THE INFLUENCE OF USING MOBILE TECHNOLOGIES DURING PROJECT EXECUTION ON PERCEIVED MANAGERIAL COMPETENCIES OF EMERGING CONSTRUCTION FIRM OWNERS/ MANAGERS IN THE FREE STATE PROVINCE

By

THABO JAMES LESEBO

MASTER'S IN MANAGEMENT SCIENCES

Specialising in

BUSINESS ADMINISTRATION

In the

Faculty of Management Sciences

CENTRAL UNIVERSITY OF TECHNOLOGY, FREE STATE

Promoter: Professor Patient Rambe

October 2022

DECLARATION

I, Thabo James Lesebo, student number _____, do hereby declare that this research project submitted to the Central University of Technology, Free State, for the degree of Masters in Management Sciences specialising in Business Administration, is my own independent work and it complies with the Code of Academic Integrity, as well as other relevant policies, procedures, rules and regulations of the Central University of Technology, Free State; and has not been submitted before to any institution by myself or any other person in fulfilment (or partial fulfilment) of the requirements for the attainment of any qualification.

Signature of Student

20 October 2022

Date

ACKNOWLEDGEMENTS

Jehova, Ke U Tšepile.

What shall I render to you, **Abba Father? Baruk atah Yahuah Tseva'oth**, for the strength, wisdom, guidance, and knowledge that you have granted me to complete this study.

To my precious wife, **Rethabile Lesebo – Panana,** your faith in me has brought us this far. For your unfailing support and prayers, I am grateful for taking care of our family's affairs during the winter of our lives. I will always remember that "... *love breeds courage, sets us free, and brings us closer to the things we once feared."* To my sister and prayer partner, **Nkaiseng Khooe**, you are God-sent! To my mother, **Pulane Lesebo**, and my brother, **Thato Lesebo**, I cannot thank you enough for your support and prayers. To **Mocumi** and **Bogolo Motse**, **Advocate Emily Zim** and **Dr Helen Motloung,** thank you for taking care of my family and sharing your life with us.

To my supervisor, **Professor Patient Rambe**, I am eternally grateful for the unwavering assistance, encouragement, contribution, constructive criticism, and the time invested in supervising my study. This journey would not have been possible without your guidance. *Dai Musiki wedenga nepasi akuropafadzayi, ndatenda Mufasa*!

To the respondents, research assistants, statistician, and language editor who gave my work shape and meaning, you played a significant role in this study and assisted in achieving this dream.

I also wish to extend a special thanks to the Central University of Technology, Free State, for the financial assistance offered to me throughout my studies.

Finally, to all my friends and everyone who assisted in one way or the other in making this study a success, thank you all and God bless you.

"BOKANG MOLIMO OA KHANYA – SELI LA HAE KE LE FAHLANG JOALOKA LEHAKOE"

DEDICATION

I dedicate this thesis to my daughters, Kganya-YaModimo and Lehakoe.

“Whatever your dream is, put it into action and you will achieve it.” ~ Daddy

In loving memory of my grandmother
Maleqhoa Annah Mokati
(June 1934 – May 2021)

ABSTRACT

The exponential growth in the utilisation of mobile technologies (MTs) for cost reduction and improving organisational efficiency is widely acknowledged in entrepreneurship literature. Despite this promise, the exact effect of MTs on the managerial competencies of small, micro, and medium enterprises is yet to be fully comprehended by emerging construction firms (ECFs). To address this gap, the current study drew on a quantitative approach and survey conducted on 252 emerging construction firms' owners/managers in the Free State province of South Africa to establish how mobile technology adoption during project execution impacted the perceived managerial competencies (MCs) of these entrepreneurs.

The results indicate that the adoption of MTs during project execution has a positive and statistically significant effect on the communicative and social competencies of ECF owners and managers, with MT adoption during project execution explaining 65.1% of the variance of communicative competencies and 71.2% of social competencies. The results further demonstrate that the type of device used (laptops and tablets) used moderated the strength of the MT adoption-MC relationship. The study recommends the wider rollout of other mobile technologies to improve managerial competencies in ways that optimise the efficiency of project-related operations. The study contributes to the broad project management theory and literature, especially project execution, by exploring how mobile technology adoption facilitates enhanced communication and social competencies that improve organisational efficiency of ECFs.

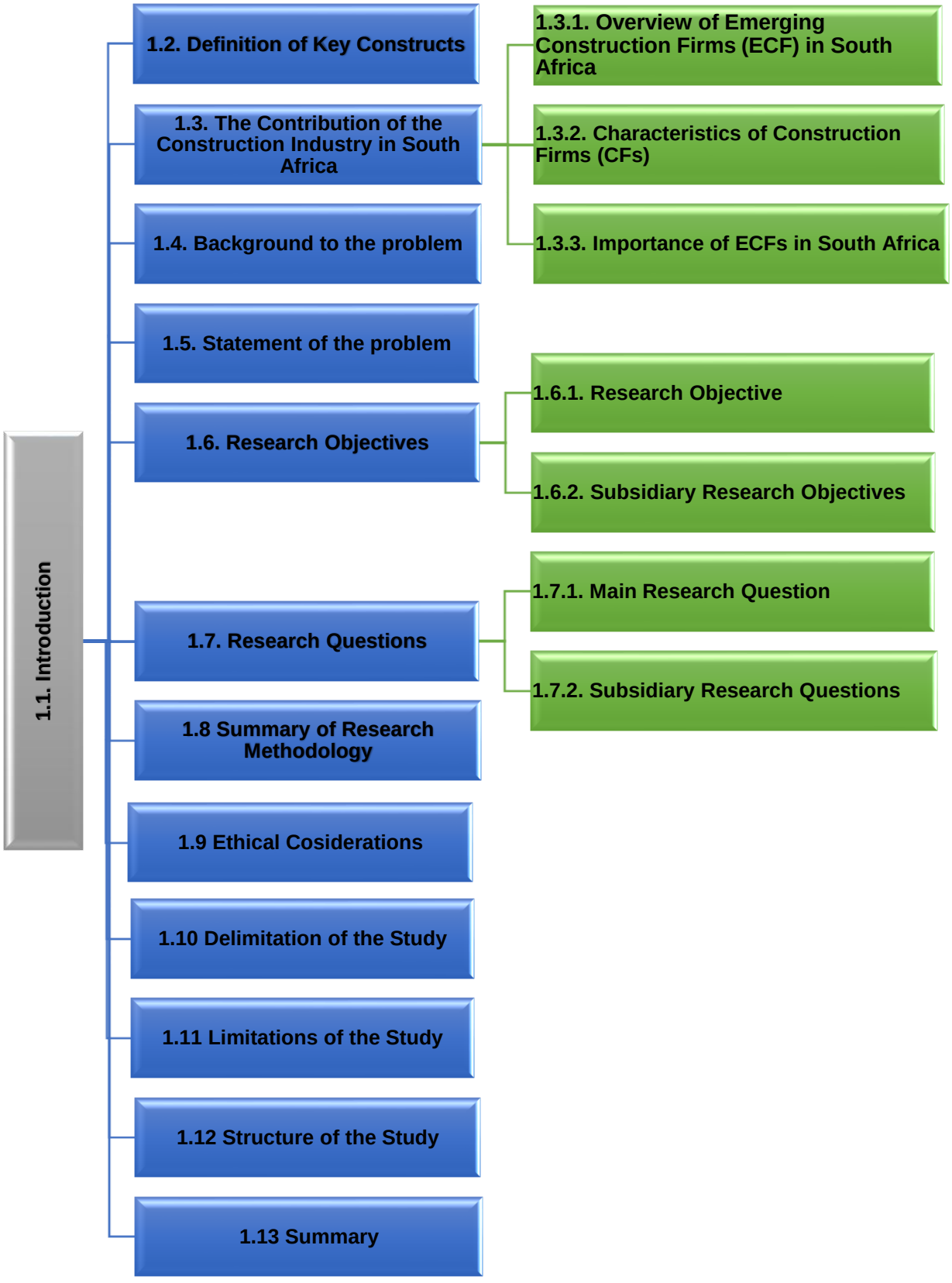
TABLE OF CONTENTS

LIST OF TABLES

TABLE OF FIGURES

CHAPTER 1

ORIENTATION TO THE STUDY



1.1. INTRODUCTION

Emerging construction firms (ECFs), as a subset of small, micro, and medium enterprises (SMMEs), contribute to the economic growth of most developing countries. Statistics South Africa (Stats-SA) (2016) reported that the contribution of the construction industry, in total value added in 2014 was 4.1% of GDP. Furthermore, the same report by Stats-SA (2016) shows that SMMEs in the construction industry are significant contributors to job creation, creating 62.7% of all employment opportunities in the construction industry in the year 2014.

These statistics illustrate that the SMMEs in construction are labour-intensive and currently employ more people than large enterprises in the industry. Given the highly technical nature of their activities, ECFs are expected to be at the cutting edge of technology to simplify the complexities of their daily business operations and project-related business. The central proposition of the current study is, therefore, to investigate the influence of using mobile technologies during project execution on perceived managerial competencies of these ECFs. Furthermore, in terms of managerial competencies, the underlying premise associated with the use of mobile technologies in organisations is that encourages managers and leaders to adopt different approaches in their daily practice of managing organisations and business operations.

This chapter provides a general overview of the study, including the definition of key concepts, the research problem and its setting, the research objectives and questions, an outline of the research methodology employed, ethical issues related to the study, the delimitation of the current study and its limitations, and finally the structure of the study.

1.2. DEFINITION OF KEY CONCEPTS

This section defines key terms that are extensively used in this study to develop a shared understanding of such terms. The definition of these terms also contributes to a reduction of misconceptions that may arise from the application of such terms in the current study. For the purpose of brevity, mobile technologies, project execution, and perceived managerial competencies are defined in subsequent sections of this study.

1.2.1. Mobile technologies

Mobile technologies are an expansive set that includes all internet-enabled devices, protocols, and infrastructures that provide a user with diverse protocols to communicate, interact, and exchange data with an individual or system anywhere and at any time, albeit in a variety of formats or on a more limited or constrained basis (Xiaojun, Junichi & Sho, 2004; Lau, 2018).

1.2.2. Project execution

Project Execution is the third phase of a project life cycle, and it is considered the stage in which the project deliverables outlined in the project management plan are developed and completed (Larson & Gray, 2017; Project Management Institute (PMI), 2017). The objective of project execution is to deliver what was promised in the project requirements phase.

1.2.3. Perceived managerial competencies

Managerial competencies are "sets of knowledge, skills, behaviours, and attitudes that can contribute to the personal effectiveness of managers/owners of small businesses" (Hellriegel, Jackson, Solcum & Staude, 2008; Makhalemele, 2016:40; Rambe, 2018). Managerial competencies are also core abilities necessary for the achievement of tasks, advancement in a career, and so-called meta-competencies (Dowling, 2003). Even though the construct of managerial competencies is accepted as useful in examining the personal effectiveness of managers, not all competency models have been investigated by researchers; some aspects have actually only been examined qualitatively (Chang, Moorman & Morgan, 2006, Rambe 2018). Therefore, in this study, the terms "perceived managerial competencies" and "managerial competencies" are used interchangeably throughout the discussion.

1.3. THE CONTRIBUTION OF THE CONSTRUCTION INDUSTRY IN SOUTH AFRICA

The construction industry plays an important role in the economy of South Africa; the 2018/2019 Government Budget shows that close to R50 billion is earmarked for infrastructure-related spending (Ncwadi & Dangalazan, 2006; Ramokolo &

Smallwood, 2008; Construction Industry Development Board (CIDB), 2012; Price Waterhouse Coopers (PwC), 2019). According to Lekula (2019), PwC (2019) and the Stats-SA's Quarterly Labour Force Survey report (2019). The execution of these projects could deal with unemployment. It is also worth noting that the abovementioned important contributions of the sector underpin the government's empowerment policy of the previously disadvantaged population groups via the construction industry (Stats-SA, 2019c:4; Stats-SA, 2019e). The emerging construction firms that form part of these previously disadvantaged population groups are an important part of this empowerment policy. The study explores these emerging construction firms in the next subsection.

1.3.1. Overview of Emerging Construction Firms (ECF) in South Africa

As alluded to previously, emerging construction firms (ECFs) are a subset of small, micro, and medium enterprises (SMMEs) that contribute to the economic growth of South Africa. The government's effort to economically empower individuals from previously disadvantaged groups led to the establishment and formalisation of the ECF programme (Timmons & Spinelli, 2007; Katz & Green, 2013; Kuratko, 2016). The aim of the programme is to assist and support individuals from formerly disadvantaged groups to establish and manage small businesses. ECFs are mainly formed and operated by previously disadvantaged population groups, consisting of blacks, coloured, Indians, women, and the disabled (Preferential Procurement Policy Framework Act, 2000 [PPPF Act] 5 of 2000; Broad-Based Black Economic Empowerment Act, 2013 [BBBEE Act] 46 of 2013). These population groups were discriminated against with regard access to education during the apartheid era. This post-democratic preference is in line with helping them create, grow, and manage sustainable small businesses (Thwala & Phaladi, 2009). The owners of such businesses are referred to as "Emerging Contractors" (ECs), and their business format is defined within the small business category. The term "ECFs" is used to refer to small businesses in the construction industry that are established, owned, and managed by individuals from previously disadvantaged backgrounds. It is also called small businesses in South Africa ([NBS Act] 102 of 1996; CIDB, 2012).

The mandate of the CIDB is to develop, grow and promote the construction industry in South Africa (CIDB Act 38 of 2000). The government is convinced that the industry can economically empower individuals from previously disadvantaged groups. CIDB has categorised construction firms according to specific characteristics to allow for easy identification and management. For a small business to be classified under the ECF category and benefit from government support and assistance such as PPP, the small business must exhibit certain prescribed attributes. The characteristics are discussed in the subsequent section.

1.3.2. Characteristics of construction firms (CFs)

The CIDB was established by the government with a mandate to develop and grow the construction industry. CIDB's role is to control the activities of all players in the construction sector, no matter the size of the player (CIDB Act 38 of 2000; CIDB, 2017a). Most of the ECFs fall within Grades 1 to 6 since most of the activities are at the local or regional levels. ECFs falling within these grades (see Table 1.1) can undertake projects in either the General Building (GB) or Civil Engineering (CE) class of work.

Table 1.1: Construction Contractor Classification Criteria in South Africa

Grades	Maximum Contract Value	Largest Contract Completed in 5 Years	Characteristics
9	No Limit	R 90 000 000	Operates at national and international levels
8	R 130 000 000	R 30 000 000	Operates at provincial and regional levels
7	R 40 000 000	R 9 000 000	Operates at provincial and regional levels
6	R 13 000 000	R 3 000 000	Operates at local and regional levels
5	R 6 500 000	R 1 500 000	Operates at local and regional levels
4	R 4 000 000	R 900 000	Operates at local levels
3	R 2 000 000	R 450 000	Operates at local levels
2	R 650 000	R 130 000	Operates at local levels
1	R 200 000	No Requirements	Operates at local levels

Source: CIDB Study of Grade 1 Contractors Report, 2017

1.3.3. Importance of ECFs in South Africa

The importance of empowering ECFs is that they can work in remote locations of the country, and their services are offered at lower costs (CIDB, 2012). The empowerment of ECFs could also serve as a tool to promote entrepreneurship within the communities in which they operate, whereby 88.6% of the total population that is unskilled falls under the Black Africans and the Coloured population groups (Stats-SA, 2012:8). The ECFs programme strives to enable the government to integrate most of the unskilled population into the main economy.

The national unemployment rate, according to Statistics South Africa (2014), was 24.3% in the last quarter of 2014. The rate of unemployment in Free State, the study's

area of interest, was the highest at 32.2%. The rising unemployment rate leads to other serious problems, such as crime and poverty. Furthermore, Ramorena (2016) contends that ECFs are the only means of curbing an increase in unemployment. The overall TEA of the Free State was 9, compared with 30 in Gauteng, 17 in KwaZulu-Natal, 15 in the Western Cape, and 10 in Limpopo. These statistics are a cause for concern to the economy of the Free State and the continued survival of ECFs in the province.

1.4. BACKGROUND TO THE PROBLEM

With the increased use of mobile technologies, organisations of all types are utilising mobile technologies around the globe, not only for the purpose of cutting costs and improving organisational efficiency, but to provide better services. It can thus be argued that the role of mobile technology has become important in facilitating their business operations and processes (Almgren, 2014). Despite the increasing recognition of mobiles as critical drivers of organisational processes, including those in the construction sector, the performance of ECFs continues to be of concern to key role players and government agencies. For instance, the low managerial competencies of owners and managers negatively affect the performance of ECFs, which often leads to some leaving the construction industry (Zulu, 2014; Construction Industry Development Board (CIDB), 2017b).

To further advance this argument of ECFs being at the cutting edge of technology use, Akaba, Rambe & Agbobli (2016) suggest that, as entrepreneurial business ventures whose business success depends on the implementation of an appropriate strategy for effective project execution, they could consider the use of relevant and inexpensive technologies. A recent study conducted in the United Kingdom by Eadie, Browne, Odeyinka, McKeown & McNiff (2013) suggests that the implementation of Building Information Modelling (BIM) in the project lifecycle has substantial impacts, such as long-term financial benefits for organisations. Kim, Park, Lim & Kim's (2013) study conducted on Korean firms suggests that mobile computing technology embodied in smartphones can be used to streamline on-site construction management (Park & Kim, 2014). In spite of this evidence and the aforementioned low managerial competencies of South African ECF owners and managers, no systematic study has

been conducted to ascertain the contribution of mobile technology adoption to the enhancement of ECF owners' and managers' managerial competencies.

Other recent scholarly studies in both South Africa, New Zealand and India, such as those of Rambe & Bere (2013); Ng'ambi & Bozalek (2015); Bozalek, Gachago & Watters (2015); Cochran, Narayan & Oldfield (2015) and Uddin, Biswas, Adhikary, Ali, Alam, Palit, Uddin, Uddin, Khatun & Bhuiya (2017), have considered the application of mobile technologies in enhancing authentic learning at universities and for health improvement. The current study extends this body of research by exploring the extent to which adopting mobile technology during project execution could improve the managerial competencies of ECF owners and managers.

1.5. STATEMENT OF THE PROBLEM

Since a project is temporary in nature (PMI, 2017), its success is influenced by how well it is executed. In the contemporary business world, where ECFs are often faced with the challenge of coordinating resources (financial, information, and skills) as well as integrating project activities to produce successful projects, the communicative and organisational capabilities of mobile phones cannot be underestimated. Yet Ghobakhloo and Tang (2015) suggest that due to severe limitations of resources, SMMEs rely on and use an informal, dynamic decision-making process. It can be argued that the interactive and trans-active affordances of mobile technologies could be integral to and facilitate such decision-making if integrated into the project execution processes of ECFs. Therefore, tapping into such technologies during project execution cannot be a trivial matter. Yet there are deficiencies in studies that have examined the extent to which the adoption of mobile technologies influences the perceived managerial competencies of ECF owners and managers. For instance, some of these studies tended to emphasise the affordances of these technologies while neglecting their impact on competencies (Evans, Pearce, Vitak & Treem, 2016; Koutamanis, 2023). Alternatively, some researches have concentrated on the managerial competencies of such entrepreneurs but have largely ignored the role of technologies in the process of competency development (Iyer & Banerjee, 2016; Nyandongo & Davids, 2017).

The implications of not adopting mobile technologies at all by the ECFs during project execution may lead to inefficient communication and collaboration among team members, which can result in delays, errors, and increased costs (Nyandongo & Davids, 2017). In addition, it may lead to missed opportunities for real-time data collection and analysis, which can impact decision-making processes and overall project outcomes. And, for managerial competencies, this means underdevelopment of skills that could affect firm competitiveness in terms of meeting customer expectations and satisfaction.

If the execution of a project and its outcomes depend on, inter alia, the managerial competencies of managers (Kurowska-Pysz, 2014), the deployment of ubiquitous resources such as mobiles during project execution may contribute to improvements in the managerial competencies of owners and managers (Geoghegan & Dulewicz, 2008; Iyer & Banerjee, 2016). Yet the relationship between mobile adoption during project execution and the perceived managerial competencies (i.e., self-perceptions of such competencies) of ECF owner/managers remains speculative and subject to multiple permutations.

According to Larson and Gray (2017), the governance (applying a set of knowledge, skills, tools and techniques) of all processes and practices should be distributed across business operations and an organisation to achieve its strategic goals and improve project management. This raises important questions about the role of communicative technologies such as mobile phones regarding the coordination of governance processes which are integral to effective project execution.

A study conducted by Doloi (2013) demonstrates that a lack of the required technical support and competency among key stakeholders (i.e., the contractors, project managers and owners) potentially leads to failure in delivering modern projects. This view is supported by the Construction Industry Development Board (CIDB) Report (2017b), which highlights that there is a strong correlation between the project manager/contractor's having construction-related competencies and the manager/contractor's survival and development. As the project execution process is increasingly saturated with mobile technologies (tools, applications, platforms), sources that could be critical to the project execution, one wonders about the exact

influence of adopting such technology on the aforementioned competencies, including managerial competencies.

1.6. RESEARCH OBJECTIVES

The aim and subsidiary research objectives of this study are indicated below.

1.6.1. Research Aim

The aim of this study is to contribute to the theory and practice of competency development by exploring the extent to which the use of mobile technologies during project execution affects the managerial competencies of owner/ project managers of emerging construction firms (ECFs).

1.6.2. Subsidiary Research Objectives

The subsidiary objectives of the study are designed to:

1. Determine the nature of mobile technologies most appropriated by ECFs in the Free State.
2. Explore the range of soft technologies (e.g., mobile applications) most appropriated by ECFs in the Free State.
3. Clarify how the mobile technologies are integrated into the project execution processes of their businesses.
4. Ascertain how the adoption of such technologies has affected the managerial competencies, especially communicative competencies, of these owner/managers.
5. Assess the extent to which the adoption of such technologies affects the managerial and social competencies of these owner/managers.
6. Identify which managerial competencies (social or communicative competencies) are more influenced by ECF adoption of mobile communication technologies and the extent of such influence.
7. Proffer some recommendations on the nature and character of an effective mobile technology-mediated approach that optimises the managerial competencies of ECFs.

1.7. RESEARCH QUESTIONS

The study seeks to examine the main research question and subsidiary research questions as indicated below.

1.7.1. Main Research Question

What is the influence of the use of mobile technologies during project execution on the managerial competencies of owner/managers of Emerging Construction Firms?

1.7.2. Subsidiary Research Questions

The subsidiary research questions are:

1. What is the nature of mobile technologies most appropriated by ECFs in the Free State?
2. What is the range of soft technologies (e.g., mobile applications) most appropriated by ECFs in the Free State?
3. How are these mobile technologies integrated into the project execution processes of their businesses?
4. How has the adoption of such technologies affected the perceived managerial competencies especially communicative competencies of these owner/managers?
5. What is the extent to which the adoption of such technologies affects the perceived managerial and social competencies of these owner/managers?
6. Which managerial competencies (social or communicative competencies) are influenced more by ECF's adoption of mobile communication technologies and what is the extent of such influence?
7. What recommendations could be proffered on the nature and character of an effective mobile technology-mediated approach to optimise the managerial competencies of owner/managers of ECFs?

1.8. RESEARCH METHODOLOGY

The study adopts a positivist epistemological position and draws on a quantitative approach to data collection and analysis. Creswell and Creswell (2018) argue that positivism is anchored on the view that knowledge should be based on the experience of the senses, which can only be obtained by observation and experiment. Thus, a

positivist epistemology was conceived as ideal for the researcher to remain independent and take the role of an objective analyst (Blumberg, Cooper & Schindler, 2014), to determine and predict the influence of mobile technology use during project execution on perceived managerial competencies (i.e., owners' and managers' self-constructions of their competencies) of ECFs.

A cross-sectional survey research design, which sought to gather data from a single point in time, was adopted. The survey was also descriptive and exploratory. It sought to describe the situation relating to the adoption of mobile technologies by emerging construction firms. It is also exploratory as this topic has not been fully researched upon and the researcher could not determine in advance what to expect regarding the outcomes of this investigation (Kumar, 2019). As a result, an in-depth structured questionnaire, which consists of closed-ended questions, whose purpose was to gain ECF owners' and managers' perspectives and views on the influence of the use of mobile technologies during project execution on perceived managerial competencies (Delport & Roestenburg, 2011), was used. The rest of the methodological processes adopted for this study are discussed in the methodology chapter.

1.9. ETHICAL CONSIDERATIONS

Ethics comprises the norms or standards of behaviour that guide the moral choices of people in relationships with other people (Cooper & Schindler, 2011; Kumar, 2019). In research, a balance has to be struck between the pursuit of scientific knowledge, which could be beneficial to society, and the rights of those studied; no harm should come to anybody involved in the research activities and no one must be coerced to participate; the purpose and benefits of the study must be explained to the respondents; participant rights must be communicated to them; and informed consent of participants must be obtained (Neuman, 2011; Kumar, 2019). In addition, voluntary participation is a key ethical issue in social research (Andres, 2012; Kumar, 2019). Efforts were made to ensure voluntary participation in this research (see Section 3.10).

1.10 DELIMITATION OF THE STUDY

The study only focuses on CIBD registered ECFs in Xhariep, Thabo Mofutsanyane, and Fezile Dabi, Lejweleputswa District Municipalities, and Mangaung Metropolitan

Area – which are the five districts of the Free State province. As such, the extent of generalisation to the entire population of Free State province is limited.

1.11 LIMITATIONS OF THE STUDY

This study was restricted to registered CIDB ECFs only in the Free State Province. The choice of random samples can, therefore, improve representativeness and, thus, generalisability. The researcher relied on trained research assistants to deliver and administer questionnaires. This can be a limitation as the researchers might have influenced participants in some way. A detailed discussion of the limitations of this study is in section 5.6 of this dissertation.

1.12 STRUCTURE OF THE STUDY

Chapter One: This introductory chapter provides the orientation of the study. It covers, inter alia, the problem statement, research questions, aims and objectives of the study.

Chapter Two: It reviews the literature on mobile technologies and managerial competencies and how these two constructs relate to project execution in the project-related operations of emerging construction firms.

Chapter Three: This chapter outlines the research methodology applied in the study.

Chapter Four: This chapter is dedicated to the presentation, interpretation, and discussion of the results of the study.

Chapter Five: Presents the conclusions and recommendations for practice, policy, and directions for further research.

1.13 SUMMARY

The first chapter provided a context for the study, an overview of the emerging construction firms and their contribution to the South African construction industry, and research objectives and questions formulated for the study. It also outlined a summary of the research methodology, ethical considerations, study delimitations, limitations of the study, and the structure of the dissertation.

CHAPTER 2

MOBILE TECHNOLOGIES, PROJECT EXECUTION PHASE AND MANAGERIAL COMPETENCIES

2.1. INTRODUCTION

The previous chapter, the orientation to the study, outlined preliminaries such as definition of key constructs, contribution of the South African construction industry to the gross domestic product, background to the specific research statement of the research problem, research objectives and questions, and a summary of the proposed research methodology, ethical considerations, and structure of the study. The second chapter builds on the previous chapter by reviewing literature on mobile technologies (MTs) and perceived managerial competencies (PMCs) to provide a broad understanding of how MTs could be harnessed to support the project execution of project-related operations in ways that ultimately influence the managerial competencies of the owners/managers of emerging construction firms (ECFs).

The chapter covers conceptualisations (including definitions) and constitution of constructs, perspectives, theories, relationships and studies on MTs and PMC. The intention is to capture the theorisation as well as the practical application of each construct, thereby reconciling the structural framing of constructs with their application in real contexts. First, the chapter defines the nature of mobile technologies and categorisation and range of mobile technologies relevant to this study. Next, the integration of MTs into project operations is discussed where project execution is assessed in the context of adoption of MTs. Subsequently, the review focuses on the theoretical perspectives surrounding mobile technologies and the appropriated mobile technologies in the construction industry, especially ECFs.

The last segment of this chapter discusses the emerging relationship between the adoption of mobile technology during project execution and managerial competencies. In addition, the study focuses on perceived managerial competencies and the models relevant to the study, and then proffers a proposed conceptual framework. The chapter closes with a summary.

2.2. DEFINITION OF MOBILE TECHNOLOGIES

Mobile technology is defined as any internet-enabled device that is accessible from anywhere the user is (Lau, 2018). Bolat (2015) defines it as an alternative way to interact with a traditional website, albeit in a different format or on a more limited or

constrained basis. This definition, though useful for presenting alternative ways through which mobiles interact with other collaborative spaces, fails to accommodate other spaces that mobiles can co-create and share knowledge with such as social media platforms and chat-based applications.

Xiaojun, Junichi and Sho (2004) provide a more comprehensive definition of mobile technology as an expansive set that includes all devices, protocols and infrastructures that allow one to communicate, interact and exchange data with an individual or system anywhere and anytime (Xiaojun et al., 2004). This study adopts the definition of Mobile Technologies (MTs) as an expansive set that includes all internet-enabled gadgets, connection services or processes, and infrastructures that provide a user with diverse ways to communicate, interact, and exchange data with an individual or system anywhere and at any time, albeit in a variety of formats or on a more limited or constrained basis (Xiaojun et al., 2004; Lau, 2018). This more comprehensive description of mobile technology accounts for the product (i.e., gadget), the service provided, and the mechanisms through which that service is provided.

2.2.1. The nature of mobile technologies

To conceptualise mobile technology precisely, the underpinning concepts and fundamental nature of mobile technology – in terms of **capabilities, technical features and, most importantly, benefits and opportunities** which it enables must be understood (Bolat, 2015). This view is supported by literature that argues that the form *separating the concept of mobile technology capabilities from its underlying technologies is fundamental to realising stable conceptualisation* (Balasubramanian, Peterson & Jarvenpaa, 2002: 39; Lau, 2018). The separation of mobile capabilities from the technologies themselves saves this conceptualisation from the volatility of technological changes that often unfolds in a short time (Balasubramanian et al., 2002). The researcher contends that the essence of any technology lies not only in the physical features of a technology but also its technical and social capabilities that give it its relevance and character in the communication context.

The nature of mobile technology can also be construed from the perspective of a range of technologies performing divergent functions in a specific environment. For instance,

Rochford (2001) argues that the capacity of mobile technologies to function uniquely is tied to the countless mobile platforms, networks and infrastructure that work collaboratively to produce a mobile technology environment. Therefore, mobile technology comprises electronic devices with specific functionalities employed in distinct environments to realise specific goals such as communication, mapping, identifying locations and document storage. And, in the context of project management, these goals can range from estimating the cost of the project, managing project stakeholder communication to monitoring of progress on site.

Another facet of the nature of mobile technology is that it is constructed as a technology offering a distinctive and unique experience relative to e-commerce business possibilities. For example, virtual touring in shops, use of augmented reality in change/fitting rooms, the convenience of scanning using QR codes and convenience of payments using a mobile device. This aspect of mobility gives rise to a fresh perspective on mobile technologies as tools that are strategic to the realisation of operational possibilities for businesses. These affordances of mobility contribute to the increased integration of mobile technologies with the core business of organisations. Equally, the convergence of capabilities contributes to increased use of mobile devices as facilitators of e-commerce decision making. In project management, the use of mobile technology can exert an impact on operations by enabling business process or complementing the conduct of project-related operations (e.g., location-based services).

According to Feijóo et al. (2009), mobile technologies offer ubiquitous project team–project stakeholder interactions (e.g., material suppliers and site procurement office interactions), convenience in e-commerce, and facilitate financial control procedures (e.g., cross-continental real-time communication between project team members, time reporting, required expenditure and disbursement reviews, accounting codes, and standard contract provisions) (Xiaojun et al., 2004; De Reuver et al., 2008; PMI, 2017). In project management contexts, therefore, one cannot downplay the role that technology plays in supporting project team and stakeholder interactions as well as in mobilising teams' labour and supporting collaboration and coordination of work activities related to remote execution of projects.

2.2.2. The essence of mobility

Mobile technology is generally associated with the ability to transmit information through wireless communication (Traxler, Barcena & Larboda, 2015). What differentiates mobile technology from other technologies is *its wireless and* ubiquitous nature that liberates it from time, space and temporal constraints. However, Balasubramanian et al. (2002), Xiaojun et al. (2004), Ngai and Gunasekaran (2007a), Traxler (2011), Kukulska-Hulme (2016) consider wireless to transcend technical functions that can be deployed by all types of IT, fixed networks and stationary desktop IT to encompass ubiquitous features, which entails the consumption of information and services, anytime and anywhere.

However, the concept of mobility transcends ubiquity to include shareability – that is having a principal feature shared by all mobile technology categories, independent of any underlying technological platform. When mobility is conceived as encapsulating shareability, it affords individuals with technologies running on ubiquitous networks the opportunity to share resources and contact and to be contacted anywhere and anytime (Balasubramanian et al., 2002; De Reuver et al. 2008; Traxler, 2011; Pauleen, Campbell, Harmer & Intezari, 2015; Kukulska-Hulme, 2016). In the context of project management, project managers share and manage project information between the project sponsor, team members, and other stakeholders (e.g., project communication plans, project progress reports, resource allocation), compute project budgets and cost, schedule activities, develop specifications and progress updates drawing on the affordance of mobile technologies and applications such as mobile phones, laptops, pro-workflow and building information modelling (BIM).

In the mobile world, mobility primarily embraces interactivity which is the ability to interact, communicate and consume information irrespective of the user's location (Yuan et al., 2010; Bolat, 2015; Derks, Duin & Tims, 2015). In the business world, there are various interactions that can be facilitated by mobility such as business-to-consumer, business-to-business, business-to-government, business-to-investors interactions. For instance, businesses such as emerging contractor firms are increasingly using cloud computing and crowd funding facilitated by mobile devices to attract finance from investors. From the perspective of communication, mobility entails project managers' ability to interact and communicate with multiple stakeholders

facilitated by the affordances of smartphones, tablets and laptops (Sanakulov & Karjaluoto, 2015; Kukulska-Hulme, 2016). This interactivity has turned into reality for firms and learning institutions alike, anticipating benefiting from exploiting and developing mobile solutions. And, for ECFs, this means effective control of progress regarding cost and schedules on their project-related operations. The next segment discusses features derived from mobility and ubiquity.

2.2.3. The functional aspects of MTs

It is essential to examine the functional aspects of mobile technologies in order to comprehend their mobility and ubiquitous nature. These functional aspects are discussed in the following subsections.

2.2.3.1. Portability of mobile technologies

The discussion of mobile technology is either grounded in its distinct features or the emergence of other features. One of the functional qualities of MTs relates to the portability of mobile devices, which allows devices with exponential computing capabilities to be kept in a pocket, which could mean convenient access to information for the ECF managers. Given the site-based nature and sometimes transitory nature of project work, the portability of mobile devices renders convenience in terms of receiving services (e.g., mobile payment authorisations and notifications, sharing of project specifications and material procurement from suppliers) to the ECF managers and to the rendering of services to their clients. In view of these affordances, Barnes (2002), Liang et al. (2007), Pauleen et al. (2015) consider portability as one of the "key technology trends" that facilitate timeless sharing and receiving of information. The miniature design of personal devices, which are handheld, enable opportunities such as online or remote submission of claims and progress reports by sub-contractors.

2.2.3.2. The personalisation/ personal nature of mobile technology

Another functional dimension of mobile technology is personalisation, which enhances distinctive operational and strategic proficiency by allowing the owner of the handheld device more control and choice regarding when and in what context to use the device. Personalisation enhances efficiency of capabilities by allowing ECFs to target communication to their clients, investors and distributors through providing updates,

really simple syndication feeds and targeted messages. De Reuver et al. (2008) and Pauleen et al. (2015) concur that mobile technologies provide a more personalised experience that increases access and reach of targeted audiences through a viral effect. Therefore, it can be argued that mobile technology offers opportunities to meet the needs and interests of specific customers in a targeted market. In the context of project management, it means project managers have an increased individualised capability to remotely coordinate communication and monitor progress across projects effectively.

Despite these avowed benefits, in comparison to the e-commerce context, personalisation in mobile contexts may compromise users' privacy as control over the mobile interaction process is largely in the hands of developers (Xiaojun et al. 2004; Wong & Tang 2008; Pauleen et al., 2015). Similarly, in the project management context, secure mobile devices that ensure the protection of personal information and guarantee the privacy of information have become a priority for device and application designers and service providers for the delivery of secure project management solutions (Ngai & Gunasekaran 2007a; Eastman, Iyer, Liao-Troth, Williams & Griffin, 2014). Furthermore, the protection of personal information is integral to project management, especially that ECF owners and managers must comply with the POPI Act when adopting and using mobile technology tools to ensure the integrity of the information communicated and shared with project stakeholders.

2.2.3.3. Ubiquity of mobile technologies

Another aspect of the functionality of MTs is that their ubiquitous features allow for greater accessibility within the mobile world. As a result, according to Barnes (2002), Xiaojun et al. (2004), Jin and Villegas (2008), Derks et al. (2015) and Kukulska-Hulme (2016), the ubiquity of MTs has increased the reach and accessibility of these technologies and has occasioned enhanced interactivity and greater communication. However, in the South African project management context, where data costs are high and network connectivity is often unreliable, especially for projects executed in rural areas, it would be expected that the increased reach and accessibility of mobile technologies would be curtailed by limited connectivity. Thus, it may be argued that in a project management context, the prevalence of mobile technologies in project

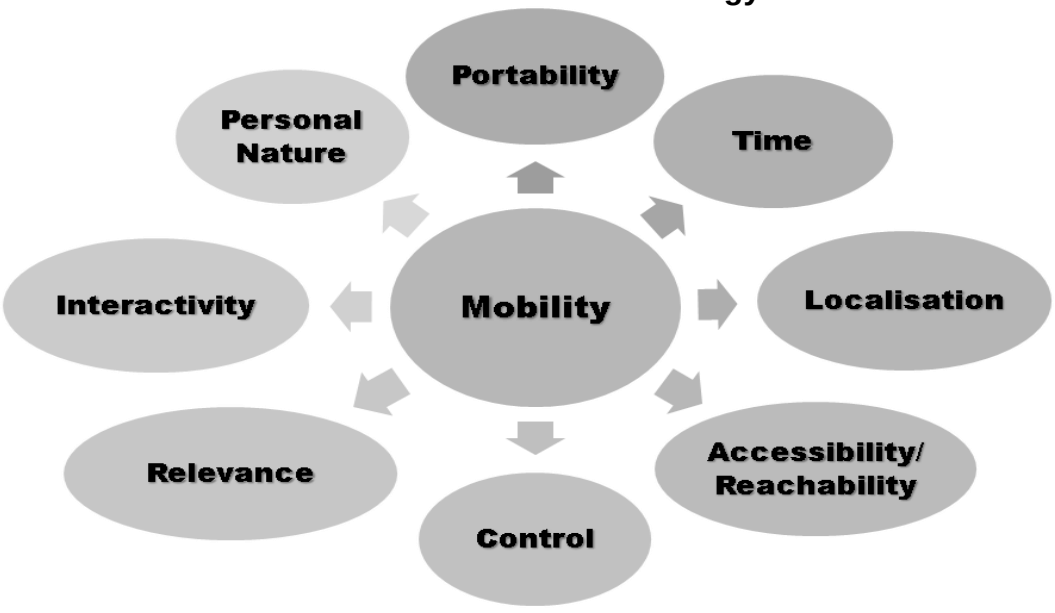
management must not be confined to an understanding of functionality and value, but also access, as availability does not always translate into physical access.

2.2.3.4. Location tracking

Lastly, location tracking of a specific construction site presents opportunities for effective delivery of building material to the correct site and promotion of real-time progress reporting (Ngai, Cheng & Lai, 2007b; Tang, Wang & Tang, 2015, InformationWeek, 2019). This capability presents opportunities for ECFs to obtain information on the construction site's exact location as well as assess the real-time progress on that site at a particular point in time to deliver location-specific feedback to various project stakeholders. It can, therefore, be argued that these innovative solutions help ECFs to create unique mobile solutions and services and experience the true 21st-century mobile revolution aspires.

In short, one can infer that the functional advantages presented by mobility, such as accessibility of project-related information, shareability of project schedules and specifications with project stakeholders, locational positioning of construction sites, and timely delivery of information from the construction site to relevant individuals, as summarised in Figure 2.1.

Figure 2.1: Distinctive Features of Mobile Technology



Source: Bolat (2015).

To understand in detail how mobile technology is deployed in business settings such as ECFs, it is critical to explore how firms take advantage of unique features of mobile technology. These issues are subject of discussion in the subsequent section on the range and categorisation of mobile technologies. This also helps to develop a clear understanding of how such technologies can be exploited to optimise project execution of ECFs.

2.3. CATEGORISATION AND RANGE OF MTS

Mobile technologies have the potential to create a broad range of opportunities for organisations. As a result, the categorisation and range of mobile technologies will be examined in the sections that follow to provide an appropriate perspective on how they can be used in the context of this study.

2.3.1. Mobile or wireless networks

The application of MTs in ECFs can be understood from the perspective of categorisation. De Reuver et al. (2008) and Pauleen et al. (2015) present a detailed analysis of mobile technology through three broad categories: namely, mobile or wireless networks, mobile devices, and mobile applications (see detailed presentation in Table 2.1). The first category, (i) mobile or wireless networks as opposed to fixed networks, focuses on the accessibility of these networks and distinguishes cellular network technologies from short-range access networks.

2.3.1.1. Cellular networks

Cellular networks relate to the wireless transmission of information, which is ideal for those project team members who are on-site. This means that any worker on-site can use their smartphones, laptops, or tablets to share updates on the progress on-site. Moreover, the advancement of cellular networks to 4G and 5G speeds allows pockets of information and data relating to project execution to be transferred through real-time data collection and transmission between the frontline staff and project managers back at the office to workers on-site via connected networks and devices.

2.3.1.2. Short range access networks

Short range access networks are about the communication distance on the level of wireless personal area network (WPAN), wireless local area network (WLAN), or Wi-Fi (wireless fidelity), which gives users within that locale connectivity. These networks can be used to access cloud-based solutions which enable project team members on-site to submit timecards, daily reports, requests for information (RFIs), work records, change orders, and other verified documentation to the project management office and to other project stakeholders. For example, remote workers can wirelessly transmit photos or videos of the building or construction site to a cloud-based collaboration portal for their project manager to assess progress and conformity to set construction standards.

2.3.2. Mobile devices

The second category represents a variety of *mobile devices* using mobile networks to connect to ECFs and their various stakeholders such as simple mobile or cell phones, smartphones with an Internet access functionality, handheld or laptop computers and wireless or non-wireless (Jones, 2021). This technology development, for the ECFs, means that should a problem happen on-site, site managers can take a few photos of the problem, create a report, and immediately send it off to be reviewed and quickly resolved by the project manager and the project team. This also means that site workers can receive revised building plan sheets on their smartphone or tablet, instead of waiting for them to be delivered to site by company messengers.

2.3.3. Mobile applications

The last category is the soft side of mobile technology such as mobile applications or widgets, which enhance the experience of mobile services (Lee et al., 2007; Donnelly, 2009; Jones 2021). Starting from organising workflows and processes, these can be better managed with the right cloud-based mobile solutions. For example, in the project management context, project managers and other project staff sometimes operating off-site (e.g., quantity surveyors, architects, etc.) can access the applications on their mobile devices, thus enabling them to respond immediately to changes or disturbances on-site. Donnelly (2009) further purports that these widgets provide the user with the capacity to schedule labour and equipment, conduct field inspections,

manage change orders, document progress, and review plans and specifications from a single device, which could significantly improve efficiency on a jobsite. The soft side of mobile technology represents a hotbed for producing innovative solutions on a continuous basis (Gerstheimer & Lupp, 2004; Barrett, Davidson, Prabhu & Vargo, 2015; Burger, 2022). For example, the range of project management and workflow management applications that have been established, such as Monday.com, Jira and Smartsheet all make project execution more efficient and effective. These applications help project managers and project teams to complete client requirements and manage time, budget, and scope constraints more effectively.

To sum up, the first category functions as a mobile business factory, where devices and widgets act as tracks and machinery for the operationalisation of business activities (Bolat, 2015). Furthermore, this implies that pen-and-paper project tracking systems can be replaced by mobile technologies - that is, as and when these mobile technologies become available and affordable to ECFs. They can also allow multiple users access to the use of applications over a network through their improved desktop applications in terms of features, scale, and security. Furthermore, the integrated use of MTs provides project managers with comprehensive estimates, allowing them to make critical decisions regarding the feasibility, procurement of financing, and profitability of a potential project.

Table 2.1: Categorisation of Mobile Technologies

Category	Representative Type	Commentary	Inferences from the Researcher
Mobile or Wireless Networks	**Cellular network technologies**: • GSM (Global System Mobile), • GPRS (General Packet Radio System), **Short-range access networks**: • Wi-Fi (Wireless Fidelity) or, • PAN (Personal Area Networks like Bluetooth).	This category is positioned between two ends of the mobility spectrum. Cellular networks with 3G and 4G standards represent opportunities for high-speed connectivity in the broadest context, whereas the connectivity spectrum for short-range access networks is reduced to specific personal areas (Thompson 2019). Due to variances in accessibility, each standard requires specific protocols to enhance the mobile experience and connection.	By using these cellular network technologies, ECFs can improve their efficiency, cost-effectiveness, and flexibility during project execution by promoting quick practical communication delivery, personalised and real time response on and off construction site.
Mobile Devices	• Smartphones with Internet access functionality • Handheld or laptop computers least advanced in terms of radio waves coverage (distance is limited): • PDA (Personal Digital Assistants), business-oriented technology • RFID (Radio Frequency Identification) tags and readers which serve as business-oriented technology.	Nowadays, there is a tendency to design devices which integrate wireless and non-wireless technical functionalities within generic interactive devices. This is obviously another step in the achievement of consistency for the provision of mobile services.	The integrated use of RFID could increase operation efficiency when planning and implementing projects by ECFs by saving time and cost of material consumed as invoices and project information are processed in real time and prices of materials can be sourced from multiple sites and compared for cost effectiveness. The receiving, monitoring and tracking of progress integral to project management information systems in construction is also enhanced.

Category	Representative Type	Commentary	Inferences from the Researcher
Soft' Technology	• Mobile applications/widgets and software	The soft side of mobile technologies in the form of applications for mobile information systems has completely outperformed software designed for stationary IT. Mobile applications are used both for professional and personal purposes (Donnelly 2009).	Information, and how it is communicated, are a major resource utilised in construction projects. Thus, the capability of mobile applications to store and deliver information as and when required becomes very critical for the success of construction projects.

(Sources: Tarasewich et al. (2002); Kim et al. (2013), Karjaluoto, Töllinen, Pirttiniemi & Jayawardhena (2014) and Bolat (2015)).

2.4. MTS APPROPRIATED BY THE CONSTRUCTION INDUSTRY

In this section, studies of mobile technologies appropriated by the construction industry from various countries including South Africa are explored. The section reviews categorisations of mobile technologies and identifies the technologies employed in the project-based operations within the global construction industry. First, global perspective of the construction industry is reviewed, followed by a review of literature in the USA and Canadian contexts, and then emerging countries with South Africa treated in the concluding remarks.

2.4.1. The Global Construction Industry

The construction industry is expected to reach an estimated $10.5 trillion by 2023, with a forecast compound annual growth rate of 4.2% from 2018 to 2023 (Construction World, 2019). The potential for mobile technologies is enormous, particularly for businesses developing project management tools. The construction industry has exploited the affordances of technologies such as connected sensors, intelligent construction equipment, mobile devices, and IoT (Internet of Things) to augment the efficiency of construction workers and streamline information flow between subcontractors, clients, and owners (Africa.com, 2019).

It is not surprising that MTs are contributing significantly to boosting productivity, offering ROI (return on investment), reducing project delays and cost overruns, and enhancing safety and quality by facilitating lean construction activities (Beckett, 2008; Hills, Fox, Skitmore, Hon & Fong, 2008; Akaba, 2016). Therefore, MTs allow construction firms to streamline their projects, processes, and communication by lowering risks associated with project timelines and costs, improving savings through improved resource utilisation, and streamlining time-consuming processes. They allow for the integration of job sites by providing seamless information flow, which allows construction companies to streamline their projects (Worku, 2016; Tshivhase & Worku, 2012). These affordances resonate with Hoadley (2019) who claims that the construction industry is innovative and quick to adopt advanced new technologies to reduce costs, increase safety, and improve the way the industry operates. Conversely, it is worth emphasising that some new technologies are not easy to learn and use and may require specific training. For example, the adoption of computer-aided design

(CAD) and computer-aided manufacturing (CAM) tools require a high level of experience for users to execute their duties well.

Also, contractors have always faced the unique challenges of connecting the field, the office, and the maintenance operations to effectively manage heavy construction projects (Busta, 2016; Construction World, 2019; Hoadley, 2019, www.construction.com, 2019). It is precisely for this reason that MTs have become instrumental in integrating project management in the field with work processes in the office. Hoadley (2019) further posits that Cloud-BIM is an emerging technology used by communication devices such as handheld PCs, tablets, and smartphones. It can therefore be argued that education, training, and changes in industry culture can be facilitated by an understanding and adoption of such novel technology (Dossick & Neff, 2009, 2011; Modern Contractor Solutions, 2019). However, a lack of clarity over responsibility, liability, and ownership, and a shortage of expertise and technicians, which could be improved through professional education and training facilitated by new technology if available to the industry, shall remain daunting challenges (Wong, Wang, Li, Chan & Li, 2014; Harris, 2017). For example, adoption of Cloud-BIM is currently held back by the lack of skills in several fields. It can be inferred that the construction industry has a long way to go before fully realising the potential inherent in the exploitation of mobile technologies' capabilities.

2.4.2. The United States and Canadian Construction Industry

Construction is picking momentum in the United States (US) and Canada to go green (Hoadley, 2019). Customers are the driving force behind this shift, as they demand more environmentally friendly and energy-efficient buildings, something that creates massive potential for the use of emerging technologies such as MTs. Modern Contractor Solutions (2019) asserts that smartphones, tablets, laptops, and GPS devices are widely used by contractors in the United States for many project processes, including facilitating collaboration between project team members in the office and the field; making decisions in the field; and scheduling and dispatching resources. For example, MTs such as smartphones and tablets are not just used for taking pictures and videos, sending texts, and checking e-mail. However, they can be

used for tracking job progress, measuring material consumption and waste disposal, updating documents (including construction drawings) and ordering building materials.

In Canada, these technologies are used for scheduling and estimating; communicating with customers; surveying sites; taking photos and technical drawings; and sharing and controlling software. For example, a construction worker can now hold a small device in his hand and measure the dimensions of a work site. In both these countries, mobile applications and devices with good connectivity will still be highly impactful, along with telematics, big data analysis, machine automation, and drones, because these technologies provide workers with a safer, more efficient way to construct buildings faster with fewer mistakes (Resources.b2wsoftware.com., 2019). The future for the construction industry in both these countries is that of mobile technologies having a major impact on project controls/project management, field performance tracking, cost management and accounting, scheduling and resource dispatching, fleet and maintenance.

2.4.3. The European Union Construction Industry

The growth in construction in Europe is broad-based and occurs in all the main sectors: residential, non-residential, and civil engineering, both new construction and renovation (Pouris, 2012; Oesterreich & Teuteberg, 2016; Statistics South Africa, 2019). The EU construction industry is one of the biggest market players in the industry, with Germany as its lead even though north-western European markets showed the strongest market growth over 2017. In the European Union, digital construction is the most discussed new theme in the construction industry in this region (Deloitte, 2018). It involves the integration of digital manufacturing, design and building information modelling (BIM) in ways that promote the growth of the industry as it addresses market demand for better-quality buildings with optimised processes and resources. For example, there is a rise in demand for collaborative construction (i.e., every team member working together towards one project goal), which uses technologies to support integrated project delivery, allowing more complex projects to be delivered in a more efficient and agile way.

Top European construction companies make decisive effort to understand the benefits of using innovation and technological developments in all business-related activities. There is a shared focus on new technological developments, new business creation, and knowledge investment to enhance customer interaction in the construction process, such as BIM/CAD, smart devices, and IoT, while they also seek to enhance the availability of data and operations platform integration (Dossick & Neff, 2011; Deloitte, 2018). For example, the European construction industry can expect big data analysis and the collection of real-time information on its construction sites to enhance cost savings and productivity gains. Mobile technologies in construction in Europe have shaped project execution in that the utilisation of mobile devices has been paramount to job-site communication and provided the freedom to streamline process management and construction data more broadly - definitely a paradigm shift, while innovative tools in digital design, such as BIM and CAD. It can be inferred from these examples, and many others, that the European construction industry is undergoing a technological revolution to provide more sustainable and digitalised construction industry.

2.4.4. The African Construction Industry

In Africa, four of the top five countries in terms of the number of infrastructure projects (i.e., South Africa, Nigeria, Kenya, and Egypt) spent less than 20% of GDP on gross fixed capital formation (GFCF) in 2016 (Deloitte, 2017; Global Entrepreneurship Monitor (GEM), 2017a,b; Ma'aden Africa, Growth Bank, Siemens Accra, and International Monetary Fund Mozambique, 2019). Furthermore, these countries have large numbers of smartphone owners, and as more African countries continue to switch to smartphones, this mobile technology could be applied on job sites throughout the continent. However, in terms of adopting the use of mobile technologies in their construction projects, these countries have been slow to adopt new technologies, viewing them as barriers to doing business with multinational corporations. For example, Deloitte (2017) observes that the majority of African construction companies are either still using paper to plan and manage projects or working in an Excel spreadsheet format.

In addition, Egypt, Nigeria, and South Africa have consistently underspent on infrastructure in the last decade (Pouris, 2012; Deloitte, 2017; Africa.com, 2019). This has affected mobile technology adoption as it has reduced the ability to employ highly-skilled professionals and hindered the speed of implementing new technologies. For example, the use of building information modelling (BIM) is much less advanced in these African countries than in developed countries, and few firms in Africa have made use of tools such as modelling and simulation due to financial constraints. According to experts, industry stakeholders, professional bodies, and governments should collaborate to close this talent gap as it shall significantly advance the pace of technology adoption in Africa. As a result, the African construction industry is potentially missing out on many of the benefits that these technologies have to offer.

2.4.5. The South African Construction Industry

South Africa's construction industry takes mobile technology for granted, judging from the reality on the ground where contractors and project managers predominantly use smartphones (Venkatraman & Yoong, 2009; Pouris, 2012). Furthermore, many mobile tools do not integrate with the back-office systems that contractors use to run their businesses. South African Magazine-SA PROMO (2019) argues that the construction industry also needs to optimise business processes following a seven-year growth slump and the fall-out of an investigation by the Competition Commission into collusion in the industry (United Nations, 2007; Pouris, 2012). One could argue that construction SMMEs miss opportunities to streamline processes by reducing the need for redundant data capture rather than gain leverage through the use of data generated from new technologies (e.g., mobile phones) to gain better visibility in the business landscape (Deloitte, 2017). Yet it can be equally argued that the building and construction sector can experience radical transformation as artificial intelligence (AI) and the Internet of Things (IoT) mature and gain ground in emerging economies.

Some disruptive technologies emerging in South Africa's construction industry are wearables such as smart helmets and glasses using augmented reality and artificial intelligence to receive real-time visual data from the construction site. Despite the emergence of these technologies, the South African construction industry is still lagging behind in the use of technologies such as virtual reality, artificial intelligence,

and robotics. For example, according to a 2018 McKinsey report on emerging technologies, only 27% of companies in South Africa have adopted emerging technologies such as cloud computing, data analytics, and artificial intelligence (Cocorocchia, Dunn, Hall & Takahashi, 2018).

While these technologies present opportunities for construction companies to save costs by embedding sensors and cameras onsite that can warn workers of hazards or wirelessly highlight work on the blueprint so managers can see where employees are working, the business environment and culture may not be ready for such technology. Literature suggests that novel technologies challenge these firms to reskill their workforce for a digital age (Deloitte, 2017; Hislop, 2018; South African Magazine-SA PROMO, 2019). As a result, adopting new technologies requires companies to overhaul their business processes and the competencies of their staff. All this might be a challenge for new firms with limited capital and concerned about breaking even. Overall, despite the aforesaid benefits, the construction industry in South Africa has been slower generally to adopt some MTs than its counterparts in Europe or the US (Deloitte, 2017). Therefore, for the South African construction industry, the appropriation of mobile technologies may well mean grappling with a culture of innovativeness, which has long been held back by the more conservative and less diverse players in the industry; or embracing a disruptive innovation, which would require the construction industry to undergo significant modification and adjustment to remain competitive in a digital era.

2.5. MOBILE TECHNOLOGIES AND PROJECT MANAGEMENT OPERATIONS INTEGRATION

This study explores the extent to which use of Mobile Technologies is integrated by the managers/owners of ECFs in their project-based business operations. The study focuses on one phase in the project life cycle, namely, the project execution.

2.5.1. Definition of Project Execution

Project Execution (PE) is the third phase in a project life cycle, and it is a phase where project deliverables, that are mapped out in the project management plan, are developed and completed (Larson & Gray, 2017; PMI, 2017). In this phase, there are

a series of processes that are performed to assist the project manager to understand whether the project succeeds or fails (Larson & Gray, 2017; PMI, 2017). The main processes include: (1) Cost Management Process, (2) Quality Management Process, (3) Risk Management Process, (4) Procurement Management Process and (5) Communications Management Process. For this study, only these five processes are explored as constituent components of Project Execution.

2.5.1.1. Cost Management Process

Project Cost Management entails the processes of estimating, budgeting, and controlling costs so that they can be completed within an approved budget (Larson & Gray, 2017; PMI, 2017). The highly computerised power of mobile devices such as smartphones can be exploited for the calculation of quantities of raw materials and labour costs (Hoadley, 2019; Modern Contractor Solutions, 2019). Thus, the adoption and integration of mobile technologies can facilitate estimation of project costs by calculating the available materials, labour hours and amounts of materials. This dovetails into approximating the ultimate job prices and costs (PMI, 2017). These cost estimations can be conducted in real-time, real cost information with estimates of costs compared at any point in time and storing data on the cloud by the project managers.

2.5.1.2. Quality Management Process

Project Quality Management is the process of ensuring that all project activities necessary to design, plan and implement a project are effective and efficient with respect to the purpose they serve and their performance (PMI, 2017; Pm4dev.com, 2019). A holistic approach to managing for quality in projects relies significantly on the satisfaction of direct customers and recurrent customers and affected stakeholders (Carruthers, 2008; PMI, 2017). It can be argued, therefore, that the philosophy of doing the right things should precede the actions of doing things right, thus achieving both effectiveness and efficiency.

2.5.1.3. Risk Management Process

Proactive risk management throughout a project's various phases exerts a significant impact on the project's outcome. Project risk management entails identifying, analysing, and responding to risks that arise during a project's lifecycle to keep the

project on track and on target (Kendrick, 2015; Larson & Gray, 2017; PMI, 2017; Wadei, 2019). The risk identification process should be performed during the early stages of the project and continue through the entire project life cycle to account for adjustments and new developments. According to Saladis and Wais (2013), the strength of risk management lies in enumerating risks (both positive and negative) and focusing the project team on the handling the risks that emerge. In view of risks such as cost underestimates, financial constraints, stakeholder conflict, or risks associated with natural disasters or other occurrences that could adversely complicate and jeopardise project execution in construction project management, the use of mobile technologies could enable project managers and team members to optimise efficiency by enhancing planning and decision-making elements at each stage of project execution (PMI, 2017; Wadei, 2019).

2.5.1.4. Procurement Management Process

The term "Project Procurement Management" refers to the processes involved in acquiring inputs, services, or results from sources other than the project (PMI, 2017). As a result, procurement management becomes the collective processes that require associated control functions and automation tools to support the procurement and management of subsequent procurement actions associated with projects. For instance, the project manager can advertise for tenders, select the best offers and manage suppliers, monitor the progress of selected bidders, conduct necessary audits, and manage delivery schedules. Likewise, the adoption and use of mobile technologies in the procurement process provides project managers with configurable, mobile-enabled, real-time information management solutions for tracking and managing procurement activities in general (PMI, 2017).

2.5.1.5. Communication Management Process

The importance of communication in project management is widely recognised as critical to the success of construction projects (Ullah Khan, 2014; PMI, 2017; Hoadley, 2019). During construction activities, information such as purchasing details for equipment and building materials, budgets and approvals, digital drawings and construction plans are all communicated. Furthermore, mobile technologies can enable industrial information systems that reduce the time and effort required for

project teams and stakeholders to communicate during a construction project. Ullah Khan (2014) asserts that successful project execution necessitates collaboration between construction workers, supervisors, architects, managers, and even external stakeholders. As a result, the adoption and integration of mobile technologies is critical in ensuring effective and efficient communication across all parties involved in the project.

2.5.2. Integration of MTs into Project Management Operations

Project management aims to integrate tasks and resources to accomplish project objectives (Nicholas & Steyn, 2012). The most significant recent developments in project management and construction are the integration of mobile technology tools that aid in collaboration and elimination of bottlenecks throughout the three phases of construction. These tools are rooted in tablets, smartphones, and mobile intelligent hotspots via location-based services (LBS) and site survey applications, as well as the use of wireless mobile technology. These tools empower construction project managers with a plethora of scheduling, communication, collaboration, and data capture capabilities for a variety of field and office-based applications that help to streamline the construction process. For example, cloud-based technologies (which are more cost-effective and easier to manage) have enabled social collaboration among business-to-business, business-to-customer, and business-to-supplier networks during the execution of operations (Bedard, 2019). These technologies enable project managers to plan, monitor, and coordinate work across multiple locations while also encouraging team members to provide real-time updates on project progress.

Moreover, the integration of mobile technologies into project-related operations enables project managers, engineers, builders, and site supervisors to create and share project information (Venkatraman & Yoong, 2009; Clarizen, 2019a, 2019b), and mutual engagement enables teams with employees and contractors located in multiple cities, time zones, countries, and even continents to work collaboratively (Modern Contractor Solutions, 2019). Thus, the integration of mobile technologies has benefited the construction industry by facilitating the rapid setup of sites and

streamlining project workflows by enabling project managers, engineers, builders, and site supervisors with a stake in the project to create and share project information.

2.6. APPROACHES TO MOBILE TECHNOLOGIES AND PROJECT EXECUTION

All mobile technology categories do have common characteristics and features, so theoretical models of mobile technology deployment have been developed to reflect practices, irrespective of the mobile technology category chosen and deployed. Since effective project execution requires the effective application of technological capabilities to promote connections and interactions between stakeholders, the approach of organisational capabilities is examined at this point. The review starts with a discussion of the organisational capabilities approach, examining technological capabilities, organisational project management capabilities and stakeholder management capabilities.

2.6.1. The organisational capabilities approach

The dynamism and uncertainty in today's business environment have brought the issue of sustainability based on an organisation's unique capabilities to the forefront. An organisational capabilities approach, which is a subfield of strategic marketing and management research, considers a firm's strategic position in relation to managing and adapting to its operational context by taking its strengths and weaknesses into account. Thus, a firm’s organisational capabilities (such as technology capabilities, marketing capabilities, entrepreneurial capabilities, and resource management capabilities) serve as the foundation for the enterprise, operationalising the firm's strategic intent to achieve business results and maintain its competitive advantage.

In the context of ECFs, the ability of these small firms to effectively manage MTs via their applications to facilitate communication, interaction between on-site and off-site teams, and collaboration on tasks (e.g., ICT-supported information sharing, ICT-supported team interaction, and ICT-supported collaboration) may provide a significant strategic advantage in conducting business within their given context. Furthermore, such MTs enhance their competitive advantage over their rivals in the market by improving the operations and overall productivity of their firms through ICT applications. However, if ECFs are unable to effectively manage and integrate

technology tools for information sharing, interaction, and collaboration, it would eventually affect their overall business operations by rendering them ineffective for conducting business in the long run.

Literature suggests that organisational capabilities are high-level practices embedded within organisational routines and managerial decision-making processes that enable an organisation to outperform its competitors (Nelson & Winter, 1982; Leonard-Barton, 1992; Day, 1994; Winter, 2003; Ehlers & Lazenby, 2010). Paukku, Koria and Kourula (2010) highlight that organisational capabilities refer to a firm's ability to perform a specific task, function, or activity. Other literature refers to organisational capabilities as ordinary capabilities (Teagarden & Schotter, 2013). And for the ECFs, these ordinary capabilities range from the ability to estimate and control project costs, perform on-site quality control, plan and administer procurements, project team management, to the management and monitoring of stakeholders' engagement.

Furthermore, organisational capabilities can also manifest in technology capabilities, such as the firm's ability of MTs to support the exchange of information, support the building of collaborative teams, information sharing and communication, and transparency of information. This can all help to increase the ECFs' ability to perform than if a conventional project delivery were to be used. Combined, these contribute to the strategic competitiveness of ECFs through increasing their ability to quickly respond to changing conditions and evolving business opportunities. It can also improve ECF's potential to achieve efficiency improvements and/or other cost reductions in all aspects of the business. Thus, according to PMI (2017), for such capabilities to be activated, it may be necessary for ECFs to set up information technology software, such as scheduling software tools, configuration management systems, web interfaces to other online automated systems, and work authorisation systems, to enhance achieving the outcomes that are required for the delivery of their projects. The question that arises is whether ECFs in emerging economies such as South Africa have the technological capabilities to support the execution of their projects.

Some scholars argue that capabilities within an organisation can be categorised into technological capabilities, project management capabilities, and stakeholder

management capabilities (Teagarden & Schotter, 2013; PMI, 2017). Thus, organisational capabilities are critical not only for developing a competitive advantage but also for transforming VRIN resources into competitive advantage (Penrose, 1959; Wernerfelt, 1984; Barney, 1991; Winter, 2003; Ehlers & Lazenby, 2010; Teagarden & Schotter, 2013). Firstly, literature suggests that the technological capabilities of an organisation have positive impacts on firm performance (Covin & Slevin, 2000; Boyacioglu, 2015; Rahimtoola, 2016).

Secondly, the project management capabilities of an organisation have a positive impact on firm performance by enhancing internal communication, sharing experience and skills across projects, and developing teamwork skills across projects (Jones, Macpherson & Jayawarna, 2014; Wen & Lee, 2015; Chwirotugha, 2017). Lastly, the stakeholder management capabilities of an organisation are critically significant for its competitive advantage (Papadakis, 2014; Mehrotra & Bhagat, 2015). These technological, project management, and stakeholder management capabilities are also important determinants of successful project implementation.

To the extent that many scholars acknowledge that the integration of these organisational capabilities leads to the development of competitive advantage, this study considers technological capabilities, project management capabilities, and stakeholder management capabilities as organisational capabilities that can be harnessed to ensure that the organisation functions and executes their project-related activities and operations effectively. Such integration enhances their strategic advantage over other firms. The following sub-sections discuss the concept of organisational capabilities in terms of technological, organisational project management, and stakeholder management capabilities. These capabilities are consistent with this study's focus on the use of MTs to advance and enhance managerial competencies during project execution, as well as the need to harness innovative managerial practices that ensure that projects are delivered in the most effective and efficient manner.

2.6.1.1. Mobile technologies as a technological capability

Literature refers to technological capability as the ability of an organisation to deploy, develop, and use technical resources, as well as combine them with other complementary resources, to achieve organisational efficiency (Guerra & Camargo, 2016). Some scholars regard technological capabilities as the key to gaining competitive advantage for organisations, particularly the formation of technological capabilities in relation to employees' tacit knowledge, skills, and competencies (Teece, Pisano & Shuen, 1997; Tsai, 2004; Guerra & Camargo, 2016). In the context of project execution, technological capabilities allow ECFs to enhance their capabilities for managing large, complex, and challenging construction projects by significantly and positively augmenting the integration of know-how and organisational capabilities (Tsai, 2004; Teece, 2007, 2014; Petricevic & Teece, 2019). Therefore, technological capability in this study is the application of technological knowledge, skills, and competencies to achieve organisational efficiency using mobile technologies.

This definition indicates that a firm's output performance is based on its accumulated technological knowledge (Smook & Van Egmond-de Wilde de Ligny, 2001; Tsai, 2004; Omar, Takim & Nawawi, 2012). And for emerging construction firms, this means it is necessary for them to develop technological capabilities that support their business management processes to achieve higher levels of efficiency and allow them to better compete with larger construction firms. Although ECFs may have these technological capabilities, their manifestation, deployment, and successful integration into the management processes are not easily accomplished, as ECFs struggle with bridging the gap between their technological capabilities and organisational project management capabilities. This impediment arises from their lack of awareness of the impact these technological capabilities can have on the competitiveness of their businesses and limitations in efficiently using them. Thus, technological capabilities are closely related to the current state of technical knowledge, which is determined in part by other related activities (such as labour force, organisation of resources, and management) within the organisation.

Therefore, for ECFs to accumulate technological capabilities, they must draw on, tap into, and incorporate their human resources' knowledge, skills, and competencies in ways that contribute to their increased competitiveness. This is accomplished through

the development of organisational structures (including infrastructure) and management systems that mobilise, utilise, motivate, and reward these human resources. However, developing these structures may present challenges for ECFs, as ECFs in their nascent stages often face a paucity of intellectual capital due to the absence of professionals with the relevant experience to manage such developments. As a result, the South African government, through the collaboration of different departments (i.e., the Department of Home Affairs, the Department of Higher Education and Training, the Department of Labour, the Department of Trade and Industry, and all industries across South Africa), has provisions through the exceptional and scarce skills list to hire expatriate labour to compensate for internal skills shortages (Da Silva-Vergottini, 2022). Therefore, an organisation's accumulated technological knowledge plays an important role in maintaining competitive advantage and organisational efficiency. It can be further inferred that the accumulation of relevant knowledge and experience (e.g., exceptional and scarce skills) is an important route for developing an organisation's strategic capabilities and competitive advantage.

For Smook and Van Egmond-de Wilde de Ligny (2001) and Omar, Takim and Nawawi (2012), developing and maintaining cutting-edge technological capability is critical for construction firms carving a unique specialty that can help them compete in an appropriate niche market. A question may arise as to whether these ECFs are capable of competing with big construction firms, which may have gained experience in developing cutting-edge technology by doing high-profile projects.

As previous research suggests (Omar, Takim & Nawawi, 2012; Guerra & Camargo, 2016), the model developed by Smook & Van Egmond-de Wilde de Ligny (2001) for measuring construction productivity, technological performance, capabilities, and competitiveness has been used as a benchmark to evaluate technological capability utilisation over the years (Omar, Takim & Nawawi, 2012; Guerra & Camargo, 2016). For ECFs, this means that they need to do an in-depth study of their existing technological capabilities as well as how these capabilities can be used to compete on the market. On one hand, it is important to ask whether these small firms have sufficiently trained human resources to effectively compete on the market. On the other hand, it is also important to ask whether their management structure which

suffers often from the “one-man band” (founder syndrome), have the management capabilities ideally suited for increasing their competitiveness in the market. This framework confirms that for most firms the key to a sustainable competitive advantage is the harmonious co-evolution of human, organisational and technological capabilities.

2.6.1.2. Mobile technologies as organisational project management (OPM) capabilities

Organisational project management (OPM) is a project-based execution framework comprising the systematic coordination of structures, capabilities, and practices that integrates and continuously improve the performance of temporary processes (such as portfolio, program, and project management) with organisational enablers to achieve strategic goals in response to the external environment (Williams, 2011; Wanner, 2015, PMI, 2017). It is concerned with the translation of corporate strategy into an organisation's projects using portfolio management, as well as the execution of corporate strategy through programs and projects. Therefore, organisational project management capabilities are the skills, knowledge, and behaviours required to translate strategy into projects, manage a portfolio of projects whilst integrating other organisational critical functions. For instance, in the case of emerging construction firms, organisational project management capabilities require team members to display the following: self-development, learning and professional growth; leadership skills with a willingness to be a change agent, strong relationship building and networking skills. As a result, the inability to apply organisational project management capabilities by emerging construction firms may lead to their incapability of translating corporate strategy into projects and implementing the implementing projects successfully, although there is an exception for some emerging construction firms.

Literature demonstrates that the shift toward project management as an organisational capability, as featured in some project management tools, has been accompanied by an interest in developing standards and guidelines for project management of individual projects focused on practices relating to time, cost, quality, risk, human resources, communication, and procurement (Barney, 1991; Williams, 2011; PMI, 2017). This is because these aspects of project management have been proposed as relevant to performance and thus, something that needs to be monitored by such

standardised monitoring tools. For instance, the adoption of mobile technologies as a monitoring tool can capture project performance data and provide feedback to project stakeholders on specific actions designed to improve the project performance. Thus, the offering of mobile technologies as a project management capability improves project performance by focusing on some of the aspects that have been identified as critical to the success of project management (i.e., time, cost, quality and risk). To this extent, this argument can be extended to the ECFs whose core business is project-related, as their demonstration of these exceptional organisational project management capabilities contributes directly to increasing their competitive advantage in the market thus enabling them to attract more projects.

2.6.1.3. Mobile technologies as stakeholder management capabilities

Since project execution involves the coordination and integration of tasks from multiple stakeholders, stakeholder management capability (SMC) would be an invaluable capability to discuss with reference to ECFs. SMC is derived from Freeman's (1984) Stakeholder Theory and it illustrates the complex convergence of interests and expectations influencing relationships between stakeholders and firms that can be considered and integrated into the firm's strategy (Freeman, 1984; Zakhem, 2008; Habisch, Patelli, Pedrini & Shwarz, 2011; Pedrini & Ferri, 2019). This concept has evolved in response to recent developments, which have increased its wide acceptance among practitioners and academics alike. As a capability, SMC (such as analysing the needs and expectations of stakeholders, planning and implementing various tasks to engage with them) can be harnessed to the benefit of emerging construction firms by providing tools to manage the variety of stakeholders involved in ECFs projects, thus increasing opportunities for profitability. For instance, through the SMC, emerging construction firms identify possible stakeholders at different levels and with diverse interests, evaluate their expectations to identify opportunities to balance interests, then develop mitigation measures and gain commitment (Heikkurinen & Bonnedahl, 2013; Matos & Silvestre, 2013; Ranängen & Zobel, 2014; Pedrini & Ferri, 2019). However, it is worth raising the question of whether these ECFs have networks for building diverse stakeholders and further establish the effectiveness of such building networks should they exist for developing the SMC. Indeed, the integration of

mobile technologies by emerging construction firms may pave the way for enhancing their SMC.

Despite this increasing interest in studying the relationship between stakeholder management and firm performance, the extent to which small firms exploit and integrate stakeholder management capabilities to achieve their strategic objectives remains a point of contention among scholars, particularly for project-oriented enterprises. Essentially, relationships of unequal power exist between firms (e.g., large corporations and small firms). Small firms can benefit from tapping into their use of mobile technologies to create niche markets for their services (i.e., creating new clients) rather than emulate large corporations that have greater advertising power. In addition, since unbalanced stakeholder relations (such as excessive dependence on a single stakeholder) can affect the efficiency of firm performance (Lacasse, 2004; Stockard & Bonan, 2006), the integration of mobile technologies into project management operations can provide project managers in the construction industry with effective tools for managing stakeholder relationships within the project management processes of project-oriented small firms. Therefore, it can be inferred that effective stakeholder relationships can be maintained in this way and can assist ECFs in enhancing the reputation of the firm by increasing client loyalty.

2.7. THEORIES OF MOBILE TECHNOLOGIES

There are numerous theories that can be applied to the use and adoption of mobile technologies; however, the connectivism (Siemens, 2004) and resource-based view (RBV) are the most relevant for this study (Barney, 1991). Each of these theories is discussed in detail below, along with their application to the subject of this study. The following section discusses connectivism in relation to the development of organisational capabilities through the use of mobile technologies during the execution phase of a project.

2.7.1. The theory of connectivism in mobile technologies

Connectivism is a theory of learning proposed by George Siemens and Stephen Downes that emphasises the value of learning networks as an integrated whole of connections and nodes (Siemens, 2005). According to connectivism, these

connections are representations of knowledge and understanding. The theory postulates that learning occurs within a network and the larger and more diverse the network, the more opportunities for learning are created (Siemens, 2005; Lulee, Oberman & Tin, 2010; Western Governors University (WGU), 2022). One could argue that, through the facilitation of multiple mobile technologies and platforms, different forms of knowledge are exchanged that engender the development of creativity, collaboration and critical thinking (Lulee, Oberman & Tin, 2010).

Additionally, the connectivist argues that a network is a web of nodes and connections, and that a node can be any entity, including a person, a group of people, a computer, or fields of ideas and communities. In a network, a connection is a link between two entities. If nodes were to comprise a network of contractors, site workers and management collaboratively working on a project, then the networks would comprise mobile technologies that serve as purveyors of knowledge, information and artefacts that facilitate the development of managerial competencies. A change in the state of one node may cause a change in the state of the second node. This means that the use of mobile technologies during project execution may have a positive or negative impact on other nodes in the network. It can, therefore, be argued that an analysis of the types of networks ECFs have (especially those with lower grades) may provide some insight into their effectiveness as carriers of resources, values and systemic practices. As a result, such information may have some value in the process of aiding construction firms in developing countries.

In connectivism, the fundamental principles are derived from theories of chaos, network, complexity, and self-organisation (Siemens, 2005). Connectivism places a premium on the learner's ability to navigate information. In this respect, the ability to synthesise and recognise connections and patterns is a highly valued skill (Siemens, 2005; Lulee, Oberman & Tin, 2010; Siemens, 2013). In the case of ECFs in South Africa, this key education, training and skills may be acquired through free training and skills development made available by SEDA and NYDA. When interactions between site managers, contractors, site workers and senior managers are enabled and facilitated by networked technologies (e.g., mobile devices and platforms), this networked community eventually makes connections between site-based information and technical drawings. This is because such technologies provide a direct and instant

way for the project managers, site teams and other project stakeholders to exchange knowledge, participate in discussions and share information relating to the project more easily and rapidly. Albeit the use of such technologies is an essential building block in the development of ECFs' organisational capabilities, it is possible that barriers (such as language and literacy, limited access to computer networks, etc.) may limit the effective use of such technologies.

According to the connectivist, the pipe is more important than the content contained within the pipe, because the content exists only temporarily. This principle is linked to this study through an understanding that the use of mobile technologies is more important than the knowledge that they store and share. A question may arise as to why ECFs would need a pipe if it is not delivering resources that add value to the firm. Seeing that for emerging construction firms, where construction skills, knowledge and experience are the most valuable resources, the use of mobile technologies to augment these assets is even more desirable. And the pipe, or mobile technologies, should therefore be designed for optimal delivery of knowledge content to support the construction project objectives and not be an end in itself. Thus, in the context of project management processes, content such as feasibility, financing estimates, and profitability of a potential project is frozen knowledge, whereas a connection, which entails the project management tools (such as mobile technologies) used in these processes, is a pipeline that continues to generate and allow the flow of new knowledge. The stronger the connections, the faster the information flows.

To comprehend how connectivism relates to the use of MTs, one must first grasp the underlying principle, which is that learning can take place in a technologically enhanced environment (Siemens, 2005). This means, according to Kivunja (2014), that collaborative activities utilising social media technologies and run on mobile devices facilitate, amplify, and construct learning. Thus, the use of technological platforms facilitates the continuous flow of data and information within the learning network (Lulee, Oberman & Tin, 2010; Kivunja, 2014. Similarly, one can argue that the use of MTs facilitates and enhances the flow of project information among project stakeholders and ensures the project team's continuous collaboration with external and internal project stakeholders. Thus, utilising a technologically enhanced

environment becomes a means of enhancing an organisation's organisational capabilities.

2.7.2. Resource-based view theory in mobile technologies

The resource-based view (RBV) states that firms possess resources and some of these resources help the firm achieve competitive advantage (Barney, 1991). The RBV investigates organisational performance differences based on their resources (Peteraf & Barney, 2003). The theory is based on two main assumptions:

(1) organisations within an industry may have different resources, and

(2) these resources may not be perfectly mobile across organisations

If this is the case, then organisational resource differences can be very long-lasting (Barney, 1991). The theory explains how organisations can maintain a sustainable competitive advantage by controlling scarce, valuable, imperfectly imitable, and non-substitutable resources as well as maintaining distinct and long-term positions in competitive environments (Peteraf & Barney, 2003; Wittmann, Hunt & Arnett, 2009; Rawahi, Jamaluddin & Bhuiyan, 2020). For ECFs using mobile technologies, this means that such firms must exploit firm-specific resources to gain competitive advantage. For instance, firms can maintain a competitive advantage if they use their mobile technology resources as a complement to their physical construction and project management resources.

RBV focuses on differences in efficiency rather than differences in other ways such as market power, collusion, or strategic behaviour (Peteraf & Barney, 2003; Wade & Hulland, 2004). One wonders how well this concept of efficiency explains differences in resources between small construction firms and large construction firms. It can be argued that although strategic resources are important in explaining how small construction firms differ from large construction firms, there are other resources, such as those peculiar to the firm (e.g., ethnic networks, tax breaks, etc.), which are also important in explaining strategic resources. For instance, some small construction firms operate in townships and can exploit the benefits of the township economies

through taking advantage of ethnic networks to get small construction projects. Therefore, while small and large construction firms may differ in their strategic resources, some small construction firms can also deploy peculiar resources in their execution of small construction projects and in gaining competitive advantage over their rivals.

The application of RBV to project management operations can be explained by identifying organisational and project-specific resources. This study, therefore, takes a resource-based view to understand the influence of the use of mobile technologies on perceived managerial competencies during project execution. For instance, managers' perceptions about project performance may be related to the resources (including competencies and physical resources) available for project implementation. It can, therefore, be argued that the level of perceived managerial competencies affects the performance of the project and that the manager's decision on the choice of technology depends on their competencies (including managerial competencies). This is elaborated in the next section.

2.8. COMPETENCIES

Competency and competence are often problematically employed as synonyms due to the intricate ways in which they are applied (Woodruffe, 1993; Krajcovicova, Caganova, & Cambal, 2012; Fejfarová & Urbancová, 2015). However, according to Centranum (2022), competence denotes the possession of sufficient knowledge and the capacity to act effectively in a variety of circumstances (Centranum, 2022). This author further purports that since each level of responsibility has its own set of requirements, competence can occur at any point in an individual's life or career. Dubois' (2002) definition of competence is any characteristic or trait that an individual uses for successful or exemplary performance of a task. In this sense, competence is about skills, standards and measurement whereas competency is about practices relating to how the standards are achieved (Rambe, 2018; Centranum, 2022). According to Succar, Sher and Williams (2013), individual competencies are the fundamental building blocks of organisational competence.

These ‘building blocks' include an individual's knowledge, skills, thought patterns, mind-set, social roles, and aspects of self-esteem or self-efficacy, which can also be called "intent" (Boyatzis, 2008; Arditi, Gluch & Holmdahl, 2013; Rambe, 2018). In a building or construction environment, the manifestation of this intent is derived from the individual's experience, including learned skills and his/her ability to use these assets. As a result, this intent is ultimately translated into behaviour in a very individualistic manner as the construction worker becomes competent in what he/she does. In short, competence is skills-based and measurable, while competency emphasises behaviours that arise from the possession of competencies. For this study, however, the researcher is interested in competency.

Competencies involve behaviours and practices that contribute to successful project management and, ultimately, contribute to business performance (Boyatzis, 2009; Succar et al., 2013; Fejfarová & Urbancová, 2015). Managerial competencies (MCs) describe actual personal expressions and articulations of actions, and interpersonal interaction (Soderquist, Papalexandris, Ioannou & Prastacos, 2010; Makhalemele, 2016; Rambe, 2018). The managerial competencies most influenced by the adoption of mobile technologies during the project execution phase are social and operational competencies, particularly communicative competencies.

2.8.1. Constituents of Competencies

In terms of constituents, competency refers to the set of knowledge, abilities, and psychosocial characteristics required to perform a job effectively in an organisation (Le Deist, Delamare, & Winterton, 2005; Hellriegel et al., 2008; Boyatzis, 2009; Succar et al., 2013; Fejfarová & Urbancová, 2015). According to Boyatzis (2008), competencies are a behavioural approach to three clusters of traits necessary for successful project management tasks and activities: (i) cognitive competencies; (ii) emotional intelligence competencies, including self-awareness and self-management competencies; and (iii) social intelligence competencies. However, these competencies are classified differently in project management (Helfat & Peteraf, 2015; Ribeiro, Amaral & Barros, 2021). These competencies profile include eleven (11) dimensions: influence, communication, emotional intelligence, contextual awareness, management, cognitive abilities, professionalism, knowledge and experience, project

management knowledge, and personal skills and attributes. The dimensions of competencies can be expressed by exploring and applying them to the five (5) project management knowledge areas relevant to this study, as follows:

- Mobile technology-enabled cost management competencies – these are knowledge and skills that provide project managers with the ability to update real-time cost progress indicators and gain foresight into project costs.
- Mobile technology-enabled quality management competencies – these are knowledge and skills that contribute to project managers' ability to automate and digitalise quality control of deliverables.
- Mobile technology-enabled communication management competencies – these are knowledge and skills that contribute to project managers' ability to accelerate communication processes within projects, to utilise human-machine and machine-machine communication during project execution, and to reduce time spent on progress reports.
- Mobile technology-enabled project risk management competencies – these are knowledge and skills that improve project managers' abilities to simulate project execution and employ techniques for identifying and analysing risks that require the use of large amounts of data.
- Mobile technology-enabled procurement management competencies – these are knowledge and skills that promote project managers' abilities to share knowledge about purchases, utilise virtual platforms in procurement processes, and maximise the use of knowledge resources during project implementation.

The relative significance of these characteristics, according to Succar et al (2013), is not constant but varies to reflect the unique requirements of each measurable competency. This study examines the different managerial competencies of owner/managers of emerging construction firms and how they could be shaped by the adoption of mobile technologies in this industry.

2.9. MANAGERIAL COMPETENCIES

Managerial competencies are a heavily contested construct as various academics provide different conceptualisations (Kurz & Bartram, 2002; Bartram, 2005;

Krajcovicova et al, 2012; Fejfarová & Urbancová, 2015; Rambe, 2018). For instance, Fejfarová & Urbancová (2015) define managerial competence as " *specific type of individual competencies.*" This definition takes into cognisance various aspects covering knowledge, skill, psychological, emotional dispositions of an individual towards the performance of the job and the imperative to improve organisational efficiency. It includes skills, traits, motives, attitudes, values and practices necessary in improving management performance.

Some scholars also define managerial competencies as "sets of knowledge, skills, behaviours, and attitudes that can contribute to the personal effectiveness of managers/owners of small businesses" (Hellriegel, Jackson, Solcum & Staude, 2008; Rambe, 2018). Managerial competencies are also core abilities perceived necessary for the achievement of tasks, advancement in a career, and so-called meta-competencies that encompass them (Dowling, 2003). Even though the construct of managerial competencies is accepted as useful in examining the personal effectiveness of managers, not all competency models have been investigated by researchers; some aspects have only been examined qualitatively (Chang, Moorman & Morgan, 2006; Priola 2016). Therefore, in this study, the terms "perceived managerial competencies" and "managerial competencies" are used interchangeably throughout the discussion; and importantly, managerial competencies that form the area of interest for this study are communicative and social competencies.

2.9.1. Communicative Competency

Communicative competency is defined as the ability to communicate effectively in a variety of contexts and situations. It is the ability to understand and use language to communicate effectively and appropriately (Wiemann & Backlund, 1980; Crawford, 2006; Henderson, 2008, Priola, 2016). Although the development of this construct is more prevalent in the areas of linguistics and learning psychology, in project management it refers to the ability of the project manager to understand and communicate effectively with the project team, stakeholders and other project team members. This includes the ability to listen to, understand, and respond appropriately to the needs of the project team. Furthermore, communicative competency is key to project management as communication forms part of the major knowledge areas in

project execution. Also, the importance of using mobile technologies in project execution increases the efficiency of the project management process. Thus, the use of mobile technologies in the project execution process exerts a positive impact on the communicative competency of project managers.

2.9.2. Social Competency

Social competency is the foundation upon which expectations for future interaction with others are built, and upon which individuals develop perceptions of their own behaviour (Semrud-Clikeman, 2007; Gresham, 2018). Past and current research extends the understanding of how and why social competency is important in social development (Rose-Krasnor, 1997; Chen, 2006; Semrud-Clikeman, 2007; Balda & Sangwan, 2018; Gresham, 2018). The term "social competency" refers to "the extent to which individuals act effectively in social situations" (Hill & Roberts, 1998). Social competency is defined in the American Psychological Association's (APA) Dictionary of Psychology (2022) as the capacity to evaluate social situations and determine what is expected, to recognise the feelings and intentions of others, and to choose social behaviours that are most appropriate in that context.

The construct of social competency has been conceptualised and operationalised from diverse perspectives and theoretical orientations across various specialities (Semrud-Clikeman, 2007; Stump, Ratliff, Wu & Hawley, 2009; Gresham, 2018). Social competency in project management manifests as leadership skills, the ability to collaborate and co-operate with others, effective communication skills, and a broad range of soft skills. These skills can be expressed as a project manager's ability to manage project teams and stakeholders' expectations (both internally and externally). Therefore, there is a strong case for social competency as a core aptitude of project management.

2.10. MANAGERIAL COMPETENCIES MODELS

Models of managerial competencies have evolved over time as they attracted the attention of many scholars (Boyatzis, 1993; Spencer & Spencer, 1993; Tett, Guterman, Bleier & Murphy, 2000; Mumford, Zaccaro, Connelly & Marks, 2000a; Mumford et al., 2000b; Krajcovicova et al., 2012). There are several types of

competency models. As a result, the development of the competency model is strongly influenced by the company's intentions and strategy. This study is interested only in the communication competencies and social competencies models, as communication and social competencies are the most relevant to the interactive nature of the construction industry (Berenger & Justus, 2016).

2.10.1 Communication competency model

For the greater part of the 21st century, the quest to understand why, how, and under what conditions managers perform at their best has centred on the recurrent question, *"Are there skills or competencies that distinguish 'effective' managers from 'less effective' managers?"* (Hunt & Baruch, 2003:731). This quest culminated in the development of the Communication Competency Model, which identifies the dimensions of managerial functioning that correlate with employee performance, that is, *"top performers' knowledge, skills, and behaviours*" (Szpekman, 2000: 29). Various studies (Szpekman, 2000; 2004; 2007) utilising the Communication Competency Model demonstrate the importance of managers' communicative competency to maximise communication skills across the organisation for improved inter- and intra-organisational communication performance. This model sheds light on the use of mobile communication in facilitating the development of managerial competencies through instant feedback and the effective use of technological communications to complete tasks that improve performance and personal productivity. Thus, the three dimensions contribute to the study's argument, which is the importance of facilitating personal and organisational communication skills through the development of managerial competencies and encouraging the use of technological capabilities to improve such performance. And this can be used to identify critical competencies of ECF owners or managers that are influenced by the use of mobile technologies.

2.10.2. Mobile communication competency model

Bakke (2010) developed a model of mobile communication competence (MCC) to assess students' communicative competence in using mobile technologies (Bakke, 2010). In addition, the same researcher asserts that the dimensionality of the communication competence measure established six (6) constructs across twenty-four (24) items that are deemed critical for mobile communication competence (Light

& McNaughton, 2014). These include the individual's willingness to use, mobile preference, asynchronous communication, communication efficacy, affect, and appropriate communication. This model has shed some light into the use of mobile technologies in the construction project management context in that, it appears to be a suitable and valuable tool for purposes of measurement of communication competence and the use of technology through mobile platforms for communication. Also, for the purpose of this study, it clarifies that communication competence is an area which can also be improved by using mobile technology.

2.10.3. Social competency model

The social competency model represents a continuous and persistently cyclical process as we move from situation to situation throughout our day (Felner, Lease & Phillips, 1990; Holmes, Heckel & Gordon, 1991; Winner & Crooke, 2021). The model is predicated on the premise that we are all social beings capable of social competence in any given situation. Likewise, the model implies that we do not inherit a fixed set of social competencies but rather develop them throughout our lives (Holmes et al., 1991). Thus, in the context of project management, this model emphasises the importance of project managers honing their social competencies to be effective in their roles (Larson & Gray, 2017). This model is demonstrated in this study using mobile technologies in project management operations as a means of enhancing project managers' social competencies. Furthermore, this model emphasises the importance of social competencies for project managers in the context of mobile technologies. It explains how the use of mobile technologies during the project execution phase can influence project managers' social competence.

2.11. THEORETICAL PERSPECTIVES ON MCS

This study subscribes to Resource-Based View as a theoretical lens used to understand managerial competencies. Key terms within RBV include resources, competencies and capabilities. This study employs Peppard and Ward's (2004) view that 'resources' are combined to form 'competencies' at a functional level. These competencies reflect a bundle of skills and technologies rather than a single, discrete skill or technology. According to Makhalemele (2016) and Rambe (2018), a firm could combine knowledge and processes to develop the competency of ensuring that the

firm identifies advantageous uses of Information Systems. This theory has been discussed at length in section 2.7 of this study.

2.12. THE RELATIONSHIP BETWEEN MTS AND MCS DURING PROJECT EXECUTION

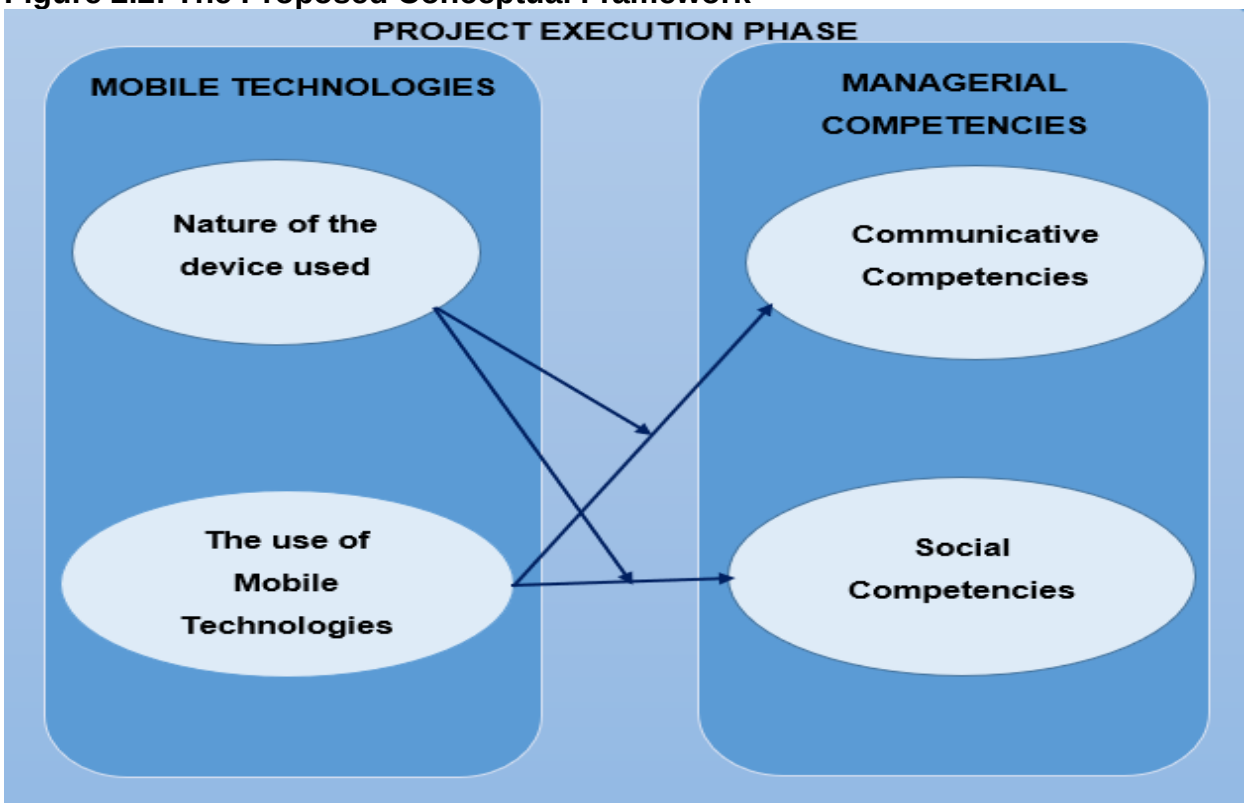
The relationship between perceived managerial competencies and mobile technologies can be expressed by reference to the Resource-Based View. The challenges faced by construction or project managers on-site (such as collecting and sharing real-time site information) have necessitated the development of tools equipped with suitable sensing and communication capabilities (Kim, Park, Lim & Kim, 2013; Succar et al., 2013; Shaw 2014). It can, therefore, be argued that the use of mobile technology has helped address some of the managerial soft skills (such as communication, leadership, and collaborative networking) required by construction project managers to deal with the vicissitudes of projects. In addition, such technologies [i.e., smartphones combined with mobile computing (such as tablets, laptops, etc.), personal digital assistant (PDA) technology, and wireless communication technology] have the potential to significantly improve collaboration and communication among the project team and enable project managers to consolidate and better utilise distributed knowledge that may reside within the extended project team (Hall et al., 2010; Succar et al., 2013). As a result, it would be expected that the adoption of MTs has shaped the managerial competencies of ECFs' owners or managers by enhancing their project management skills and managerial soft skills, especially the coordination of information and resources from all construction team members via a centralised platform. It can, therefore, be argued that MTs can be used to enhance the managerial competencies required by modern-day construction project managers. The study benchmarks the knowledge gap while answering the research question of the use of mobile technologies.

2.13. CONCEPTUAL FRAMEWORK

Drawing on the relationships already discussed, a conceptual framework was developed based on these postulated relationships. The framework assumes that the adoption of MTs by ECFs is a process that is influenced by the project's context, in this case, the project execution phase. The conceptual framework in Figure 2.2

illustrates the direct influence of the independent variable MTs adopted on-site and off-site during project execution on the dependent variable perceived managerial competencies (MCs) of ECFs, which is moderated by the nature of the device used.

Figure 2.2: The Proposed Conceptual Framework



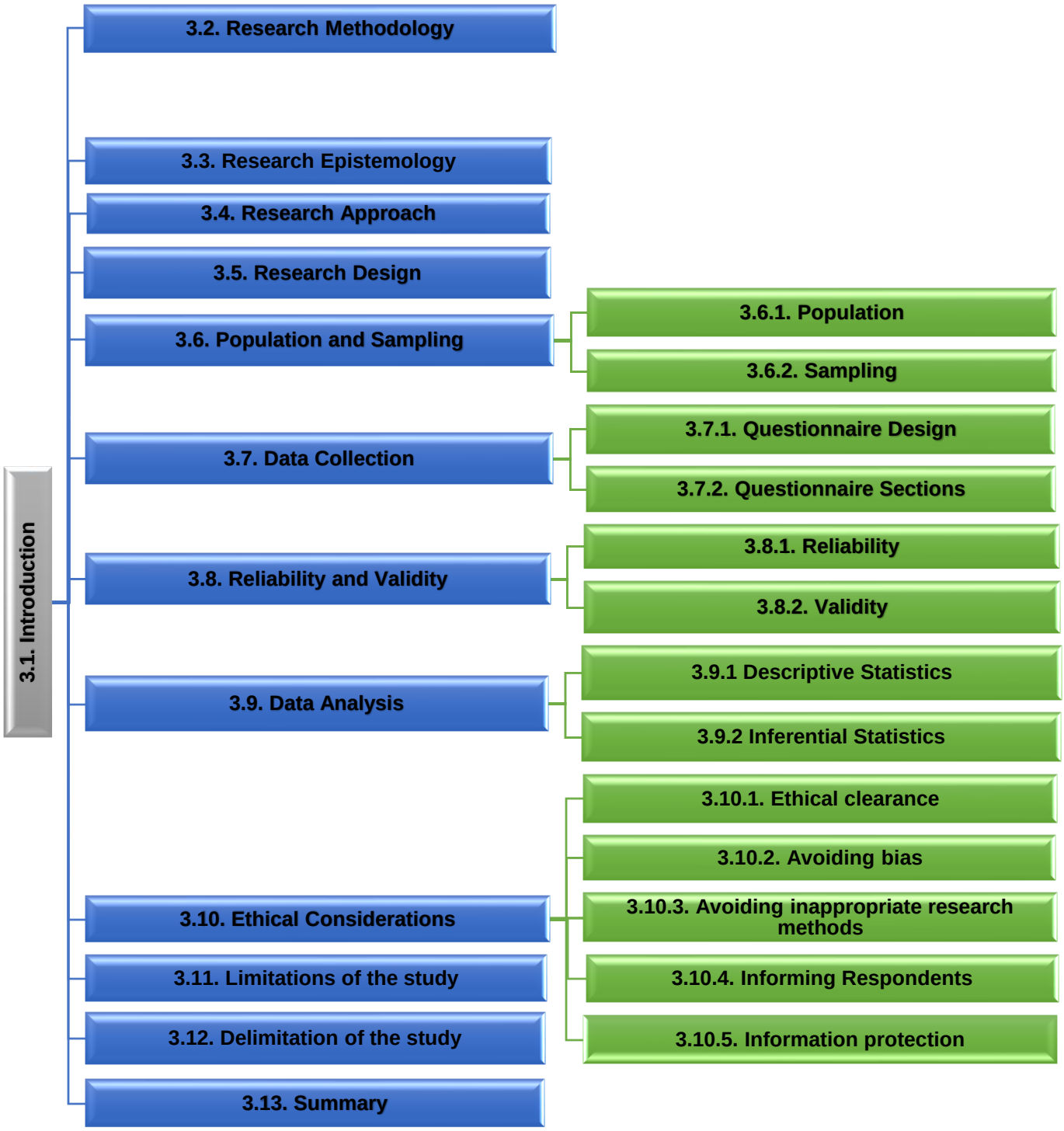
Source: Author's Own Compilation

2.14. SUMMARY

This chapter discussed the nature of mobile technologies appropriated in the construction industry. It also debated how MT adoption shapes the development of MC. Lastly, the chapter explored the role of MT adoption in project execution in construction projects. At a theoretical level, perspectives and theories on technological capabilities as manifestations of the MTs' adoption as organisational resources were also examined. The chapter concluded with a proposed conceptual model of the relationships between the use of mobile technologies and communicative competencies and social competencies. The next chapter provides a detailed research methodology for this study. It highlights how philosophical and methodological issues were considered and applied in answering the research questions.

CHAPTER 3

RESEARCH METHODOLOGY



3.1. INTRODUCTION

The preceding chapter reviewed the literature on the influence of using mobile technologies during project execution on the perceived managerial competencies of emerging construction firm owners/managers in the Free State Province of South Africa. This chapter outlines the research methodology adopted in this empirical study. The chapter outlines the epistemological stance, research approach, research design, target population, sampling strategy, research instruments, and procedures adopted in the data collection process. It also describes the data analysis and the ethical considerations applied to the study.

3.2. RESEARCH METHODOLOGY

A research methodology describes approaches, procedures, and methods used in any study to collect, analyse, and report on research data. Singh and Nath (2010) highlight that a research methodology involves general activities such as identifying the research problem, reviewing the literature, formulating research hypotheses, testing hypotheses, data collection, analysing data, interpreting results and drawing conclusions. For this study, the research methodology provided an overarching perspective on the research processes, procedures, and techniques employed in the collection, analysis, reporting, and interpretation of research data.

Leedy and Ormrod (2014) argue that the prevalence of various research methodologies necessitates the researcher to consider both the nature of the research problem and the data collected before selecting a methodology. Nonetheless, if a methodology is viewed as a strategy, plan, or a process of adopting a particular method and linking the choice of methods to the preferred outcome (Tight, 2013), then there is scope to align the detailed process of data collection to the phenomenon under investigation and the analysis of the research results.

3.3. RESEARCH EPISTEMOLOGY

An epistemological approach captures the nature of how knowledge, and the rationality of a belief are constructed, articulated, and communicated to fellow human beings. The terms "epistemology" and "paradigm" are often used interchangeably (Babbie, 2007, Sullivan, 2012; Creswell & Creswell, 2018), even though some contend

that they refer to different constructs (Mertens, 2010; Lincoln, Lynham, & Guba, 2018). For this reason, it is vital to define a paradigm. Sullivan (2012) defines a paradigm as the beliefs or set of assumptions about how a social phenomenon works and how it affects a research's overall stance. According to Hennink, Hutter and Bailey (2011), paradigms are frameworks that provide a way of comprehending social reality and these determine the methodological approach of one's research. While paradigms emphasise assumptions that shape one's conception of reality, including methodological stance, epistemology relates to beliefs about what constitutes authentic knowledge and how that knowledge is transmitted between and across individuals.

According to Blumberg, Cooper and Schindler (2014), there are two notable research paradigms for approaching research, namely positivism and interpretivism. One of the principles that underpin positivism, postulated by Blumberg et al. (2014), is that knowledge exists externally and is viewed objectively. Various scholars also claim that positivism posits that knowledge should be based on experience of the senses, which can only be obtained by observation and experiment (Blumberg et al., 2014; Creswell & Creswell, 2018; Kumar, 2019). Interpretivism (subjectivism/constructivism), on the other hand, is founded on the notion that social reality is always seen by multiple people who interpret events differently, leaving multiple perspectives relating to an incident. Interpretivism therefore emphasises the ability of the individual to construct meanings (Mack, 2010:7).

This study adopted the positivist paradigm as it allows the researcher to remain independent and take the role of an objective analyst (Blumberg et al., 2014). The intention in this stance is to determine and predict the influence of mobile technologies usage during project execution on perceived managerial competencies (i.e., owners' or managers' self-construction of their competencies) of ECFs. To the extent that this study draws on theories and a pre-determined instrument to establish associative and predictive relationships between variables based on numerical computations, a positivist paradigm best suits this investigation.

3.4. RESEARCH APPROACH

Creswell and Creswell (2018) define a research approach as the plan and the procedure for research that covers the steps from broad hypotheses to detailed methods of data collection, analysis, and interpretation. There are two main approaches that are advanced in scientific inquiry: the qualitative approach and the quantitative approach. The quantitative approach to research or knowledge, which is sometimes known as the positivist approach (Welman, Kruger & Mitchell, 2005), emphasises the use of objective measurements and testing of objective theories and the statistical analysis of data collected through questionnaires and surveys or by manipulating pre-existing statistical data using computational techniques or statistical procedures (Creswell & Creswell, 2018; Kumar, 2019). The extreme opposite of the quantitative approach is the qualitative approach, which is a flexible and unstructured approach that explores diversity rather than seeking to quantify it, by communicating the findings in a descriptive and narrative manner rather than in a numerical manner (Kumar, 2019).

In view of the nature of research questions designed to explore the descriptive aspects of mobile technologies and the correlations between variables examined, a quantitative approach was adopted in this study so that the objective reality may be captured and translated into testable statistical computations (Ling, Low, Wang & Lim, 2009).

3.5. RESEARCH DESIGN

Research design is a set of scientific actions, techniques, and instruments used to execute the research project to address the research problem and achieve the project objectives (Lues & Lategan, 2006). There are various methods the researcher uses to collect, analyse and interpret data, even though the chosen method often depends on available resources and skills (Stangor, 2011; Creswell & Creswell, 2018).

To the extent that the researcher used scientific approaches and statistical methods to address the research questions, a survey based on an in-depth structured questionnaire was employed to execute the research. This questionnaire covered a wide area and was a less expensive method of collecting data from ECFs (Kumar,

2019). A cross-sectional survey research design, which sought to gather data from a single point in time, was adopted. Cross-sectional survey research designs are useful in obtaining an overall picture at the time of the study (Kumar, 2019). The survey was also descriptive and exploratory to the extent that it sought to describe the status of the adoption of mobile technologies by emerging construction firms and exploratory as this topic was underexplored and the researcher could not determine in advance what to expect regarding the outcomes of this investigation (Kumar, 2019).

3.6. POPULATION AND SAMPLING

The selection of the study population emanates from the choice of the research design phase. A research study should ideally cover the entire population, but due to time and financial limitations, this is usually not possible. As a result, a sample is chosen that is representative of the entire population that will be the subject of the study. The population and sampling are covered in the following subsections.

3.6.1. Population

A population, which is also referred to as "the target population," is defined as the entire group of people or objects from which a sample is selected on the problem that the researcher desires to learn about (Stangor, 2011). A population can, therefore, be referred to as the total collection of elements about which the researcher wishes to make some inferences. It is important that the researcher clearly defines and describes the population of the study. The reason is to prevent generalisation about a population beyond the characteristics it holds based on a sample investigated (Creswell & Creswell, 2018). For this study, the target population comprised all SMME owners or managers of emerging contractor firms in the construction industry. According to CIDB (2017b), there are 4 537 registered emerging construction firms in the Free State. While the CIDB lists firms rather than individuals on their website, the difficulty of using firms in this study would have been that individuals who own and manage firms use MTs, participate in project execution, and have their MC tested. Thus, while firms would have been the ideal subject of investigation, individuals were deemed more appropriate for this study for the reasons previously stated.

3.6.2. Sampling

Sampling is the process of selecting a few (a sample) from a bigger group (the sampling population), which becomes the basis for estimating or predicting the prevalence of a phenomenon, situation, or outcome regarding the bigger group (Kumar, 2019). There are two general sampling strategies to choose from, namely, probability sampling and non-probability sampling. Probability sampling refers to the use of any strategy in which samples are selected in such a way that every element in the population has a known and non-zero chance of being selected (Leavy, 2017). In addition, non-probability sampling is defined as any strategy used when the number of elements in a population is either unknown or cannot be individually identified (Kumar, 2019). This study adopted probability sampling. There are four probability sampling strategies, namely: simple random sampling, systematic sampling, stratified sampling, and cluster sampling (Van Zyl, 2014).

Firstly, simple random sampling is a strategy in which every element in the study population has an equal chance of being selected (Leavy, 2017:268). Secondly, systematic sampling is a strategy in which the first element in the study population is selected randomly and then every *n*th element, after the first element, is selected (Leavy, 2017:268). Thirdly, stratified sampling is a strategy in which elements in the study population are divided into two or more groups based on a shared characteristic (these groups are called *strata*); then simple random, systematic, or cluster sampling is conducted on each stratum (Leavy, 2017:268). Lastly, cluster sampling is a multistage strategy where pre-existing clusters are randomly selected from a population and then elements in each cluster are sampled (Leavy, 2017:268).

Given the quantitative nature of the study and the research questions, which were exploratory and descriptive, the researcher adopted stratified sampling to execute this study. In stratified sampling, the research attempts to stratify the population so that each stratum is homogeneous in terms of the parameters (Kumar, 2019). Even though time-consuming and tedious (Van Zyl, 2014), this sampling ensured a high degree of representation in the sample as strata based on the age of the business and gender were considered. The CIDB grading of firms and their years in business were used to characterise each stratum and these are discussed in detail in the demographic section in chapter 4 (see section 4.3). This allowed for increased representativeness

of the sample and allowed for generalisability of the results. Using a sample size calculator obtained from surveysystem.com, a target population of 4 537 owners/managers at a confidence level of 95%, a margin of error of 5% and a sample response distribution of 50% generated a sample size of 252 owners /managers. The researcher, however, collected data from 300 owners/managers to cater for possible low response rates.

3.7. DATA COLLECTION

As already indicated, the researcher used structured questionnaires to collect data. A questionnaire, maintains Stangor (2011), is a set of fixed-format, self-report items that are completed by respondents at their own pace, often without supervision and provides a basis for generalising and gives some degree of statistical power. In a closed question the possible answers are set out in the questionnaire guide and the respondent ticks the category that best describes the respondent's answer (Kumar, 2019). The duration for completion of online questionnaires (Question Pro) given to respondents was 6 weeks from the date of distribution. However, the researcher extended it to 12 weeks due to the slow pace of responses. Since the December 2019 recess period for construction firms disrupted the data collection process, the researcher employed three trained research assistants to deliver and administer questionnaires for all five districts of the Free State province.

Quantitative data collection methods were employed in consistency with the positivist epistemology. An in-depth structured questionnaire, which consists of 69 closed-ended questions, whose purpose was to gain ECF owners /managers' perspectives and views on the influence of the use of mobile technologies during project execution on perceived managerial competencies (Delport & Roestenburg, 2011), was used. Stangor (2015) states that quantitative data is collected using systematic methods and the data are analysed using statistical techniques. Five-point Likert scale questions (1 – strongly disagree to 5 – strongly agree), which are widely used for asking respondents about the extent of agreement with predetermined statements (Pietersen & Maree, 2016) were employed in this study. A Likert scale is an ordinal measure of a person's attitude or perception towards a subject of interest (Pietersen & Maree, 2016).

It is the most preferred tool in statistical studies, easy and economical to use (Van Zyl, 2014; Kumar, 2019).

3.7.1. Questionnaire design

Questionnaires commonly comprise several measurement scales and closed questions that provide valuable quantitative data on demographics and other variables explored in the study. McMillian and Schumacher (2010) also view the use of a questionnaire as relatively economical because it has the same questions for all subjects, which ensures uniformity on the issues respondents address and can ensure anonymity as no personal details such as company registration number, identity document number, or CIDB registration number are required.

3.7.2. Questionnaire sections

The structured questionnaire comprised a cover page which outlined the purpose of the study, including a description of the respondent's rights and exhortation to complete the questionnaire, including names of persons who could be contacted to authenticate the investigation. The rest of the questionnaire was divided into sections covering personal demographics, descriptive questions, and other individual variables amenable to correlations and predictions tests. The questionnaire comprised 69 items on a Likert scale format. In addition, the questionnaire was developed based on the research questions extracted from the proposal. It also drew on concepts extensively discussed in the literature review to ensure the validity of the instrument. As already highlighted, the questions were divided into four sections, as presented below.

Section A: This section sought to collect personal demographic data. As a result, the questions requested information about the SMME owner/managers' gender, age, race, nationality, highest academic education, roles in their businesses, and the nature of business ownership.

Section B: This section collected data on the use of mobile technologies by the owners and managers operating the ECFs.

Section C: This section collected data on the use of MTs during the project execution processes. The variables measured in this section included use of MTs during project execution activities identified in the literature (see section 2.7 of the literature review) such as cost management, quality management, risk management, procurement management, and communications management. It was postulated that the use of MTs during the execution of these aspects of project execution has the potential to shape different dimensions of managerial competencies, such as communicative and social competencies.

Section D: This section collected data on managerial competencies. The variables which were measured are communicative and social competencies, those which literature deemed most critical to both the construction industry due to its dependence of multiple stakeholders for its operations including demands for multiple social engagements within organisations and across sectors.

3.8. RELIABILITY AND VALIDITY

For the survey results to be meaningful, they should at all material times adhere to the two characteristics of reliability and validity. To obtain valid and reliable data, one must ensure that the measurement procedures and instruments of measurement have adequate levels of reliability and validity (Delport & Roestenburg, 2011). Furthermore, Delport & Roestenburg (2011) and Pietersen & Maree (2016) describe measures of validity and reliability as dealing with designing measures and instruments that allow generalisability of results and internal consistency of measures.

3.8.1. Reliability

Stangor (2011) maintains that the reliability of a measure refers to the extent to which it is free from random error. It is reliable if it can be applied several times and produces the same results (Ray, 2012). According to Van Zyl (2014), the standardised tests used in most research projects generally have reliability coefficients in the 0.80 to 0.90 range. Thus, this study regards survey results as reliable should the Cronbach alpha coefficient, a measure of instrument reliability, be in the 0.80–0.90 range. In the case of this study, the reliability of items ranged from the use of mobile technologies during

project execution to social competencies, showing a high level of internal consistency. The Cronbach alpha coefficient for this study, therefore, is 0.973.

3.8.1.1. Internal consistency

Internal consistency refers to the extent to which items on a test or instrument measure the same thing. Internal consistency requires running the instrument once through the split half method, in which the test items are divided into two halves and the researcher must match the difficulty and content of each half (Cohen, Manion & Morrison, 2018). Split half reliability requires a high degree of correlation between the marks obtained on each half. A correlation coefficient is used to make the comparison (Pietersen & Maree, 2016).

When a collection of items is developed for a particular instrument, there should be a high degree of similarity between them, as they are intended to measure the same construct. Internal consistency (or reliability) is determined by correlations between items (Pietersen & Maree, 2016). If the items are highly correlated, their internal consistency is high, and their alpha coefficient approaches one (details in the next chapter, section 4.4.1-Table 4.1). Other measures of internal consistency include test-retest reliability and equivalent form reliability, neither of which is relevant to this study.

3.8.2. Validity

Validity refers to the extent to which the measured variable measures the conceptual variable (that is, the construct) that it is designed to measure (Stangor, 2011). As required, exploratory factor analysis was conducted to ensure the convergent validity of items that constitute the constructed mobile technologies. The content validity of the instrument was ensured by drawing on a comprehensive literature review in the development of the constructs and their corresponding scales. The researcher further ensured content validity by sending the research instrument to the supervisor and statistician to cross-check the completeness of the constructs and the scales applied to them. The supervisor and statistician commented on the instrument, and their comments were incorporated into the design of the final research instrument.

The following factors were taken into consideration: consistency, question-wording, question structure, the period of reference, and placement of questions.

- Consistency: the researcher ensured that the style and method of questioning were the same across the entire survey, topic, or subject (Van Zyl, 2014).
- Question-wording: the researcher avoided the use of complex words, technical terms, jargon, and phrases that were difficult-to-understand (Van Zyl, 2014).
- Question structure: the researcher ensured that each question was easy for the respondent to comprehend (Van Zyl, 2014).
- Period of reference: the researcher made his questions as explicit as possible and did not leave it to each respondent to guess how far back they should remember (Van Zyl, 2014).
- Placement of questions: the researcher placed the questions in a systematic and logical order as per the subject or variables being measured (Van Zyl, 2014).

3.9. DATA ANALYSIS

Quantitative data analysis is helpful in evaluation because it provides quantifiable and easy-to-understand results, and it can be analysed in a variety of ways. To the extent that this study sought to investigate the influence of mobile technologies used during the project execution and its impact on managerial competencies of emerging construction firms, it adopted descriptive statistics and inferential statistics to analyse the data, which allowed the researcher to get an accurate impression of what the data looked like (Van Zyl, 2014). For the analysis of the data, SPSS version 23 computer software, which enabled the researcher to further analyse the data for correlation and regression of variables to test the hypothesis, was employed for the analysis of the data. This program worked best in the computation of all statistical data.

3.9.1. Descriptive statistics

Descriptive statistics are used to summarise a body of data (Sekaran & Bougie, 2013:282; Salkind, 2014:229) in the form of the central tendency construct. In this study, the descriptive statistics produced were frequencies and percentages, which

were displayed in tables, pie charts, and bar charts. The next chapter provides the details of the descriptive statistics used.

3.9.2. Inferential statistics

Inferential statistics allow researchers to generalise from samples to large populations (Leedy & Ormrod, 2014:275; Salkind, 2014:229). According to Leedy and Ormrod (2014:275) and Salkind (2014:247), this method has two main functions: to estimate population parameters from a random sample and to test the statistical hypothesis. Even though the current study did not test hypotheses, each question can be converted to a hypothesis to test and establish correlational and regression results.

Inferential statistical techniques are categorised into two, namely, parametric and non-parametric. The type used by a researcher is dependent on the nature of questions, the extent of precision sought, sample size, and the normality of data. Parametric statistics are used if data is collected on a scale (interval and ratio), while non-parametric statistics are used if data is collected on a categorical scale (nominal and ordinal). As indicated earlier, the Likert scale was used to collect data, which produced ordinal data (Leedy & Ormrod, 2014:275; Salkind, 2014:247). As a result, non-parametric statistics in the form of the Kruskal-Wallis H test was used to test if there were statistically significant differences between the variables tested (Keller, 2012:757; Black, 2013:709). In addition, a post hoc test was performed to determine which groups differed from each other using the Kruskal-Wallis H test. Details are provided in the next chapter of the study.

3.9.3. Standard multiple regression analysis

The standard multiple regression statistical technique was used to analyse the data in this study. This statistical approach was adopted because the dependent variables of the model are continuous (Pallant, 2016). According to Pallant (2016), multiple regression allows for the investigation of the relationship between multiple independent variables and a single dependent variable, making it an appropriate method for analysing complex data sets. In addition, this technique can help the researcher identify which independent variables have the strongest influence on the dependent variable. Standard multiple regression assesses the simultaneous

predictive power of an independent variable (the use of mobile technologies during project execution) on dependent variables (communicative and social competencies) (Pallant, 2016). Furthermore, the researcher examined the possible causal linkage between statistical variables by using various aspects of the distribution of scores and the nature of the underlying relationship between the variables, such as standardised path coefficients, normality, linearity, homoscedasticity, and residual independence. Details are in the next chapter.

3.10. ETHICAL CONSIDERATIONS

When collecting data from respondents, the researcher should always comply with the code of conduct for their professional association (Creswell & Creswell, 2018). Research ethics involves requirements for research work, the protection of dignity of participants, publication of the information in the research, and ethical implications of their research for the mitigation of negative risks, prejudices, and undesirable consequences on subjects that may arise from the conduct of their research (Fouka & Mantzorou, 2011).

For this study, ethical issues considered by the researcher were: ethical clearance, avoiding bias, avoiding inappropriate research methods, informing respondents of the purpose of the study, respondents' voluntary participation, and respondents' information protection.

3.10.1. Ethical clearance

The researcher obtained the necessary ethical clearance by applying for approval from the Business Research Committee (BRC) and Faculty Research and Innovation Committee (FRIC) in the Faculty of Management Sciences at the Central University of Technology Free State (CUT, Free State) before administering the questionnaire to participants.

3.10.2. Avoiding bias

Kumar (2019) describes bias as a deliberate attempt either to hide what the researcher has found in his study, or to highlight something disproportionately. In this regard, the researcher avoided bias in the way he interpreted the findings based on his training

and professional background. He attempted to report data with sincerity, candidly, with clarity, completeness, and precision such that no critical information deemed worthy of reporting was hidden. No information of less significance was unnecessarily emphasised or of significance was under reported on and hence, no disproportionate reporting was tolerated in this study.

3.10.3. Avoiding inappropriate research methods

It is unethical to use a method or procedure that the researcher knows to be inappropriate to prove or disprove something that the researcher wants to, such as selecting a highly biased sample, using an invalid instrument, or drawing wrong conclusions deliberately (Kumar, 2019). The researcher avoided using inappropriate research methodology by not drawing on a biased sample and not using invalid instruments. The researcher maintained his obligation to use appropriate methodology.

3.10.4. Informed consent

Informed consent implies that respondents are made aware of the type of information a researcher elicits from them, the reasons for it being sought, for what purpose, how they are expected to participate in the study, and how it directly or indirectly affects them (Kumar, 2019). To this extent, the ECFs who responded to the study were informed of the purpose of the study, that their data would be used for the development of my dissertation, and that one article would be published from the work reporting on the study results in aggregate form to protect respondents' identities. The researcher also assured respondents that no financial benefit would accrue directly to him from their active participation. Also, the responding ECFs were informed that participation in the study was voluntary and, therefore, respondents could withdraw from the study without any potential sanctions or risks.

3.10.5. Information protection

The researcher needs to ensure that after the information has been collected, its source cannot be identified by participants as well as third parties who share the results of the study (Kumar, 2019). Thus, in this study, the ECFs' identities were protected for their dignity, safety, and security and from law enforcement agencies

such as SARS, even though none of them was of a criminal nature. Information received from responders was not used in a manner that harmed the firms directly or indirectly to ensure the reputation of the firms stayed intact. This study was conducted considering all other ethical issues in social research not mentioned in this chapter.

3.11. LIMITATIONS OF THE STUDY

This study was restricted to registered CIDB ECFs only in the Free State Province. The choice of random samples can, therefore, improve representativeness and, thus, generalizability. The researcher relied on trained research assistants to have questionnaires delivered and administered. This can be a limitation as it may be speculated that the researchers might have influenced participants in some way. A detailed discussion of the limitations of this study is in section 5.6 of this dissertation.

3.12. DELIMITATION OF THE STUDY

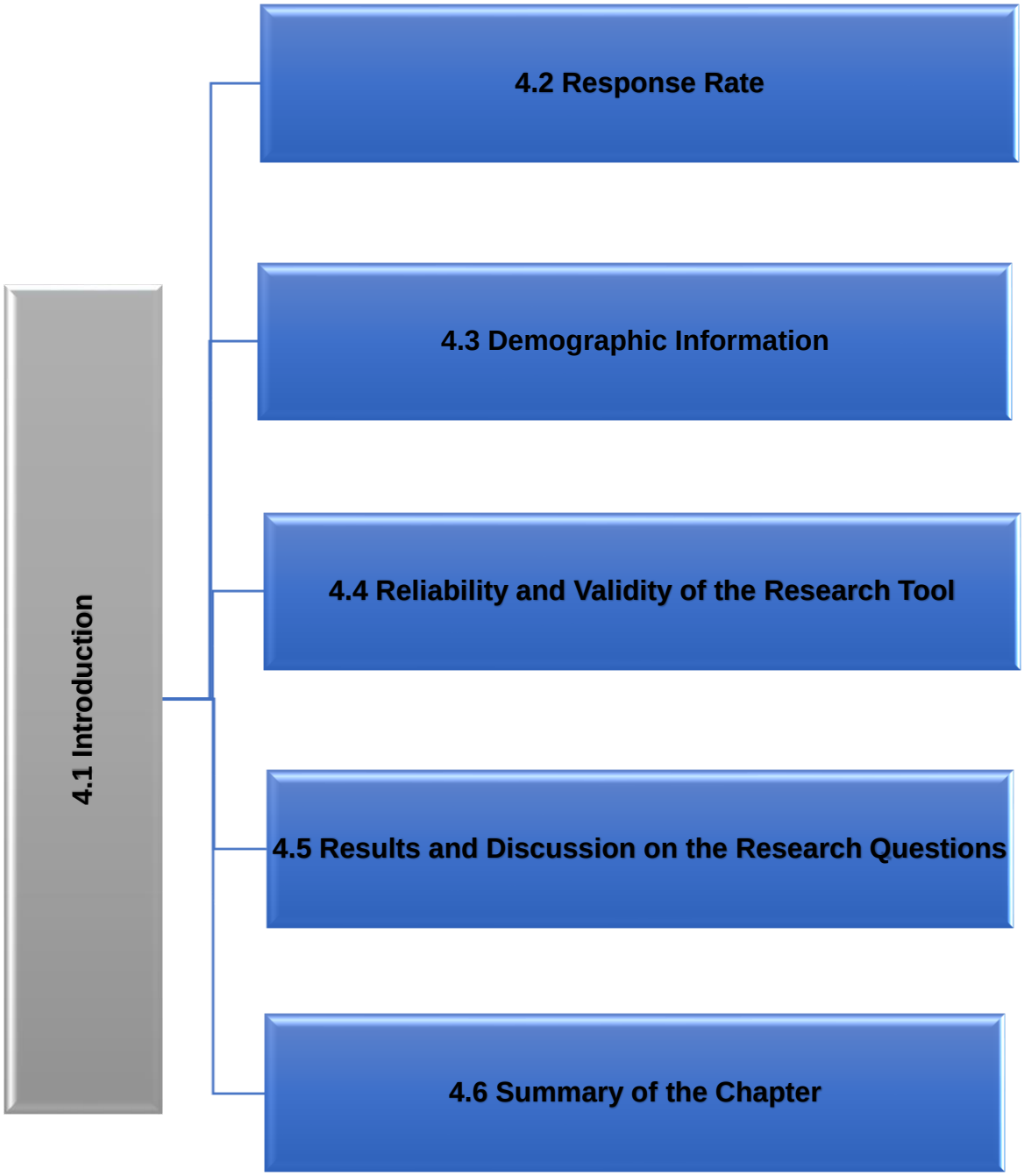
The study only focuses on CIBD registered ECFs in Xhariep, Thabo Mofutsanyane, and Fezile Dabi, Lejweleputswa District Municipalities, and Mangaung Metropolitan Area. As such, the extent of generalisation to the entire population of Free State province is limited.

3.13. SUMMARY

This chapter focused on the research methodology that was followed in the study. In line with the positivist epistemology, quantitative research, survey design, and analysis were used. The data collection methods and the instruments used were also described in the chapter. In addition, data generation and analysis procedures were discussed. Ethical issues that were considered in the research process were also presented. Issues relating to the validity and reliability of the questionnaire were discussed. The next chapter presents and discusses the empirical findings of the study.

CHAPTER 4

RESEARCH RESULTS AND DISCUSSION



4.1 INTRODUCTION

The previous chapter on research methodology provided a detailed account of the research design employed in this study. This chapter presents and discusses the results of the study. To understand the findings better, the chapter specifies the analysis that was conducted and includes descriptive analysis, reliability and validity analysis, correlation analysis, and multiple regression analysis. In short, the chapter is subdivided into the data analysis and subsequent discussion of the findings.

4.2 RESPONSE RATE

Drawing on the datasets from the Construction Industry Development Board (CIDB), it was established that there were 4 508 active registered emerging contractor firms (ECFs) in the Free State Province. Drawing on this dataset, a sample of 252 was deemed sufficient for the analysis. Therefore, the study targeted 300 respondents from ECF owners and managers across the Free State province to mitigate a possible low response rate. Even though the sample was extracted from ECF businesses, it was necessary to conduct the study on owners and managers as they were the individuals whose knowledge of construction and project management processes was tested in the study.

Only 222 out of the 300 questionnaires sent out were correctly filled out and returned, representing a response rate of 74%. Saunders, Lewis and Thornhill (2012) argue that the ideal scenario is to have samples that are representative of the population from which the data is collected. Saunders, et al. (2012) further observes that there is also a possibility of non-response even though a high response rate reduces the risk of non-response bias. In addition, Bryman & Bell (2011) argued that a response rate of 50% is acceptable for data analysis. It was therefore, assumed that the response rate of 74% was high enough for detailed data analysis (McBurney & White, 2009).

4.3 DEMOGRAPHIC INFORMATION

The profile of the respondents is presented in this section. Frequency tables are used to determine the demographic profile of the respondents. Demographics include gender, age, ethnic group, home language, the highest level of qualification, the highest level of education in construction, the highest level of training in project

management, the highest level of training in business, role in business, type of business ownership, CIDB contractor grade, number of years in business, number of employees, and the sector in which the business is most active.

4.3.1 Gender of respondents

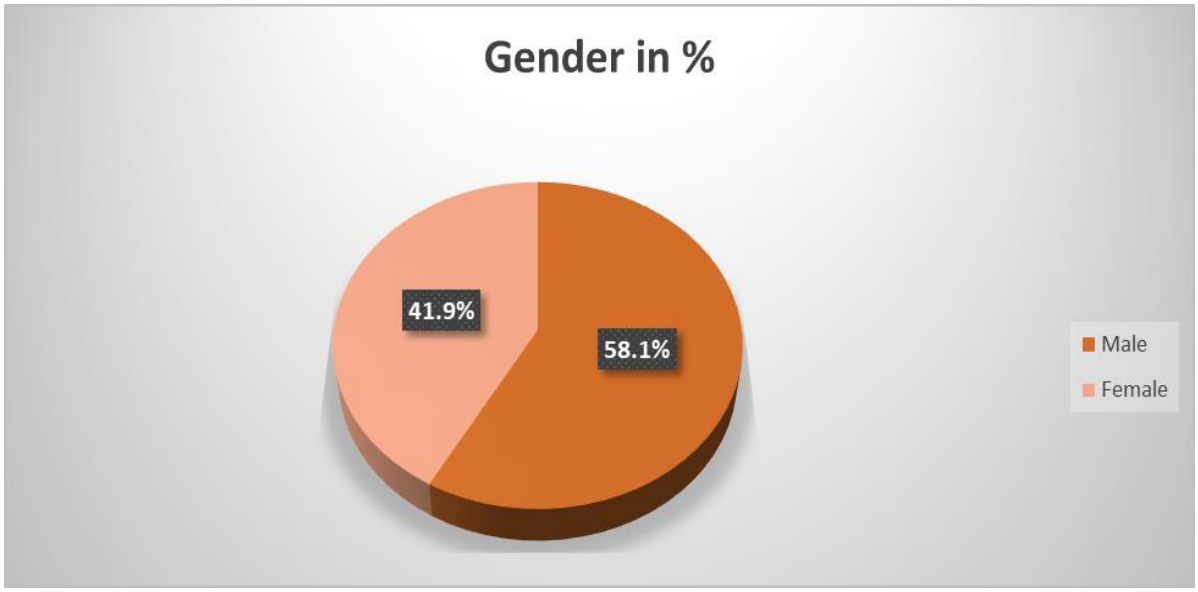


Figure 4.1: Gender of Respondents

The demographic results in Figure 4.1 illustrate a moderate representation of male owners/managers of ECFs (58.1%) compared to their female counterparts, who constituted 41.9% of the respondents. The moderate preponderance of men over women could be attributed to the fact that the construction business is a male-dominated industry. However, the current narrowing gap between these two groups in relation to the 1994 period when male representation was more dominant suggests that females are becoming more involved in industries that were traditionally patriarchal fields (CIDB, 2019b).

4.3.2 Age distribution of respondents

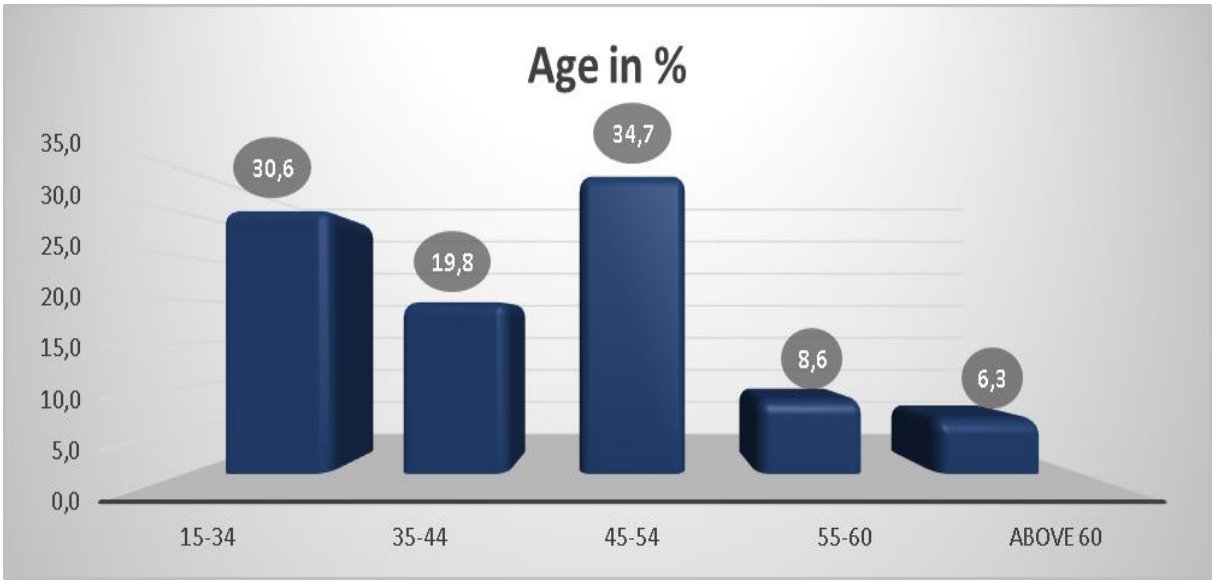


Figure 4.2: Age distribution of respondents

Regarding age distribution, Figure 4.2 depicts that the majority (85.1%) of ECF owners and managers who participated in the study are between the ages of 15 and 54 years. This assertion is in line with the Stats-SA (2019) Quarterly Labour Force Survey report. This implies that most owners and managers operating ECFs in the Free State province comprise young to mature adults. The considerable youth representation in this sample could be explained by a sizeable youth presence in the province (Stats-SA, 2019b; South Africa, 2021). Overall, evidence suggests that there is some significant youth participation in the construction industry in the Free State.

4.3.3 Ethnic group of respondents

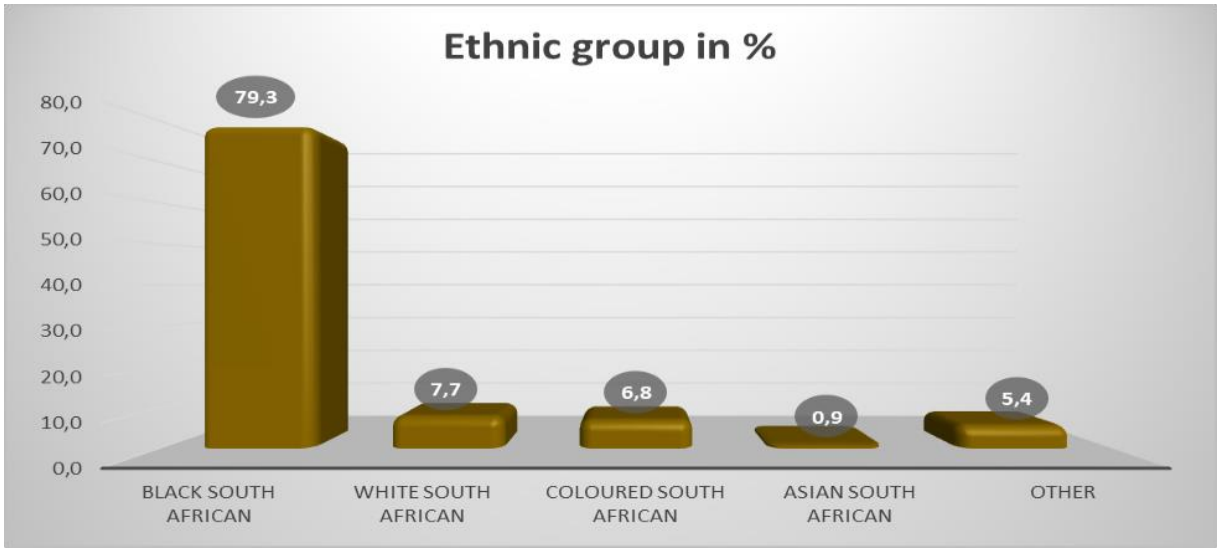


Figure 4.3: Ethnic group of respondents

The results in Figure 4.3 indicate that the majority of the emerging construction firm owner/managers who participated in the study are black South Africans (79,3%), whilst white and coloured South Africans make up 7,7% and 6,8% respectively. This is expected since the emerging construction programme targets individuals from previously disadvantaged population groups. This assertion is supported by the Annual Report of 2019-2020 presented by the Construction Industry Development Board, reporting black-ownership levels of 51% (CIDB, 2020a). The dominance of blacks also signals the general population structure in the Free State province, which is largely black dominated (CIBD, 2020a; South Africa, 2021). In addition, 5,4% and 0,9% represent other nationals and Asian South Africans, respectively.

4.3.4 Home language

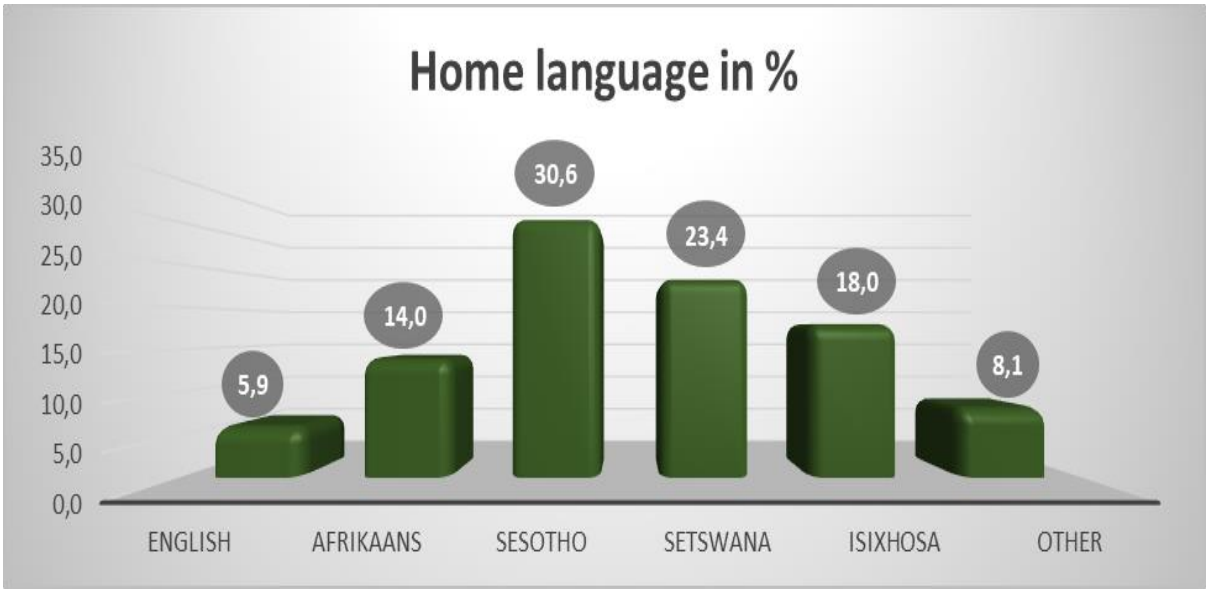


Figure 4.4: Home language

Regarding home language, Figure 4.4 indicates that the majority (68%) of the respondents are Sesotho, Setswana, isiXhosa, and Afrikaans native speakers, which are native languages spoken in the Free State according to the City Population Report (South Africa, 2021). In addition, 8,1% and 5,9% represent respondents speaking other languages and English. Since the speakers of Sesotho, Setswana, and isiXhosa languages are predominantly black, it would be anticipated that access to mobiles for business must align with the population structure of the province so that the majority (previously disadvantaged groups) are not further disadvantaged in business (Etu.org.za, 2021).

4.3.5 Highest level of qualification

Figure 4.5: Highest level of qualification

The results in Figure 4.5 above show that the majority (87%) of the respondents have matric, FET or equivalent qualifications and a university degree/diploma, whilst 3,2% have postgraduate qualifications. In addition, 13,1% of the respondents have primary schooling and no formal education. This result shows that most ECFs possess some high educational standards, supporting the CIDB requirement that CIBD contractor grades 1 to 6 must have the minimum formal qualifications [Trade Test (including Foreman Certificate), National Diploma, B-Tech and higher qualifications] to be involved in the construction industry (Martin, 2010; CIDB, 2011).

4.3.6 Highest level of education in construction

Figure 4.6: Highest level of education in construction

The demographic results in Figure 4.6 above illustrate that 83,8% of the ECFs respondents who took part in the study have an apprenticeship or short-course undergraduate level of education in construction, whilst 2,7% of the ECFs respondents have a postgraduate level of education in construction, respectively. Only 8,6% and 5,0% of the ECF respondents have a high school certificate and no level of education in construction. This shows that ECFs are choosing career pathways that may require less time investment than others (e.g., postgrad qualification). The reason for this is that ECFs are highly time-conscious ventures due to the fusion of managerial and ownership roles in one person, which speaks to the structure of SMMEs.

4.3.7 Highest level of education in project management

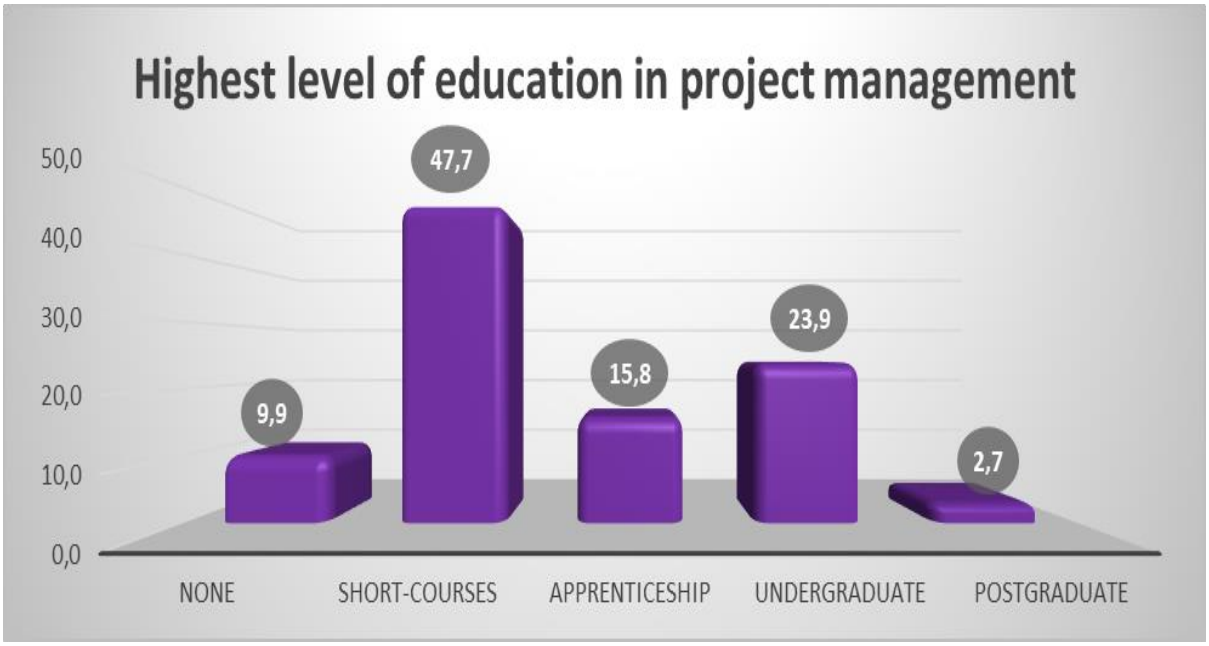


Figure 4.7: Highest level of education in project management

The results in Figure 4.7 show that the majority (71,6%) of the ECFs respondents who participated in the study have short-course training and undergraduate degrees in project management, whilst 15,8% and 2,7% of the respondents have apprenticeship and postgraduate training in project management. Moreover, the results reveal that 9,9% of the respondents have no knowledge of project management. This shows that ECFs are choosing career pathways that may require less time investment than others (e.g., apprenticeships and postgraduate qualifications).

4.3.8 Highest level of business training

Figure 4.8: Highest level in business training

The results depicted in Figure 4.8 indicate that the majority (56.8%) of respondents have a short course level of business training, whilst 8.1%, 20.3%, 7.7% and 2.3% of respondents have a similar level of business training at apprenticeship, high school, undergraduate and postgraduate level, respectively. The results further show that only 5.0% of respondents have no level of business training. The interesting feature of the results is that a short course qualification is the most preferred, followed by an undergraduate qualification and then an apprenticeship. The order of preference can be attributed to time constraints in enrolling for higher qualifications and the increasing importance of a college or university qualification, such as an undergraduate degree.

4.3.9 Role in the business

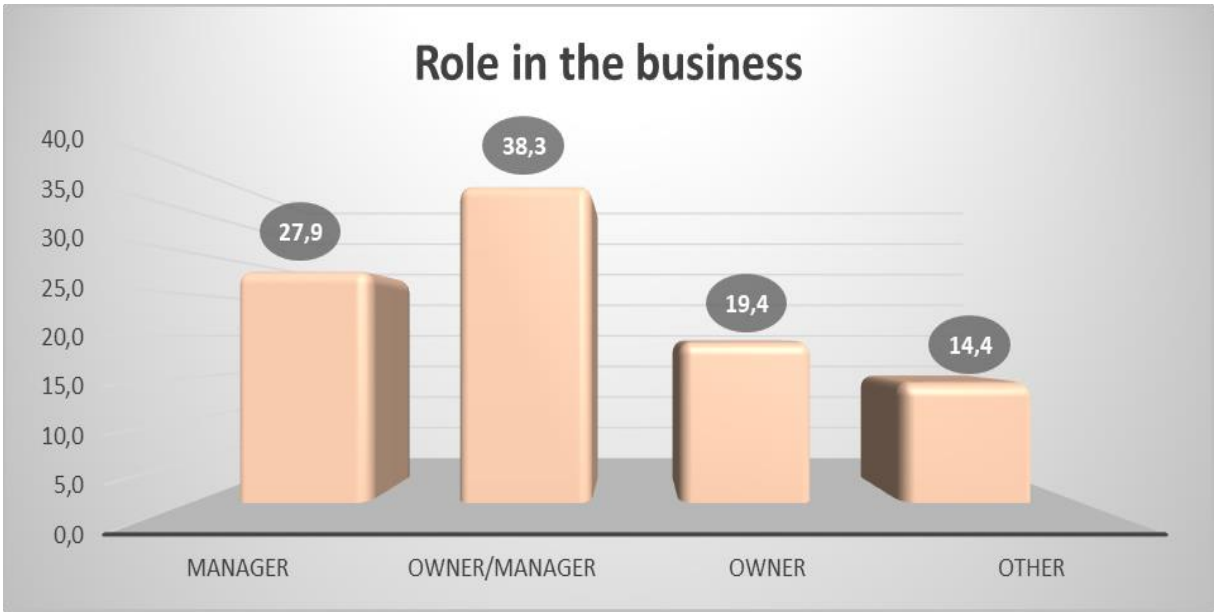


Figure 4.9: Role in the business

The demographic results in Figure 4.9 show that 38,3% of the respondents are owners/managers of ECFs and that 27,9% and 19,4% of the respondents are owners and managers of the ECFs. In addition, 14,4% of the respondents have other roles within the business of ECFs. The results suggest that the majority (57,7%) of owners are responsible for managing the company. It shows that in small businesses, the management and ownership roles are fused into one individual for various reasons. These include minimising costs of operations, a bootstrapping strategy, and the difficulty of paying salaries for a large staff complement (Makhalemele, 2016). Ownership and management, both complex responsibilities, are welded into one individual and role, thus complicating the structural organisation of the ECFs.

4.3.10 Type of business ownership

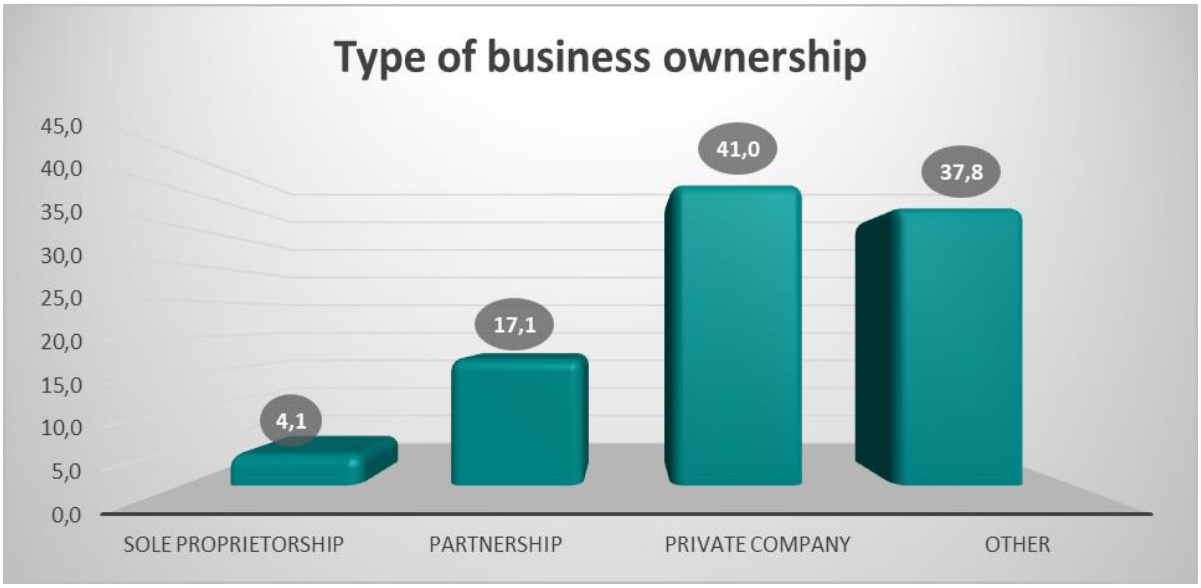


Figure 4.10: Type of business ownership

The results in Figure 4.10 demonstrate that 41% of ECF owner/managers operate a private company type of ownership, whilst 37,8%, 17,1%, and 4,1% of ECF owner/managers operate in other, partnership, and sole proprietorship types of ownership. The preference for the private company ownership can be explained by the need for formalisation of businesses as a requirement for the disbursement of funding by public funding agencies (Falkena, et al., 2022). It can also be explained by the easy and quick process with which this institutional arrangement can be created (Companies and Intellectual Property Commission (CIPC), 2022). Furthermore, it elucidates the importance of distinguishing individuals and companies as legal entities for administrative and accounting processes, which is critical for efficient business functioning that prevents the flow of funds between the owner and business (Companies Act, 71 of 2008).

4.3.11 CIDB contractor grade

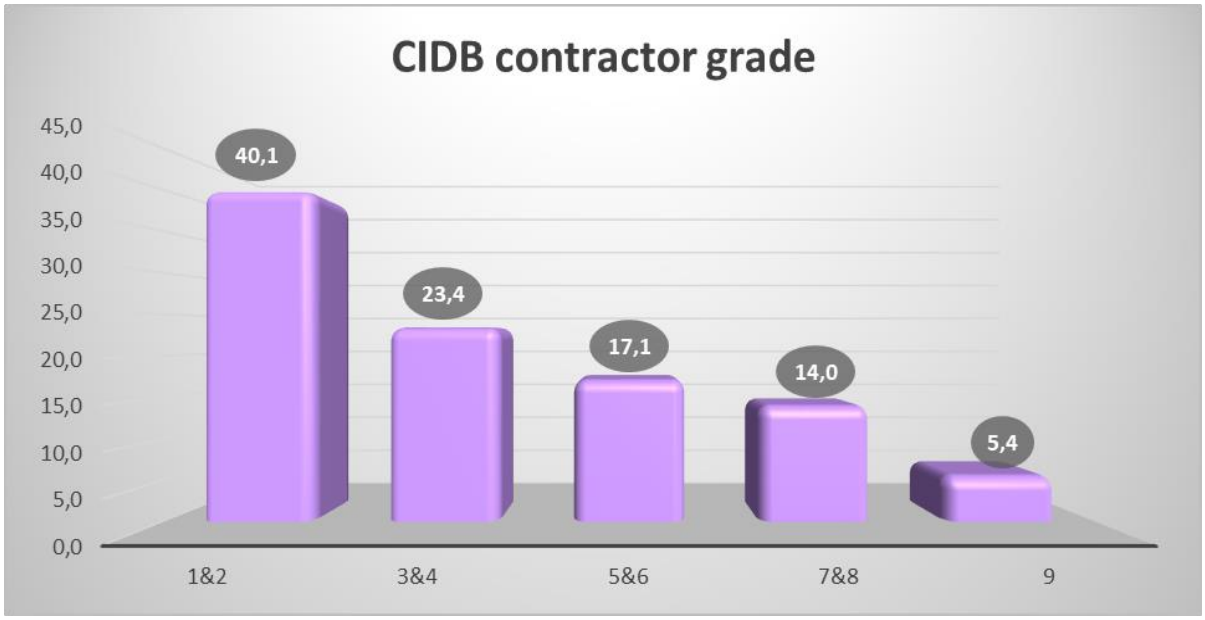


Figure 4.11: CIDB contractor grade

As indicated in the results (Figure 4.11), 40,1% of the respondents have 1 and 2 CIDB contractor grades. Also, results indicate that 23,4%, 17,1%, 14%, and 5,4% of the respondents have 3 and 4, 5 and 6, 7 and 8, and 9 CIDB contractor grades. The fact that most respondents (80,6%) fall within grades 1 to 6 suggests that most businesses have not accumulated much in terms of asset value or the size of businesses to acquire high grades such as 7 to 9. This observation is supported by CIDB's (2019b) Q2 Construction Monitor Report that highlights that most construction businesses have not matured in terms of BBBEE legislation expectations (e.g., asset value, number of employees, market share etc.) to allow for transition from the lower grade often associated with new companies (Organisation for Economic Co-operation and Development (OECD), 2015; CIDB, 2019b).

4.3.12 Number of years in business

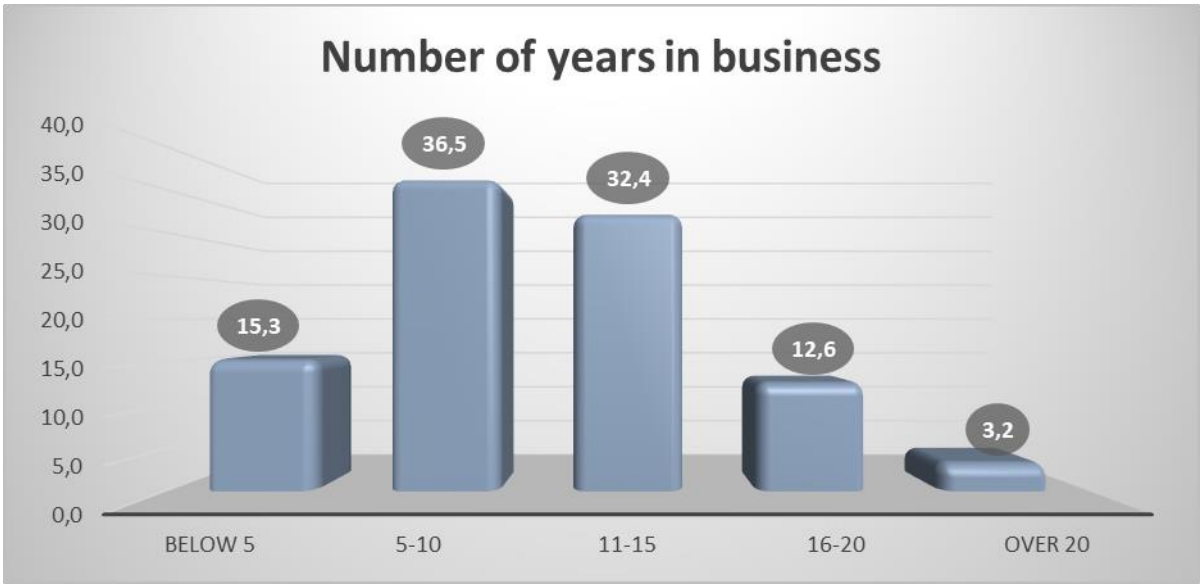


Figure 4.12: Number of years in business

The results shown in Figure 4.12 below indicate that the majority (68,9%) of ECF owner/managers have been in the business for 5-15 years. Yet other owner/managers indicated that they have been in the business of construction for 16-20 years, over 20 years, and less than 5 years, respectively. It shows that while most businesses have overcome newness and have survived, the rest are either fledgling businesses or are well established (i.e., over 20 years) pointing to their different levels of resilience given the tough construction environment in SA. This may speak to challenges in growth and decline since the industry has been struggling to grow by creating more income and generating employment opportunities (CIDB, 2019a). The survival of such enterprises also shows some magnitude of difference since the end of apartheid and the more positive support rendered by the policies on deregulating such ventures.

4.3.13 Number of employees

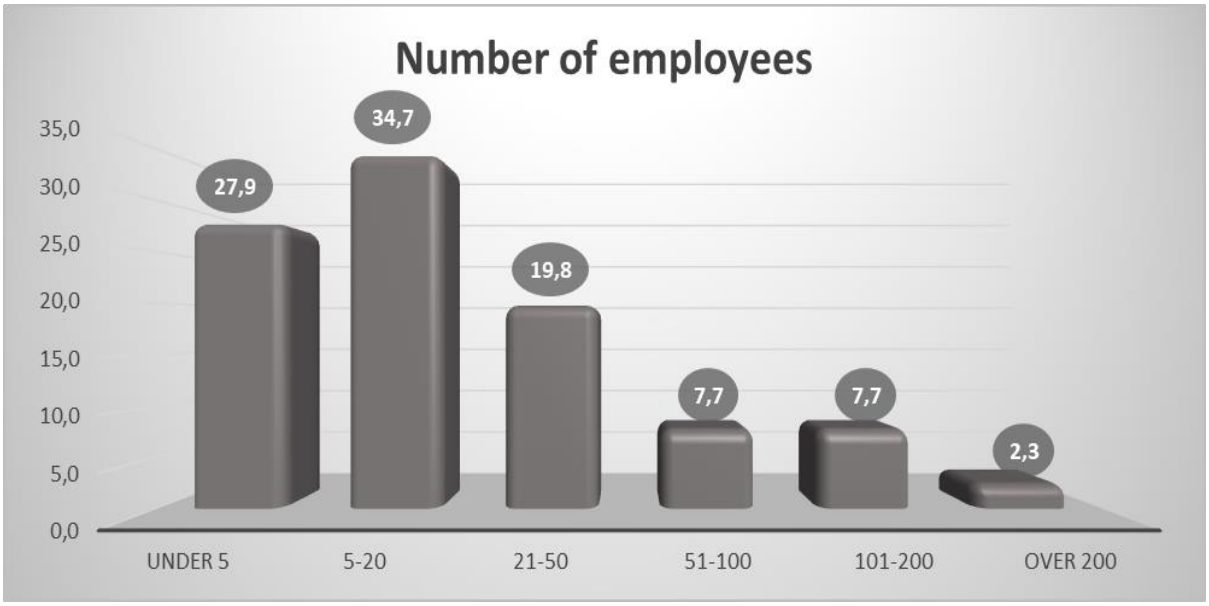


Figure 4.13: Number of employees

The demographic results in Figure 4.13 illustrate that 82,4% of the construction firm owner/managers have less than 50 employees in their organisations. Despite most firms having survived for between 5-15 years, the fact that most could only employ less than 50 employees demonstrates that their transition from newness may not have significantly developed their book value (financial) and thus allowed them to employ more people. This could be attributed to their operating in a difficult environment, limited market opportunities to support growth in terms of profits and the capacity to employ more people (National Treasury, 2019; Leibbrandt, Woolard, McEwen & Koep, 2022).

4.3.14 Sector in which the business mostly takes the projects

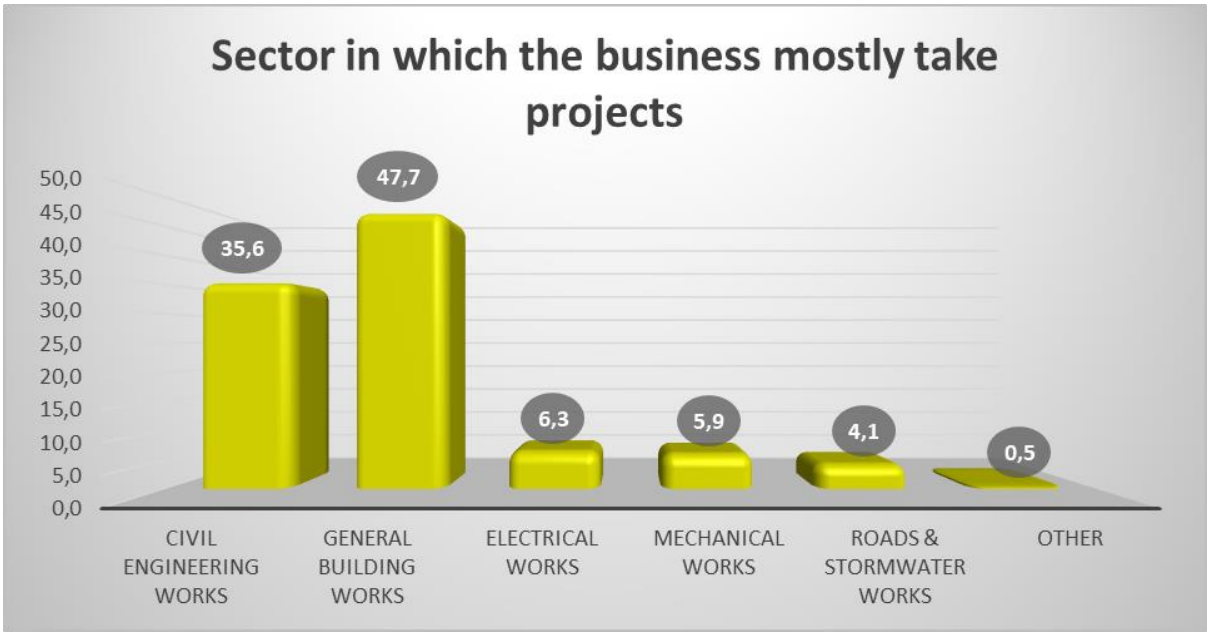


Figure 4.14: Sector in which the business mostly takes the projects

The results in Figure 4.14 show that the majority (83,3%) of construction business owners/managers who took part in the study undertook projects from the civil and general building sectors. This could be reflective of the large infrastructure development projects operational in the country and construction projects that are dominated by small businesses because they are funded by public agencies under BBBEE and public preferential policy for small businesses (Watermeyer & Phillips, 2020). Other respondents mostly undertake projects in electrical (6,3%), mechanical (5,9%), roads and stormwater (4,1%) and other projects in the construction industry (CIDB, 2019c; Stats-SA, 2019b; CIDB, 2020b; Stats-SA, 2020).

4.4 RELIABILITY AND VALIDITY OF THE RESEARCH TOOL

Before using the constructs to test the research hypotheses, it is important to first establish their reliability and content validity. Reliability is the degree of internal consistency of a set of questions (items) related to a construct (Pallant, 2016). Therefore, each characteristic will be outlined in the next subsection.

4.4.1 Reliability and Content validity

The reliability of the construct is commonly assessed through the Cronbach alpha, which must be above 0.7 (although 0.6 is sometimes acceptable) (Hair, Wolfinbarger,

Ortinau & Bush, 2014). Furthermore, content validity is defined as the degree to which items in an instrument reflect the content universe to which the instrument is generalised (Taherdoost, 2016:30). Taherdoost further suggests that content validity involves evaluation of a survey instrument to ensure that it includes all the items that are essential and eliminates undesirable items from a particular construct domain. Results in Table 4.1 indicate that all the constructs considered in the study have an acceptable level of reliability as all of them have Cronbach alphas above 0.6.

Table 4.1: Questionnaire Reliability Statistics

Section	N	Number of questionnaire items	Cronbach's Alpha	Comment
Cost Management Process (questions 19, 20, 21)	222	3	0.956	High internal consistency
Quality Management Process (questions 22, 23, 24)	222	3	0.936	High internal consistency
Risk Management Process (questions 25, 26, 27, 28, 29, 30, 31)	222	7	0.971	High internal consistency
Procurement Management Process (questions 32, 33, 34, 35)	222	4	0.963	High internal consistency
Communication Management Process (questions 36, 37, 38, 39, 40, 41, 42, 43)	222	8	0.972	High internal consistency
Communicative Competencies (questions 44, 45, 46, 47, 48, 49, 52, 53, 54, 55, 56, 57, 58)	222	13	0.981	High internal consistency
Social Competencies (questions 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69)	222	11	0.981	High internal consistency
All Likert scale questions	**222**	**68**	**0.973**	**High internal consistency**

4.5 RESULTS AND DISCUSSION ON THE RESEARCH QUESTIONS

This section discusses statistical analysis results focused on the research questions examined in the study. It uses frequency tables, with each table consisting of three (3) columns. The first column includes the categories of the nominal scale selected by the respondent for each question. The second column (frequency) indicates the number of respondents for each category of the scale, and finally, the third column estimates the percentage of respondents for each (yes/no) scale selected by respondents.

4.5.1 The nature of mobile technologies most appropriated by emerging construction firms in the Free State province

Regarding the nature of mobile technologies most appropriated by ECFs, the results in Table 4.2 demonstrate that 91% of the ECF owner/managers use laptops and 44,6% use tablets as mobile devices for project-related operations. All the owners/managers who took part in the study used smartphones. However, only 0,5% of the respondents use drones and PDAs for project-related operations. The literature indicates that despite noticeable recent developments in mobile ICT, which can improve communication and access to information in construction projects, differences in usage, style, and user attitude have limited their overall impact on productivity (Hasan, Elmualim, Rameezdeen, Baroudi & Marshall, 2018). The findings of the study conducted by Hasan et al. (2018) illustrate that a lack of training and guidelines on effective adoption and appropriation of these technologies to construction projects is a major bottleneck.

The fact that there is a high penetration of mobile phones in SA compared to tablets and drones could explain their wider usage among ECFs. This observation is supported by the Independent Communications Authority of South Africa's (ICASA) State of the ICT Sector in South Africa's 2020 report, which confirms that SA's smartphone penetration is at 91,2% (Gilbert, 2019; ICASA, 2020). Furthermore, the fact that drones are a new phenomenon could be the reason why they are less popular. This observation is supported by Steenhoff-Snethlage (2018), who points out challenges that relate to the adoption of drone technology into company operations. Among these challenges are capital investment and strict legislation. The fact that new technology is often expensive upon adoption and that, with greater penetration, the prices fall drastically, may cause many ECFs in the Free State to shy away from

adopting such modern technology (Steenhoff-Snethlage, 2018). In addition, due to a lengthy, often costly licensing process and stringent drone regulations, it could explain the slow pace of adoption by owners/managers of the ECFs from previously disadvantaged groups.

Table 4.2: My organisation uses these mobile devices for project-related operations

LAPTOPS		
-	Frequency	Valid Percent
Yes	202	91,0
No	20	9,0
Total	222	100,0
TABLETS		
Yes	99	44,6
No	123	55,4
Total	222	100,0
SMARTPHONES		
Yes	222	100,0
PDAs		
Yes	1	0,5
No	221	99,5
Total	222	100,0
DRONES		
Yes	1	0,5
No	221	99,5
Total	222	100,0

4.5.2 The range of soft technologies (e.g., mobile applications) most appropriated by emerging construction firms in the Free State province

Considering the range of mobile technologies most appropriated by ECFs, the results from Table 4.3 indicate that most respondents do not use soft technologies (i.e., mobile applications) such as BIM (95,5%), MS Project (84,7%), Jira (99,1%), Pro-workflow (99,1%), Hive (99,5%), WhatsApp only (85,1%), Microsoft office only (66,7%) and WhatsApp and Microsoft office (63,5%) for project-related operations. Though surprising given the range of project activities that could be facilitated by such

technologies, this evidence is supported by submissions made by Pouris (2012) and Venkatraman and Yoong (2009) purporting that the South African construction industry takes mobile technology for granted, with contractors and project managers in the field relying only on the use of smartphones. In addition, Maime and Musvoto (2018) contend that most smartphone usage is for accessing soft technologies. It can be argued, therefore, that most Free State ECFs have not yet seen the need for, nor fully comprehended the importance of, integrating such mobile tools with the back-office systems to run their businesses effectively compared to their counterparts around the globe.

Table 4.3: My organisation uses soft technologies (i.e., mobile applications) for project-related operations

BIM	Frequency	Valid Percent
Yes	10	4,5
No	212	95,5
Total	222	100,0
MS PROJECTS		
Yes	34	15,3
No	188	84,7
Total	222	100,0
JIRA		
Yes	2	0,9
No	220	99,1
Total	222	100,0
PRO-WORKFLOW		
Yes	2	0,9
No	220	99,1
Total	222	100,0
HIVE		
Yes	1	0,5
No	221	99,5
Total	222	100,0
WHATSAPP ONLY		
Yes	33	14,9
No	189	85,1
Total	222	100,0
MICROSOFT OFFICE ONLY		
Yes	74	33,3
No	148	66,7
Total	222	100,0
WHATSAPP AND MICROSOFT OFFICE		
Yes	81	36,5
No	141	63,5
Total	222	100,0

4.5.3 How mobile technologies are integrated into the project execution processes of their businesses

In terms of how mobile technologies are integrated into the project execution processes of ECFs, the results in Table 4.4 below demonstrate that 54,5% and 70,7% of the emerging construction firm owners/managers do not rely on mobile technologies for initiating projects and closing projects, respectively. However, most respondents indicated that they rely on mobile technologies for planning projects (84,2%), implementing and executing projects (74,8%), and monitoring and evaluation of projects (82,9%). Similarly, a survey carried out by Sage Software established that 80% of construction professionals already use mobile devices when managing projects (Infragistic Community, 2015).

However, it is worth noting that, due to the responses to the questions relating to the range of mobile technologies most appropriated by ECFs as discussed in section 4.5.2 and the responses to the questions on the integration of such technologies into the project management operations (especially project execution) of their businesses as discussed in the previous paragraph, it can, therefore, be inferred that the responses to the questions on the integration of such technologies refer to the same range of technologies as discussed in section 4.5.2. Derived from this evidence, the use of mobile technology has been a fascinating trend that emerging construction firms have yet to fully exploit when managing projects.

Table 4.4: My organisation relies on the use of mobile technologies for these project-related operations.

INITIATING OF PROJECTS		
-	Frequency	Valid Percent
Yes	101	45,5
No	121	54,5
Total	222	100,0
PLANNING OF PROJECTS		
Yes	187	84,2
No	35	15,8
Total	222	100,0
IMPLEMENTING/ EXECUTING OF PROJECTS		
Yes	166	74,8
No	56	25,2
Total	222	100,0
MONITORING & EVALUATING OF PROJECTS		
Yes	184	82,9
No	38	17,1
Total	222	100,0
CLOSING OF PROJECTS		
Yes	65	29,3
No	157	70,7
Total	222	100,0

Furthermore, results in Table 4.5 below illustrate that 45% of the respondents agree that they rely heavily on mobile technologies to conduct project-related operations. Contrary to similar studies conducted in the US, where 96% of construction professionals admit that a consolidated integration of mobile technologies, specifically mobile apps, into construction management programmes is crucial for managing projects (Infragistics Community, 2015), it can be inferred that mobile usage is not integral to the operations of most ECFs in the free State province, even though they use them a lot. Even though evidence may suggest high usage, as 57,2% of ECFs reported that they realise the vast opportunity presented by the integration of mobile technologies into their project-related operations (see Table 4.5), it can be argued that such realisation has not translated into wider integration of technologies into most

ECFs' business operations. This limited integration can be attributed to challenges relating to information overload, convincing employees to use the mobile applications, and greater security concerns when adapting mobile applications into project related routines (Stieglitz, Lattemann, & Brockmann, 2015).

Table 4.5: My organisation relies heavily on the use of mobile technologies to conduct project-related operations.

-	Frequency	Valid Percent
Strongly Disagree	9	4,1
Disagree	46	20,7
Neutral	40	18,0
Agree	100	45,0
Strongly Agree	27	12,2
Total	222	100,0

4.5.4 How adoption of such technologies affects the perceived managerial competencies, especially communicative competencies of these owner/managers

The researcher employed descriptive statistics to understand the manner in which the use of mobile technologies affects the perceived managerial competencies, especially communicative competencies, of these owners/managers.

4.5.4.1 Descriptive Statistics

Central tendency measures were used to analyse each concept involved in the study. A five-point Likert scale where the value 1 corresponds to "Strongly Disagree" and the value 5 corresponds to "Strongly Agree" was used to measure the following concepts: use of mobile technologies during the project cost management process; use of mobile technologies during the quality management process; use of mobile technologies during the risk management process; use of mobile technologies during the procurement management process; use of mobile technologies during the communications management process; and associated managerial competencies (communicative and social competencies).

The mean point of a five-point Likert scale is 2.5 (5/2). Any mean scores below 2.5 indicate that most respondents tend to either strongly disagree or disagree with the

statements. While mean scores between 2.5 and 3.4 suggest that most respondents are not sure about the statements, all the mean scores equal to or above 3.5 indicate that the majority of respondents tend to either agree or strongly agree with the statements. Results on how the adoption of mobile technologies affected the perceived managerial competencies, especially communicative competencies, of these owners/managers are presented below.

Table 4.6: Use of mobile technologies during the project execution

	Mean	Median	Std. Deviation
Project Cost Management Process	3,33	3,00	1,03
Quality Management Process	3,17	3,00	1,07
Risk Management Process	3,23	3,00	1,05
Procurement Management Process	3,19	3,00	1,05
Communication Management Process	3,58	4,00	0,97

According to the results in Table 4.6, most respondents tend to be neutral on statements about the **use of mobile technologies during the project cost management process** because the overall mean score (m = 3,33) is below 3,4. Again, the results indicate that most respondents are neutral on the statements about the **use of mobile technologies during the quality management process** because the overall mean score (m = 3,17) is below 3,4. In addition, most emerging construction owners/managers are neutral on statements about the **use of mobile technologies during the risk management process** because the overall mean score (m = 3,23) is below 3,4.

Furthermore, according to the results, most respondents are neutral about the statements on the **use of mobile technologies during the procurement management process** because the overall mean score (m = 3,19) is below 3,4. Ultimately, results show that most respondents tend to agree with the statements about the **use of mobile technologies during the communications management process** because the overall mean score (m = 3,58) is higher than 3,5. The overall results presented above demonstrate that most emerging construction firm owner/managers tend to present neutral views on questions asked about the use of

mobile technologies during the project execution processes. The reasons for the neutrality of views amongst the respondents can range from a poor understanding of possible innovative uses of mobiles in construction to a limited understanding of how to integrate such technology into their businesses, despite the high penetration of mobiles in South Africa (ICASA, 2020). On the one hand, it can be argued that the holistic adoption and integration of mobile technologies into project execution processes by the ECFs in this study has not yet been fully realised. This implies that while the majority of ECFs recognise the importance of fit when selecting mobile technologies, they may not properly assess the viability of such technologies. On the other hand, it can also be argued that the current ECFs' understanding of how mobile technologies can be adopted into their project-related operations, especially project execution, is limited. As a result, it is necessary to develop unique, customised mobile applications that are tailored to specific mobile business processes that can be appropriated for and adopted by ECFs.

According to the results in Table 4.7 below, most respondents agree with the communicative competency (CC) statements relating to facilitation, understanding of the importance of and promotion of communication, because the overall mean (m = 3,66) score is above 3,5. Thus, overall results presented below demonstrate that the majority of ECF owners/managers agree that the use of mobile technologies has positively influenced their managerial competencies, such as communication competencies. This observation is supported by Zulch's (2014) findings, which ranked electronic communication as the most effective method of communication used during the execution of the project.

Table 4.7: Communicative Competencies

Mean	**3,66**
Median	4
Std. Deviation	0,95

4.5.5 The extent to which the adoption of such technologies affects the perceived managerial competencies in particular social competencies of these owner/managers

Table 4.8 below indicates that most respondents agree with social competency statements because the overall mean score (m = 3,50) is equal to 3.5. Thus, overall results demonstrate that most emerging construction firm owners/managers agree that the use of mobile technologies has positively influenced their managerial competencies, such as social competencies. If conceived in reverse order, this finding corroborates findings in Lebioda, Hahn and Martins (2019) observations suggesting that social and communication practices can influence the mode of communication adopted. It can be inferred that the adoption of mobile technologies by the ECFs in this study has positively influenced their managerial competencies, especially social competencies.

Table 4.8: Social Competencies

Mean	**3,50**
Median	4
Std. Deviation	1,11

4.5.6 Managerial competencies (social or communicative competencies) most influenced by ECF's adoption of mobile communication technologies and the extent of such influence

This section clarifies the extent to which the adoption of mobile communication technologies by ECFs has influenced managerial competencies. To address this, a normality test was conducted to assess if the data was normally distributed.

4.5.6.1 Normality assessment

The normality of the data is assessed through skewness and kurtosis. As recommended by Kline (2016), the indicators' skewness and kurtosis values should be below ±3 and ±10, respectively. The results presented in Table 4.9 show that the assumption of univariate normality is met because the skewness and kurtosis values of each construct fall within the recommended threshold of Kline's (2016). Therefore, we can confidently use the data for analysis. The next subsection deals with the reliability and validity of the constructs.

Table 4.9: Normality Assessment

Descriptive Statistics		
Constructs	Skewness	Kurtosis
Cost management	-0,122	-1,161
Quality management	-0,089	-1,121
Risk management	-0,067	-1,533
Procurement management	-0,185	-1,434
Communication management	-0,584	-1,079
Communicative competencies	-0,613	-1,301
Social competencies	-0,514	-1,535

4.5.6.2 Reliability and convergent validity assessment of the constructs

To ensure that survey results are meaningful, the measurement procedures and instruments used must meet two criteria: convergent validity and reliability. Each characteristic is described in detail below.

4.5.6.2.1 Reliability

Before using the constructs to test the research hypotheses, it is important to first establish their reliability and convergent validity. Reliability is the degree of internal consistency of a set of questions (items) related to a construct (Pallant, 2016). The reliability of the construct is commonly assessed using the Cronbach alpha, which is expected to be above 0.7 (although 0.6 is sometimes acceptable) (Hair et al., 2014). Results in Table 4.10 indicate that all the constructs considered in the study have an acceptable level of reliability as all of them have Cronbach alphas above 0.6.

4.5.6.2.2 Convergent validity

Convergent validity refers to the degree to which a set of items correlate together more than they correlate with other items to form a construct (Field, 2013). In other words, convergent validity ensures that the items considered for a specific construct are converging toward the same construct. Convergent validity is commonly assessed through the column "Corrected Item-Total Correlation". The values of the items are expected to have a coefficient of above 0.5. According to Table 4.10, all the items

have a good level of convergent validity, meaning that all the items are good measures for their respective constructs.

NB: The sub-construct "use of technologies in communications management process" was removed from the analysis because it did not correlate with the rest of the sub-constructs on the use of mobile technologies during project execution.

Table 4.10: Reliability and validity of the scales

Constructs / Items	Corrected Item-Total Correlation	Cronbach's Alpha	Number of items
The use of mobile technologies during Project Execution			
Q19. The use of mobile technologies has assisted my organisation during cost estimation for project-related operations.	0,904	0.980	14
Q20. The use of mobile technologies has assisted my organisation in determining budgets for project-related operations.	0,862		
Q21. The use of mobile technologies has assisted my organisation in controlling costs in project-related operations.	0,891		
Q22. The use of mobile technologies has supported my organisation in the quality planning process.	0,873		
Q23. The use of mobile technologies has aided my organisation in performing the quality assurance process (i.e., maintaining the desired level of quality).	0,898		
Q24. The use of mobile technologies has assisted my organisation in performing quality control (providing a system of maintaining the desired level of quality).	0,845		
Q25. The use of mobile technologies has assisted my organisation in the planning of risk.	0,922		
Q26. The use of mobile technologies has aided my organisation in the management of risk.	0,850		
Q27. The use of mobile technologies has assisted my organisation in the risk identification process.	0,847		
Q28. The use of mobile technologies has assisted my organisation in the qualitative risk analysis process (i.e., prioritising risk by assessing the probability of occurrence and impact).	0,920		

Q29. The use of mobile technologies has assisted my organisation in the quantitative risk analysis process (i.e., numerally analysing the effect of identified risks).	0,842		
Q30. The use of mobile technologies has assisted my organisation in the planning of risk responses (i.e., developing options and actions to enhance and reduce threats).	0,891		
Q32. The use of mobile technologies has helped my organisation in planning procurements (i.e., the process of identifying and consolidating requirements and determining the timeframes for their procurement).	0,870		
Q33. The use of mobile technologies has assisted my organisation in conducting procurements (i.e., the process of obtaining seller responses, selecting a seller, and awarding a contract).	0,814		
Communicative Competencies			
Q44. The use of mobile technologies has shaped my organisation's facilitation of (cross) functional communication (i.e., communication within different departments in my organisation).	0,899	0.981	13
Q45. The use of mobile technologies has shaped my organisation's understanding of the importance of (cross) functional communication.	0,888		
Q46. The use of mobile technologies has enhanced my organisation's promotion of adequate communication to the project teams.	0,897		
Q47. The use of mobile technologies has enhanced my organisation's promotion of adequate communication to the different stakeholders in general.	0,856		
Q48. The use of mobile technologies has improved my organisation's understanding of the importance of adequate communication among internal stakeholders (e.g., project manager, project teams, the organisation and project sponsors).	0,866		

Q49. The use of mobile technologies has improved my organisation's understanding of the importance of adequate communication among external stakeholders (e.g., consumers, sub-contractors, local communities, government and its agencies).	0,909		
Q52. The use of mobile technologies has assisted my organisation to understand the importance of distributing information among the project team.	0,841		
Q53. The use of mobile technologies has assisted my organisation to understand the importance of distributing information among different stakeholder levels.	0,860		
Q54. The use of mobile technologies has allowed my organisation to accumulate sufficient knowledge of project operations.	0,893		
Q55. The use of mobile technologies has allowed my organisation to make appropriate judgements about project operations.	0,900		
Q56. The use of mobile technologies has assisted my organisation to understand the importance of accumulating sufficient knowledge required to enhance project-related operations.	0,904		
Q57. The use of mobile technologies has assisted my organisation to understand the importance of applying appropriate judgment required to enhance project-related operations.	0,911		
Q58. The use of mobile technologies has assisted my organisation to understand the importance of applying the skill required to enhance project-related operations.	0,896		
Social Competencies			
Q59. The use of mobile technologies has enabled my organisation to build effective project teams.	0,922	0.981	11
Q60. The use of mobile technologies has assisted my organisation in the effective management of project teams.	0,901		
Q61. The use of mobile technologies has assisted my organisation in the effective management of stakeholder expectations.	0,905		

Q62. The use of mobile technologies has helped my organisation to understand the importance of effective management of project teams.	0,911		
Q63. The use of mobile technologies has helped my organisation to understand the importance of effective management of stakeholder expectations.	0,893		
Q64. The use of mobile technologies has assisted me in influencing others (i.e., project team and stakeholders) in the decision-making process.	0,876		
Q65. The use of mobile technologies has assisted me in understanding the importance of influencing others.	0,871		
Q66. The use of mobile technologies has enhanced my facilitation of political awareness in project-related operations.	0,837		
Q67. The use of mobile technologies has enhanced my facilitation of cultural awareness in project-related operations.	0,921		
Q68. The use of mobile technologies has assisted me to understand the importance of political awareness in project-related operations.	0,926		
Q69. The use of mobile technologies has assisted me to understand the importance of cultural awareness in project-related operations.	0,925		

Since reliability and validity of the constructs are established, the constructs can be used with confidence for the regression analysis discussed in the next section.

4.5.6.3 Standard multiple regression analysis

Standard multiple regression is a statistical technique used to analyse the data. This statistical approach was adopted because the dependent variables of the model are continuous (Pallant, 2016). Standard multiple regression assesses the simultaneous predictive power of independent variables (the use of mobile technologies during project execution) on dependent variables (communicative and social competencies) (Pallant, 2016).

4.5.6.3.1 Evaluation of the conceptual model

This section assesses the significance of the variance explained in the dependent variables, which in this case are communicative and social competencies. According to Table 4.11, project execution explained 65.1% of the variance in communicative competencies and 71.2% of social competencies. Table 4.12 further indicates that the variance explained is statistically significant enough to validate the models as the p-values are both significant (Communicative Competencies P = 0.000 and Social Competencies P = 0.000).

Table 4.11: Model evaluation

Model Summary[b]				
Model	R	R Square	Adjusted R Square	Standard Error of the Estimate
1. Communicative Competencies	0.808[a]	0,653	0,651	0,60255
2. Social Competencies	0.845[a]	0,714	0,712	0,59786
Predictors: Project execution				

Table 4.12: Model validation

ANOVA[a]						
Model		Sum of Squares	Df	Mean Square	F	P-value
1. Communicative Competencies	Regression	150,300	1	150,300	413,969	0.000[b]
	Residual	79,876	220	0,363		
	Total	230,176	221			
2. Social Competencies	Regression	195,972	1	195,972	548,273	0.000[b]
	Residual	78,636	220	0,357		
	Total	274,607	221			
b. Predictors: (Constant), Project execution						

4.5.6.3.2 Predictive power of the independent variables

Table 4.13 presents the established predictive effects of independent variables on dependent variables. There are two columns of interest: "beta" and "p-value." The beta values indicate the direction and strength of the relationship, while the p values (Sig) estimate the significance of the predictive effect (Pallant, 2016). The significance of the relationship is measured by the p-value being below 0.05.

From the formulated research objective, the use of MTs during project execution is expected to have a positive effect on communicative and social managerial competencies. The results provided below support the research objectives [research objective (iv), (v), and (vi)]. According to the results, it is evident that the use and adoption of MTs during project execution has a positive ($\beta = 0.808$) and significant ($p = 0.000$) effect on communicative competencies; it also has a positive and significant effect on social competencies ($\beta = 0,845$: $p = 0.000$).

The results are evident from the positive beta values and the p-values below 0.05. However, these results suggest that social competencies have the strongest impact compared to communicative competencies. Therefore, the results indicate that adoption of MTs during project execution is pivotal in shaping managerial competencies. Furthermore, the most vital aspects of managerial competencies in construction companies are social competencies.

Table 4.13: Hypotheses Testing

Model	Independent Variable	Dependent Variable	Standardised Coefficients	
			Beta	P-value
1	(Constant)			0,000
	Project Execution	Communicative Competencies	0,808	0,000
2	(Constant)			0,000
	Project Execution	Social Competencies	0,845	0,000

4.5.7 Recommendations on the nature and character of an effective mobile technology-mediated approach that would optimise the managerial competencies of owner/managers of ECFs

Before conducting the moderation effects, data was assessed to check its suitability prior to the analysis. When moderator variables are categorical as the one in this study, it is a prerequisite to have the balance in the response for ‘’yes’’ and for ‘’no’’. The results are outlined below.

4.5.7.1 Moderation analysis

The Process tool developed by Hayes (2017) was used to test the moderating effects. The study proposes mobile technologies (e.g., laptops, tablets, smartphones, PDAs, and drones) as potential moderators of the relationships between project execution (an independent variable) and managerial competencies (dependent variables). Moderation occurs when the strength or direction of the relationship between two variables depends on the level of a moderator. Any p-value below 0.05 suggests that there is a moderation effect, while any p-value above 0.05 indicates that there is no moderation effect. The results of the moderation analysis are presented in Table 4.15 below.

Table 4.14: Moderators

Moderators		Frequencies
Laptops	Yes	202
	No	20
Tablets	Yes	99
	No	123
Smartphones	Yes	222
	No	0
PDA	Yes	1
	No	221
Drones	Yes	1
	No	221

According to the results in Table 4.14 the data for smartphones, PDA, and drones is not adequate to conduct the moderating analysis, therefore they are excluded from the analysis. The results indicated in Table 4.15 illustrate that the direction of the relationship between project execution and managerial competencies significantly depend on the presence of third variables which are laptops and tablets.

Table 4.15: Moderation Analysis

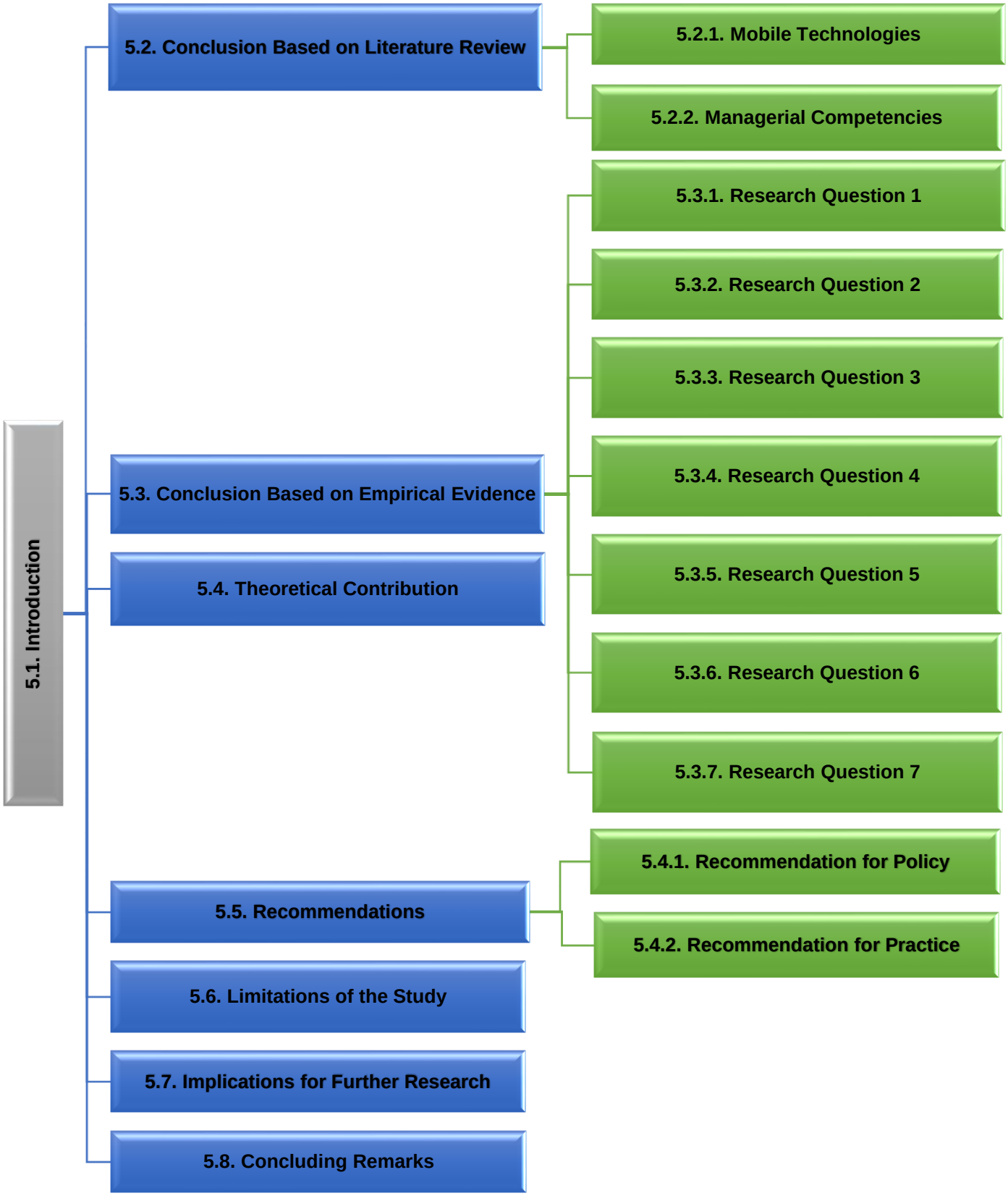
Independent Variables		Dependent Variables	Moderators/Interaction effects	Moderation effects.	P-value	Hypotheses conclusion
Project Execution	->	Communicative Competencies	Laptops	-2.2970	0.000	Laptops moderate the relationship between project execution and communicative competencies as its p-value (0.000) is lower than 0.05.
			Tablets	0.7448	0.000	Tablets moderate the relationship between project execution and communicative competencies as its p-value (0.000) is lower than 0.05.
	->	Social Competencies	Laptops	-2,4006	0.000	Laptops moderate the relationship between Project execution and Social competencies as its p-value (0.000) is lower than 0.05.
			Tablets	0.8004	0.000	Tablets moderate the relationship between Project execution and Social competencies as its p-value (0.000) is lower than 0.05.

4.6 SUMMARY OF THE CHAPTER

This chapter presented results on the relationship between the use of mobile technologies during project execution and managerial competencies (communicative and social competencies). The regression analysis results indicated that the use of mobile technologies during project execution has a positive and statistically significant effect on managerial competencies (communicative and social competencies). This study also examined the moderating role of laptops and tablets in the relationship between use of mobile technologies during project execution and managerial competencies. The results indicated that the strength of the relationship between the use of mobile technologies during project execution and managerial competencies is moderated by the type of device used (laptops and tablets). The next chapter provides the conclusion and recommendation for the study.

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS



5.1. INTRODUCTION

The foregoing chapter presented and discussed the research findings on the influence of using mobile technologies during project execution on the perceived managerial competencies of owners and managers of emerging construction firms (ECFs) in the Free State. The study focused on the Free State province because, unlike Gauteng, Western Cape and KwaZulu-Natal provinces in South Africa where mobile phones have a higher penetration rate than tablets and drones, the province has recorded a relatively lower level of mobile technology penetration, hence necessitating this study (ICASA, 2020). Moreover, despite the general stability in the use of mobiles by ECFs in the province, the influence of these technologies on project-related operations is yet to be fully appreciated (Mohammadi, Sarvestani & Nouroozi, 2020). Besides that, because ECFs are highly time-intensive due to the fusion of managerial and ownership roles in a single person, one can anticipate a relatively high use of such technologies for project-related operations, hence the effort in this study to analyse patterns.

This chapter is structured as follows: the first part presents a conclusion based on the available literature (as discussed in Chapter 2) and demonstrates the study's contribution to grasping concepts in parallel studies. Second, the study concludes with empirical evidence. The objective of the empirical section is to summarise the study's research questions and responses based on the presentation and discussion of findings. Third, the chapter reflects on theory and practice recommendations. Fourth, the study discusses its own limitations. In the penultimate, it discusses the implications for future research and terminates with its concluding remarks.

5.2. CONCLUSIONS BASED ON LITERATURE

A rigorous review of the literature was conducted to establish the conceptual framework for the study. The review examined the current body of knowledge regarding the influence of mobile technologies on perceived managerial competencies, specifically communicative and social competencies, during project execution. The following sections summarise the findings from the literature regarding the moderated influence of this independent variable on managerial competencies.

5.2.1. Mobile technologies

This study adopted the definition of mobile technologies (MTs) as an expansive set that includes all internet-enabled gadgets, connection services or processes, and infrastructures that provide a user with diverse ways to communicate, interact, and exchange data with an individual or system anywhere and at any time, albeit in a variety of formats or on a more limited or constrained basis (Xiaojun et al., 2004; Lau, 2018). The review of literature confirmed that the use of mobile technology can impact operations by enabling emerging construction firms (ECFs) to perform project-related operations. Further investigation of the literature established that mobile technologies offer ubiquitous project team–project stakeholder interactions; field performance tracking; cost management and accounting; scheduling and resource dispatching; and facilitate financial control procedures. In addition, the literature review indicated that the use of mobile technologies enables project managers and team members to optimise efficiency by enhancing planning and decision-making elements at each stage of project execution. Furthermore, the review of literature consolidated the observation that the most significant developments in project management and construction as the integration of mobile technology tools that aid in collaboration and eliminate bottlenecks throughout the project execution phase.

5.2.2. Managerial competencies

The literature review suggested that even though the construct of managerial competencies is accepted as useful in examining the personal effectiveness of managers, not all competency models have been investigated by researchers. Furthermore, the literature demonstrated that social competency in project management manifests as leadership skills, the ability to collaborate and co-operate with others, effective communication skills, and a broad range of soft skills. In addition, the study reviewed the Communication Competency Model and the Social Competency Model which shed light on the dimensions of managerial communication which facilitate the development of managerial competencies through the effective use of technological apparatuses. These models are assessed in this study using mobile technologies in project management operations as a means of enhancing project managers' communicative and social competencies.

Based on the review of the literature, this study concluded that the relationship between perceived managerial competencies and mobile technologies can be expressed by inferences to the Resource-Based View. It also concluded that use of mobile technology has helped to address some of the managerial soft skills required by construction project managers, and such technologies (i.e., tablets, laptops, etc.) have the potential to significantly improve collaboration and communication among the project team.

5.3. CONCLUSIONS BASED ON EMPIRICAL EVIDENCE

This investigation strove to reach a conclusion based on the empirical findings. A review of the research questions, responses to each question, and empirical findings that led to this conclusion are summarised in the next section.

5.3.1. Research question 1

What is the nature of mobile technologies most appropriated by emerging construction firms in the Free State?

The results in Table 4.2 indicate that 91% of ECF owners/managers use laptops and 44,6% use tablets as mobile technologies for project-related operations. However, only 0,5% of the respondents use drones and personal digital assistants (PDAs) for project-related operations. The underutilisation of the latter technologies can be attributed to a lack of training and guidelines on the effective adoption of these technologies in construction projects, which is a major setback (Hasan, Elmualim, Rameezdeen, Baroudi & Marshall, 2018; Gilbert, 2019; ICASA, 2020). Also, the lengthy, often costly licensing process and stringent regulations on the use of drones could explain their slow pace of adoption by owners and managers. In addition, the fact that there is a high penetration of mobile phones in SA compared to tablets and drones could also explain the wider usage of mobile phones among ECFs (ICASA, 2020).

Furthermore, even though the prices of technology may fall drastically with greater penetration of such technologies in society, the reality that new technology is often expensive upon adoption may discourage many ECFs from adopting the technology.

It should also be noted that the cost of upgrading or reskilling employees with new behavioural paradigms is a significant cost for ECFs which may dampen their enthusiasm to adopt new technologies such as drones for construction purposes (Venkatraman et al., 2009).

Therefore, it can be concluded that the mobile technologies most appropriated by ECFs are laptops and tablets for project-related operations. This can be attributed to several factors, that is, ECF owner managers' familiarity with and the ease of use of such technologies as they are more domesticated technologies compared to other technologies (Costley, 2014) and the large graphic interface for showing construction materials such as diagrams and technical drawing (Chi, Kang & Wang, 2013). In addition, the user-friendly nature of features allows for customisation of projects (Tiihonen, & Felfernig, 2017) and the high computation capacities of such technologies (Hilbert, & López, 2012). Furthermore, it is concluded that the retarded pace in the appropriation of other technologies, which can be attributed to a lack of training, guidelines on effective adoption of these technologies to construction projects, and the cost implications attached, contribute to the Free State ECFs' lag in adopting such technologies for their project-related operations.

5.3.2. Research question 2

What is the range of soft technologies (e.g., mobile applications) most appropriated by emerging construction firms in the Free State?

The results in Table 4.3 indicate that most respondents do not use soft technologies (i.e., mobile applications) such as building information modelling (BIM) (95,5%), MS Project (84,7%) or Jira (99,1%) for project-related operations. This is surprising given the range of project activities that could be facilitated by such technology applications. It can be argued that most Free State ECFs have not yet seen the need for nor appreciated the importance of, integrating such mobile tools with the back-office systems. Furthermore, as the Free State ECFs gain more experience with office-related technologies such as BIM and Jira, the need for mobile applications to support their project-related operations could become more apparent. Therefore, it is

concluded that most Free State ECFs do not use the range of soft technologies (i.e., mobile applications) such as BIM or Jira for project-related operations.

5.3.3. Research question 3

How are these mobile technologies being integrated into the project execution processes of their businesses?

The results in Table 4.4 illustrate that mobile technologies are partially integrated into the project management operations of ECFs. Most respondents indicated that they rely on mobile technologies for planning projects (84,2%), implementing and executing projects (74,8%) and monitoring and evaluation of projects (82,9%). However, only 45% of ECF respondents agree that they rely heavily on mobile technologies to conduct project-related operations (see results in Table 4.5). This evidence is closer to the average (42,2%) of the respondents, which is 42,2%, who indicated that they either used WhatsApp and/or MS Office applications for their project-related operations. This contrasts with similar studies conducted in the US, where 96% of construction professionals agreed to integrating similar technologies for managing their projects (Infragistics Community, 2015).

The use of mobile technology has been a fascinating trend that emerging construction firms have yet to fully appreciate when managing projects. However, it can be inferred that the responses to the questions on the integration of such technologies refer to the same range of technologies as discussed in section 4.5.2. This limited integration can be attributed to information overload, difficulty in convincing employees to use the mobile applications, and greater security concerns in the use of such technologies. Although there appears to be little difference in the way ECFs use mobile technologies for project management as opposed to general business administration, it can be argued that ECFs have neither fully appreciated nor yet comprehended the importance of the role mobile technologies play in the project execution processes.

Therefore, it is concluded that while mobile technologies are being integrated into ECF project execution processes to conduct project-related operations, and while this

integration is critical for project management, there is still lack of appreciation for such technologies among the owners/managers' of ECFs.

5.3.4. Research question 4

How has the adoption of such technologies affected the perceived managerial competencies especially communicative competencies of these owner/managers?

The overall analysis of each concept (e.g., use of mobile technology during project execution) was conducted using central tendency measures. The findings regarding the effect of mobile technology adoption on perceived managerial competencies indicate that most respondents are neutral regarding the use of mobile technologies during the quality management process, as the overall mean score (m = 3,17) is less than 3,4 (which is the midpoint of the scale is 2,5). Additionally, the findings confirm that most emerging construction owners/managers are ambivalent about the use of mobile technology for risk management as the mean score (m = 3,23) is below 3,4. The results obtained here suggest that mobile technology adoption varied by the level of perceived importance at which each concept operates.

Most survey respondents were concerned about the impact of mobile technology on the communication management process for projects because the overall mean score (m = 3,58) is slightly higher than 3,5. Again, it is worth noting that most emerging construction firm owner/managers have reservations on the use of mobile technologies during the project execution process (see Table 5.1). The reason could be attributed to the fact that emerging construction firms' owners and managers, especially in emerging economies, tend to rely more on people than on technology (Nazir & Roomi, 2021).

Table 5.1: Project Execution

Mean	3,30
Median	3,2
Std. Deviation	1,03

The reasons for respondents' apathy range from a lack of awareness of innovative uses for mobile technology to a limited appreciation of how such technology could be integrated into other project execution processes other than project communication processes. The majority (65,1%) of ECF owners/managers agree that their use of mobile technologies has bolstered their managerial capabilities, particularly in terms of communication. Zulch's (2014) findings corroborate this perception, indicating that electronic communication was the most effective mode of communication to use throughout the project's execution. Therefore, it can be concluded that most respondents are concerned with the impact of mobile technology on the project communication management process.

5.3.5. Research question 5

What is the extent to which the adoption of such technologies affects the perceived managerial competencies in particular social competencies of these owner/managers?

The results indicate that most respondents agree with social competency statements ranging from the ability to form effective project teams (mean score m = 3,48), manage stakeholder expectations effectively (mean score = 3,52), and understand the critical nature of political and cultural awareness in project-related operations (mean score m = 3,50), as indicated by the overall mean score of 3.5 (m = 3,50). This finding corroborates Lebioda, Hahn and Martins (2019), who suggest that mobile technology usage behaviour (explained by generational differences) increases the perceived work improvement performance (especially social and communication practices). Even though, in the case of this study, most respondents did not necessarily view mobile technology usage as a major project management tool even though they were using it.

A normality test was conducted to assess if the data collected by ECFs is normally distributed. The results indicated in Table 4.9 show that the assumption of univariate normality is met because the skewness and kurtosis values of each construct fall within the recommended threshold of Kline's (2016). Furthermore, Table 4.10 shows that all the items have accepted levels of reliability and convergent validity. In addition,

according to Table 4.11, the use mobile technologies during project execution explained 65.1% of the variance in communicative competencies and 71.2% of social competencies. Table 4.12 indicates that variance explained is statistically significant enough to validate the models as the p-values are both significant. Therefore, it can be concluded that the ECFs' adoption of mobile technologies benefited their managerial competencies, particularly their social competencies.

5.3.6. Research question 6

Which managerial competencies (social or communicative competencies) are more influenced by ECF's adoption of mobile communication technologies and what is the extent of such influence?

The results depicted in Table 4.13 present the established predictive effects of independent variables on dependent variables. According to the results, the use and adoption of MTs during project execution has a positive (β = 0.808) and significant (p = 0.000) effect on communicative competencies; it also has a positive and significant effect on social competencies (β = 0,845: p = 0.000). These results confirm the hypothesis that the use and adoption of MTs during project execution positively influences communicative and social competencies.

It can be concluded, therefore, that the positive and significant (p = 0.000) effects of use and adoption of MTs during project execution on managerial competencies indicate that the use and adoption of MTs during project execution positively affect managerial competencies. The most vital aspects of managerial competency in ECFs are social competencies, according to this study.

5.3.7. Research question 7

What recommendations on the nature and character of an effective mobile technology-mediated approach would optimise the managerial competencies of ECFs?

To address this question properly, the researcher reviewed the inferences made from the literature on the nature and character of MTs (which MTs were used the most, their functionalities, their applications used on these MTs, what they are used for, and at

which stage of PM they are used), which could be harnessed to improve the development of managerial competencies. The review of literature suggested that the wireless and ubiquitous nature of mobile technologies differentiate them from other technologies. In addition, literature illustrates that the concept of mobility transcends ubiquity to include shareability and personalisation, which enhances distinctive operational and strategic proficiency.

In the context of project management, it means project managers have an increased individualised capability to remotely coordinate communication and monitor progress across projects effectively. For instance, laptops were used the most; some applications that run on laptops were used; laptops have large graphic interfaces that cohere with project development, e.g., technical project drawing; spreadsheets for calculation of quantity of materials; communicating these outputs with clients and suppliers, etc. The question then is, in view of these affordances and uses of laptops, which competencies could the use of laptops best develop and support during project execution - communicative or social competencies, and why?

It can, therefore, be concluded that laptops can help project managers in developing their communicative and social competencies by enabling them to handle communications with stakeholders remotely.

5.4. CONTRIBUTION TO THEORY

The study draws on the dynamic capabilities approach using connectivism and resource-based view (RBV) theories to understand the concepts explored. Connectivism focuses on the value of learning networks as an integrated whole of connections and nodes, and thus, it allowed the researcher to explore the embedded relationships between the use of mobile technologies during project execution and managerial competencies. Moreover, the adopted RBV theory enhanced understanding how the use of mobile technologies by emerging construction firms' (ECFs) owners and managers improved their managerial competencies, which in turn assists ECFs to maintain a sustainable competitive advantage.

From a conceptual perspective, the study set out to explore the use of mobile technologies (organisational capabilities) as strategic resources that can be used during the project execution of construction projects to enhance managerial competencies. The study argued that despite the exploration of mobile technologies that serve as purveyors of knowledge, information, and artefacts that facilitate the development of managerial competencies (communicative and social competencies) on the one hand, and reserved acknowledgement by the emerging construction firms' (ECFs) owners and managers regarding the use of mobile technologies during the project execution process on the other hand, the study postulated that these parallel studies do not offer a complete picture of how the adoption and usage of MTs by ECFs is attained if the nature of MTs used during project execution were to be ignored. The study argued and tested the moderating role of laptops and tablets in the relationship between the use of mobile technologies during project execution and managerial competencies.

The study contributes to the theory by proposing that the adoption and usage of mobile technologies during the project execution process is positively affected by the usage of laptops and tablets, which act as enablers for mobile technologies in the construction sector.

5.5. RECOMMENDATIONS

The study verified and confirmed the moderating role of laptops and tablets in the relationship between the use of mobile technologies during project execution and managerial competencies. This section outlines the key recommendations, proposed for policy and practice, based on the research objectives and the findings of the study.

5.5.1. Recommendations for policy

The following aspects can be regarded as the recommendations for policy: encouraging appropriation and integration of MTs by ECFs, change of policy on ECFs project execution strategy and strengthening of competency development plan around use of MTs.

5.5.1.1. Encouraging appropriation and integration of MTs by ECFs

The findings from responses to research questions one and two illustrate that the use of mobile technology has been a fascinating trend that emerging construction firms have yet to fully exploit when managing projects. Even though evidence suggests high usage, as 57,2% of ECFs reported that they realise the vast opportunity presented by the integration of mobile technologies into their project-related operations, such realisation has not translated into wider integration of technologies into most ECFs' business operations. This limited integration can be attributed to challenges relating to information overload, convincing employees to use the mobile applications, and security concerns related to adapting mobile applications into project related routines (Stieglitz, Lattemann, & Brockmann, 2015). It is therefore, recommended that the Department of Public Works provide the ECFs with guidelines on the effective usage of mobile technologies for project-related operations by incorporating these technologies into the construction projects so that their adoption will not be an afterthought as is prevalent presently.

5.5.1.2. Change of policy on ECFs project execution strategy

Even though results show high use of mobile technologies, only 45% of respondents agree to relying heavily on the use of mobile technologies to conduct project-related operations. This conclusion suggests that most of the respondents do not use mobile technologies when conducting project-related operations. It is therefore, recommended that the Construction Industry Development Board (CIDB) put more emphasis on creating awareness of the benefits of mobile technologies and encourage their proper use for project-related operations (especially project execution) by implementing the following measures: (1) increasing awareness of the benefits of mobile technologies through seminars and publications, (2) conducting in-house seminars to promote its use in emerging construction firms, and (3) reinforcing training programmes for both existing and newly registered emerging construction firms.

5.5.1.3. Strengthening of competency development plan around use of MTs

The evidence in this study indicate that most respondents do not use soft technologies (i.e., mobile applications) such as BIM (95,5%) and MS Project (84,7%) which are considered and have proven to be the most popular applications in the construction

industry. This conclusion suggests that one can find several problems and challenges in implementing soft technologies in the construction industry, especially among emerging construction firms. It is therefore, recommended that the Construction Education and Training Authority (CETA), in partnership with the Construction Industry Development Board (CIDB), as part of skills development, develop a competency development training programme that could strengthen soft technology skills, specifically in the areas of construction planning, building information modelling and project execution, for managers, supervisors and team leaders to allow for more effective project implementation.

5.5.2. Recommendations for practice

The following aspects can be regarded as the recommendations for practice: strengthen adoption of a mobile technology-based approach, standardise use of MTs for construction projects, and normalise frequent use of industry-specific soft technologies (mobile applications) on projects.

5.5.2.1. Strengthen adoption of a mobile technology-based approach

The results in Table 4.15 indicated that the strength of the relationship between the use of mobile technologies during project execution and managerial competencies is moderated by the type of device used (laptops and tablets), with a p-value ($p = 0.000$) both laptops and tablets. This evidence suggests that emerging construction firms (ECFs) possess necessary resources for the adoption of a mobile technology-based approach to project communication management. As a result, the researcher recommends a significant increase in awareness, particularly among ECFs, to allow them to fully exploit the capabilities of both devices.

5.5.2.2. Standardise use of MTs for construction projects

It was noted that 91% of the ECF owner/managers use laptops and 44,6% use tablets as mobile devices for project-related operations. It is therefore, recommended that these devices should be considered as the basic computing resource for ECF owner/managers, and a standardised project management system be put in place to enable them to execute project related tasks.

5.5.2.3. Normalise frequent use of industry-specific soft technologies (mobile applications) on projects

It was noted that most ECFs do not rely on the use of soft technologies that are industry-specific, such as BIM and MS Project, for their project-related operations. It is therefore recommended a significant increase in awareness creation, particularly among ECFs, management and stakeholders, be launched to normalise the use of soft technologies for ECFs' project-related operations to deal with apathy attributed to a lack of awareness or a lack of appreciation regarding how such technology should be integrated into project-related operations.

5.6. LIMITATIONS OF THE STUDY

No research, no matter the methods and the approach employed, is without its shortfalls. The first limitation, though several ECFs were found in other areas of the Free State Province, is that the focus of this investigation was restricted to registered Construction Industry Development Board (CIDB) registered ECFs only in the Free State Province. The choice of registered ECFs was to ensure that all of them met the criteria of being registered companies, conform to labour practices and were law-abiding firms (e.g., in terms of tax payment) so that a homogenous sample could be developed from which findings could be generalised. As such, while the results can be generalised to registered ECFs, the findings might not apply to unregistered ECFs as their characteristics may not be the same. Therefore, while the study can be generalised to registered ECFs in the Free State province, these findings may not be generalised to other provinces as the conditions obtaining in these provinces could qualitatively be different from those in the Free State Province.

Another limitation relates to the financial constraints faced by the researcher. The researcher relied on trained research assistants to have questionnaires delivered and administered to respondents in Xhariep, Thabo Mofutsanyane, and Fezile Dabi District Municipalities. Even though the use of research assistants did not diminish the quality of data collected as the researcher trained these assistants in data collection, the researcher delegated control of the selection of the exact locations data was collected to these assistants.

Only the respondents in the Lejweleputswa District Municipality and Mangaung Metropolitan were physically attended to by the researcher as they were more accessible to the researcher due to the apparent cost constraints.

The other limitation was that of the use of cross-sectional survey. This means that the perceptions, views and attitudes of respondents were those at the time when data was collected and cannot be assumed to be the same over time. A longitudinal study could have provided more information on the change of such attitudes over time. However, lack of resources (time and money) prevented the researchers from using this approach to data collection.

5.7. IMPLICATIONS FOR FURTHER RESEARCH

This study focused on a single province, the Free State. Future research may expand the investigation to other provinces or the entire country to determine the extent to which the current study's findings can be generalised to the entire country.

This study analysed the various variables using a quantitative approach that omitted control variables. As such, the study did not shed light on how these relationships play out in the presence of control variables such as age, gender, racial background, years of experience of ECF owners/managers, exposure to and understanding of mobile technologies, study location, firm size, and project management and construction experience of ECF owners/managers. While their inclusion would have provided additional insight, the researcher felt that including them would have expanded the scope of the study beyond his ability to manage in terms of the statistical techniques required and the time allocated to the study in terms of residence of the study, and thus they were excluded from this study. Future research may need to incorporate these control variables to shed light on how and under what circumstances MTs affect managerial competencies.

The study focused exclusively on direct relationships between variables, with little attention paid to moderator variables. This paves the way for additional research into moderating variables that underpin these relationships. The inclusion of moderating variables such as experience of managers/owners with technologies, ease of use,

availability, perceived usefulness of such technologies could have further enriched the study. This was deemed beyond the scope of the study and statistical capabilities of the researcher.

Given that the dynamics of major businesses and SMMEs may differ in terms of the variables studied, comparing them to these groups would help clarify whether big enterprises experience these variables and their relationships similarly or differently. This would, however, necessitate a thorough comparison of data sets and a more rigorous analysis of both types of firms, which was deemed beyond the scope of this study due to the study's focus on emerging firms.

5.8. CONCLUDING REMARKS

This chapter provided a conclusion based on both the literature review and empirical evidence. The study demonstrated the variables, such as the use of mobile technologies, which have the potential to either inhibit or greatly improve managerial competencies (especially communicative and social competencies). The core of the variables under study was to understand the influence of the use of mobile technologies on perceived managerial competencies during project execution. While literature emphasised how mobile technologies as organisational capabilities can be harnessed to the benefit of emerging construction firms' owners/managers in shaping their managerial competencies, more significantly, empirical evidence confirms that this study provided evidence that the use of mobile technologies can improve managerial competencies during project execution and noted that the strength of the relationship between the use of mobile technologies during project execution and managerial competencies is moderated by the type of device used (laptops and tablets). Lastly, the study provided some recommendations based on these findings, highlighted some limitations of the study, and presented the implications of this study for future research.

REFERENCES

Africa.com. 2019. *East Africa Digital Construction - Africa.com*. [Online] Available at: https://www.africa.com/east-africa-digital-construction/ [Accessed 18 April 2019].

Akaba, J. 2016. Formal Project Management Adoption Readiness of Emerging Construction Firms: The Case of Mangaung Metropolitan Municipality. Unpublished Master's Dissertation. Bloemfontein: Central University of Technology.

Akaba, J., Rambe, P & Agbobli, E. K. 2016. 'Formal project management adoption readiness of emerging contractor firms in the Mangaung Metropolitan Municipality', in M. Darko (Ed.). *International Conference on Business and Management Dynamics,* 62-68, AOSIS, Cape Town. https://doi.org/10.4102/aosis.2016.icbmd10.08. [18 April 2019].

Almgren, K. 2014. Information technology project management processes and practices: A comprehensive study for successful implementation of IT projects. *International Journal of Business and Social Science*, 5(11): 84-91.

American Psychology Association (APA) Dictionary of Psychology. 2022. *APA Dictionary of Psychology*. [online] Available at: <https://dictionary.apa.org/social-competence> [Accessed 8 April 2022].

Arditi, D., Gluch, P. & Holmdahl, M. 2013. Managerial competencies of female and male managers in the Swedish construction industry. *Construction Management and Economics*, 31(9): 979-990.

Bakke, E. 2010. A Model and Measure of Mobile Communication Competence. *Human Communication Research*, 36(3): 348-371.

Balasubramanian, S., Peterson, R. A. & Jarvenpaa, S. L. 2002. Exploring the implications of m-commerce for markets and marketing. *Journal of the Academy of Marketing Science*, 30(4): 348-361.

Balda, S. & Sangwan, S. 2018. Promoting social competence for management of aggressive behaviour. *Indian Journal of Health and Well-being*, 9(8-9): 878-881.

Barnes, S. J. 2002. The mobile commerce value chain: Analysis and future developments. *International Journal of Information Management*, 22(2): 91-108.

Barney, J. 1991. Firm resources and sustained competitive advantage. *Journal of Management*, 17(1): 99-120.

Barrett, M., Davidson, E., Prabhu, J. & Vargo, S. L. 2015. Service innovation in the digital age: Key contributions and future directions. *MIS Quarterly*, 39(1): 135-154.

Bartram, D. 2005. The great eight competencies: A criterion-centric approach to validation. *Journal of Applied Psychology*, 90(6): 1185-1203.

Beckett, K. 2008. *Construction industry 2008*. Available at: https://www.oecd.org/regreform/sectors/41765075.pdf [Accessed: 20 December 2018].

Bedard, P. 2019. *How Mobile Technologies are Boosting Construction Site Efficiency - Area Development*. [Online] Area Development. Available at: http://www.areadevelopment.com/AssetManagement/April2013/construction-site-mobile-project-management-272725.shtml [Accessed 3 April 2019].

Berenger, Y. R. & Justus, N. A. 2016. The Issue of Communication in the Construction Industry: A case of South Africa. In O. J. Ebohon, D. A Ayeni, C. O Egbu, & F. K. Omole. *Proceedings of the Joint International Conference (JIC) on 21st Century Human Habitat: Issues, Sustainability and Development*, 21-24 March 2016, Akure, Nigeria :1729-1738.

Blumberg, B. F., Cooper, D. R. & Schindler, P. S. 2014. *Business Research Methods*. 4th Edition. London: McGraw-Hill Education.

Bolat, E. 2015. Mobile Technology Capabilities and their Role in Service Innovation Practices in Creative SMEs. Doctor of Philosophy. Bournemouth: Bournemouth University.

Boyatzis, R. E. 1993. Beyond competence: The choice to be a leader. *Human Resource Management Review*. 3(1): 1-14.

Boyatzis, R. E. 2008. Competencies in the 21st century. *Journal of Management Development*, 27(1): 5-12.

Boyatzis, R. E. 2009. Competencies as a behavioural approach to emotional intelligence. *Journal of Management Development*, 28(9): 749-770.

Bozalek, V., Gachago, D. & Watters, K. 2015. Chapter 10: Twenty-first-century pedagogies. In Editors: V. Bozalek, D. Ng'ambi, D. Wood, J. Herrington, J. Hardman & A. Amory. 2015. *Activity Theory, Authentic Learning and Emerging Technologies: Towards a Transformative Higher Education Pedagogy*. New York: Routledge, 115-125.

Bryman, A. & Bell, E. 2011. *Business Research Methods.* 3rd Edition. New York: Oxford University Press.

Burger, A. K. 2022. *M-Commerce Hot Spots, Part 1: Beyond Ringtones and Wallpaper.* [online] https://www.ecommercetimes.com. Available at: <https://www.ecommercetimes.com/story/m-commerce-hot-spots-part-1-beyond-ringtones-and-wallpaper-57109.html> [Accessed 5 January 2022].

Busta, H. 2016. *6 technology trends that defined construction in 2016*. [Online] Available at: https://www.constructiondive.com/news/6-technology-trends-that-defined-construction-in-2016/432863/ [Accessed 19 March 2019].

Carruthers, M.C. 2008. *Principles of Management for Quality Projects*. United Kingdom: CENGAGE Learning EMEA.

Centranum. 2022. *Competence and Competency*. [online] Available at: <https://www.centranum.com/resources/competency-management/competence-and-competency/> [Accessed 6 April 2022].

Chen, K. 2006. Social Skills Intervention for Students with Emotional/Behavioural Disorders: A Literature Review from the American Perspective. *Educational Research and Reviews,* 1(3): 143-149.

Chi, H., Kang, S. & Wang, X. 2013. Research trends and opportunities of augmented reality applications in architecture, engineering, and construction. *Automation in Construction*, 33: 116-122.

Clarizen. 2019a. *5 ways technology has changed project management - Clarizen*. [Online] Available at: https://www.clarizen.com/5-ways-technology-has-changed-project-management/ [Accessed 2 April 2019].

Clarizen. 2019b. *Five Technologies That Can Improve Project Management - Clarizen*. [Online] Available at: https://www.clarizen.com/five-technologies-can-improve-project-management/ [Accessed 2 April 2019].

Cochran, T. Narayan, V. & Oldfield, J. 2015. Chapter 11: Emerging technologies in New Zealand. In Editors: V. Bozalek, D. Ng'ambi, D. Wood, J. Herrington, J. Hardman & A. Amory. 2015. *Activity Theory, Authentic Learning and Emerging Technologies: Towards a Transformative Higher Education Pedagogy.* New York: Routledge, 126-143.

Cohen, L., Manion, L. & Morrison, K. 2018. *Research methods in education.* 8th Edition. Abingdon, Oxfordshire: Routledge.

Companies and Intellectual Property Commission (CIPC). 2022. *CIPC: Register a Private Company with a Standard MOI*. [online] Cipc.co.za. Available at: <http://www.cipc.co.za/index.php/register-your-business/companies/register-private-company/> [Accessed 23 January 2022].

Construction Industry Development Board (CIDB). 2011. *Contractor Skills Survey.* Pretoria: CIDB.

Construction Industry Development Board (CIDB). 2012. The Construction Industry as a Vehicle for Contractor Development and Transformation. Pretoria: CIDB.

Construction Industry Development Board (CIDB). 2017a. *Study of Grade 1 Contractors Report*. Pretoria: CIDB.

Construction Industry Development Board (CIDB). 2017b. *Register for Contractors*. Available at https://registers.cidb.org.za/PublicContractors/ContractorSearch. [28 April 2017].

Construction Industry Development Board (CIDB). 2019a. *Construction Monitor – Employment Quarter 3 2019*. Pretoria: CIDB.

Construction Industry Development Board (CIDB). 2019b. *Construction Monitor – Contractor Development Quarter 2 2019*. Pretoria: CIDB.

Construction Industry Development Board (CIDB). 2019c. *Construction Monitor – Employment Quarter 3 2019*. Pretoria: CIDB.

Construction Industry Development Board (CIDB). 2020a. *Annual Report 2019/2020*. Pretoria: CIDB.

Construction Industry Development Board (CIDB). 2020b. *CIDB SME Business Conditions Survey, Quarter 4 2020*. Pretoria: CIDB

Construction World. 2019. *The Top 10 Construction Technology Trends to Watch for in 2018 - Construction World.* [Online] Available at: http://www.constructionworld.org/top-10-construction-technology-trends-2018/ [Accessed 19 March 2019].

Costley, K. C. 2014. *The Positive Effects of Technology on Teaching and Student Learning.* [online] Files.eric.ed.gov. Available at: <https://files.eric.ed.gov/fulltext/ED554557.pdf> [Accessed 16 March 2022].

Crawford, L. 2006. Developing organizational project management capability: Theory and Practice. In: *PMI Research Conference: New Directions in Project Management*. Newtown Square, Pennsylvania: Project Management Institute.

Creswell, J. W. & Creswell, J. D. 2018. *Research Design: Quantitative, Qualitative and Mixed Methods Approaches*. International Student Edition. 5th Edition. London: SAGE.

Da Silva-Vergottini, J. 2022. *News | critical skills list – what South Africans need to know | Work Permit South Africa*. [online] Work Permit South Africa. Available at: <https://www.workpermitsouthafrica.co.za/critical-skills-list-what-south-africans-need-to-know/> [Accessed 14 August 2022].

Day, G. S. 1994. The capabilities of market-driven organisations. *Journal of Marketing*, 58(4): 37-52.

Delport, C.S.L. & Roestenburg, W.J.H. 2011. Quantitative data collection methods. In A. S. De Vos, H. Strydom, C. B. Fouché & C. S. L. Delport. *Research at the grass roots for the social sciences and human service professions.* 4th ed. Pretoria: Van Schaik Publishers.

De Reuver, M., Bouwman, H. & De Koning, T. 2008. The mobile context explored. In: H. Bowman, H. De Vos, & T. Haaker, (Eds.), *Mobile service innovation and business models.* Berlin Heidelberg: Springer-Verlag: 89-114.

Deloitte. 2017. A shift to more but less: Africa Construction Trends Report. Netherlands: Deloitte.

Deloitte. 2018. European Construction Monitor | 2017-2018: A looming new construction crisis? Netherlands: Deloitte.

Derks, D., Duin, D., Tims, M., & Bakker, A. B. 2015. Smartphone use and work-home interference: The moderating role of social norms and employee work engagement. *Journal of Occupational and Organizational Psychology*, 88(1): 155-177.

Doloi, H. 2013. Cost overruns and failure in project management: Understanding the roles of key stakeholders in construction projects. *Journal of Construction Engineering and Management*, 139(3): 267-279.

Donnelly, K. 2009. Learning on the move: How m-learning could transfer training and development. *Development and Learning in Organisations*, 23(4): 8-11.

Dossick, C. S., & Neff, G. 2009. Organizational divisions in BIM-enabled commercial construction. *Journal of Construction Engineering and Management*, 136(4): 459-467.

Dossick, C. S., & Neff, G. 2011. Messy talk and clean technology: Communication, problem solving and collaboration using Building Information Modelling. *The Engineering Project Organization Journal*, 1(2): 83-93.

Dubois, D.D. 2002. What competencies and why are they important? *Career Planning and Adult Development Journal,* 18(4): 1-7.

Eadie, R., Browne, M., Odeyinka, H., McKeown, C. & McNiff, S. 2013. BIM implementation throughout the UK construction project lifecycle: An analysis. *Automation in Construction*, 36(2013): 145-151.

Eastman, J. K., Iyer, R., Liao-Troth, S., Williams, D. F., & Griffin, M. 2014. The Role of Involvement on Millennials' Mobile Technology Behaviours: The Moderating Impact of Status Consumption, Innovation, and Opinion Leadership. *Journal of Marketing Theory and Practice*, 22(4): 455-470.

Ehlers, T. & Lazenby, J. A. A. 2010. *Strategic Management: Southern African Concepts and Cases.* 3rd Edition. Pretoria: Van Schaik Publishers.

Etu.org.za. 2021. *Local Economic Development (LED)*. [online] Available at: <https://www.etu.org.za/toolbox/docs/government/led.html> [Accessed 24 January 2021].

Evans, S. K., Pearce, K. E., Vitak, J. & Treem, J. W. 2016. Explicating affordances: A conceptual framework for understanding affordances in Communication Research. *Journal of Computer-Mediated Communication*. 22(1): 35 – 52. Available at: https://doi.org/10.1111/jcc4.12180.

Feijóo, C., Maghiros, I., Abadie, F. & Gómez-Barroso, J. L. 2009. Exploring a heterogeneous and fragmented digital ecosystem: Mobile content. *Telematics and Informatics*, 26(3): 282-292.

Fejfarová, M. & Urbancová, H. 2015. Application of the competency-based approach in organisations in the Czech Republic. *Business Administration and Management*, 1(18): 111-121.

Felner, R.D., Lease, A.M. & Phillips, R.S.C. 1990. In: T.P. Gullota, G. R. Adams, & R. Montemayor, (Eds.), *The development of social competence in adolescence*. Beverly Hills, CA: Sage: 245-264.

Field, A. 2013. Discovering Statistics Using IBM SPSS Statistics: And Sex and Drugs and Rock 'N' Roll. 4th Edition. Los Angeles: Sage.

Fouka, G. & Mantzorou, M. 2011. What are the Major Ethical Issues in Conducting Research? Is there a Conflict between the Research Ethics and the Nature of Nursing? *Health Science Journal*, 5(1): 3-14.

Freeman, R. F. 1984. *Strategic Management: A Stakeholder Approach.* London: Pitman Publishing Inc.

Geoghegan, L. & Dulewicz, V. 2008. Do project managers' leadership competencies contribute to project success? *Project Management Journal*, 39(4): 58–67.

Gerstheimer, O. & Lupp, C. 2004. Needs versus technology - The challenge to design third-generation mobile applications. *Journal of Business Research*, 57(12): 1409-1415.

Ghobakhloo, M. & Tang, S.H. 2015. Information system success among manufacturing SMEs: Case of developing countries. *Information Technology for Development,* 21(4): 573-600.

Gilbert, P. 2019. *SA smartphone penetration now at over 80%, says ICASA*. [online] ITWeb. Available at: <https://www.itweb.co.za/content/GxwQDM1AYy8MlPVo> [Accessed 5 February 2022].

Global Entrepreneurship Monitor (GEM). 2017a. *Global Report 2016/2017*. London: Global Entrepreneurship Research Association (GERA).

Global Entrepreneurship Monitor (GEM). 2017b. *South Africa Report 2016/2017*. London: Global Entrepreneurship Research Association (GERA).

Gresham, F. M. 2018. *Effective Interventions for Social-Emotional Learning*. New York: Guilford Publications.

Guerra, R. M. A. & Camargo, M. E. 2016. The role of technological capability in the internationalization of the company and new product success: A systematic literature review. *Internext*, 11(1): 49-62.

Habisch, A., Patelli, L., Pedrini, M. & Shwarz, C. 2011. Different talks with different folks: A comparative survey of stakeholder dialogue in Germany, Italy, and the US. *Journal of Business Ethics*, 100(3): 381-404.

Hair, J.F., Wolfinbarger, M.F., Ortinau, D.J. & Bush, R.B. 2014. *Essentials of Marketing Research*. 2nd Edition. McGraw-Hill: Singapore.

Harris, V. 2017. Implementing a BIM process successfully. *PositionIT,* April 2017: 38-40.

Hasan, A., Elmualim, A., Rameezdeen, R., Baroudi, B. & Marshall, A. 2018. An exploratory study on the impact of mobile ICT on productivity in construction projects. *Built Environment Project and Asset Management*. 8(3): 320-332.

Heikkurinen, P. & Bonnedahl, K.J. 2013. Corporate responsibility for sustainable development: A review and conceptual comparison of market-and stakeholder-oriented strategies. *Journal of Cleaner Production*, 43: 191-198.

Helfat, C. E., & Peteraf, M. A. 2015. Managerial cognitive capabilities and the microfoundations of dynamic capabilities. *Strategic Management Journal*, 36(6): 831-850.

Hellriegel, D., Jackson, S.E., Slocum, J., Staude, G., Amos, T., Klopper, H.P., Louw, L. & Oosthuizen, T. 2008. *Management*. 2nd Edition. Oxford: Oxford University Press.

Henderson, L. S. 2008. The impact of project managers' communication competencies: Validation and extension of a research model for virtuality, satisfaction, and productivity on project teams. *Project Management Journal,* 39(2):48–59.

Hennink, M., Hutter, I. & Bailey, M. 2011. *Qualitative Research Methods*. 1st Edition. London: Sage.

Hills, M.J., Fox, P.W., Skitmore, M, Hon, C.K.H., & Fong, P.S.W. 2008. The role of project managers in construction industry development. In C Bridge. (Ed.) *AACE International's 52nd Annual Meeting & ICEC's 6th World Congress on Cost Engineering, Project Management and Quantity Surveying, 29 June - 02 July 2008*, Toronto, Ontario, Canada.

Hislop, R. 2018. *Ideas for solving rural South African internet connection - EE Publishers*. [online] EE Publishers. Available at: <https://www.ee.co.za/article/ideas-for-solving-rural-south-african-internet-connection.html> [Accessed 9 August 2021].

Hoadley, G. 2019. *5 New Technologies Used in the Construction Industry in 2017*. [Online] Dg.ca. Available at: http://www.dg.ca/blog/5-new-technologies-used-in-the-construction-industry-in-2017 [Accessed 19 March 2019].

Holmes, G., Heckel, R. & Gordon, L. 1991. *Adolescent group therapy: A social competency model*. 1st Edition. New York: Praeger Publishers.

Hunt, J. W., & Baruch, Y. 2003. Developing top managers: The impact of interpersonal skills training. *The Journal of Management Development*, 22(8): 729-752. doi:10.1108/02621710310487882

Independent Communications Authority of South Africa (ICASA). 2020. *The State of the ICT Sector Report in South Africa.* [online] Icasa.org.za. Available at: <https://www.icasa.org.za/legislation-and-regulations/state-of-the-ict-sector-in-south-africa-2020-report> [Accessed 5 February 2022].

InformationWeek. 2019. *Coke's RFID-Based Dispensers Redefine Business Intelligence - InformationWeek*. [Online] Available at: https://www.informationweek.com/mobile/mobile-devices/cokes-rfid-based-dispensers-redefine-business-intelligence-/d/d-id/1080236 [Accessed 7 February 2019].

Infragistics Community. 2015. *How Mobile Technology is Transforming the Construction Industry, Infragistics Blog*. [online] Available at: <https://www.infragistics.com/community/blogs/b/mobileman/posts/how-mobile-technology-is-transforming-the-construction-industry> [Accessed 4 February 2021].

Iyer, K. & Banerjee, P. 2016. Measuring and benchmarking managerial efficiency of project execution schedule performance. *International Journal of Project Management*, 34(2): 219-236.

Jin, C. H. & Villegas, J. 2008. Mobile phone users' behaviours: The motivation factors of the mobile phone user. *International Journal of Mobile Marketing*, 3(2): 4-14.

Jones, K. 2021. *Going Mobile: The Benefits of Mobile Construction Technology.* [online] Constructconnect.com. Available at: <https://www.constructconnect.com/blog/going-mobile-benefits-mobile-construction-technology> [Accessed 31 July 2021].

Jones, O., Macpherson, A. & Jayawarna, D. 2014. Resourcing the start-up business: Creating dynamic entrepreneurial learning capabilities. Oxon: Routledge.

Kendrick, T. 2015. Identifying and Managing Project Risk: Essential tools for failure-proofing your project. 3rd Edition. New York: AMACOM

Kim, C., Park, T., Lim, H. & Kim, C. 2013. On-site construction management using mobile computing technology. *Automation in Construction*, (35), November 2013: 415-423.

Kivunja, C. 2014. Do You Want Your Students to Be Job-Ready with 21st Century Skills? Change Pedagogies: A Pedagogical Paradigm Shift from Vygotskian Social Constructivism to Critical Thinking, Problem Solving and Siemens' Digital Connectivism. *International Journal of Higher Education*, 3(3):1-11.

Kline, R. B. 2016. *Principles and Practice of Structural Equation Modelling*. 4th Edition. New York: The Guilford Press.

Koutamanis, A. 2023. Technologies, Inbetweenness and Affordances. *Global Philosophy*. 33, 5 (2023). https://doi.org/10.1007/s10516-023-09668-0.

Krajcovicova, K, Caganova, D., & Cambal, M. 2012. Key managerial competencies and competency models in industrial enterprises. *Annals of DAAAM for 2012 & Proceedings of the 23rd International DAAAM Symposium*, 23(1):1119-1122.

Kukulska-Hulme, A. 2016. *Personalization of language learning through mobile technologies.* Cambridge University Press, Cambridge, UK.

Kumar, R. 2019. Research Methodology: A step-by-step guide for beginners. 5th Edition. London: SAGE.

Kuratko, D.F. 2016. *Entrepreneurship: Theory, process, and practice*. 10th Edition. Boston: CENGAGE Learning Custom Publishing.

Kurowska-Pysz, J. 2014. Shaping of Competencies of Managers in Academic Incubators of Entrepreneurship in Poland. *Organizacija*, 47(1): 52-65.

Kurz, R. & Bartram, D. 2002. Competency and individual performance: Modelling the world of work. In: I.T. Robertson, M. Callinan and D. Bartram (Eds). *Organizational Effectiveness: The Role of Psychology*. Chichester, UK: John Wiley and Sons: 227–255.

Larson, E. W. & Gray, C. F. 2017. *Project Management: The Managerial Process*. 7th Edition. New York: McGraw-Hill Education.

Lau, J. 2018. *Definition of Mobile Technology | Introduction to Mobile Learning Blog*. [Online] Sites. Psu.edu. Available at: https://sites.psu.edu/mobilelearninglau/2014/05/25/definition-of-mobile-technology/ [Accessed 20 November 2018].

Lazenby, J. A. A. 2015. Chapter 1: Introduction to Management. *In Editor: J. A. A. Lazenby. 2015. General Management*. 1st edition. Pretoria: Van Schaik Publishers.

Le Deist, F.D., Delamare, F. & Winterton, J. 2005. What is competence? *Human Resource Development International*, 8(1): 27-46.

Lebioda, L., Hahn, I.S. & Martins, A. A. M. 2019. The influence of mobile technology usage behaviour on perceived work performance improvement. *International Journal of Development Research*, 9(2): 25733-25738.

Lee, C. C., Cheng, H. K. & Cheng, H. H. 2007. An empirical study of mobile commerce in insurance industry: Task-technology fit and individual differences. *Decision Support Systems*, 43(1): 95-110.

Leibbrandt, M., Woolard, I., McEwen, H. & Koep, C. 2022. *Employment and Inequality Outcomes in South Africa*. [online] Oecd.org. Available at: <https://www.oecd.org/employment/emp/45282868.pdf> [Accessed 4 February 2022].

Lekula, N. 2019. *Construction industry a good growth barometer | IOL Business Report.* [Online] Iol.co.za. Available at: https://www.iol.co.za/business-report/economy/construction-industry-a-good-growth-barometer-14258859 [Accessed 18 April 2019].

Leonard-Barton, D. 1992. Core capabilities and core rigidities: A paradox in managing new product development. *Strategic Management Journal*, 13: 111-125.

Liang, T. P., Huang, C. W., Yeh, Y. H. & Lin, B. 2007. Adoption of mobile technology in business: A fit-viability model. *Industrial Management and Data Systems*, 107(8): 1154-1169.

Light, J. & McNaughton, D. 2014. Communicative Competence for Individuals who require Augmentative and Alternative Communication: A New Definition for a New Era of Communication? *Augmentative and Alternative Communication*, 30(1): 1-18.

Lues, L & Lategan, L.O.K. 2006. *RE: search ABC*. Stellenbosch. Sun Press.

Lulee, S., Oberman, S. & Tin, T. 2010*. Connectivism: Connecting with George Siemens.* [online] Youtube.com. Available at: <https://www.youtube.com/watch?v=4gNaOZAjkxg> [Accessed 7 January 2022].

Ma'aden Africa, Growth Bank, Siemens Accra & IMF Mozambique. 2019. *Africa's construction industry set to grow at fastest rate over next five years*. [Online] African

Review. Available at: http://www.africanreview.com/construction-a-mining/africa-s-construction-industry-to-grow-at-fastest-rate-in-next-five-years [Accessed 18 April 2019].

Maime, B. R. & Musvoto, S. W. 2018. Enhancing the cost reduction effects of Web 2.0 technologies at South African Universities. *Interdisciplinary Journal of Economics and Business Law*, 7(Special Issue): 203-231.

Makhalemele, P. 2016. The relationship between managerial competencies and performance of internet cafés in the Free State region. Unpublished Master's Dissertation. Bloemfontein: Central University of Technology.

Martin, L. 2010. Knowledge transfers in the South African construction industry: Focus on civil engineering contractors. Research Report. Cape Peninsula University of Technology. Cape Town.

Matos, S. & Silvestre, B.S. 2013. Managing stakeholder relations when developing sustainable business models: The case of the Brazilian energy sector. *Journal of Cleaner Production*, (45): 61-73.

McBurney, D.H. & White, T.L. 2009. *Research methods*. 8th Edition. Boston, MA, United States: Wadsworth Publishing Co.

Modern Contractor Solutions. 2019. *Mobile Technology Trends for Heavy Construction | MCS mag*. [online] Available at: https://mcsmag.com/mobile-technology-trends-for-heavy-construction/ [Accessed 2 April 2019].

Mohammadi, M., Sarvestani, M. & Nouroozi, S. 2020. Mobile Phone Use in Education and Learning by Faculty Members of Technical-Engineering Groups: Concurrent Mixed Methods Design. *Frontiers in Education*, 5(16): 1-9.

Mumford, M., Zaccaro, S., Connelly, M.S. & Marks, M. 2000a. Leadership skills: Conclusions and future directions. *Leadership Quarterly*, 11(1): 155-170.

Mumford, M., Zaccaro, S., Harding, F., Jacobs, O. & Fleischman, E. 2000b. Leadership skills for a changing world: Solving complex social problems. *Leadership Quarterly*, 11(1): 11-35.

National Treasury. 2019. *Economic transformation, inclusive growth, and competitiveness: Towards an Economic Strategy for South Africa*. [online] Available at: <http://www.treasury.gov.za/comm_media/press/2019/Towards%20an%20Economic%20Strategy%20for%20SA.pdfhttp://www.treasury.gov.za/comm_media/press/2019/Towards%20an%20Economic%20Strategy%20for%20SA.pdf> [Accessed 4 February 2022].

Nazir, M. & Roomi, M. 2021. Barriers to Adopting Electronic Commerce for Small and Medium-sized Enterprises in Emerging Economies. *EMAJ: Emerging Markets Journal*, 10(2): 43-55.

Ng'ambi, D. & Bozalek, V. 2015. Chapter 9: Introduction to emerging technologies. In Editors: In Editors: V. Bozalek, D. Ng'ambi, D. Wood, J. Herrington, J. Hardman & A. Amory. 2015. *Activity Theory, Authentic Learning and Emerging Technologies: Towards a transformative higher education pedagogy*. New York: Routledge: 105-114.

Ngai, E. W. T. & Gunasekaran, A. 2007a. A review for mobile commerce research and applications. *Decision Support Systems*, 43(1): 3-15.

Ngai, E. W. T., Cheng, T. C. E. & Lai, S. A. K. 2007b. Mobile commerce integrated with RFID technology in a container depot. *Decision Support Systems*, 43(1): 62-76.

Nicholas, J. M. & Steyn, H. 2012. *Project Management for Engineering, Business and Technology.* Abington, Oxon: Routledge/Taylor & Francis Group.

Nyandongo, K.M. & Davids, M. 2017. The impact of communication on project performance: an empirical study. In, *26th International Association for Management of Technology Conference*, 14-17 May 2017. IAMOT. Vienna, Austria: 404-425.

Oesterreich, T.D. & Teuteberg, F. 2016. Understanding the implications of digitisation and automation in the context of Industry 4.0: A triangulation approach and elements of a research agenda for the construction industry. *Computer Industry*, 83: 121–139. https://doi.org/10.1016/j.compind.2016.09.006.

Omar, R., Takim, R. & Nawawi, A. 2012. Measuring of Technological Capabilities in Technology Transfer (TT) Projects. *Asian Social Science*, 8(15): 211-221.

Pallant, J. 2016. SPSS Survival Manual: A Step-by-Step Guide to Data Analysis using SPSS. 6th Edition. Philadelphia: McGraw Hill.

Park, E. & Kim, K. J. 2014. An integrated adoption model of mobile cloud services: Exploration of key determinants and extension of technology acceptance model. *Telematics and Informatics*, 31(3): 376-385.

Paukku, M., Koria, M. & Kourula, A. 2010. Towards Multilevel Capabilities: Dynamic Capabilities and Sen's Capability Approach. In: *SMS 30th Annual International Conference*, 2010. Rome.

Pauleen, D., Campbell, J., Harmer, B. & Intezari, A. 2015. Making sense of mobile technology. *SAGE Open*, 5(2): 1-10.

Pedrini, M. & Ferri, L. M. 2019. Stakeholder management: A systematic literature review. *Corporate Governance: The International Journal of Business in Society*, 19(1): 44-59.

Penrose, E. T. 1959. *The theory of the growth of the firm*. Oxford: Blackwell.

Peppard, J. & Ward, J. 2004. Beyond strategic information systems: Towards an IS capability. *Journal of Strategic Information Systems,* 13: 167-194.

Peteraf, M. & Barney, J. 2003. Unravelling the Resource-Based Tangle*. Managerial and Decision Economics*, 24: 309-323.

Petricevic, O. & Teece, D. 2019. The structural reshaping of globalization: Implications for strategic sectors, profiting from innovation, and the multinational enterprise. *Journal of International Business Studies*, 50(9): 1487-1512.

Pietersen, J. & Maree, K. 2014. Standardisation of a questionnaire. In: K. Maree: *First steps in research*: 215-223. Pretoria: Van Schaik Publishers.

Pm4dev.com. 2019. *Project Quality Management: Project Management for Development Organizations*. [Online] Available at: https://www.pm4dev.com/resources/free-e-books/5-project-quality-management/file.html [Accessed 3 April 2019].

Pouris, A. 2012. *Technology Trends: A Review of Technologies and Policies.* Pretoria: Department of Trade and Industry.

Price Water Cooper (PwC). 2019. *SA construction:* 4th Edition. [Online] Available at: https://www.pwc.co.za/en/publications/sa-construction.html [Accessed 18 April 2019].

Priola, E. J. 2016. Managerial Communication Competencies That Enhance Employee Performance: A Systematic Review. Doctor of Management. University of Maryland University College.

Project Management Institute (PMI). 2017. *A Guide to the Project Management Body of Knowledge*. 6th Edition. Pennsylvania: Project Management Institute.

Rambe, P. & Bere, A. 2013. Case Study 15.4 Fostering Seamless Learning Through Mobile Devices: A Case of Student WhatsApp Postings. In Editors*:* In Editors: V. Bozalek, D. Ng'ambi, D. Wood, J. Herrington, J. Hardman & A. Amory. 2015*. Activity Theory, Authentic Learning and Emerging Technologies: Towards a Transformative Higher Education Pedagogy*. New York: Routledge: 226-233.

Rambe, P. 2018. Unravelling managerial competencies and the profitability of small technology-oriented businesses: A case of public access venues in an emerging economy. *SA Journal of Human Resource Management*, 16(0):1-15.

Ramokolo, B.S.M. & Smallwood, J. J. 2008. The capacity of emerging civil engineering contractors. *Acta Structilia,* 15(2): 45-74.

Ranängen, H. & Zobel, T. 2014. Revisiting the 'how' of corporate social responsibility in extractive industries and forestry. *Journal of Cleaner Production*, 84 (12): 299-312.

Rawahi, S., Jamaluddin, Z. & Bhuiyan, A. 2020. The Conceptual Framework for the Resource Management Attributes and Aircraft Maintenance Efficiency in the Aviation Industries in Oman. *International Journal of Accounting & Finance Review*, 5(3): 31-40.

Republic of South Africa. 1996. *National Small Business Act, Number 102 of 1996*. Pretoria. Government Printers.

Republic of South Africa. 2013. *Board-Based Black Economic Empowerment Act, Number 46 of 2013*. Pretoria: Government Printers.

Resources.b2wsoftware.com. 2019. *Study: Mobile Technology, Connectivity Will Transform Heavy Construction*. [Online] Available at: https://resources.b2wsoftware.com/news/dodge [Accessed 2 April 2019].

Ribeiro, A., Amaral, A. & Barros, T. 2021. Project Manager Competencies in the context of the Industry 4.0. *Procedia Computer Science*, 181: 803-810.

Rochford, T. 2001. The impact of mobile application technology on today's workforce. Waltham: iConverse Inc.

Saladis, F. P. & Wais, K. 2013. *Thinking positive about risk management*. Newtown Square, PA: Project Management Institute.

Sanakulov, N. & Karjaluoto, H. 2015. Consumer adoption of mobile technologies: A literature review. *International Journal of Mobile Communications*, 13(3): 244-275.

Saunders, M.N.K., Lewis, P. & Thornhill, A. 2012. *Research methods for business students.* 6th Edition. Harlow, England: Financial Times Prentice Hall.

Semrud-Clikeman, M. 2007. *Social competence in children*. New York, NY: Springer Science+Business Media.

Shaw, P. 2014. *Using Mobile Technology for Managing Construction Projects*. [online] Agc.org. Available at: <https://www.agc.org/sites/default/files/Files/Foundation/Paul%20Shaw%20Allhands%20Essay_0.pdf> [Accessed 8 March 2018].

Siemens, G. 2005. Connectivism: A learning theory for the digital age. *International Journal of Instructional Technology and Distance Learning*, *2*(1): 3-10. Retrieved from http://www.itdl.org/

Siemens, G. 2013. *George Siemens: Changing Schools, Changing Knowledge*. [online] Youtube.com. Available at: <https://www.youtube.com/watch?v=JR_ziHA_8LY> [Accessed 7 August 2021].

Smook, R. A. F & Van Egmond - de Wilde de Ligny, E. L. C. 2001. Measuring construction productivity, technological performance, capabilities and competitiveness. In: *CIB World Building Congress, April 2001*. Wellington, New Zealand, 1-12.

Soderquist, K. E., Papalexandris, A., Ioannou, G. & Prastacos, G. 2010. From task-based to competency-based: A typology and process supporting a critical HRM transition. *Personnel Review*, 39(3): 325-346.

South Africa. 2021. *Free State (Province, South Africa) - Population Statistics, Charts, Map and Location*. [online] Citypopulation.de. Available at: <https://www.citypopulation.de/en/southafrica/admin/4__free_state/> [Accessed 24 January 2021].

South African Magazine - SA PROMO. 2019. *Hope for SA construction industry in 2019 - South African Magazine - SA PROMO.* [Online] Available at: https://www.sapromo.com/news/hope-for-sa-construction-industry-in-2019/ [Accessed 18 April 2019].

Spencer, L.M. & Spencer, S.M. 1993. *Competence at Work: Models for Superior Performance.* New York: John Wiley & Sons.

Stangor, C. 2011. *Research Methods for the Behavioural Sciences*. 4th Edition. Belmont: Cengage Learning.

Statistics South Africa (Stats-SA). 2012. *Population Census 2011 Fact Sheet*. [Online] Available at: http://www.statssa.gov.za/census/census_2011/census_products/Census_2011_Fact_sheet.pdf [Accessed 20 April 2019].

Statistics South Africa (Stats-SA). 2016. *Construction Industry, 2014*. Pretoria: Statistics South Africa.

Statistics South Africa (Stats-SA). 2019a. *Construction Industry, 2017*. Pretoria: Statistics South Africa.

Statistics South Africa (Stats-SA). 2019b. *Mid-year population estimates.* Pretoria: Statistics South Africa.

Statistics South Africa (Stats-SA). 2019c. *Quarterly Employment Statistics*. Pretoria: Statistics South Africa.

Statistics South Africa (Stats-SA). 2019d. *Quarterly Financial Statistics.* Pretoria: Statistics South Africa.

Statistics South Africa (Stats-SA). 2019e. *Quarterly Labour Force Survey.* Pretoria: Statistics South Africa.

Statistics South Africa (Stats-SA). 2020. *Quarterly Labour Force Survey, Q3:2020.* Pretoria: Statistics South Africa.

Steenhoff-Snethlage, E. 2018. *Drone industry to expand in 2018*. [online] Engineering News. Available at: <https://www.engineeringnews.co.za/article/drone-industry-to-expand-in-2018-2018-05-11> [Accessed 5 February 2022].

Stieglitz, S., Lattemann, C. & Brockmann, T. 2015. Mobile Applications for Knowledge Workers and Field Workers. *Mobile Information Systems*, 2015, 1-8.

Stump, K.N.; Ratliff, J.M.; Wu, Y.P. & Hawley, P.H. 2009. In Editor: J. L. Matson. *Social competence.* New York, NY, US: Springer Science + Business Media, US, 23–37.

Succar, B., Sher, W. & Williams, A. 2013. An integrated approach to BIM competency assessment, acquisition and application. *Automation in Construction*. 35: 174-189.

Sullivan, P. 2012. Qualitative data analysis using a dialogical approach. Los Angeles: Sage.

Szpekman, A. 2000. Building communication competencies. *Strategic Communication Management,* 4: 28-32.

Szpekman, A. 2004. Three steps to improving manager communication. *Strategic Communication Management,* 8(2): 18-21.

Szpekman, A. 2007. Making Manager Toolkits Work. *Strategic Communication Management,* 11(1): 9.

Taherdoost, H. 2016. Validity and Reliability of the Research Instrument: How to Test the Validation of a Questionnaire/Survey in a Research. *International Journal of Academic Research in Management (IJARM),* 5(3): 28-36.

Tang, T. W., Wang, M. C. H. & Tang, Y. Y. 2015. Developing service innovation capability in the hotel industry. *Service Business*, 9(1): 97-113.

Tarasewich, P., Nickerson, R. C. & Warkentin, M. 2002. Issues in mobile e-commerce. *Communications of the Association for Information Systems*, 8: 41-64.

Teece, D. J. 2007. Explicating dynamic capabilities: The nature and micro-foundations of (sustainable) enterprise performance. *Strategic Management Journal,* 28(13): 1319-1350.

Teece, D. J. 2014. A dynamic capabilities-based entrepreneurial theory of the multinational enterprise. *Journal of International Business Studies,* 45(1): 8-37.

Teece, D. J., Pisano, G. & Shuen, A. 1997. Dynamic capabilities and strategic management. *Strategic Management Journal,* 18(7): 509-533.

Tett, R. P., Guterman, H.A., Bleier, A. & Murphy, P. 2000. Development and content validation of a 'hyperdimensional' taxonomy of managerial competence. *Human Performance*, 13(3): 205–251.

Thompson, V. 2019. *How 4G Accelerates the Wireless Revolution and How to Compete | ZDNet*. [Online] ZDNet. Available at: https://www.zdnet.com/article/how-4g-accelerates-the-wireless-revolution-and-how-to-compete/ [Accessed 15 March 2019].

Thwala, D. W. & Phaladi, M. J. 2009. An exploratory study of problems facing small contractors in the North-West province of South Africa. *African Journal of Business Management,* 3(10): 533-539.

Timmons, J.A. & Spinelli, S. 2007. *New venture creation: Entrepreneurship for the 21st century*. 7th Edition. United States: McGraw Hill Higher Education.

Traxler, J, Barcena, E & Laborda, J. G. 2015. Mobile Technology for Foreign Language Teaching: Building Bridges between Non-formal and Formal Scenarios. *Journal of Universal Computer Science,* 21(10): 1234-1247.

Traxler, J., 2011. The Mobile and Mobility: Information, Organisations and Systems. In: J. Pokorny, V. Repa, K. Richta, W. Wojtkowski, H. Linger and C. Barry, eds., *Information Systems Development: Business Systems and Services: Modelling and Development*. Prague: 25-34.

Tsai, K. 2004. The impact of technological capability on firm performance in Taiwan's electronics industry. *The Journal of High Technology Management Research*, 15(2): 183-195.

Tshivhase, L. & Worku, Z. 2012. Barriers toward the Development of Emerging Contractors in the Limpopo Province. *Journal of US-China Public Administration*, 9(3): 268-279.

Uddin, J., Biswas, T., Adhikary, G., Ali, W., Alam, N., Palit, R., Uddin, N., Uddin, A., Khatun, F. & Bhuiya, A. 2017. Impact of mobile phone-based technology to improve health, population and nutrition services in Rural Bangladesh: A study protocol. *BMC Medical Informatics and Decision Making* (2017), 17(1):101.

Ullah Khan, A. 2014. Effects of cultural assimilation on the performance of a construction project – Evidence from UAE. *Benchmarking: An International Journal*, 21(3): 430-449.

United Nations (UN). 2007. *Industrial Development for the 21st Century: Sustainable Development Perspectives.* New York: United Nations – Department of Economic and Social Affairs

Van Zyl, L. E. 2014. Research Methodology for The Economic and Management Sciences. London: Pearson.

Venkatraman, S. & Yoong, P. 2009. Role of mobile technology in the construction industry – A case study. *International Journal of Business Information Systems (IJBIS)*, 4(2): 195-209.

Venkatraman, V., Reddy, R., Zhang, F., Evans, D., Ulrich, B. & Prasad, S. 2009. Iridium oxide nano monitors: Clinical diagnostic devices for health monitoring systems. *Biosensors and Bioelectronics*, 24(10): 3078-3083.

Wade, M. & Hulland, J. 2004. Review: The resource-based view and information systems research - Review, extension, and suggestions for future research. *MIS Quarterly*, 28(1): 107-142.

Wadei, S. 2019. *Effectively Managing Risks During Project Execution*. [Online] ProjectManagement.com. Available at: https://www.projectmanagement.com/articles/421532/Effectively-Managing-Risks-During-Project-Execution [Accessed 3 April 2019].

Wanner, M., 2015. Build organizational capability to improve strategy implementation: Enterprise change management (ECM) and organizational project management (OPM). In: *PMI Global Congress 2015 - EMEA,* 11 May 2015. Newtown Square, Pennsylvania: Project Management Institute.

Watermeyer, R. & Phillips, S. 2020. *Public infrastructure delivery and construction sector dynamism in the South African economy.* [online] Nationalplanningcommission.org.za. Available at: <https://www.nationalplanningcommission.org.za/assets/Documents/NPC%20background%20paper%20-%20Infrastructure%20delivery%20Watermeyer%20Phillips%206%20March%202020%20FINAL.pdf> [Accessed 4 February 2022].

Welman, C., Kruger, F. & Mitchell, B., 2005. *Research Methodology*. 3rd Edition. Cape Town: Oxford University Press.

Wernerfelt, B. 1984. A resource-based view of the firm. *Strategic Management Journal*: 5(1): 171-180.

Western Governors University (WGU). 2022. *Connectivism Learning Theory*. [online] Available at: <https://www.wgu.edu/blog/connectivism-learning-theory2105.html#close> [Accessed 2 February 2022].

Wiemann, J. & Backlund, P. 1980. Current Theory and Research in Communicative Competence. *Review of Educational Research*, 50(1): 185-199.

Williams, N. L. 2011. Defining organizational project management. *In: PMI Global Congress 2011 - North America, Dallas, Texas,* 22 October 2011. Newtown Square, Pennsylvania: Project Management Institute.

Winner, M. G. & Crooke, P. 2021. The Updated and Expanded Social Thinking–Social Competency Model: Exploring Sensory Processing, Anxiety Management and Screen Time Overload! [online] https://www.socialthinking.com. Available at: <https://www.socialthinking.com/Articles?name=social-competency-model-attend-interpret-problem-solve-respond> [Accessed 15 April 2022].

Winter, S. G. 2003. Understanding dynamic capabilities. *Strategic Management Journal*, 24(10): 991-995.

Wittmann, C., Hunt, S. & Arnett, D. 2009. Explaining alliance success: Competences, resources, relational factors, and resource-advantage theory. *Industrial Marketing Management*, 38(7): 743-756.

Wong, J., Wang, X., Li, H., Chan, G. & Li, H. 2014. A review of cloud-based BIM technology in the construction sector. *Journal of Information Technology in Construction* (ITcon), Special Issue BIM Cloud-Based Technology in the AEC Sector: Present Status and Future Trends,19: 281-291, http://itcon.org/2014/16

Wong, M. M. T. & Tang, E. P. Y. 2008. Consumer attitudes toward advertising: The role of permission. *Review of Business Research*, 8(3): 181-187.

Woodruffe C. 1993. What is meant by a competency? *Leadership and Organisation Development Journal*, 14: 29–36.

Worku, Z. 2016. Developmental obstacles adversely affecting emerging contractors in the construction industry of Limpopo province. *Problems and Perspectives in Management*, 14(4-1): 170-180. doi:10.21511/ppm.14(4- 1).2016.05

www.construction.com. 2019. *New Study Finds Mobile Technologies and Connectivity Poised to Transform Heavy Construction Projects*. [Online] Available at: https://www.construction.com/news/mobile-technologies-connectivity-transform-heavy-construction-projects-may-2018 [Accessed 2 April 2019].

Xiaojun, D., Junichi, I. & Sho, H. 2004. Unique features of mobile commerce. *Journal of Electronic Science and Technology of China*, 2(3): 205-210.

Yuan, Y., Archer, N., Connelly, C. E. & Zheng, W. 2010. Identifying the ideal fit between mobile work and mobile work support. *Information and Management,* 47(3): 125-137.

Zakhem, A. 2008. Stakeholder Management Capability: A Discourse-Theoretical Approach. *Journal of Business Ethics*, 79(4): 395-405.

Zulch, B. 2014. Communication: The Foundation of Project Management. *Procedia Technology*, 16:1000-1009.

Zulch, B. 2016. A proposed model for construction project management communication in the South African construction industry. *Acta Structilia*, 23(1): 1-35.

Zulu, L. 2014. *SMMEs hold key to economic growth*. Available at http://www.gov.za/blog/smmes-hold-key-economic-growth. [Accessed 20 February 2017].

ANNEXURE A: BIOGRAPHICAL STATEMENT

Thabo James Lesebo is an emerging researcher who holds a Baccalaureus Technologiae Degree in Project Management from the Central University of Technology, Free State. He holds a National Diploma in Mechanical Engineering from Cape Peninsula University of Technology and is currently enrolled for a Master's degree in Business Administration at the Central University of Technology, Free State. Some of his research interests are in innovative entrepreneurship, practical project management administration and knowledge management in emerging SMMEs in the construction industry.

ANNEXURE B: CERTIFICATE OF LANGUAGE EDITING

Office: 0183892451

FACULTY OF EDUCATION Cell: 0729116600

Date: 20th August, 2022

CERTIFICATE OF EDITING

I, Muchativugwa Liberty Hove, confirm and certify that I have read and edited the entire dissertation, THE INFLUENCE OF USING MOBILE TECHNOLOGIES DURING PROJECT EXECUTION ON PERCEIVED MANAGERIAL COMPETENCIES OF EMERGING CONSTRUCTION FIRM OWNER/ MANAGERS IN THE FREE STATE PROVINCE, submitted by THABO JAMES LESEBO, in fulfilment of the requirements for the degree MASTER'S IN MANAGEMENT SCIENCES, specialising in BUSINESS ADMINISTRATION, in the Faculty of Management Sciences at CENTRAL UNIVERSITY OF TECHNOLOGY, FREE STATE.

THABO JAMES LESEBO was supervised by Professor Patient Rambe.

I hold a PhD in English Language and Literature in English and am qualified to edit such a thesis for cohesion and coherence. The views expressed herein, however, remain those of the researcher/s.

Yours sincerely

Professor M.L. Hove (PhD, MA, PGDE, PGCE, BA Honours – English)

ANNEXURE C: ETHICAL CLEARANCE REPORT

FACULTY RESEARCH AND INNOVATION COMMITTEE

FACULTY OF MANAGEMENT SCIENCES

RESEARCH ETHICS APPROVAL LETTER

Date: 06 September 2022

This is to confirm that:

Applicant's Name	Thabo James Lesebo
Supervisors' Name[s] for Student Project (where applicable)	Prof Patient Rambe
Level of Qualification for Student Project (where applicable)	Master's in Management Sciences: Business Administratio
Tittle of research project	**The influence of using Mobile Technologies durin Project Execution on perceived Manageria Competencies of Emerging Construction Firm Owner/managers in the Free State Province.**

Ethical clearance has been provided by the Faculty Research and Innovation Committee in view of the CUT Research Ethics and Integrity Framework, 2016 with reference number **FMSEC0318**

The following special conditions were set:

[X] None

[ ] Specific conditions

The following specific conditions apply:

1. _____NA_____
2. _____NA_____
3. _____NA_____

We wish you success with your research project.

Professor D Kokt
Acting FRIC Chairperson

ANNEXURE D: SIMILARITY INDEX REPORT

THE INFLUENCE OF USING MOBILE TECHNOLOGIES DURING PROJECT EXECUTION ON PERCEIVED MANAGERIAL COMPETENCIES OF EMERGING CONSTRUCTION FIRM OWNER/ MANAGERS IN THE FREE STATE PROVINCE

ORIGINALITY REPORT

12%	12%	1%	2%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	hdl.handle.net Internet Source	7%
2	eprints.bournemouth.ac.uk Internet Source	2%
3	ir.cut.ac.za Internet Source	1%
4	Submitted to University of Stellenbosch, South Africa Student Paper	1%
5	aisel.aisnet.org Internet Source	1%
6	uir.unisa.ac.za Internet Source	1%

ANNEXURE E: QUESTIONNAIRE

QUESTIONNAIRE: THE INFLUENCE OF USING MOBILE TECHNOLOGIES DURING PROJECT EXECUTION ON PERCEIVED MANAGERIAL COMPETENCIES OF EMERGING CONSTRUCTION FIRM OWNER/MANAGERS IN THE FREE STATE PROVINCE

Dear Sir/ Madam,

I am Thabo J. Lesebo, a Master's in Management Sciences specialising in Business Administration student from the Central University of Technology, Free State, Bloemfontein campus. I am currently conducting research on the influence of using mobile technologies during project execution on perceived managerial Competencies of Emerging Construction Firm Owner/managers in the Free State Province. At this stage, I am collecting data on the managers/owners of Emerging Construction Firms' perceptions on how their use of mobile technologies influence their managerial competencies (i.e., communicative and social competencies) in their project-related business.

This study is supervised by Professor Patient Rambe who can be contacted on the following contact details:

Professor Patient Rambe (Supervisor): 051 507 4064 / 073 380 1687 or prambe@cut.ac.za

At this stage, I am conducting my fieldwork on this topic, and I would be very pleased if you take the time to complete this questionnaire. Your participation in this survey is voluntary and your responses are confidential. The findings from this study will be useful in understanding the current project related uses of mobile technologies within the construction industry in the Free State including how they can be effectively integrated into the emerging construction businesses to enhance managerial competencies of owner/managers in the Free State Province. Your responses to the survey will be very instrumental in shaping and developing a framework that can be used by both business and academic communities on the adoption of mobile technologies in the immediate future. The results of this survey will be reported in aggregate form to ensure your anonymity. Please be advised that participation in this study is voluntary and you are at liberty to withdraw from the study without any

potential threat or risk. The confidentiality of your personal information and responses is guaranteed. This survey will take approximately 10-15 minutes to complete.

I will be very grateful if you would answer all sections of this questionnaire as honestly as possible.

Yours faithfully,

Thabo Lesebo: thabo.lesebo@gmail.com or 071 251 4823

SECTION A: DEMOGRAPHIC DATA (Business and Owner Information)								
Please mark appropriate answer with X								
1.	**Please indicate your gender**	**1** Male			**2** Female			
2.	**Please indicate your age**	**1** (Under 18)	**2** (18-34)	**3** (35-44)	**4** (45-54)	**5** (55-60)	**6** (Above 60)	
3	**Please indicate your ethnic group**	**1** Black South African	**2** White South African	**3** Coloured South African	**4** Asian South African	**5** Other (Specify)		
4.	**Please indicate your home language**	**1** English	**2** Afrikaans	**3** Sesotho	**4** Setswana	**5** isiXhosa	**6** Other (Specify)	
5.	**Please indicate your highest level of qualification**	**1** No Formal Education	**2** Primary Schooling	**3** Matric Certificate	**4** FET Or Equivalent	**5** University Degree/ Diploma	**6** Postgraduate	

6.	**Please indicate your highest level of education in construction**	**1** None	**2** Short-Courses	**3** Apprenticeship	**4** High School	**5** Undergraduate	**6** Postgraduate
7.	**Please indicate your highest level of education in project management**	**1** None	**2** Short-Courses	**3** Apprenticeship	**4** High School	**5** Undergraduate	**6** Postgraduate
8.	**Please indicate your highest level of business training**	**1** None	**2** Short-Courses	**3** Apprenticeship	**4** High School	**5** Undergraduate	**6** Postgraduate
9.	**Please indicate your role in the business**	**1** Manager	**2** Owner/ Manager	**3** Owner	**4** Other (Specify)		
10.	**Please indicate your business ownership type**	**1** Sole Proprietorship	**2** Partnership	**3** Private Company	**4** Public Company	**5** Other (Specify)	
11.	**Please indicate your CIDB contractor grade**	**1** (1&2)	**2** (3&4)	**3** (5&6)	**4** (7&8)	**5** (9)	
12.	**Please indicate the number of years your business has been in operation**	**1** (Below 5)	**2** (5-10)	**3** (11-15)	**4** (16-20)	**5** (Over 20)	

13.	**Please indicate the number of employees employed by your business**	**1** (Under 5)	**2** (5-20)	**3** (21-50)	**4** (51-100)	**5** (101-200)	**6** (Over 200)
14.	**Please indicate the sector in which your business mostly undertakes projects**	**1** Civil Engineering Works	**2** General Building Works	**3** Electrical Works	**4** Mechanical Works	**5** Roads & Stormwater Works	**6** Other (Specify)

SECTION B: THE USE OF MOBILE TECHNOLOGIES BY THE ORGANISATION				
Please mark appropriate answer with X				
15.	**My organisation uses these mobile devices for project-related operations**	Laptops	**YES**	**NO**
		Tablets	**YES**	**NO**
		Smartphones	**YES**	**NO**
		PDAs	**YES**	**NO**
		Drones	**YES**	**NO**

16.	**My organisation uses soft technologies (i.e., mobile applications) for project-related operations**	Building Information Modelling (BIM)	**YES**	**NO**
		MS Project	**YES**	**NO**
		Jira	**YES**	**NO**
		Pro-Workflow	**YES**	**NO**
		Hive	**YES**	**NO**
		WhatsApp Only	**YES**	**NO**
		Microsoft Office Only	**YES**	**NO**
		WhatsApp and Microsoft Office	**YES**	**NO**
17.	**My organisation relies on the use of mobile technologies for these project-related operations.**	Initiating of Projects	**YES**	**NO**
		Planning of Projects	**YES**	**NO**
		Implementing/ Executing of Projects	**YES**	**NO**
		Monitoring & Evaluating of Projects	**YES**	**NO**
		Closing of Projects	**YES**	**NO**

Please mark the appropriate answer with X: The weight of your selected response is correspondent to the value attached to the response. That is (5) representing the highest weight and (1) the lowest weight

18.	**My organisation relies heavily on the use of mobile technologies to conduct project-related operations.**	**1** Strongly Disagree	**2** Disagree	**3** Neutral	**4** Agree	**5** Strongly Agree

SECTION C: USE OF MOBILE TECHNOLOGIES DURING PROJECT EXECUTION						
Please mark the appropriate answer with X: The weight of your selected response is correspondent to the value attached to the response. That is (5) representing the highest weight and (1) the lowest weight						
Use of Mobile Technologies during the Project Cost Management Process						
19.	**The use of mobile technologies has assisted my organisation during cost estimation for project-related operations.**	**1** Strongly Disagree	**2** Disagree	**3** Neutral	**4** Agree	**5** Strongly Agree
20.	**The use of mobile technologies has assisted my organisation in determining budgets for project-related operations.**	**1** Strongly Disagree	**2** Disagree	**3** Neutral	**4** Agree	**5** Strongly Agree
21.	**The use of mobile technologies has assisted my organisation in controlling costs in project-related operations.**	**1** Strongly Disagree	**2** Disagree	**3** Neutral	**4** Agree	**5** Strongly Agree

Use of Mobile Technologies during the Quality Management Process						
22.	**The use of mobile technologies has supported my organisation in the quality planning process.**	**1** Strongly Disagree	**2** Disagree	**3** Neutral	**4** Agree	**5** Strongly Agree
23.	**The use of mobile technologies has aided my organisation in performing the quality assurance process (i.e., maintaining the desired level of quality).**	**1** Strongly Disagree	**2** Disagree	**3** Neutral	**4** Agree	**5** Strongly Agree
24.	**The use of mobile technologies has assisted my organisation in performing quality control (providing a system of maintaining the desired level of quality)**.	**1** Strongly Disagree	**2** Disagree	**3** Neutral	**4** Agree	**5** Strongly Agree

Use of Mobile Technologies during the Risk Management Process						
25.	**The use of mobile technologies has assisted my organisation in the planning of risk.**	**1** Strongly Disagree	**2** Disagree	**3** Neutral	**4** Agree	**5** Strongly Agree
26.	**The use of mobile technologies has aided my organisation in the management of risk.**	**1** Strongly Disagree	**2** Disagree	**3** Neutral	**4** Agree	**5** Strongly Agree
27.	**The use of mobile technologies has assisted my organisation in the risk identification process.**	**1** Strongly Disagree	**2** Disagree	**3** Neutral	**4** Agree	**5** Strongly Agree
28.	**The use of mobile technologies has assisted my organisation in the qualitative risk analysis process (i.e., prioritising risk by assessing the probability of occurrence and impact).**	**1** Strongly Disagree	**2** Disagree	**3** Neutral	**4** Agree	**5** Strongly Agree

29.	**The use of mobile technologies has assisted my organisation in the quantitative risk analysis process (i.e., numerally analysing the effect of identified risks).**	**1** Strongly Disagree	**2** Disagree	**3** Neutral	**4** Agree	**5** Strongly Agree
30.	**The use of mobile technologies has assisted my organisation in the planning of risk responses (i.e., developing options and actions to enhance and reduce threats).**	**1** Strongly Disagree	**2** Disagree	**3** Neutral	**4** Agree	**5** Strongly Agree
31.	**The use of mobile technologies has assisted my organisation in the monitoring and controlling of risks (i.e., both identified and unidentified).**	**1** Strongly Disagree	**2** Disagree	**3** Neutral	**4** Agree	**5** Strongly Agree

Use of Mobile Technologies during Procurement Management Process						
32.	**The use of mobile technologies has helped my organisation in planning procurements (i.e., the process of identifying and consolidating requirements and determining the timeframes for their procurement).**	**1** Strongly Disagree	**2** Disagree	**3** Neutral	**4** Agree	**5** Strongly Agree
33.	**The use of mobile technologies has assisted my organisation in conducting procurements (i.e., the process of obtaining seller responses, selecting a seller, and awarding a contract).**	**1** Strongly Disagree	**2** Disagree	**3** Neutral	**4** Agree	**5** Strongly Agree
34.	**The use of mobile technologies has assisted my organisation in administering procurements (i.e., an act of obtaining or buying goods and services).**	**1** Strongly Disagree	**2** Disagree	**3** Neutral	**4** Agree	**5** Strongly Agree

35.	**The use of mobile technologies has assisted my organisation in closing procurements (i.e., the process of completing each procurement).**	**1** Strongly Disagree	**2** Disagree	**3** Neutral	**4** Agree	**5** Strongly Agree
Use of Mobile Technologies during the Communications Management Process						
36.	**The use of mobile technologies has assisted my organisation in the identification of key stakeholders.**	**1** Strongly Disagree	**2** Disagree	**3** Neutral	**4** Agree	**5** Strongly Agree
37.	**The use of mobile technologies has assisted my organisation in the planning of communications for project-related operations (i.e., project teams).**	**1** Strongly Disagree	**2** Disagree	**3** Neutral	**4** Agree	**5** Strongly Agree

38.	**The use of mobile technologies has assisted my organisation in the planning of communications for project-related operations (i.e., consultants).**	**1** Strongly Disagree	**2** Disagree	**3** Neutral	**4** Agree	**5** Strongly Agree
39.	**The use of mobile technologies has assisted my organisation in the planning of communications for project-related operations (i.e., government agencies).**	**1** Strongly Disagree	**2** Disagree	**3** Neutral	**4** Agree	**5** Strongly Agree
40.	**The use of mobile technologies has assisted my organisation in the planning of communications for project-related operations (i.e., communities involved in the projects).**	**1** Strongly Disagree	**2** Disagree	**3** Neutral	**4** Agree	**5** Strongly Agree
41.	**The use of mobile technologies has assisted my organisation in the distribution of key information on project-related operations.**	**1** Strongly Disagree	**2** Disagree	**3** Neutral	**4** Agree	**5** Strongly Agree

42.	**The use of mobile technologies has assisted my organisation in the management of stakeholder expectations in general.**	**1** Strongly Disagree	**2** Disagree	**3** Neutral	**4** Agree	**5** Strongly Agree
43.	**The use of mobile technologies has assisted my organisation in the facilitation of performance reports related to project progress.**	**1** Strongly Disagree	**2** Disagree	**3** Neutral	**4** Agree	**5** Strongly Agree

SECTION D: MANAGERIAL COMPETENCIES						
Please mark the appropriate answer with X: The weight of your selected response is correspondent to the value attached to the response. That is (5) representing the highest weight and (1) the lowest weight						
Communicative Competencies						
44.	**The use of mobile technologies has shaped my organisation's facilitation of (cross) functional communication (i.e., communication within different departments in my organisation).**	**1** Strongly Disagree	**2** Disagree	**3** Neutral	**4** Agree	**5** Strongly Agree
45.	**The use of mobile technologies has shaped my organisation's understanding of the importance of (cross) functional communication.**	**1** Strongly Disagree	**2** Disagree	**3** Neutral	**4** Agree	**5** Strongly Agree
46.	**The use of mobile technologies has enhanced my organisation's promotion of adequate communication to the project teams.**	**1** Strongly Disagree	**2** Disagree	**3** Neutral	**4** Agree	**5** Strongly Agree

47.	**The use of mobile technologies has enhanced my organisation's promotion of adequate communication to the different stakeholders in general.**	**1** Strongly Disagree	**2** Disagree	**3** Neutral	**4** Agree	**5** Strongly Agree
48.	**The use of mobile technologies has improved my organisation's understanding of the importance of adequate communication among internal stakeholders (e.g., project manager, project teams, the organisation and project sponsors).**	**1** Strongly Disagree	**2** Disagree	**3** Neutral	**4** Agree	**5** Strongly Agree
49.	**The use of mobile technologies has improved my organisation's understanding of the importance of adequate communication among external stakeholders (e.g., consumers, sub-contractors, local communities, government and its agencies).**	**1** Strongly Disagree	**2** Disagree	**3** Neutral	**4** Agree	**5** Strongly Agree

50.	**The use of mobile technologies has enabled my organisation to distribute information to the project team.**	**1** Strongly Disagree	**2** Disagree	**3** Neutral	**4** Agree	**5** Strongly Agree
51.	**The use of mobile technologies has enabled my organisation to distribute information to relevant stakeholders.**	**1** Strongly Disagree	**2** Disagree	**3** Neutral	**4** Agree	**5** Strongly Agree
52.	**The use of mobile technologies has assisted my organisation to understand the importance of distributing information among the project team.**	**1** Strongly Disagree	**2** Disagree	**3** Neutral	**4** Agree	**5** Strongly Agree
53.	**The use of mobile technologies has assisted my organisation to understand the importance of distributing information among different stakeholder levels.**	**1** Strongly Disagree	**2** Disagree	**3** Neutral	**4** Agree	**5** Strongly Agree

54.	**The use of mobile technologies has allowed my organisation to accumulate sufficient knowledge of project operations.**	**1** Strongly Disagree	**2** Disagree	**3** Neutral	**4** Agree	**5** Strongly Agree
55.	**The use of mobile technologies has allowed my organisation to make appropriate judgements about project operations.**	**1** Strongly Disagree	**2** Disagree	**3** Neutral	**4** Agree	**5** Strongly Agree
56.	**The use of mobile technologies has assisted my organisation to understand the importance of accumulating sufficient knowledge required to enhance project-related operations.**	**1** Strongly Disagree	**2** Disagree	**3** Neutral	**4** Agree	**5** Strongly Agree
57.	**The use of mobile technologies has assisted my organisation to understand the importance of applying appropriate judgement required to enhance project-related operations.**	**1** Strongly Disagree	**2** Disagree	**3** Neutral	**4** Agree	**5** Strongly Agree

58.	**The use of mobile technologies has assisted my organisation to understand the importance of applying the skill required to enhance project-related operations.**	**1** Strongly Disagree	**2** Disagree	**3** Neutral	**4** Agree	**5** Strongly Agree
Social Competencies						
59.	**The use of mobile technologies has enabled my organisation to build effective project teams.**	**1** Strongly Disagree	**2** Disagree	**3** Neutral	**4** Agree	**5** Strongly Agree
60.	**The use of mobile technologies has assisted my organisation in the effective management of project teams.**	**1** Strongly Disagree	**2** Disagree	**3** Neutral	**4** Agree	**5** Strongly Agree
61.	**The use of mobile technologies has assisted my organisation in the effective management of stakeholder expectation.**	**1** Strongly Disagree	**2** Disagree	**3** Neutral	**4** Agree	**5** Strongly Agree

62	**The use of mobile technologies has helped my organisation to understand the importance of effective management of project teams.**	**1** Strongly Disagree	**2** Disagree	**3** Neutral	**4** Agree	**5** Strongly Agree
63	**The use of mobile technologies has helped my organisation to understand the importance of effective management of stakeholder expectation.**	**1** Strongly Disagree	**2** Disagree	**3** Neutral	**4** Agree	**5** Strongly Agree
64.	**The use of mobile technologies has assisted me in influencing others (i.e., project team and stakeholders) in the decision-making process.**	**1** Strongly Disagree	**2** Disagree	**3** Neutral	**4** Agree	**5** Strongly Agree
65.	**The use of mobile technologies has assisted me in understanding the importance of influencing others.**	**1** Strongly Disagree	**2** Disagree	**3** Neutral	**4** Agree	**5** Strongly Agree
66.	**The use of mobile technologies has enhanced my facilitation of political awareness in project-related operations.**	**1** Strongly Disagree	**2** Disagree	**3** Neutral	**4** Agree	**5** Strongly Agree

67.	**The use of mobile technologies has enhanced my facilitation of cultural awareness in project-related operations.**	**1** Strongly Disagree	**2** Disagree	**3** Neutral	**4** Agree	**5** Strongly Agree
68.	**The use of mobile technologies has assisted me to understand the importance of political awareness in project-related operations.**	**1** Strongly Disagree	**2** Disagree	**3** Neutral	**4** Agree	**5** Strongly Agree
69.	**The use of mobile technologies has assisted me to understand the importance of cultural awareness in project-related operations.**	**1** Strongly Disagree	**2** Disagree	**3** Neutral	**4** Agree	**5** Strongly Agree

Thank You!