-4	16	-1	1	-4	16	0	0	1	1	0	0

Factor Code	The following factors are the main causes of time and cost overruns	CLIENT vs CONSULTANT						CLIENT vs CONTRACTOR						CONSULTANT vs CONTRACTOR					
		RII		IMPI		RII+IMPI		RII		IMPI		RII+IMPI		RII		IMPI		RII+IMPI	
		D	d2	D	d2	D	d2	D	d2	D	d2	D	d2	D	d2	D	d2	D	d2
Correlation of views between respondents groups for contractor-related group																			
3.14	Contractor's ownership of the critical construction equipment for work continuity	0	0	0	0	1	1	5	25	3	9	4	16	5	25	3	9	3	9
	Σd^2		233		111		172		256		101		170		191		60		52
	Rs		0.49		0.76		0.62		0.44		0.78		0.63		0.58		0.87		0.89

Factor Code	The following factors are the main causes of time and cost overruns	CLIENT vs CONSULTANT						CLIENT vs CONTRACTOR						CONSULTANT vs CONTRACTOR					
		RII		IMPI		RII+IMPI		RII		IMPI		RII+IMPI		RII		IMPI		RII+IMPI	
		D	d2	D	d2	D	d2	D	d2	D	d2	D	d2	D	d2	D	d2	D	d2
Correlation of views between respondents groups for resources-related group																			
4.1	Shortage of skilled labourers	0	0	0	0	0	0	2	4	0	0	0	0	2	4	0	0	0	0
4.2	Unproductivity of labour force	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4.3	Shortage of materials	3	9	-2	4	1	1	-2	4	4	16	3	9	-5	25	2	4	2	4
4.4	Delay in material and equipment delivery	2	4	-2	4	2	4	1	1	-1	1	0	0	-1	1	-3	9	-2	4
4.5	Shortage of equipment	0	0	1	1	-1	1	-6	36	-1	1	-1	1	-6	36	0	0	0	0
4.6	Low productivity of equipment	-4	16	2	4	-2	4	-3	9	-5	25	-4	16	1	1	-3	9	-2	4
4.7	Material price increases	1	1	2	4	1	1	6	36	-2	4	2	4	5	25	0	0	1	1
4.8	Equipment rental rate increases	0	0	0	0	-1	1	2	4	0	0	0	0	2	4	0	0	1	1
4.9	Increase in labour rates	-1	1	1	1	-1	1	-1	1	-1	1	-1	1	0	0	0	0	0	0
4.10	High cost of skilled labour	0	0	-1	1	1	1	0	0	5	25	1	1	0	0	4	16	0	0
	Σd^2		31		19		14		95		73		32		96		38		14
	Rs		0.81		0.88		0.92		0.42		0.56		0.81		0.42		0.77		0.92

Factor Code	The following factors are the main causes of time and cost overruns	CLIENT vs CONSULTANT						CLIENT vs CONTRACTOR						CONSULTANT vs CONTRACTOR					
		RII		IMPI		RII+IMPI		RII		IMPI		RII+IMPI		RII		IMPI		RII+IMPI	
		D	d2	D	d2	D	d2	D	d2	D	d2	D	d2	D	d2	D	d2	D	d2
Correlation of views between respondents groups for externally related group																			
5.1	Community disruptions	0	0	1	1	-1	1	0	0	-1	1	-1	1	0	0	0	0	0	0
5.2	Environmental issues	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	-1	1
5.3	Inclement weather	-4	16	-1	1	-1	1	-2	4	0	0	0	0	2	4	-1	1	1	1
5.4	Regulatory changes	-1	1	0	0	-1	1	1	1	1	1	0	0	2	4	1	1	1	1
5.5	Unforeseen site condition	-1	1	0	0	0	0	-1	1	0	0	0	0	0	0	0	0	0	0
5.6	Accident during construction	3	9	0	0	1	1	0	0	-1	1	0	0	-3	9	-1	1	-1	1
5.7	Corruption	2	4	-1	1	1	1	3	9	1	1	1	1	1	1	0	0	0	0
	Σd^2		31		3		6		15		4		2		18		3		4
	Rs		0.45		0.95		0.89		0.73		0.93		0.96		0.68		0.95		0.93

Factor Code	The following factors are the main causes of time and cost overruns	CLIENT vs CONSULTANT						CLIENT vs CONTRACTOR						CONSULTANT vs CONTRACTOR					
		RII		IMPI		RII+IMPI		RII		IMPI		RII+IMPI		RII		IMPI		RII+IMPI	
		D	d2	D	d2	D	d2	D	d2	D	d2	D	d2	D	d2	D	d2	D	d2
Correlation of views between respondents groups for contract-related group																			
6.1	Errors	4	16	-4	16	4	16	5	25	5	25	5	25	1	1	1	1	1	1
6.2	Discrepancies and omissions in contract document	-3	9	1	1	-3	9	2	4	-1	1	-1	1	5	25	0	0	2	4
6.3	Contract dispute and negotiations	4	16	2	4	1	1	1	1	-2	4	0	0	-3	9	0	0	-1	1
6.4	Change of specifications	-2	4	1	1	-1	1	-3	9	-1	1	-2	4	-1	1	0	0	-1	1
6.5	Penalties ineffective and/or not administered	-3	9	1	1	-1	1	0	0	-3	9	-2	4	3	9	-2	4	-1	1
6.6	Poor communication and co-ordination between parties	2	4	-1	1	2	4	2	4	1	1	2	4	0	0	0	0	0	0
6.7	Contract claims	-2	4	1	1	-2	4	-4	16	0	0	-2	4	-2	4	1	1	0	0
Σd^2			62		25		36		59		41		42		49		6		8
Rs			**-0.11**		**0.55**		**0.36**		**-0.05**		**0.27**		**0.25**		**0.13**		**0.89**		**0.86**

TABLE G.3: CORRELATION OF THE RANKING OF FACTORS BETWEEN RII AND IMPI METHODS

Factor Code	The following factors are the main causes of time and cost overruns	AGGREGATE		CLIENT		CONSULTANT		CONTRACTOR	
		RII vs IMPI		RII vs IMPI		RII vs IMPI		RII vs IMPI	
		d	d2	d	d2	d	d2	d	d2
Correlation of the ranking of factors between RII and IMPI methods									
1.1	Lack of project funding (budget)	39	1521	29	841	38	1444	43	1849
1.2	Delays in progress payments	10	100	7	49	10	100	9	81
1.3	Client interference	22	484	-11	121	26	676	18	324
1.4	Slow decision making by client	6	36	7	49	13	169	-6	36
1.5	Unresolved land ownership	-2	4	-3	9	-6	36	-2	4
1.6	Appointment of incompetent service providers	8	64	-3	9	8	64	18	324
1.7	Interest payment on overdue claims	4	16	11	121	-1	1	5	25
1.8	Increase in scope of work	2	4	-12	144	-2	4	4	16
1.9	Bureaucracy in client's administration	4	16	0	0	1	1	9	81
1.10	Delays in handing over site	-4	16	3	9	-19	361	1	1
1.11	Change of specifications	0	0	9	81	-4	16	2	4

Factor Code	The following factors are the main causes of time and cost overruns	AGGREGATE		CLIENT		CONSULTANT		CONTRACTOR	
		RII vs IMPI		RII vs IMPI		RII vs IMPI		RII vs IMPI	
		d	d2	d	d2	d	d2	d	d2
Correlation of the ranking of factors between RII and IMPI methods									
2.1	Incomplete design information at tender stage	-8	64	-3	9	-3	9	-19	361
2.2	Design mistakes	-3	9	-8	64	4	16	-19	361
2.3	Design changes	-9	81	-8	64	-9	81	-9	81
2.4	Delay in issuing approvals on site (tests and inspections)	5	25	4	16	3	9	-1	1
2.5	Inflexibility (rigid) consultant	0	0	1	1	-13	169	0	0
2.6	Failure to give practical solutions on site	-2	4	0	0	5	25	-18	324
2.7	Unrealistic contract duration estimate	18	324	13	169	2	4	8	64
2.8	Inaccurate bill of quantities	-2	4	-14	196	8	64	-10	100
2.9	Slow decision-making	1	1	-10	100	10	100	-7	49
2.10	Incomplete designs at the start of construction stage	2	4	10	100	-4	16	-8	64
2.11	Inexperience consultant’s team	18	324	15	225	19	361	15	225
2.12	Appointment of consultant with political clout	4	16	22	484	-6	36	-2	4

Factor Code	The following factors are the main causes of time and cost overruns	AGGREGATE		CLIENT		CONSULTANT		CONTRACTOR	
		RII vs IMPI		RII vs IMPI		RII vs IMPI		RII vs IMPI	
		d	d2	d	d2	d	d2	d	d2
Correlation of the ranking of factors between RII and IMPI methods									
3.1	Labour unrest	-4	16	-1	1	-4	16	-5	25
3.2	Subcontracting challenges (dispute and performance)	-2	4	-4	16	1	1	-1	1
3.3	Contractor's cashflow	2	4	3	9	0	0	9	81
3.4	Lack of site management and supervision	2	4	2	4	-2	4	13	169
3.5	Re-work due to errors during construction	-1	1	-10	100	-3	9	9	81
3.6	Poor planning and scheduling of work	-7	49	-5	25	-7	49	-7	49
3.7	Lack of experience on similar work	-16	256	-18	324	-14	196	-20	400
3.8	Under-pricing of the work due to overconfidence in own ability	-5	25	-10	100	-3	9	-1	1
3.9	Outdated construction methods	-2	4	-15	225	21	441	-20	400
3.10	Appointment of contractors with political clout	-3	9	-4	16	0	0	-2	4
3.11	Under-pricing of the work due to strategic misrepresentation	2	4	0	0	5	25	-1	1
3.12	Poor cost planning, monitoring and control	-11	121	-7	49	-2	4	-8	64
3.13	Termination of contract and appointment of another contractor to finish the work	-27	729	-23	529	-21	441	-23	529
3.14	Contractor's ownership of the critical construction equipment for work continuity	1	1	-5	25	-1	1	-6	36

Factor Code	The following factors are the main causes of time and cost overruns	AGGREGATE		CLIENT		CONSULTANT		CONTRACTOR	
		RII vs IMPI		RII vs IMPI		RII vs IMPI		RII vs IMPI	
		d	d2	d	d2	d	d2	d	d2
Correlation of the ranking of factors between RII and IMPI methods									
4.1	Shortage of skilled labourers	11	121	18	324	2	4	12	144
4.2	Unproductivity of labour force	-5	25	-1	1	0	0	2	4
4.3	Shortage of materials	0	0	-17	289	-8	64	19	361
4.4	Delay in material and equipment delivery	-10	100	-20	400	-5	25	-10	100
4.5	Shortage of equipment	2	4	-13	169	-6	36	14	196
4.6	Low productivity of equipment	-12	144	-21	441	-7	49	-8	64
4.7	Material price increases	-4	16	3	9	8	64	-14	196
4.8	Equipment rental rate increases	-6	36	-6	36	-6	36	-7	49
4.9	Increase in labour rates	0	0	-3	9	-1	1	0	0
4.10	High cost of skilled labour	7	49	0	0	5	25	9	81
5.1	Community disruptions	-3	9	-3	9	-2	4	-1	1
5.2	Environmental issues	-6	36	-1	1	-7	49	-5	25
5.3	Inclement weather	3	9	-9	81	13	169	-1	1
5.4	Regulatory changes	-2	4	-5	25	1	1	-9	81
5.5	Unforeseen site condition	-8	64	1	1	-7	49	-14	196
5.6	Accident during construction	-4	16	6	36	-16	256	0	0
5.7	Corruption	4	16	23	529	3	9	4	16

Factor Code	The following factors are the main causes of time and cost overruns	AGGREGATE		CLIENT		CONSULTANT		CONTRACTOR	
		RII vs IMPI		RII vs IMPI		RII vs IMPI		RII vs IMPI	
		d	d2	d	d2	d	d2	d	d2
Correlation of the ranking of factors between RII and IMPI methods									
6.1	Errors	2	4	4	16	-3	9	1	1
6.2	Discrepancies and omissions in contract document	-1	1	-3	9	-6	36	-5	25
6.3	Contract dispute and negotiations	-16	256	6	36	-24	576	-9	81
6.4	Change of specifications	-8	64	-6	36	-19	361	-2	4
6.5	Penalties ineffective and/or not administered	0	0	4	16	4	16	-3	9
6.6	Poor communication and co-ordination between parties	1	1	14	196	-6	36	-1	1
6.7	Contract claims	-10	100	-15	225	-9	81	2	4
Σd2			5419		7178		6914		7860
Rs			0.86		0.81		0.82		0.79

APPENDIX H: DETAILED CRONBACH ALPHA ANALYSIS

```
##
## Reliability evaluation of block:  B.1
##
## Reliability analysis
## Call: psych::alpha(x = x)
##
##   raw_alpha std.alpha G6(smc) average_r S/N   ase mean   sd media
n_r
##    0.77    0.76    0.84    0.23 3.2 0.056    4 0.79     0.23
##
##  lower alpha upper     95% confidence boundaries
## 0.66 0.77 0.88
##
##  Reliability if an item is dropped:
##     raw_alpha std.alpha G6(smc) average_r S/N alpha se var.r med.
r
## B.1.1    0.75    0.75    0.83    0.23 2.9    0.059 0.031  0.22
## B.1.2    0.75    0.74    0.80    0.22 2.8    0.061 0.029  0.21
## B.1.3    0.77    0.76    0.82    0.24 3.2    0.056 0.027  0.25
## B.1.4    0.75    0.74    0.80    0.22 2.8    0.060 0.029  0.23
## B.1.5    0.76    0.76    0.81    0.24 3.1    0.056 0.031  0.25
## B.1.6    0.78    0.78    0.84    0.26 3.4    0.055 0.030  0.26
## B.1.7    0.75    0.74    0.80    0.22 2.9    0.060 0.029  0.23
## B.1.8    0.74    0.74    0.81    0.22 2.8    0.062 0.032  0.22
## B.1.9    0.75    0.75    0.82    0.23 3.0    0.059 0.031  0.21
## B.1.10   0.73    0.72    0.81    0.21 2.6    0.067 0.029  0.21
## B.1.11   0.71    0.71    0.80    0.20 2.5    0.070 0.029  0.19
##
##  Item statistics
##    n raw.r std.r r.cor r.drop mean  sd
## B.1.1  37  0.53  0.53  0.46   0.39  3.5 1.5
## B.1.2  37  0.57  0.58  0.56   0.45  4.8 1.3
## B.1.3  37  0.40  0.41  0.36   0.26  3.8 1.4
## B.1.4  37  0.56  0.58  0.56   0.44  4.5 1.3
## B.1.5  37  0.47  0.45  0.40   0.31  3.4 1.6
## B.1.6  37  0.30  0.31  0.19   0.16  4.6 1.2
## B.1.7  37  0.57  0.55  0.53   0.43  3.1 1.6
## B.1.8  37  0.59  0.59  0.55   0.48  4.0 1.3
## B.1.9  37  0.52  0.52  0.47   0.39  4.7 1.3
## B.1.10 37  0.71  0.69  0.66   0.60  3.7 1.6
## B.1.11 37  0.77  0.75  0.74   0.67  3.8 1.7
##
## Non-missing response frequency for each item
##     1     2    3    4    5    6 miss
## B.1.1  0.11 0.19 0.16 0.30 0.16 0.08    0
## B.1.2  0.03 0.03 0.11 0.22 0.22 0.41    0
```

```
## B.1.3  0.03 0.24 0.08 0.32 0.24 0.08    0
## B.1.4  0.00 0.14 0.03 0.27 0.32 0.24    0
## B.1.5  0.16 0.22 0.11 0.24 0.16 0.11    0
## B.1.6  0.03 0.05 0.05 0.27 0.35 0.24    0
## B.1.7  0.14 0.32 0.16 0.19 0.05 0.14    0
## B.1.8  0.03 0.19 0.08 0.22 0.43 0.05    0
## B.1.9  0.03 0.08 0.03 0.22 0.32 0.32    0
## B.1.10 0.11 0.19 0.05 0.32 0.19 0.14    0
## B.1.11 0.11 0.22 0.05 0.16 0.32 0.14    0
##
##
## Reliability evaluation of block:  B.2
##
## Reliability analysis
## Call: psych::alpha(x = x)
##
##   raw_alpha std.alpha G6(smc) average_r S/N   ase mean   sd media
n_r
##    0.91    0.91    0.96    0.47  10 0.021  4.1 0.98     0.47
##
##  lower alpha upper     95% confidence boundaries
## 0.87 0.91 0.95
##
##  Reliability if an item is dropped:
##     raw_alpha std.alpha G6(smc) average_r  S/N alpha se var.r med
.r
## B.2.1    0.91    0.91    0.95    0.48 10.3    0.021 0.033  0.50
## B.2.2    0.90    0.90    0.95    0.46  9.2    0.024 0.037  0.45
## B.2.3    0.90    0.91    0.95    0.47  9.6    0.023 0.035  0.48
## B.2.4    0.91    0.91    0.95    0.47  9.6    0.023 0.043  0.45
## B.2.5    0.92    0.92    0.96    0.51 11.5    0.020 0.028  0.56
## B.2.6    0.90    0.90    0.95    0.45  9.0    0.024 0.041  0.45
## B.2.7    0.91    0.91    0.95    0.47  9.6    0.023 0.039  0.45
## B.2.8    0.90    0.90    0.95    0.46  9.3    0.024 0.039  0.45
## B.2.9    0.90    0.90    0.94    0.44  8.8    0.025 0.036  0.45
## B.2.10   0.90    0.90    0.95    0.44  8.8    0.025 0.038  0.45
## B.2.11   0.90    0.90    0.95    0.46  9.4    0.023 0.040  0.48
## B.2.12   0.91    0.91    0.96    0.49 10.7    0.021 0.038  0.56
##
##  Item statistics
##    n raw.r std.r r.cor r.drop mean  sd
## B.2.1  37  0.60  0.61  0.59   0.52  4.2 1.4
## B.2.2  37  0.78  0.79  0.78   0.73  4.1 1.2
## B.2.3  37  0.72  0.72  0.72   0.66  4.2 1.3
## B.2.4  37  0.72  0.72  0.70   0.66  3.7 1.5
## B.2.5  37  0.44  0.44  0.40   0.34  3.7 1.4
## B.2.6  37  0.82  0.82  0.80   0.78  3.9 1.3
## B.2.7  37  0.72  0.71  0.70   0.65  4.0 1.6
## B.2.8  37  0.76  0.77  0.76   0.71  4.2 1.3
```

```
## B.2.9  37  0.86  0.86  0.86   0.83  4.3 1.4
## B.2.10 37  0.87  0.86  0.86   0.83  4.1 1.5
## B.2.11 37  0.75  0.75  0.73   0.69  3.9 1.3
## B.2.12 37  0.53  0.54  0.50   0.45  4.7 1.3
##
## Non-missing response frequency for each item
##     1     2    3    4    5    6 miss
## B.2.1  0.05 0.11 0.05 0.27 0.35 0.16    0
## B.2.2  0.03 0.11 0.14 0.30 0.35 0.08    0
## B.2.3  0.03 0.11 0.11 0.30 0.30 0.16    0
## B.2.4  0.08 0.16 0.14 0.32 0.19 0.11    0
## B.2.5  0.05 0.16 0.27 0.16 0.27 0.08    0
## B.2.6  0.05 0.11 0.16 0.27 0.32 0.08    0
## B.2.7  0.05 0.19 0.08 0.22 0.27 0.19    0
## B.2.8  0.03 0.14 0.08 0.22 0.41 0.14    0
## B.2.9  0.03 0.14 0.05 0.24 0.38 0.16    0
## B.2.10 0.08 0.11 0.11 0.24 0.27 0.19    0
## B.2.11 0.05 0.14 0.11 0.38 0.24 0.08    0
## B.2.12 0.03 0.03 0.08 0.27 0.24 0.35    0
##
##
## Reliability evaluation of block:  B.3
##
## Reliability analysis
## Call: psych::alpha(x = x)
##
##   raw_alpha std.alpha G6(smc) average_r S/N   ase mean   sd media
n_r
##    0.85    0.85    0.93    0.29 5.6 0.034  4.8 0.63     0.26
##
##  lower alpha upper     95% confidence boundaries
## 0.78 0.85 0.92
##
##  Reliability if an item is dropped:
##     raw_alpha std.alpha G6(smc) average_r S/N alpha se var.r med.
r
## B.3.1    0.85    0.85    0.92    0.31 5.9    0.034 0.050  0.30
## B.3.2    0.85    0.86    0.92    0.31 5.9    0.034 0.049  0.29
## B.3.3    0.85    0.85    0.92    0.30 5.6    0.035 0.054  0.26
## B.3.4    0.83    0.83    0.90    0.27 4.8    0.040 0.051  0.25
## B.3.5    0.84    0.84    0.92    0.29 5.3    0.036 0.054  0.26
## B.3.6    0.82    0.81    0.90    0.25 4.4    0.042 0.042  0.24
## B.3.7    0.82    0.82    0.90    0.26 4.6    0.042 0.045  0.25
## B.3.8    0.83    0.83    0.90    0.27 4.8    0.039 0.048  0.24
## B.3.9    0.86    0.86    0.91    0.31 5.9    0.032 0.047  0.29
## B.3.10   0.84    0.84    0.93    0.29 5.3    0.036 0.056  0.26
## B.3.11   0.83    0.83    0.91    0.28 4.9    0.039 0.050  0.24
## B.3.12   0.83    0.82    0.91    0.27 4.7    0.040 0.050  0.24
## B.3.13   0.84    0.84    0.90    0.29 5.3    0.036 0.048  0.26
```

```
## B.3.14    0.85    0.85    0.93    0.30 5.5    0.034 0.055  0.26
##
##  Item statistics
##     n raw.r std.r r.cor r.drop mean   sd
## B.3.1  37  0.28  0.33  0.28   0.19  5.3 0.80
## B.3.2  37  0.27  0.32  0.27   0.19  5.2 0.78
## B.3.3  37  0.40  0.42  0.38   0.31  5.2 0.94
## B.3.4  37  0.75  0.75  0.75   0.68  4.5 1.22
## B.3.5  37  0.57  0.55  0.53   0.46  4.4 1.25
## B.3.6  37  0.91  0.90  0.92   0.88  4.8 1.04
## B.3.7  37  0.83  0.82  0.84   0.78  4.8 1.21
## B.3.8  37  0.74  0.73  0.74   0.68  4.9 1.07
## B.3.9  37  0.34  0.31  0.28   0.20  3.8 1.28
## B.3.10 37  0.52  0.54  0.48   0.45  5.4 0.86
## B.3.11 37  0.69  0.68  0.66   0.61  4.8 1.19
## B.3.12 37  0.78  0.77  0.77   0.73  5.0 0.96
## B.3.13 37  0.55  0.53  0.53   0.44  4.6 1.21
## B.3.14 37  0.47  0.45  0.38   0.35  4.5 1.24
##
## Non-missing response frequency for each item
##     1     2    3    4    5    6 miss
## B.3.1  0.00 0.00 0.03 0.14 0.38 0.46    0
## B.3.2  0.00 0.00 0.03 0.14 0.46 0.38    0
## B.3.3  0.00 0.00 0.08 0.11 0.35 0.46    0
## B.3.4  0.00 0.11 0.05 0.30 0.32 0.22    0
## B.3.5  0.03 0.05 0.16 0.22 0.38 0.16    0
## B.3.6  0.00 0.05 0.03 0.27 0.41 0.24    0
## B.3.7  0.00 0.08 0.08 0.14 0.41 0.30    0
## B.3.8  0.00 0.03 0.08 0.22 0.32 0.35    0
## B.3.9  0.05 0.14 0.14 0.43 0.16 0.08    0
## B.3.10 0.00 0.00 0.03 0.16 0.24 0.57    0
## B.3.11 0.00 0.05 0.08 0.22 0.27 0.38    0
## B.3.12 0.00 0.03 0.03 0.22 0.41 0.32    0
## B.3.13 0.00 0.05 0.14 0.27 0.24 0.30    0
## B.3.14 0.00 0.05 0.22 0.19 0.30 0.24    0
##
##
## Reliability evaluation of block:  B.4
##
## Reliability analysis
## Call: psych::alpha(x = x)
##
##   raw_alpha std.alpha G6(smc) average_r S/N   ase mean   sd media
n_r
##    0.89    0.88    0.93    0.43 7.7 0.029    4 0.92     0.38
##
##  lower alpha upper     95% confidence boundaries
## 0.83 0.89 0.94
##
```

```
##  Reliability if an item is dropped:
##     raw_alpha std.alpha G6(smc) average_r S/N alpha se var.r med.
r
## B.4.1    0.88    0.88    0.92    0.44 7.1    0.031 0.034  0.39
## B.4.2    0.88    0.88    0.93    0.46 7.5    0.030 0.034  0.39
## B.4.3    0.87    0.87    0.91    0.43 6.7    0.032 0.028  0.39
## B.4.4    0.88    0.88    0.92    0.44 7.0    0.031 0.026  0.39
## B.4.5    0.87    0.87    0.91    0.43 6.7    0.032 0.029  0.39
## B.4.6    0.88    0.88    0.93    0.45 7.3    0.030 0.035  0.38
## B.4.7    0.87    0.87    0.92    0.42 6.6    0.033 0.032  0.38
## B.4.8    0.87    0.87    0.92    0.44 6.9    0.032 0.032  0.38
## B.4.9    0.87    0.87    0.91    0.42 6.5    0.034 0.031  0.38
## B.4.10   0.87    0.87    0.92    0.43 6.7    0.033 0.030  0.39
##
##  Item statistics
##    n raw.r std.r r.cor r.drop mean  sd
## B.4.1  37  0.68  0.66  0.62   0.57  4.2 1.5
## B.4.2  37  0.57  0.59  0.53   0.49  4.9 1.0
## B.4.3  37  0.73  0.74  0.74   0.65  4.1 1.3
## B.4.4  37  0.68  0.68  0.68   0.60  4.2 1.2
## B.4.5  37  0.73  0.74  0.73   0.65  4.2 1.3
## B.4.6  37  0.61  0.63  0.57   0.51  4.1 1.3
## B.4.7  37  0.77  0.76  0.74   0.70  3.8 1.3
## B.4.8  37  0.70  0.70  0.67   0.62  3.8 1.3
## B.4.9  37  0.80  0.78  0.77   0.73  3.4 1.5
## B.4.10 37  0.75  0.73  0.72   0.67  3.3 1.5
##
## Non-missing response frequency for each item
##     1     2    3    4    5    6 miss
## B.4.1  0.05 0.16 0.08 0.11 0.46 0.14    0
## B.4.2  0.00 0.03 0.11 0.08 0.54 0.24    0
## B.4.3  0.00 0.08 0.30 0.24 0.16 0.22    0
## B.4.4  0.00 0.08 0.19 0.32 0.22 0.19    0
## B.4.5  0.00 0.14 0.16 0.35 0.11 0.24    0
## B.4.6  0.00 0.11 0.22 0.27 0.24 0.16    0
## B.4.7  0.00 0.19 0.24 0.22 0.27 0.08    0
## B.4.8  0.05 0.11 0.22 0.35 0.19 0.08    0
## B.4.9  0.08 0.24 0.19 0.22 0.19 0.08    0
## B.4.10 0.05 0.35 0.19 0.11 0.22 0.08    0
##
##
## Reliability evaluation of block:  B.5
##
## Reliability analysis
## Call: psych::alpha(x = x)
##
##   raw_alpha std.alpha G6(smc) average_r S/N   ase mean   sd media
n_r
##    0.73    0.72    0.81    0.27 2.6 0.066  4.1 0.77     0.26
```

```
##
##  lower alpha upper     95% confidence boundaries
## 0.6 0.73 0.86
##
##  Reliability if an item is dropped:
##    raw_alpha std.alpha G6(smc) average_r S/N alpha se var.r med.r
## B.5.1    0.76    0.76    0.82    0.35 3.2    0.061 0.032  0.34
## B.5.2    0.64    0.63    0.66    0.22 1.7    0.090 0.031  0.22
## B.5.3    0.71    0.70    0.77    0.28 2.3    0.070 0.043  0.26
## B.5.4    0.65    0.65    0.70    0.23 1.8    0.086 0.025  0.18
## B.5.5    0.69    0.67    0.71    0.25 2.0    0.075 0.048  0.22
## B.5.6    0.69    0.67    0.79    0.26 2.1    0.077 0.049  0.22
## B.5.7    0.72    0.71    0.76    0.29 2.4    0.068 0.045  0.30
##
##  Item statistics
##     n raw.r std.r r.cor r.drop mean  sd
## B.5.1 37  0.30  0.34  0.17   0.11  5.3 1.0
## B.5.2 37  0.79  0.77  0.80   0.66  3.8 1.4
## B.5.3 37  0.56  0.57  0.49   0.38  3.8 1.2
## B.5.4 37  0.76  0.73  0.75   0.62  3.4 1.3
## B.5.5 37  0.65  0.66  0.63   0.50  4.3 1.2
## B.5.6 37  0.66  0.65  0.54   0.49  3.5 1.3
## B.5.7 37  0.55  0.54  0.46   0.35  4.9 1.3
##
## Non-missing response frequency for each item
##     1    2    3    4    5    6 miss
## B.5.1 0.00 0.05 0.00 0.08 0.30 0.57    0
## B.5.2 0.03 0.16 0.27 0.19 0.22 0.14    0
## B.5.3 0.03 0.16 0.11 0.41 0.24 0.05    0
## B.5.4 0.03 0.30 0.19 0.27 0.16 0.05    0
## B.5.5 0.00 0.08 0.16 0.27 0.35 0.14    0
## B.5.6 0.03 0.24 0.27 0.22 0.19 0.05    0
## B.5.7 0.03 0.05 0.05 0.14 0.32 0.41    0
##
##
## Reliability evaluation of block:  B.6
##
## Reliability analysis
## Call: psych::alpha(x = x)
##
##   raw_alpha std.alpha G6(smc) average_r S/N   ase mean   sd media
n_r
##    0.81    0.8    0.85    0.36   4 0.048  4.3 0.89     0.31
##
##  lower alpha upper     95% confidence boundaries
## 0.71 0.81 0.9
##
##  Reliability if an item is dropped:
##    raw_alpha std.alpha G6(smc) average_r S/N alpha se var.r med.r
```

```
## B.6.1    0.77    0.76    0.81    0.34 3.1    0.059 0.052  0.27
## B.6.2    0.75    0.75    0.77    0.33 3.0    0.063 0.029  0.31
## B.6.3    0.76    0.75    0.80    0.33 3.0    0.062 0.043  0.30
## B.6.4    0.76    0.75    0.81    0.33 3.0    0.062 0.051  0.31
## B.6.5    0.83    0.83    0.86    0.45 5.0    0.042 0.033  0.45
## B.6.6    0.79    0.78    0.82    0.37 3.5    0.053 0.063  0.31
## B.6.7    0.80    0.79    0.84    0.38 3.7    0.049 0.065  0.42
##
##  Item statistics
##     n raw.r std.r r.cor r.drop mean  sd
## B.6.1 37  0.75  0.74  0.71   0.63  4.1 1.3
## B.6.2 37  0.80  0.78  0.79   0.68  4.1 1.4
## B.6.3 37  0.78  0.77  0.76   0.67  4.2 1.3
## B.6.4 37  0.78  0.77  0.73   0.67  4.0 1.4
## B.6.5 37  0.36  0.39  0.25   0.19  4.4 1.2
## B.6.6 37  0.64  0.66  0.59   0.51  4.6 1.2
## B.6.7 37  0.61  0.62  0.53   0.45  4.5 1.3
##
## Non-missing response frequency for each item
##     1    2    3    4    5    6 miss
## B.6.1 0.05 0.08 0.11 0.27 0.41 0.08    0
## B.6.2 0.08 0.05 0.22 0.11 0.43 0.11    0
## B.6.3 0.05 0.05 0.14 0.27 0.32 0.16    0
## B.6.4 0.05 0.14 0.11 0.24 0.38 0.08    0
## B.6.5 0.03 0.03 0.14 0.32 0.32 0.16    0
## B.6.6 0.03 0.03 0.11 0.19 0.41 0.24    0
## B.6.7 0.00 0.11 0.14 0.19 0.32 0.24    0
##
##
## Reliability evaluation of block:  C.1i
##
## Reliability analysis
## Call: psych::alpha(x = x)
##
##   raw_alpha std.alpha G6(smc) average_r S/N   ase mean   sd media
n_r
##    0.85    0.85    0.89    0.34 5.7 0.038  3.4 0.67     0.35
##
##  lower alpha upper     95% confidence boundaries
## 0.77 0.85 0.92
##
##  Reliability if an item is dropped:
##    raw_alpha std.alpha G6(smc) average_r S/N alpha se var.r med.r
## C.1.1i    0.85    0.85    0.89    0.37 5.8    0.038 0.021  0.37
## C.1.2i    0.83    0.83    0.88    0.33 5.0    0.042 0.025  0.34
## C.1.3i    0.84    0.84    0.88    0.35 5.4    0.040 0.022  0.36
## C.1.4i    0.84    0.84    0.88    0.35 5.3    0.040 0.022  0.36
## C.1.5i    0.83    0.84    0.88    0.34 5.2    0.041 0.025  0.34
## C.1.6i    0.83    0.84    0.88    0.34 5.2    0.041 0.023  0.35
```

```
## C.1.7i    0.82    0.83    0.87    0.33 4.9    0.043 0.019  0.34
## C.1.8i    0.83    0.83    0.88    0.33 5.0    0.042 0.023  0.34
## C.1.9i    0.84    0.85    0.89    0.36 5.6    0.039 0.022  0.36
## C.1.10i   0.83    0.83    0.87    0.33 4.9    0.043 0.021  0.34
## C.1.11i   0.82    0.82    0.87    0.32 4.7    0.045 0.023  0.33
##
##  Item statistics
##      n raw.r std.r r.cor r.drop mean   sd
## C.1.1i  37  0.49  0.47  0.39   0.35  3.6 1.14
## C.1.2i  37  0.67  0.69  0.66   0.59  4.2 0.94
## C.1.3i  37  0.58  0.58  0.55   0.47  3.2 1.09
## C.1.4i  37  0.60  0.60  0.58   0.49  3.8 1.09
## C.1.5i  37  0.66  0.62  0.58   0.53  2.9 1.39
## C.1.6i  37  0.62  0.61  0.57   0.52  3.8 1.09
## C.1.7i  37  0.71  0.72  0.71   0.63  2.7 1.11
## C.1.8i  37  0.67  0.69  0.66   0.60  3.1 0.91
## C.1.9i  37  0.49  0.50  0.45   0.38  3.6 0.98
## C.1.10i 37  0.70  0.70  0.69   0.62  2.9 0.94
## C.1.11i 37  0.76  0.77  0.76   0.69  3.3 1.05
##
## Non-missing response frequency for each item
##       1    2    3    4    5 miss
## C.1.1i  0.03 0.16 0.22 0.32 0.27    0
## C.1.2i  0.00 0.08 0.11 0.35 0.46    0
## C.1.3i  0.05 0.19 0.35 0.27 0.14    0
## C.1.4i  0.03 0.14 0.16 0.41 0.27    0
## C.1.5i  0.14 0.35 0.16 0.14 0.22    0
## C.1.6i  0.03 0.11 0.19 0.35 0.32    0
## C.1.7i  0.16 0.30 0.27 0.24 0.03    0
## C.1.8i  0.00 0.30 0.35 0.30 0.05    0
## C.1.9i  0.00 0.14 0.30 0.35 0.22    0
## C.1.10i 0.05 0.24 0.46 0.19 0.05    0
## C.1.11i 0.00 0.27 0.32 0.24 0.16    0
##
##
## Reliability evaluation of block:  C.1f

## Warning in psych:: alpha(x): Some items were negatively correlate
d with the total scale and probably
## should be reversed.
## To do this, run the function again with the 'check.keys=TRUE.' op
tion
```

Some items (C.1.5f C.1.10f C.1.11f) were negatively correlated with the total scale and

probably should be reversed.

To do this, run the function again with the 'check.keys=TRUE.' option

```
## Reliability analysis
## Call: psych::alpha(x = x)
##
##   raw_alpha std.alpha G6(smc) average_r S/N   ase mean   sd
median_r
##    0.71    0.69    0.83    0.17 2.3 0.065  2.8 0.45     0.17
##
##  lower alpha upper     95% confidence boundaries
## 0.59 0.71 0.84
##
##  Reliability if an item is dropped:
##    raw_alpha std.alpha G6(smc) average_r S/N alpha se var.r med.r
## C.1.1f    0.68    0.66    0.81    0.16 2.0    0.076 0.092  0.17
## C.1.2f    0.62    0.61    0.78    0.14 1.6    0.089 0.093  0.16
## C.1.3f    0.67    0.66    0.80    0.17 2.0    0.078 0.088  0.17
## C.1.4f    0.66    0.65    0.80    0.15 1.8    0.079 0.098  0.17
## C.1.5f    0.73    0.72    0.84    0.21 2.6    0.061 0.095  0.26
## C.1.6f    0.69    0.68    0.82    0.17 2.1    0.072 0.095  0.17
## C.1.7f    0.68    0.65    0.81    0.15 1.8    0.072 0.115  0.16
## C.1.8f    0.71    0.68    0.83    0.18 2.2    0.066 0.114  0.28
## C.1.9f    0.64    0.63    0.79    0.14 1.7    0.084 0.094  0.17
## C.1.10f   0.73    0.69    0.82    0.19 2.3    0.060 0.100  0.23
## C.1.11f   0.77    0.73    0.84    0.21 2.7    0.050 0.085  0.24
##
##  Item statistics
##     n raw.r std.r r.cor r.drop mean   sd
## C.1.1f  37 0.634  0.54 0.516  0.467  3.3 1.13
## C.1.2f  37 0.834  0.78 0.795  0.754  3.9 1.00
## C.1.3f  37 0.643  0.54 0.522  0.487  2.9 1.08
## C.1.4f  37 0.685  0.63 0.619  0.556  3.4 0.98
## C.1.5f  37 0.050  0.19 0.091 -0.051  1.5 0.51
## C.1.6f  37 0.545  0.47 0.415  0.372  3.5 1.04
## C.1.7f  37 0.575  0.63 0.566  0.483  2.1 0.62
```

```
## C.1.8f  37 0.346  0.44 0.348  0.233  2.5 0.61
## C.1.9f  37 0.774  0.72 0.724  0.681  3.6 0.93
## C.1.10f 37 0.246  0.37 0.325  0.100  2.0 0.75
## C.1.11f 37 0.022  0.14 0.059 -0.159  2.1 0.92
##
## Non-missing response frequency for each item
##      1     2    3    4    5 miss
## C.1.1f  0.03 0.27 0.24 0.30 0.16    0
## C.1.2f  0.00 0.08 0.27 0.27 0.38    0
## C.1.3f  0.05 0.32 0.35 0.16 0.11    0
## C.1.4f  0.03 0.16 0.32 0.38 0.11    0
## C.1.5f  0.49 0.51 0.00 0.00 0.00    0
## C.1.6f  0.03 0.19 0.22 0.43 0.14    0
## C.1.7f  0.16 0.62 0.22 0.00 0.00    0
## C.1.8f  0.00 0.51 0.43 0.05 0.00    0
## C.1.9f  0.00 0.14 0.30 0.41 0.16    0
## C.1.10f 0.27 0.46 0.27 0.00 0.00    0
## C.1.11f 0.24 0.46 0.24 0.03 0.03    0
##
##
## Reliability evaluation of block:  C.2i
##
## Reliability analysis
## Call: psych::alpha(x = x)
##
##   raw_alpha std.alpha G6(smc) average_r S/N   ase mean   sd
median_r
##    0.93    0.93    0.97    0.54  14 0.016  3.3 0.82     0.55
##
##  lower alpha upper     95% confidence boundaries
## 0.9 0.93 0.97
##
##  Reliability if an item is dropped:
```

```
##    raw_alpha std.alpha G6(smc) average_r S/N alpha se var.r med.r
## C.2.1i    0.92    0.93    0.95    0.53  12    0.018 0.015  0.54
## C.2.2i    0.92    0.93    0.95    0.53  12    0.019 0.013  0.54
## C.2.3i    0.93    0.93    0.96    0.55  14    0.017 0.017  0.56
## C.2.4i    0.93    0.93    0.96    0.55  14    0.017 0.016  0.55
## C.2.5i    0.93    0.93    0.96    0.54  13    0.018 0.017  0.54
## C.2.6i    0.93    0.93    0.96    0.54  13    0.018 0.017  0.54
## C.2.7i    0.93    0.93    0.96    0.56  14    0.017 0.016  0.56
## C.2.8i    0.93    0.93    0.96    0.54  13    0.018 0.015  0.55
## C.2.9i    0.93    0.93    0.96    0.55  13    0.017 0.018  0.55
## C.2.10i   0.92    0.93    0.96    0.53  12    0.019 0.014  0.54
## C.2.11i   0.93    0.93    0.96    0.55  13    0.017 0.018  0.55
## C.2.12i   0.94    0.94    0.96    0.57  15    0.015 0.012  0.56
##
##  Item statistics
##      n raw.r std.r r.cor r.drop mean   sd
## C.2.1i  37  0.84  0.85  0.85   0.81  3.3 1.00
## C.2.2i  37  0.85  0.85  0.86   0.82  3.3 1.17
## C.2.3i  37  0.71  0.72  0.70   0.66  3.2 0.90
## C.2.4i  37  0.72  0.72  0.69   0.66  3.1 1.10
## C.2.5i  37  0.80  0.80  0.79   0.76  2.9 1.07
## C.2.6i  37  0.81  0.81  0.81   0.77  3.1 1.05
## C.2.7i  37  0.68  0.68  0.65   0.62  3.3 1.00
## C.2.8i  37  0.77  0.77  0.76   0.72  3.5 1.12
## C.2.9i  37  0.73  0.74  0.72   0.68  3.4 0.93
## C.2.10i 37  0.85  0.85  0.85   0.82  3.4 1.14
## C.2.11i 37  0.76  0.75  0.73   0.70  3.5 1.19
## C.2.12i 37  0.61  0.61  0.59   0.53  3.7 1.15
##
## Non-missing response frequency for each item
##       1     2    3    4    5 miss
## C.2.1i  0.03 0.16 0.43 0.24 0.14    0
## C.2.2i  0.03 0.32 0.16 0.32 0.16    0
```

```
## C.2.3i  0.00 0.24 0.43 0.24 0.08    0
## C.2.4i  0.08 0.24 0.30 0.30 0.08    0
## C.2.5i  0.08 0.32 0.27 0.27 0.05    0
## C.2.6i  0.08 0.16 0.41 0.27 0.08    0
## C.2.7i  0.03 0.19 0.32 0.35 0.11    0
## C.2.8i  0.03 0.22 0.22 0.35 0.19    0
## C.2.9i  0.03 0.14 0.32 0.43 0.08    0
## C.2.10i 0.03 0.22 0.30 0.24 0.22    0
## C.2.11i 0.03 0.19 0.30 0.19 0.30    0
## C.2.12i 0.05 0.08 0.24 0.32 0.30    0
##
##
## Reliability evaluation of block:  C.2f
##
## Reliability analysis
## Call: psych::alpha(x = x)
##
##   raw_alpha std.alpha G6(smc) average_r S/N   ase mean   sd
median_r
##    0.89    0.9    0.94    0.44 9.3 0.026  2.6 0.64    0.5
##
##  lower alpha upper     95% confidence boundaries
## 0.84 0.89 0.95
##
##  Reliability if an item is dropped:
##    raw_alpha std.alpha G6(smc) average_r  S/N alpha se var.r
med.r
## C.2.1f    0.89    0.90    0.93    0.44  8.7    0.028 0.034  0.50
## C.2.2f    0.88    0.89    0.93    0.42  7.9    0.029 0.036  0.45
## C.2.3f    0.89    0.90    0.94    0.45  8.9    0.027 0.033  0.50
## C.2.4f    0.88    0.89    0.94    0.43  8.1    0.029 0.042  0.49
## C.2.5f    0.88    0.89    0.93    0.42  8.0    0.030 0.040  0.44
## C.2.6f    0.88    0.89    0.93    0.43  8.3    0.029 0.040  0.50
```

```
## C.2.7f    0.89    0.90    0.93    0.46  9.3    0.026 0.037  0.51
## C.2.8f    0.88    0.89    0.94    0.43  8.2    0.029 0.038  0.49
## C.2.9f    0.90    0.91    0.94    0.49 10.5    0.024 0.026  0.53
## C.2.10f   0.88    0.88    0.93    0.41  7.6    0.030 0.035  0.44
## C.2.11f   0.88    0.89    0.94    0.43  8.4    0.029 0.041  0.50
## C.2.12f   0.89    0.90    0.94    0.45  9.1    0.026 0.039  0.51
##
##  Item statistics
##     n raw.r std.r r.cor r.drop mean   sd
## C.2.1f  37  0.66  0.68  0.67   0.59  2.5 0.90
## C.2.2f  37  0.80  0.82  0.82   0.76  2.4 0.83
## C.2.3f  37  0.60  0.64  0.62   0.52  2.5 0.90
## C.2.4f  37  0.77  0.77  0.75   0.72  2.4 0.95
## C.2.5f  37  0.81  0.80  0.80   0.76  2.1 1.00
## C.2.6f  37  0.73  0.75  0.74   0.68  2.4 0.86
## C.2.7f  37  0.59  0.55  0.52   0.48  3.1 1.13
## C.2.8f  37  0.75  0.77  0.75   0.70  2.6 0.79
## C.2.9f  37  0.37  0.36  0.30   0.26  2.9 0.94
## C.2.10f 37  0.87  0.88  0.88   0.84  2.4 0.76
## C.2.11f 37  0.73  0.72  0.70   0.67  2.7 0.91
## C.2.12f 37  0.63  0.60  0.56   0.52  3.5 1.24
##
## Non-missing response frequency for each item
##      1     2    3    4    5 miss
## C.2.1f  0.14 0.35 0.43 0.05 0.03    0
## C.2.2f  0.08 0.54 0.30 0.05 0.03    0
## C.2.3f  0.11 0.43 0.35 0.08 0.03    0
## C.2.4f  0.19 0.41 0.27 0.14 0.00    0
## C.2.5f  0.30 0.41 0.16 0.14 0.00    0
## C.2.6f  0.14 0.46 0.35 0.03 0.03    0
## C.2.7f  0.05 0.32 0.24 0.27 0.11    0
## C.2.8f  0.03 0.46 0.41 0.08 0.03    0
## C.2.9f  0.05 0.27 0.38 0.27 0.03    0
```

```
## C.2.10f 0.11 0.43 0.41 0.05 0.00    0
## C.2.11f 0.05 0.41 0.35 0.16 0.03    0
## C.2.12f 0.05 0.19 0.19 0.30 0.27    0
##
##
## Reliability evaluation of block:  C.3i
##
## Reliability analysis
## Call: psych::alpha(x = x)
##
##   raw_alpha std.alpha G6(smc) average_r S/N   ase mean   sd
median_r
##     0.9    0.9    0.94    0.4 9.3 0.024  3.7 0.66    0.4
##
##  lower alpha upper     95% confidence boundaries
## 0.85 0.9 0.95
##
##  Reliability if an item is dropped:
##    raw_alpha std.alpha G6(smc) average_r S/N alpha se var.r med.r
## C.3.1i    0.90    0.91    0.94    0.43 9.9    0.023 0.022  0.43
## C.3.2i    0.89    0.90    0.94    0.41 8.9    0.025 0.031  0.41
## C.3.3i    0.89    0.90    0.94    0.40 8.8    0.026 0.033  0.41
## C.3.4i    0.89    0.89    0.93    0.38 8.0    0.028 0.030  0.40
## C.3.5i    0.89    0.89    0.93    0.40 8.5    0.026 0.029  0.40
## C.3.6i    0.89    0.89    0.93    0.38 8.0    0.028 0.027  0.40
## C.3.7i    0.88    0.89    0.94    0.38 8.1    0.028 0.028  0.40
## C.3.8i    0.89    0.89    0.93    0.39 8.2    0.028 0.031  0.40
## C.3.9i    0.90    0.90    0.94    0.41 9.1    0.025 0.028  0.41
## C.3.10i   0.89    0.90    0.94    0.40 8.6    0.026 0.032  0.40
## C.3.11i   0.89    0.89    0.94    0.39 8.3    0.027 0.032  0.40
## C.3.12i   0.89    0.89    0.93    0.39 8.5    0.027 0.029  0.40
## C.3.13i   0.90    0.90    0.94    0.42 9.3    0.024 0.026  0.41
## C.3.14i   0.89    0.90    0.94    0.41 8.9    0.025 0.031  0.42
```

```
##
##  Item statistics
##      n raw.r std.r r.cor r.drop mean   sd
## C.3.1i  37  0.38  0.38  0.35   0.28  4.0 1.04
## C.3.2i  37  0.59  0.60  0.57   0.52  4.0 0.96
## C.3.3i  37  0.62  0.63  0.59   0.57  4.3 0.74
## C.3.4i  37  0.81  0.81  0.81   0.77  3.8 0.85
## C.3.5i  37  0.69  0.70  0.70   0.63  3.6 0.98
## C.3.6i  37  0.81  0.81  0.81   0.77  3.7 0.91
## C.3.7i  37  0.80  0.80  0.79   0.75  3.6 1.01
## C.3.8i  37  0.77  0.76  0.75   0.71  3.7 1.19
## C.3.9i  37  0.56  0.56  0.54   0.48  2.8 1.01
## C.3.10i 37  0.68  0.68  0.64   0.61  4.2 1.01
## C.3.11i 37  0.75  0.75  0.72   0.70  3.8 1.00
## C.3.12i 37  0.70  0.71  0.70   0.64  3.9 0.95
## C.3.13i 37  0.53  0.52  0.50   0.42  3.4 1.17
## C.3.14i 37  0.61  0.60  0.57   0.53  3.4 1.11
##
## Non-missing response frequency for each item
##       1    2    3    4    5 miss
## C.3.1i  0.00 0.11 0.19 0.27 0.43    0
## C.3.2i  0.00 0.08 0.22 0.35 0.35    0
## C.3.3i  0.00 0.00 0.16 0.38 0.46    0
## C.3.4i  0.00 0.08 0.24 0.49 0.19    0
## C.3.5i  0.00 0.16 0.27 0.38 0.19    0
## C.3.6i  0.00 0.08 0.35 0.35 0.22    0
## C.3.7i  0.00 0.19 0.22 0.41 0.19    0
## C.3.8i  0.05 0.11 0.22 0.30 0.32    0
## C.3.9i  0.08 0.35 0.35 0.16 0.05    0
## C.3.10i 0.03 0.05 0.11 0.35 0.46    0
## C.3.11i 0.03 0.05 0.27 0.38 0.27    0
## C.3.12i 0.03 0.05 0.19 0.49 0.24    0
## C.3.13i 0.00 0.30 0.24 0.22 0.24    0
```

```
## C.3.14i 0.03 0.22 0.32 0.24 0.19    0
##
##
## Reliability evaluation of block:  C.3f
##
## Reliability analysis
## Call: psych::alpha(x = x)
##
##   raw_alpha std.alpha G6(smc) average_r S/N   ase mean   sd
median_r
##    0.81    0.82     0.9    0.24 4.4 0.046  3.1 0.49     0.23
##
##  lower alpha upper     95% confidence boundaries
## 0.72 0.81 0.9
##
##  Reliability if an item is dropped:
##    raw_alpha std.alpha G6(smc) average_r S/N alpha se var.r med.r
## C.3.1f    0.81    0.81    0.89    0.25 4.4    0.046 0.049  0.26
## C.3.2f    0.81    0.82    0.89    0.26 4.5    0.045 0.045  0.26
## C.3.3f    0.80    0.81    0.90    0.24 4.2    0.049 0.058  0.21
## C.3.4f    0.81    0.82    0.90    0.26 4.5    0.046 0.051  0.26
## C.3.5f    0.80    0.80    0.89    0.23 4.0    0.049 0.054  0.22
## C.3.6f    0.80    0.80    0.89    0.24 4.0    0.049 0.051  0.24
## C.3.7f    0.78    0.79    0.89    0.22 3.7    0.052 0.054  0.20
## C.3.8f    0.78    0.79    0.88    0.22 3.7    0.055 0.052  0.21
## C.3.9f    0.81    0.82    0.90    0.25 4.4    0.046 0.056  0.27
## C.3.10f   0.79    0.80    0.89    0.23 4.0    0.051 0.052  0.22
## C.3.11f   0.79    0.80    0.89    0.23 3.9    0.052 0.050  0.21
## C.3.12f   0.78    0.79    0.89    0.22 3.7    0.053 0.056  0.19
## C.3.13f   0.81    0.81    0.89    0.25 4.4    0.044 0.047  0.26
## C.3.14f   0.81    0.82    0.90    0.26 4.6    0.046 0.054  0.27
##
##  Item statistics
```

```
##      n raw.r std.r r.cor r.drop mean   sd
## C.3.1f  37  0.47  0.43  0.42   0.34  3.6 1.06
## C.3.2f  37  0.42  0.37  0.37   0.28  3.7 1.04
## C.3.3f  37  0.53  0.53  0.46   0.44  3.8 0.76
## C.3.4f  37  0.35  0.40  0.34   0.26  2.9 0.72
## C.3.5f  37  0.56  0.60  0.57   0.49  2.7 0.69
## C.3.6f  37  0.57  0.60  0.59   0.48  2.8 0.81
## C.3.7f  37  0.71  0.73  0.71   0.63  2.6 0.95
## C.3.8f  37  0.76  0.74  0.74   0.69  3.4 0.99
## C.3.9f  37  0.38  0.40  0.34   0.27  2.3 0.82
## C.3.10f 37  0.65  0.61  0.59   0.54  3.9 1.08
## C.3.11f 37  0.67  0.64  0.63   0.58  3.6 1.01
## C.3.12f 37  0.76  0.77  0.75   0.71  3.1 0.74
## C.3.13f 37  0.40  0.44  0.42   0.26  2.2 1.01
## C.3.14f 37  0.35  0.35  0.29   0.23  3.1 0.85
##
## Non-missing response frequency for each item
##       1    2    3    4    5 miss
## C.3.1f  0.00 0.16 0.30 0.27 0.27    0
## C.3.2f  0.00 0.14 0.30 0.27 0.30    0
## C.3.3f  0.00 0.03 0.30 0.49 0.19    0
## C.3.4f  0.00 0.27 0.57 0.14 0.03    0
## C.3.5f  0.00 0.41 0.46 0.14 0.00    0
## C.3.6f  0.03 0.32 0.49 0.14 0.03    0
## C.3.7f  0.05 0.51 0.22 0.19 0.03    0
## C.3.8f  0.03 0.16 0.27 0.43 0.11    0
## C.3.9f  0.14 0.49 0.30 0.08 0.00    0
## C.3.10f 0.03 0.08 0.24 0.30 0.35    0
## C.3.11f 0.03 0.14 0.16 0.51 0.16    0
## C.3.12f 0.03 0.14 0.54 0.30 0.00    0
## C.3.13f 0.27 0.46 0.11 0.16 0.00    0
## C.3.14f 0.03 0.22 0.46 0.27 0.03    0
##
```

```
##
## Reliability evaluation of block:  C.4i
##
## Reliability analysis
## Call: psych::alpha(x = x)
##
##   raw_alpha std.alpha G6(smc) average_r S/N   ase mean   sd
median_r
##     0.9    0.9    0.95    0.48 9.3 0.024  3.2 0.77     0.51
##
##  lower alpha upper     95% confidence boundaries
## 0.86 0.9 0.95
##
##  Reliability if an item is dropped:
##    raw_alpha std.alpha G6(smc) average_r  S/N alpha se var.r
med.r
## C.4.1i    0.91    0.91    0.95    0.54 10.4    0.023 0.018  0.52
## C.4.2i    0.89    0.89    0.94    0.47  7.8    0.027 0.037  0.48
## C.4.3i    0.89    0.89    0.93    0.47  7.9    0.028 0.035  0.51
## C.4.4i    0.89    0.89    0.93    0.47  8.1    0.027 0.031  0.51
## C.4.5i    0.89    0.89    0.94    0.47  8.1    0.027 0.033  0.51
## C.4.6i    0.89    0.89    0.93    0.47  7.9    0.028 0.032  0.48
## C.4.7i    0.89    0.90    0.93    0.49  8.6    0.026 0.029  0.51
## C.4.8i    0.89    0.89    0.93    0.47  8.1    0.027 0.031  0.50
## C.4.9i    0.89    0.89    0.94    0.48  8.2    0.026 0.035  0.51
## C.4.10i   0.90    0.90    0.94    0.49  8.6    0.025 0.036  0.52
##
##  Item statistics
##     n raw.r std.r r.cor r.drop mean   sd
## C.4.1i  37  0.43  0.46  0.39   0.33  3.5 0.90
## C.4.2i  37  0.79  0.81  0.79   0.75  4.0 0.80
## C.4.3i  37  0.81  0.80  0.79   0.74  3.3 1.20
## C.4.4i  37  0.77  0.76  0.76   0.70  3.4 1.06
```

```
## C.4.5i  37  0.77  0.77  0.75   0.70  3.5 1.12
## C.4.6i  37  0.80  0.79  0.79   0.73  3.2 1.17
## C.4.7i  37  0.70  0.70  0.68   0.63  3.1 0.97
## C.4.8i  37  0.77  0.77  0.77   0.71  2.9 1.05
## C.4.9i  37  0.75  0.75  0.73   0.68  2.9 1.00
## C.4.10i 37  0.70  0.70  0.67   0.61  2.8 1.16
##
## Non-missing response frequency for each item
##       1     2    3    4    5 miss
## C.4.1i  0.00 0.19 0.24 0.49 0.08    0
## C.4.2i  0.00 0.03 0.24 0.46 0.27    0
## C.4.3i  0.05 0.24 0.24 0.27 0.19    0
## C.4.4i  0.03 0.22 0.27 0.35 0.14    0
## C.4.5i  0.03 0.19 0.30 0.27 0.22    0
## C.4.6i  0.05 0.30 0.22 0.30 0.14    0
## C.4.7i  0.03 0.30 0.32 0.30 0.05    0
## C.4.8i  0.05 0.35 0.32 0.19 0.08    0
## C.4.9i  0.05 0.35 0.32 0.22 0.05    0
## C.4.10i 0.11 0.38 0.22 0.22 0.08    0
##
##
## Reliability evaluation of block:  C.4f
##
## Reliability analysis
## Call: psych::alpha(x = x)
##
##   raw_alpha std.alpha G6(smc) average_r S/N   ase mean  sd
median_r
##     0.9    0.9    0.94    0.49 9.5 0.024  2.5 0.6     0.52
##
##  lower alpha upper     95% confidence boundaries
## 0.85 0.9 0.95
##
```

```
##  Reliability if an item is dropped:
##    raw_alpha std.alpha G6(smc) average_r  S/N alpha se var.r
med.r
## C.4.1f    0.89    0.90    0.93    0.49  8.7    0.026 0.024  0.52
## C.4.2f    0.89    0.90    0.93    0.49  8.8    0.026 0.025  0.52
## C.4.3f    0.89    0.90    0.93    0.49  8.6    0.027 0.026  0.52
## C.4.4f    0.88    0.89    0.92    0.47  8.0    0.028 0.025  0.49
## C.4.5f    0.89    0.89    0.92    0.48  8.4    0.028 0.024  0.52
## C.4.6f    0.89    0.90    0.92    0.49  8.7    0.026 0.019  0.52
## C.4.7f    0.88    0.88    0.91    0.46  7.6    0.029 0.021  0.46
## C.4.8f    0.88    0.89    0.92    0.46  7.8    0.028 0.022  0.47
## C.4.9f    0.89    0.90    0.93    0.50  9.0    0.026 0.026  0.53
## C.4.10f   0.91    0.91    0.93    0.53 10.2    0.023 0.013  0.53
##
##  Item statistics
##      n raw.r std.r r.cor r.drop mean   sd
## C.4.1f  37  0.71  0.71  0.68   0.62  2.9 0.94
## C.4.2f  37  0.70  0.70  0.67   0.63  3.2 0.73
## C.4.3f  37  0.73  0.73  0.69   0.66  2.6 0.87
## C.4.4f  37  0.81  0.81  0.79   0.75  2.4 0.83
## C.4.5f  37  0.78  0.76  0.74   0.71  2.6 0.96
## C.4.6f  37  0.75  0.72  0.71   0.65  2.3 1.10
## C.4.7f  37  0.87  0.88  0.88   0.84  2.3 0.77
## C.4.8f  37  0.84  0.84  0.84   0.80  2.1 0.66
## C.4.9f  37  0.65  0.68  0.63   0.58  1.9 0.60
## C.4.10f 37  0.48  0.52  0.48   0.37  2.2 0.76
##
## Non-missing response frequency for each item
##       1     2    3    4    5 miss
## C.4.1f  0.03 0.32 0.38 0.22 0.05    0
## C.4.2f  0.00 0.16 0.54 0.27 0.03    0
## C.4.3f  0.08 0.41 0.41 0.08 0.03    0
## C.4.4f  0.08 0.54 0.30 0.05 0.03    0
```

```
## C.4.5f  0.05 0.51 0.27 0.11 0.05    0
## C.4.6f  0.24 0.41 0.22 0.08 0.05    0
## C.4.7f  0.08 0.68 0.14 0.11 0.00    0
## C.4.8f  0.11 0.73 0.11 0.05 0.00    0
## C.4.9f  0.22 0.65 0.14 0.00 0.00    0
## C.4.10f 0.16 0.46 0.35 0.03 0.00    0
##
##
## Reliability evaluation of block:  C.5i
##
## Reliability analysis
## Call: psych::alpha(x = x)
##
##   raw_alpha std.alpha G6(smc) average_r S/N   ase mean   sd
median_r
##    0.81    0.81    0.82    0.38 4.4 0.048  3.4 0.71     0.35
##
##  lower alpha upper     95% confidence boundaries
## 0.72 0.81 0.9
##
##  Reliability if an item is dropped:
##     raw_alpha std.alpha G6(smc) average_r S/N alpha se var.r
med.r
## C.5.1i    0.81    0.81    0.81    0.42 4.3    0.050 0.022  0.43
## C.5.2i    0.81    0.81    0.81    0.42 4.3    0.049 0.021  0.43
## C.5.3i    0.78    0.79    0.79    0.38 3.7    0.056 0.021  0.35
## C.5.4i    0.76    0.77    0.76    0.35 3.3    0.061 0.015  0.33
## C.5.5i    0.76    0.77    0.76    0.35 3.3    0.060 0.017  0.33
## C.5.6i    0.76    0.77    0.76    0.35 3.3    0.060 0.015  0.33
## C.5.7i    0.80    0.81    0.81    0.41 4.2    0.051 0.021  0.35
##
##  Item statistics
##    n raw.r std.r r.cor r.drop mean   sd
```

```
## C.5.1i 37  0.59  0.59  0.48   0.43  4.1 1.06
## C.5.2i 37  0.59  0.58  0.47   0.42  3.1 1.10
## C.5.3i 37  0.69  0.70  0.63   0.56  3.2 1.04
## C.5.4i 37  0.78  0.78  0.76   0.67  3.1 1.08
## C.5.5i 37  0.77  0.78  0.75   0.67  3.4 0.95
## C.5.6i 37  0.77  0.78  0.76   0.67  2.9 0.97
## C.5.7i 37  0.61  0.61  0.50   0.45  4.2 1.05
##
## Non-missing response frequency for each item
##      1    2    3    4    5 miss
## C.5.1i 0.00 0.11 0.16 0.22 0.51    0
## C.5.2i 0.03 0.32 0.30 0.22 0.14    0
## C.5.3i 0.03 0.22 0.49 0.11 0.16    0
## C.5.4i 0.08 0.24 0.27 0.35 0.05    0
## C.5.5i 0.00 0.22 0.30 0.38 0.11    0
## C.5.6i 0.03 0.35 0.32 0.24 0.05    0
## C.5.7i 0.03 0.03 0.22 0.19 0.54    0
##
##
## Reliability evaluation of block:  C.5f
##
## Reliability analysis
## Call: psych::alpha(x = x)
##
##   raw_alpha std.alpha G6(smc) average_r S/N   ase mean   sd
median_r
##    0.66    0.71    0.77    0.26 2.4 0.089  2.6 0.49     0.27
##
##  lower alpha upper     95% confidence boundaries
## 0.48 0.66 0.83
##
##  Reliability if an item is dropped:
##     raw_alpha std.alpha G6(smc) average_r S/N alpha se var.r
```

```
med.r
## C.5.1f    0.63    0.71    0.74    0.29 2.5    0.099 0.064  0.34
## C.5.2f    0.56    0.61    0.68    0.21 1.5    0.115 0.061  0.16
## C.5.3f    0.64    0.69    0.76    0.27 2.3    0.096 0.073  0.27
## C.5.4f    0.61    0.66    0.71    0.24 1.9    0.101 0.058  0.27
## C.5.5f    0.58    0.63    0.70    0.22 1.7    0.108 0.060  0.17
## C.5.6f    0.63    0.67    0.71    0.25 2.0    0.096 0.042  0.17
## C.5.7f    0.71    0.75    0.76    0.33 2.9    0.076 0.042  0.34
##
##  Item statistics
##    n raw.r std.r r.cor r.drop mean   sd
## C.5.1f 37  0.61  0.49  0.38   0.36  3.7 1.02
## C.5.2f 37  0.74  0.79  0.77   0.62  2.0 0.73
## C.5.3f 37  0.49  0.55  0.42   0.31  2.5 0.69
## C.5.4f 37  0.61  0.67  0.61   0.42  1.6 0.83
## C.5.5f 37  0.68  0.74  0.69   0.53  2.5 0.73
## C.5.6f 37  0.50  0.63  0.59   0.36  1.7 0.56
## C.5.7f 37  0.52  0.35  0.23   0.19  3.9 1.21
##
## Non-missing response frequency for each item
##      1    2    3    4    5 miss
## C.5.1f 0.00 0.14 0.30 0.30 0.27    0
## C.5.2f 0.19 0.65 0.11 0.05 0.00    0
## C.5.3f 0.03 0.54 0.41 0.00 0.03    0
## C.5.4f 0.54 0.35 0.05 0.05 0.00    0
## C.5.5f 0.03 0.51 0.41 0.03 0.03    0
## C.5.6f 0.32 0.62 0.05 0.00 0.00    0
## C.5.7f 0.05 0.11 0.14 0.32 0.38    0
##
##
## Reliability evaluation of block:  C.6i
##
## Reliability analysis
```

```
## Call: psych::alpha(x = x)
##
##   raw_alpha std.alpha G6(smc) average_r S/N   ase mean   sd
median_r
##    0.86    0.86    0.88    0.47 6.2 0.034  3.4 0.74     0.52
##
##  lower alpha upper     95% confidence boundaries
## 0.79 0.86 0.93
##
##  Reliability if an item is dropped:
##     raw_alpha std.alpha G6(smc) average_r S/N alpha se  var.r
med.r
## C.6.1i    0.83    0.83    0.85    0.45 4.9    0.043 0.0370  0.46
## C.6.2i    0.82    0.82    0.83    0.43 4.6    0.045 0.0326  0.46
## C.6.3i    0.83    0.83    0.83    0.45 4.9    0.042 0.0299  0.47
## C.6.4i    0.85    0.85    0.86    0.48 5.5    0.039 0.0405  0.55
## C.6.5i    0.89    0.89    0.89    0.57 8.0    0.029 0.0082  0.56
## C.6.6i    0.83    0.83    0.84    0.45 4.9    0.042 0.0459  0.52
## C.6.7i    0.84    0.84    0.86    0.47 5.3    0.040 0.0415  0.55
##
##  Item statistics
##    n raw.r std.r r.cor r.drop mean   sd
## C.6.1i 37  0.81  0.81  0.77   0.72  3.4 1.09
## C.6.2i 37  0.85  0.85  0.84   0.78  3.4 0.98
## C.6.3i 37  0.79  0.80  0.79   0.71  3.3 0.94
## C.6.4i 37  0.72  0.72  0.66   0.61  3.1 0.98
## C.6.5i 37  0.45  0.45  0.33   0.28  3.4 0.98
## C.6.6i 37  0.80  0.80  0.76   0.71  3.6 1.09
## C.6.7i 37  0.74  0.75  0.69   0.64  3.3 0.90
##
## Non-missing response frequency for each item
##      1    2    3    4    5 miss
## C.6.1i 0.03 0.24 0.22 0.38 0.14    0
```

```
## C.6.2i 0.00 0.24 0.22 0.43 0.11    0
## C.6.3i 0.00 0.22 0.38 0.30 0.11    0
## C.6.4i 0.03 0.22 0.46 0.19 0.11    0
## C.6.5i 0.00 0.19 0.43 0.22 0.16    0
## C.6.6i 0.03 0.11 0.32 0.27 0.27    0
## C.6.7i 0.00 0.22 0.38 0.32 0.08    0
##
##
## Reliability evaluation of block:  C.6f
##
## Reliability analysis
## Call: psych::alpha(x = x)
##
##   raw_alpha std.alpha G6(smc) average_r S/N   ase mean   sd
median_r
##    0.82    0.85    0.86    0.44 5.6 0.046  2.6 0.64     0.41
##
##  lower alpha upper     95% confidence boundaries
## 0.73 0.82 0.91
##
##  Reliability if an item is dropped:
##     raw_alpha std.alpha G6(smc) average_r S/N alpha se var.r
med.r
## C.6.1f    0.78    0.81    0.81    0.42 4.3    0.057 0.022  0.32
## C.6.2f    0.78    0.80    0.80    0.40 4.1    0.058 0.023  0.32
## C.6.3f    0.79    0.82    0.82    0.42 4.4    0.057 0.029  0.40
## C.6.4f    0.79    0.82    0.83    0.43 4.6    0.056 0.033  0.40
## C.6.5f    0.86    0.86    0.87    0.51 6.3    0.038 0.021  0.56
## C.6.6f    0.82    0.85    0.86    0.49 5.7    0.048 0.032  0.56
## C.6.7f    0.79    0.82    0.83    0.44 4.6    0.055 0.028  0.40
##
##  Item statistics
##    n raw.r std.r r.cor r.drop mean   sd
```

```
## C.6.1f 37  0.78  0.81  0.80   0.69  2.6 0.83
## C.6.2f 37  0.82  0.84  0.85   0.75  2.3 0.75
## C.6.3f 37  0.76  0.78  0.76   0.67  2.2 0.83
## C.6.4f 37  0.74  0.76  0.70   0.64  2.2 0.83
## C.6.5f 37  0.59  0.52  0.39   0.36  3.0 1.27
## C.6.6f 37  0.62  0.60  0.48   0.45  3.4 0.99
## C.6.7f 37  0.73  0.75  0.71   0.62  2.7 0.87
##
## Non-missing response frequency for each item
##      1    2    3    4    5 miss
## C.6.1f 0.03 0.51 0.38 0.03 0.05    0
## C.6.2f 0.03 0.73 0.16 0.05 0.03    0
## C.6.3f 0.14 0.57 0.24 0.03 0.03    0
## C.6.4f 0.16 0.51 0.24 0.08 0.00    0
## C.6.5f 0.11 0.30 0.24 0.19 0.16    0
## C.6.6f 0.05 0.11 0.27 0.49 0.08    0
## C.6.7f 0.05 0.35 0.43 0.14 0.03    0
```