Cape Peninsula University of Technology

On-site Labour Productivity Modalities for Small and Medium Enterprises to Enhance Sustainable Construction Project Delivery in the Western Cape Province of South Africa

by

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DECLARATION

I, Yongama Mtshakaza, declare that the contents of this thesis represent my own unaided work, and that the thesis/dissertation has not previously been submitted for academic examination towards any qualification. Furthermore, it represents my own opinions and not necessarily those of the Cape Peninsula University of Technology.

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ABSTRACT

On-site labour productivity is a major determinant of the success of SME contractors that play a major role in the growth and employment in South Africa. Nevertheless, 70-80 percent of the SME contractors have been failing within the first five years, mainly because of low productivity, which affects the economy negatively and ends up causing job losses. It has been observed that poor on-site labour productivity often leads to profit losses, inefficiency in utilisation of resources, and lack of competitiveness. Therefore, in this study, effective on-site labour productivity modalities that can be adopted by SME contractors to enhance sustainable construction project delivery are proposed.

In an effort to improve SME contractor's on-site labour productivity, this study investigates perceptions of SME contractors regarding on-site labour productivity, on-site labour productivity challenges among SME contractors, factors in enhancing effective on-site labour productivity, and effective modalities recommended by SME contractors to enhance labour in the Western Cape.

This study adopted a quantitative research methodological choice, and therefore, collected data was based on an online survey questionnaire applied through Google Forms to the SME contractors registered under the cidb Grade 1 to 6 of General Building (GB). The sampling was of the site management staff of the SME contractors in the Western Cape directed at managing directors, quantity surveyors, construction managers, foremen and site agents. In order to analyse the results, descriptive statistical analyses (Mean Value and Relative Importance Index) and inferential statistics (Factor Analysis) were employed in this study using SPSS. Furthermore, this study made of Cronbachs Alpha in order to ascertain the reliability of the study findings.

The results have indicated that SME contractors in the Western Cape consider the following practices important towards improving on-site labour productivity: continuous training and skill building, job satisfaction, and the adoption of new technologies, and compliance with Safety, Health and Quality (SHEQ) regulations and clear instructions and guidelines. The results also revealed the challenges faced by the SME contractors in terms of on-site labour productivity that encompassed poor site layout plan, negligence of labour, alteration of government policies and compliance with labour laws. Also, the findings identified key factors for enhancing effective on-site labour productivity, which include the level of skill of the labour, the motivation, the training, the external conditions and the influence of the stakeholder. Regarding SME contractors' modalities for improving on-site labour productivity, the results indicated the presence of excellent task supervision, monitoring of construction equipment (via telematics),

employment of labour-assistive robotics and addressing labour-related issues promptly and fairly.
In conclusion, on-site labour productivity of SME contractors can be improved by means of constant training and development of on-site labour, appropriate supervision and site management and the use of technology.

Keywords: on-site labour productivity, SME contractors, sustainability, construction project delivery.

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DEDICATION

This thesis is dedicated to my mother, Ms. A. Mtshakaza, and my late grandmother, Mrs. A. Sokutu, whose encouragement and unwavering belief in me aguided me to make the right decisions in life. Without my mother's love, support, and sacrifices, this achievement would not have been possible.

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LIST OF ABBREVIATIONS

CI:	Construction Industry
cidb:	Construction Industry Development Board
GB:	General Building
GDP:	Gross Domestic Product
ILO:	International Labour Organisation
PMBOK:	Project Management Body of Knowledge
RII:	Relative Importance Index
SACI:	South African Construction Industry
SDG:	Sustainable Development Goal
SEDA:	Small Enterprise Development Agency
SFA:	Small Enterprise Finance Agency
SMEs:	Small and medium enterprises
SPSS:	Statistical Package for the Social Sciences

GLOSSARY TERMS

Construction Industry Development Board (cidb): It is a leading regulator in the South African construction industry that was formed under the Construction Industry Development Board Act 38 of 2000 and acts as the central organ that governs and regulates the construction industry in South Africa with the goal to achieving improved delivery management, capacity development and contractor development, as a measure to enhance sustainability and growth as well as associated empowerment of the construction industry in South Africa (cidb, 2020).

Construction industry: it is the industrial branch dealing with the manufacturing of buildings, repair, renovation, and maintenance of infrastructures (Manzi & Bignozzi, 2020).

Construction Site: It is a designated area of land where construction works take place, encompassing various activities like building structures, infrastructure, roads, and landscaping. It typically includes machinery, building materials, temporary structures, and personnel from different trades working on the project (Schwartz, 2023).

On-site labour productivity: According to Manoharan *et al*. (2020), on-site labour productivity is the measure of how well and efficiently construction labourers perform their work on-site.

Project delivery: Project delivery is described by Estrellas (2023) as the entire process of starting and finishing a project, like building a facility or renovating an existing one.

SME contractors: SME contractors are a set of enterprises that registered on the construction industry development board (cidb) register of contractors between grades one and six, with current upper limits of tender value that is between less than one million up to twenty million (Wentzel, Fapohunda & Haldenwang, 2022).

Sustainability: The ability to maintain or support a process continuously over time (Mollenkamp, 2023).

Sustainable construction project: A sustainable construction project seeks to achieve a balance between economic advancement, social well-being, and environmental control over the long term (Kibert, 2016).

CHAPTER ONE
INTRODUCTION

1.1 Background to the study

Small and Medium Enterprises (SMEs) play a significant role in the economic development of developing nations like South Africa (Musonda *et al*., 2023; Kamal & Flanagan, 2014; Sogaxa & Simpeh, 2022). In addition, SME contractors are the core of unemployment reduction as they create more job opportunities (Balogun, Ansary & Agumba, 2016). The SMEs contribute to approximately 40 % of the GDP in the developing countries (Pulka & Gawuna, 2022). Given the significant contribution of SMEs to socioeconomic development, it is critical to promote sustainability practices among SMEs for long-term viability and competitiveness (Abisuga-Oyekunle, Patra & Muchie, 2020). Hence the South African government established the Small Enterprise Development Agency (SEDA), which oversees fostering entrepreneurship and developing SMEs in the country, and the Small Enterprise Finance Agency (SFA), which was created to guarantee the expansion and survival of SME contractors in the nation (Aigbavboa & Thwala, 2014b).

However, SME contractors particularly in the construction industry are confronted by several obstacles that prevent them from succeeding in their business performance (Sogaxa & Simpeh, 2022; Hove & Banjo, 2018; Bierman, Marnewick & Pretorius, 2016). Evidence from Wentzel, Fapohunda and Haldenwang (2022) indicated that 70%-80% of SME contractors in South Africa fail within their first five years of operation due to poor performance i.e., poor production. Stats SA (2018) reports that 78.5% of firms in SACI are SMEs, hence when they fail, it has a major negative impact on the nation's development since the SME contractors are the backbone of economic growth in South Africa. In addition, the inability of the SACI to sustain SME contractors leads to significant job insecurity and widespread job losses (Pulka & Gawuna, 2022).

Adebowale and Agumba (2021) argues that the construction industry is labour intensive and SME contractors heavily rely on on-site labour productivity to grow and to ensure sustainable construction project delivery. Lefoka (2019) uncovered factors that lead to low on-site labour productivity in SACI including a range of challenges comprising quality of site management, ineffective communication, disruption from local forum groups, equipment problems, and delays in material delivery. Bierman et al. (2016) outlined several factors that hinder SME contractors' productivity: lack of experience among workers, delays in labour payment, project scope changes from designers or consultants, and unfavourable relationships between labourers and their supervisors. Hence, Adebowale and Agumba (2021) argued that it cannot be ignored that the productivity of the construction workforce is a major contributor to contractors' sustainability specifically in developing nations.

SME contractors must enhance on-site labour productivity to improve business performance and promote sustainable construction project delivery in South Africa (Sogaxa & Simpeh, 2022). In addition, Sogaxa, Simpeh and Ndihokubwayo (2021) argue that SME contractors need to invest in training programmes and ensure the recruitment of qualified workers to increase project productivity and enhance sustainable construction project delivery. Furthermore, Farhadi (2024) highlighted that site layout can have an immense impact on optimising productivity. Thus, an effective site layout plan plays a crucial role in maximising production in construction sites (Otukogbe *et al*., 2021). By strategically planning the site layout, construction teams can minimise material handling, reduce downtime, enhance logistics, facilitate the movement of material and equipment, and create a conducive environment for productivity (Farhadi, 2024).

In an effort to overcome the challenge of poor on-site labour productivity among SME contractors, this research attempts to provide on-site labour productivity modalities that SME contractors can adopt to enhance sustainable construction project delivery in the Western Cape. Western Cape is a province located in the southwestern part of South Africa surrounded by the Northern Cape and Eastern Cape. Effective on-site labour productivity can help SME contractors sustain their businesses by enhancing productivity, ensuring efficient, cost-effective, and high-standard construction project completion in the Western Cape. Supporting SME contractors can contribute to a more sustainable and robust construction industry, driving socioeconomic development (Mabasa *et al*., 2023).

Despite the importance of on-site worker productivity for SME contractor sustainability, there is a lack of theoretical understanding of how productivity enhancement can be progressively achieved within the South Africa construction industry. Previous studies have identified productivity challenges among SME Contractors (Lefoka, 2019; Bierman *et al.,* 2016). However, there is lack of adopted theoretical frameworks to discuss the underlying factors, which can sustain their productivity improvement. This study addresses this knowledge gap, by adopting an integrated theoretical approach. It integrates Resource-Based View (RBV), Human Capital Theory (HCT) and Sustainable Development Theory (SDT). This integration provides a concrete conceptual foundation for improving and understanding on-site labour productivity among SME contractors in the Western Cape.

1.2 Problem statement

Although SME contractors play a significant role in socioeconomic development globally, they are confronted with a myriad challenges associated with low on-site labour productivity (Adams, 2024). Despite the South African government's efforts to support SME contractors, 70–80 percent of SME contractor's businesses fail during the first five years of operation due to poor performance i.e., low productivity (Fapohunda & Haldenwang, 2022). According to Adebowale and Agumba (2023b), the failure of SME contractors undermines their contribution to job creation and poverty alleviation in thriving nations like South Africa. Furthermore, there is a paucity of studies specifically addressing on-site labour productivity of SME contractors in the Western Cape Province. Importantly, existing studies lack a comprehensive theoretical framework that integrates resource management, human resource development, and sustainability principles to understand and address workers productivity challenges faced by SME contractors. In addressing this issue, this study employs the Resource Based View (RBV), Human Capital Theory (HCT) and Sustainable Development Theory (SDT) to identify obstacles and suggest practical modalities to enhance the on-site labour productivity of SME contractors in the Western Cape. Enhanced on-site labour productivity will not only strengthen the operational sustainability of SME contractors but also contribute to sustainable construction project delivery in the Western Cape.

1.2.1 Sub-problems

The problems that contribute to low on-site labour productivity in the delivery of sustainable construction projects among construction SMEs in the Western Cape include:

- SME contractors are often confronted with poor on-site labour productivity and subsequently fail to remain in business.
- SME contractors' failure is mostly associated with poor construction resource management that leads to project delays.
- SME contractors' on-site productivity being hindered by poor sustainable construction management practices.
- SME contractors' lack of workforce training leads to poor on-site labour productivity in construction sites.
- SME contractors lack effective modalities that can enhance on-site labour productivity and promote sustainable construction project delivery

1.3 Research questions

What are the modalities to enhance SME contractors' on-site labour productivity and promote sustainable construction project delivery in the Western Cape province?
Sub-questions:

- What are the perceptions of SME contractors regarding on-site labour productivity in Western Cape province?
- What are the on-site labour productivity challenges faced by SME contractors in the Western Cape province?
- What are the factors that could enhance effective on-site labour productivity of SME contractors on sustainable construction project delivery?
- What are the modalities that can be recommended for SME contractors to enhance on-site labour productivity in sustainable construction delivery?

1.4 Research Aim

The study aims to investigate and propose on-site labour productivity modalities for SME contractors to enhance sustainable construction project delivery in the Western Cape.

1.5 Objectives

- To determine perceptions of SME contractors regarding on-site labour productivity in Western Cape province.
- To investigate on-site labour productivity challenges faced by SME contractors in the Western Cape province.
- To identify factors that could enhance effective on-site labour productivity in sustainable construction project delivery.
- To investigate and propose the modalities that can be recommended for SME contractors to enhance on-site labour productivity in sustainable construction delivery.

1.6 Context of the research

The study is based in South Africa and will focus on the Western Cape SME contractors. The investigation is conducted through an on-site management team consisting of directors, foremen, construction managers site engineers/technicians, and quantity surveyors. The study findings will be utilised to determine on-site labour productivity modalities for Western Cape SME contractors to enhance sustainable construction project delivery in the region.

1.7 Assumptions

Key assumptions are:

- Selected construction SMEs will participate in the research.
- The site management team will be willing to provide their experience about modalities to enhance on-site labour productivity.

- The research sample will provide honest and relevant information on survey questionnaires, to achieve the aim and objectives of the study.

1.8 Significance

In light of the above, the study is significant considering the challenges faced by SME contractors which are vital in driving economic growth and employment in South Africa. SME contractors in South Africa are confronted with the issue of low on-site labour productivity, which is harming the delivery of sustainable construction projects (Adebowale & Agumba, 2023a); Lefoka, 2019; Bierman et al., 2016). The low productivity of SME contractors can be attributed to several factors such as poor construction management, inadequate workforce training, and lack of skills development programmes (Toriola-Coker *et al*., 2021). The low productivity of on-site labourers not only affects the timely completion of construction projects but also compromises SME contractors' business performance and reputation (Albert, Shakantu & Ibrahim, 2021). Hence, Daoud *et al* (2025), Windapo (2021) and Dlamini and Cumberlege (2021) argue that without efficient and productive construction, labour SME contractors' construction projects may experience delays, cost overruns, and a decrease in overall quality which in turn results in their failure.

There is a pressing need to address on-site labour productivity-related issues and propose modalities for enhancing SME contractors' labour productivity (Adebowale & Agumba, 2023a). Modalities for enhancing on-site labour productivity will promote the sustainable delivery of construction projects (Agyei, Thwala & Aigbavboa, 2023). The findings of this study can help Western Cape SME contractors improve productivity, sustain their businesses, and contribute to sustainable construction project delivery, ultimately benefiting socio-economic development. Furthermore, this study can contribute to the Construction Industry Body of Knowledge (CIBOK) by contributing to advanced knowledge that can be applied to solve the issue of low production in the construction industry.

1.9 Ethical statement

This study adhered with ethical standards (Bos, 2020). The ethical application for this study was conducted and approved to ensure ethical compliance when conducting this research study.
The following is the list of moral concerns considered in this study:

- Informed consent: The participants received a consent letter to participate in the study outlining the voluntary nature of their participation, comments, contributions, and their anonymity. Participants were also informed that they can either consent to participate or not.

- Confidentiality and anonymity: The participants/respondents were not required to disclose their details (names, surnames, ID number, etc.).
- Plagiarism: All work of other authors and scholars is acknowledged through referencing. Additionally, Turnitin software was used to prevent plagiarism,
- Harm and risk: There is no harm caused during the research study
- Data Storage: The project's data will be stored and backed up in the institutional repository located at http://digitalknowledge.cput.ac.za, as well as the CPUT data repositories Figshare at https://cput.figshare.com/ and MediaTum at www.rdm.cput.ac.za. The data will be stored for the period of 5 years.

1.10 Limitations

The limitations of this study are as follows:

- The study focuses on construction firms operating in the Western Cape province of South Africa.
- The research is based on SME contractors as per the cidb grading system, grades 1 to 6; and
- The study focuses on on-site labour productivity modalities for SME contractors to enhance sustainable construction project delivery

1.11 Overview of research methodology

This study adopted a quantitative research approach to investigate on-site labour productivity modalities for SME contractors to enhance sustainable construction project delivery in the Western Cape Province. The research design involved the use of a structured questionnaire survey distributed to registered SME contractors under the Construction Industry Development Board (cidb) grades 1 to 6 in the General Building (GB) category. The data collected were statistically analysed using Mean Values (MV), the Relative Importance Index (RII), and Factor Analysis (FA) to identify and rank the key factors influencing on-site labour productivity, as well as to group interrelated variables into underlying constructs. These techniques were selected for their suitability in analysing quantitative data, establishing relative rankings, and revealing patterns that enhance the interpretive depth of the findings.

1.14 Chapter Outline

These are the chapters covered in the research study:

Chapter One: The chapter includes introduction of the problem and background to the problem sub problems, research questions, research objectives, expected research outcomes, the aim of the study, preliminary literature, conceptual framework, research methodology and significance of the research study.

Chapter Two: The chapter will encompass a relevant and strong literature review on the on-site modalities of labour productivity of SME contractors towards sustainable delivery of projects.

Chapter Three: This chapter includes research methodology, which includes the methodology of research and its design that was used to gather information. The nature of research design and approach adopted by the researcher was expounded which implied population and sample of the researched, questionnaire design and data analysis.

Chapter Four: The chapter is composed of data findings analysis of the research study. The research study of was analysed. The research questions were answered based on analysed findings.

Chapter Five: This is a chapter involving the conclusion and suggests. The study used the analysed results when making conclusions and providing viable recommendations of on-site labour productivity models which can be adopted by SME contractors to facilitate sustainable construction projects delivery in Western Cape. This chapter closes by giving recommendations to future studies.

1.15 Chapter Summary

This chapter outlined the research background, the research problem, sub-problems, aim, objectives, and research questions, all aimed at identifying and proposing practical on-site labour productivity modalities for SME contractors to enhance sustainable construction delivery in the Western Cape. The context, assumptions, and significance of the study were also addressed, emphasising its potential contribution to socio-economic development and the Construction Industry Body of Knowledge (CIBOK). Ethical considerations, limitations, and an overview of the subsequent chapters were also provided, setting a clear foundation for the research.

CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

The background to the problem, research questions and objectives were identified in the previous chapter. In this chapter, the current knowledge that relates to the modalities of on-site labour productivity that can be utilized by SME contractors to improve sustainable construction project delivery is discussed. As stated by Assaad and El-Adaway (2021), the construction business is characterised as labour-intensive and labour productivity in any construction site is one of the prime determinants of the industry as a whole. Moreover, the productivity of labour is done on site and its consistency constitutes the only way under which the construction projects are set to continuously thrive in the leading process of the contractors as a contributing path to sustainable development (Dhliwayo, Musonda, Gumbo & Kaisara, 2024; Urrahmi, Oktaviani & Mubarak, 2024; Bamfo-Agyei, Thwala & Aigbavboa, 2023a). Adebowale and Agumba (2023c) and Al Alawi, Al Abdali, Al Shahri & Altawil, (2022) noted that poor on-site labour productivity is just one of several factors contributing to business failure, a challenge South African SME contractor have long faced. Additionally, the low productivity of SME contractors undermines their role in sustainable development in South Africa (Rens, Iwu, Tengeh & Esambe, 2021). According to Hamza, Shahid, Bin Hainin, and Nashwan (2022) and Ghate, More, and Minde (2016), One of the key parameters to measure the performance of any construction project and successful contribution by the SME contractors towards the delivery of sustainable construction projects is its on-site labour productivity; hence, as contractors continue to make meaningful contribution towards sustainable construction project delivery, their on-site labour productivity must keep rising. Also, the competitiveness of SME contractors is directly linked to on-site labour productivity (Hamza *et al*, 2022); consequently, modalities in managing the on-site labour is the significant factor to help boost the on-site labour productivity of SME contractors (Bamfo-Agyei, Thwala & Aigbavboa, 2023a).

South Africa is the country where on-site labour productivity at the site has been low during the last 46 years (Bierman et al., 2016). Nonetheless, the problem of low on-site labour productivity at the point of contact does not involve South Africa alone (Adebowale & Smallwood, 2020). Patel, Bhavsar, and Pitroda (2017) highlighted that improving on-site labour productivity is the most challenging issue in developing and developed countries. Agrawal and Halder (2020) also list low on-site labour productivity in Brazilian construction industry resulting in the project schedule slips. The on-site labour productivity in the world dropped by 8 per cent between 2020 and 2022, which indicates the scope of wider problems that are felt by developing countries, in particular (Mischke, Stokvis & Koen, 2024). The on-site labour cost in most countries consumes between 30 and 50 percent of the overall cost of a construction enterprise and therefore, the on-site labour productivity has become a major aspect in defining the profitability of the construction entities (Adebowale & Agumba, 2023d); therefore, improving on-site labour productivity is vital for profit-oriented organisations in construction like SME contractors. Moreover, on-site labour productivity should be increased so that clients and contractors can get value of money they paid and play valuable roles in the economy (Adebowale & Agumba, 2021; Adebowale & Agumba, 2022).

A rigorous review is based on the overview of South African SME contractors, SME contractors' on-site labour productivity, sustainable construction project delivery, perceptions and challenges regarding the SME contractors' on-site labour productivity, and factors for enhancing on-site labour productivity. Lastly, this chapter will explore on-site labour productivity modalities for SME contractors.

2.2 An Overview of SME contractors in South Africa

The SEDA (2016) states that SME contractors are a very broad category of firms with some of these firms consisting of registered, informal and non-VAT registered firms. According to Shakantu (2012), there is a problem that arises when defining an SME contractor and in most cases they are diverse criteria used. The common measures adopted are total workforce, value of fixed assets, paid-up capital, annual turnover and the volume of physical products per annum which is produced by the company. The size is also determined based on the type of activity and thus it is indifferent that SMEs do not have uniform definition. According to Renault, Agumba, and Ansary (2020), the SME contractors have 250 full-time employees and then they produce a turnover of less than R220 million per year. In the construction sector, SME contractors in South Africa refer to the contractors registered by the cidb in grades one to six with top tender value cap between less than one million and twenty million rand (Wentzel, Fapohunda & Haldenwang, 2023). According to the construction industry development board (cidb) register of contractors, the SME contractors are in the majority, in comparison to the established firms within the South African region.

In developing nations like South Africa, SME contractors are the key engine of employment, economic growth, innovation, poverty alleviation, and wealth distribution (Ali, 2021; Musonda *et al.*, 2023; Sogaxa & Simpeh, 2022). Asia-Europe Foundation (ASEF) (2023) suggests that the 2030 Sustainable Development Goals (SDGs) highly rely on SME contractors since they play major roles in innovative management, employment, and economic prosperity. According to the National Development Plan (2030), it was envisaged that SME contractors comprise above 90 per cent of the registered enterprises in South Africa, absorbing more than half of the labour force and making up more than a third of the Gross Domestic Product (GDP) (Hewitt & Van Rensburg, 2020). Moreover, the Organisation for Economic Co-operation and Development (OECD) (2018) predicts that out of the 2.6 million SME contractors in South

Africa, only approximately 37 percent are formal establishments. Most of them, totalling about 54 percent, are micro-enterprises and 15 percent are in the rural setups.

The South African government uses various measures in promoting sustainability of SME contractors, including development of SEDA and the Small Enterprise Finance Agency (SFA), tax incentives and reliefs, and encouraging the engagement of SME contractors in government purchasing (National Integrated Small Enterprise Development (NISED), 2023). Furthermore, Broad-Based Black Economic Empowerment (BBB-EE) was introduced to correct the economic legacy of exclusion and inequality by empowering the black people to manage and own businesses (Hewitt & Van Rensburg, 2020).

Nevertheless, despite these attempts, South African SME contractors still have to struggle against various issues that hold them back in terms of their performance and sustainable existence (Rens *et al.*, 2021; Pulka & Gawuna, 2022). One of the key issues faced by SME contractors is their access to the funding (Megersa, 2020; Nkwinika & Mashau, 2020). The SEDA 2023/2024 report shows that formal access to finance yields satisfactory results to 12 percent of SME contractors (SEDA, 2024). Moreover, as the World Bank (2019) describes, most of the economy is occupied by large enterprises that are the source of approximately 70% of the GDP, with the rest of the economy being occupied by the activity of SME businesses. Such high operating costs were highlighted by Nkwinika and Mashau (2020), who point out that those are necessitated by inflation rates in the country, which are always above 5 percent, making the situation even more difficult for SME contractors. Moreover, the limited supply of quality labour resources and an inability to easily navigate the regulatory framework introduce another challenge to the business development of SME contractors (Alshahrani *et al.*, 2023). According to Bushe (2019), the internal challenges highlighted included the fact that the company had poor financial management, poor human resource management, poor marketing, and poor information technology.

As it has been pointed out by a number of researchers, one of the underlying challenges of the SACI is the low level of on-site productivity of SME contractors (Adebowale & Agumaba, 2023c; Al Alawi, Al Abdali, Al Shahri & Altawil, 2022; Lefoka, 2019; Bierman et al., 2016). The inefficient on-site labour work supports the idea that construction projects cannot be developed sustainably and it is a threat to the sustainability of SME contractors (Urrahmi, Oktaviani & Mubarak, 2024). It is imperative to reduce these productivity challenges and enhance management by the SME contractors in terms of utilising resources, financial resources, and human expertise to support their survival and growth (Dhliwayo, Musonda, Gumbo & Kaisara,2024).

2.3 SME contractors' construction project delivery in South Africa.

SME contractors are the majority players in most construction projects and their performance has a major impact on the overall performance of the SACI and the sustainable development of a country (Ali, 2021; Amoah & Bikitsha,2022; Aigbavboa & Thwala, 2014b). In SACI, SME contractors can obtain tenders based on cidb grading. The following table shows the tender value ranges for SME contractors in South Africa.

Table 2. 1 SME contractor's tender value

Grading Designation	Tender Value Range (less than or equal to)
1	R 500 000
2	R 1 000 000
3	R 3 000 000
4	R 6 000 000
5	R 10 000 000
6	R 20 000 000

cidb, (2024)

According to cidb (2024), a client may not award a contract or a contract value beyond the above maximum tender value limit. However, the tender value range can change periodically to stay aligned with inflation and economic conditions (cidb, 2024).

Even though SME contractors can obtain their work they normally subcontract under large contractors (Mambwe, Mwanaumo, Phiri & Chabota, 2020). Mambwe *et al*. (2020) also concurred that large contractors often manage the subcontractors to meet clients' expectations and subcontractors as SME contractors manage the workforce to meet main contractors' requirements. In addition to ensuring that SME contractors secure projects, in public infrastructure projects over 30 million, local SME contractors are entitled to 30% of the project scope as subcontractors to the main contractor (Windapo, Olugboyega, & Odediran, 2020). Msomi and Olarewaju (2021) posit that SME contractors learn from large contractors especially managerial skills to improve cidb grading. However, Bolton, Wedawatta, Wanigarathna, and Malalgoda (2022) argue that SME contractors have less power to negotiate subcontracts with the main contractors transferring more project risks to the SME contractors. Renault, Agumba, and Ansary (2020) share a similar opinion by suggesting that, despite having more risk exposure than big contractors, SME contractors tend to experience risk exposure procedures as big contractors do. Furthermore, Amoah and Bikitsha (2022) highlighted that SME contractors are often disadvantaged when it comes to payments, with the main contractor delaying payments and that negatively impact SME contractor's cash flow. Agumba (2021) asserted that the late payment of the SME contractor by the main contractor or client delays the SME contractor's credit payment with suppliers and delays the payment of the on-site labour.

Most SME contractors are not sustainable as the public projects are short-term and cannot be secured long-term (Nzo, 2020). In addition, SME contractors tend to operate in their local areas limiting their growth (Thwala & Mofokeng, 2012; Tubane, 2017).

2.4 Sustainable Construction Project Delivery

According to Mollenkamp (2023), sustainability is the ability to maintain or support a process continuously over time. Kibert (2016) argues that sustainability not only involves the ongoing maintenance of processes over time but also a broader consideration of economic, environmental, and social dimensions. Although the definition of sustainability can be interpreted differently, this study intends to look into the deliverable sustainable construction project through the improvement of on-site labour productivity of the SME contractors with an aim of transforming socially, economically and environmentally.

On a social level, sustainable construction projects focus on the well-being and safety of workers, their design, including the promotion of inclusivity and accessibility, as well as the positive aspects of their contribution to the surrounding community, including the creation of job opportunities and the enhancement of the quality of life (Onu & Mbohwa, 2019). In economic terms, a sustainable construction project will mean that the project is economically feasible, and will have a long-term value, in respect of economic returns and value it provides to the economy (Hanafi *et al*.,2021). Nadeem (2023) states that environmentally sustainable construction projects attempt to limit their impact on the carbon footprint and observe minimisation of energy consumption with regard to building materials used by adopting building materials that are harmonious with the environment, enforcing energy efficient systems and using techniques of waste management. Moreover, sustainable construction projects have an advantage in that they focus on environmental, social, and economic implications of the building process to reduce the negative factors and enhance the benefits (Hanafi *et al*.,2021). Generally, sustainable construction projects aim at the long-term balance of economic progress, social development, and environmental management (Kibert, 2016).

2.5 On-site Labour Productivity as Contributor to Sustainable Construction Delivery

Enhancing on-site labour productivity is a vital element of creating sustainable construction delivery due to better resource consumption and reduced wastages on construction sites (Ahmad *et al*., 2022). Mahamid (2020) opined that higher on-site labour productivity contributes directly to higher project efficiency that avoids any work redo, and waste and energy requirements that are core parameters in establishing environmental sustainability. A well cultural workforce promotes sound material handling and energy efficient working habits (Stringer, 2010). Moreover, Nwaogbe *et al*. (2025) emphasised that less time and resource costs to complete a project, enhanced on-site labour productivity and have environmental objectives since they restrict the environmental impact of construction works.

On an economic front, the increase in the on-site labour productivity makes the construction projects cost-effective and helps in meeting the deadline of completion, enhancing the financial feasibility of any project (Obiuto *et al*., 2024). Mahamid (2018) explains that increased on-site labour productivity reduces the chances of cost overrun and budgetary pressure, hence making overall SME contractors more profitable and competitive. In addition, when SME contractors are more productive, they will be able to perform more projects, which will provide job opportunities and boost the economy (Surya *et al*., 2021). Furthermore, enhanced productivity of on-site labour also contributes to the further development of social sustainability since it is usually linked to more training, higher labour safety and worker engagement (Manoharan *et al*., 2024a). Moreover, the concept of labour productivity fosters environmentally friendly practices of inclusive employment, particularly, in the context of SME contractors, as the process of upskilling and empowering workers inherits to long-term development of the community and enhanced living standards (OECD, 2018).

2.6 On-Site labour productivity

Productivity is typically understood as an activity of making the most out of output on the terms of optimising the input (Kenton, 2024). According to Bierman *et al.* (2016), a mathematical formular for productivity is the output divided by the input (Productivity = Output/Input). Ghate, More, and Minde (2016) indicated that different productivity measurements serve different purposes as shown below:

a) Economic Model: (TFP):

Total Factor Productivity TFP = Total Output/labour + Material + Equipment + Energy

b) Project Specific Model:

Productivity = Output/labour + material + Equipment

c) Activity Oriented Model:

Labour Productivity = Output/labour cost
Or = Output/work hour

This study focused on productivity on a construction project level. The construction sector is labour intensive, making the on-site labour productivity determine the productivity of project delivery (Ghate, More & Minde, 2016). Del Gatto, Di Liberto, and Petraglia (2011) define on-site labour productivity as the ratio of actual labour employed to output produced in the process of providing services or producing products. Durdyev and Mbachu (2011) outlined that the productivity of labour on-site is an indicator of efficiency and effectiveness of the on-site workforce in a construction project. Monoharan *et al*. (2022) also details that the on-site labour productivity is dependent on the adoption of a collection of standard outputs or alongside the norms to every unit operation.

Furthermore, on-site productivity in construction projects comprises the efficiency of converting physical inputs, such as labour, materials, and equipment, into measurable outputs like construction volume (m, no, m^2, and m^3) and quality (Shan et al.,2021). Mohd Fateh, Mohamed and Omar (2022) concurred that labour plays a crucial role, with productivity often measured by output per worker per hour or day. Skilled or trained on-site labourers are found to be more productive as compared to unskilled labourers (Monoharan *et al*., 2022). The materials are also an important input, where its efficient use, availability, and minimal waste could significantly increase the levels of productivity (Monoharan *et al*., 2022). According to Gurmu and Albinu (2017), productive outputs can be obtained due to the use of advanced equipment, and machinery to increase the speed of construction activities and accuracy. Also, Sombolayuk and Tanjung (2024) stress that work quality performed at the on-site including meeting the specifications, standards, and codes can be regarded as a significant output measure.

Gurmu and Ongkowijoyo (2020) have shown that it is possible to use job-site labour productivity according to a different scenario of working conditions in determining on-site labour productivity. In addition to that, Hamza *et al*. (2022) point out the influence of on-site labour productivity on contractor competitiveness and sustainable performance. However, low labour productivity on site is one of the fundamental challenges, which leads to construction project delays, thereby leading to high-cost overruns and even abandonments of projects (Amini *et al*., 2023). On the same note, Oladiran and Onatay (2019) and emphasized that site production is also tracked by comparing planned productivity and on-site production and, where appropriate, corrective measurements are taken.

2.7 Factors influencing on-site labour productivity

The critical factors that positively and negatively influence productivity are essential for devising strategies to reduce inefficiencies and enhance the effectiveness of project performance (Attar, Gupta & Desai, 2012; Jimoh, Oyewobi, Suleiman & Isa, 2017). According to Durdyev and Mbachu (2011), one major factor influencing on-site labour productivity is material availability. When materials are readily available and easily accessible, labourers can work efficiently without interruptions, leading to higher productivity (Akwuobi, 2023). Conversely, a lack of material availability can cause delays and downtime as workers wait for materials, disrupting workflow and slowing progress (Naoum, 2016).

The construction site layout plan also significantly impacts on-site labour productivity (Farhadi, 2024). Effective layout planning that considers site access, material storage, equipment positioning, and worker circulation can boost productivity, whereas neglecting these factors can lead to substantial productivity losses (Vashishta, 2022). Additionally, manpower characteristics such as the age of labourers play a crucial role in productivity (Bayram, 2022). Bukit *et al*. (2018) highlighted that older labourers, particularly those in their 30s, tend to be more productive due to their work experience compared to younger workers. Manoharan *et al*. (2022) assert that problem solving skills among on-site labour result in improved on-site productivity. Moreover, factors like absenteeism and alcoholism can negatively affect labour productivity (Hamza et al., 2022). Bamfo-Agyei, Thwala and Aigbavboa (2022b) indicated the level of experience of on-site labour as a significant contributor to on-site productivity.

The adverse and positive factors behind productivity are the key drivers that determine which strategies to use to minimise inefficiencies and increase the efficiency of the projects (Attar, Gupta & Desai, 2012; Jimoh, Oyewobi, Suleiman & Isa, 2017). Durdyev and Mbachu (2011) argue that material availability is one of the significant factors that can determine the productivity of labour on-site. This is because when materials are easily accessible and readily available labourers can easily work efficiently without much distraction resulting in increased productivity (Akwuobi, 2023). Material unavailability, on the other hand, may create delays and idle time as employees await the arrival of materials thus affecting the flow and stagnation of the construction progress (Naoum, 2016).

The construction site layout plan is an important influencing factor of labour productivity in specific locations (Farhadi, 2024). Good layout planning, which takes into consideration site access, material storage, equipment locations and staff circulation, can increase productivity, but the opposite can imply massive loss in productivity (Vashishta, 2022). Moreover, the age of the labourers influences the productivity significantly, which is one of the manpower characteristics (Bayram, 2022). Bukit *et al*. (2018) emphasised that labourers of older age, especially the ones aged in their 30s, are more productive in respect to the work experience than the younger workers. Their assessment is that the on-site productivity is the result of problem-solving skills of on-site labour (Manoharan *et al*., 2022). Additionally, the labour productivity can be influenced negatively by such factors as absenteeism and alcoholism (Hamza, 2022). Bamfo-Agyei, Thwala and Aigbavboa (2022b) reported the degree of experience of on-site labour as one of the salient components of on-site productivity.

Another highly important determinant of the productivity of on-site labour is site conditions (Agyei *et al*., 2023). As an example, the weather conditions, site safety and security are typical conditions that impact the productivity (Vigneshwar & Shanmugapriya, 2023). Moreover, most importantly, the accessibility and state of site equipment and tools are essential, and efficient management of this factor is the key to keeping the level of productivity in the construction project at a high mark (Farhadi, 2024; Harris *et al.*, 2021). It was stressed by Aigbavboa and Akinradewo (2023) that interaction with the local community can help to increase labour productivity on-site due to the absence of community protest. According to Gabriel, Jaffu and Ismail (2024), motivation by on-site labour contributes to the enhancement of productivity. As Almamlook *et al*. (2020) and Sombolayuk and Tanjung (2024) explain, the high-quality requirement is one of the essential factors affecting the on-site labour productivity. According to Love *et al*. (2022), high quality takes time and detailed attention, and may request revisions or a reworking of work when the finished work is no longer of the required quality. Thomas (1991) cited by Jimoh et al. (2017) identify the following factors, which have influenced on-site labour productivity: the type of project, its scope, layout, and complexity; the method of the construction work; weather; the skill of labour; the labour practice; the length of a working day; the availability of materials; incentives; the supervisory level; the enabling environment; the government regulations; and the organisation size.

2.8 Perception of SME Contractors Regarding On-site Labour Productivity

SME contractors are pivotal to the construction industry, particularly in developing economies (Kamal & Flanagan, 2014; Sogaxa & Simpeh, 2022; Hanafi *et al*., 2021). The SME contractors undertake the management of the labour force, the overtime of the projects, the quality of outcomes given, and the timelines maintained (Hanafi et al., 2021). The perceptions of SME construction contractors towards on-site labour productivity are increasingly becoming an imperative determinant of the efficaciousness of construction project completion (Assaad at al., 2023). Hanafi *et al*. (2021) stress that such perceptions are important to determine how to best improve efficiency of the workforce and a project as a whole.

Van Tam *et al*. (2021) state that the experiences and project environments shape the perceptions of SME contractors, along with exposure to the best practices in the industry. SME contractors who have a significant amount of on-site experience tend to have a stronger knowledge base that is more accurate on pragmatic issues about how to tackle on-site labour productivity (Assaad at al., 2023). Therefore, Fei *et al*. (2021) recommend that one way towards having a profitable, sustainable, and competent construction sector is dissemination of knowledge by experienced contractors to new SME contractors.

One of the crucial elements that lead to the improvement of on-site labour productivity is the attraction of skilled labour (Hanafi *et al*., 2021; Assaad at al., 2023). To sustain the SME contractors, Sogaxa et al. (2021) stressed that on-site labour training should be conducted to continually improve performance. Moreover, skilled on-site labour improves the workmanship and increases the total productivity of every construction process (Van Tam *et al*., 2021; Adebowale & Agumba, 2023d). According to Adebowale and Smallwood (2020), SME contractors face the issue of obtaining skilled labour because of insufficient training systems and inefficiency in the labour market. When skilled labour is recruited, they must be retained (Nyoni & Bonga, 2016). This is however a challenge for SME contractors because of the fear of job insecurity, insufficient wages, and the inability to advance careers (Bilan *et al*., 2020). The challenge is increased by the lack of attention to continuous training and improvement of skills that is essential to sustaining the competent labour force that could follow the changes in constructions technology and methods (Odesola, Otali & Ikediashi, 2013).

According to Zhao *et al*. (2025), skilled on-site labour tends to experience higher levels of job satisfaction. Similarly, Rotimi *et al*. (2023) highlight that investment in skills development positively correlates with job motivation and labour retention in construction projects. Voordt and Jensen (2023) posit that job satisfaction among site workers significantly influences on-site labour productivity. SME contractors perceive that on-site labourers who are fairly treated, developed, involved in decision-making, and provided with a safe and engaging work environment are more productive (Adebowale & Agumba, 2025). Additionally, with the increasing digitalisation of construction processes, adaptation to new technologies is viewed as essential for on-labour productivity enhancement (Ross, McGregor & Swales, 2024). However, many SME contractors struggle with the integration of digital tools due to limited resources and technical capacity (Telukdarie, Dube, Matjuta & Philbin, 2023). Ross *et al*, (2024) contend that the integration of digital technology on construction sites managed by SME contractors necessitates a more highly skilled labour force of which there is already a significant shortage.

From a management perspective, SME contractors also highlight several internal practices that directly impact on-site labour productivity (Ross *et al.* 2024). Availability of resources, such as materials, equipment, and logistical support, is frequently noted as a major determinant of on-site labour productivity (Nyoni & Bonga, 2016; Hamza *et al*., 2022). Equally important is on-time payment of on-site labour, which affects motivation, attendance, and overall morale (Bake & Makinde, 2021). Moreover, Bake and Makinde (2021) posit that delays in wage disbursement are perceived to contribute to high absenteeism and reduced on-site labour productivity. Incentives and rewards, when aligned with performance, are recognized by SME contractors as effective motivators (Balogh, Sipos & Rideg, 2021; Adebowale & Agumba, 2023c). Skill-based on-site labour allocation is another strategic practice, whereby assigning workers to tasks based on their strengths and experience can lead to higher workmanship.

Oladiran and Onatayo, (2019) highlighted that clear instructions and directives from the site management reduces confusion, rework, and time wastage, leading to improved on-site labour productivity. Moreover, compliance with Safety, Health, Environment, and Quality (SHEQ) standards is not only a legal obligation but also a productivity enabler (Ayodele *et al*., 2020). SME contractors acknowledge that non-compliance often leads to accidents, work stoppages, and reputational damage, which ultimately hinder labour productivity. Asad *et al*. (2022) highlighted the critical role that well-defined SHEQ policies and implementation procedures play in strengthening organisational performance among SME contractors. Additionally, Mugwagwa (2021) emphasized that on-site labour should be assigned specific SHEQ roles to promote accountability and embed SHEQ principles into daily site operations. Furthermore, the design and implementation of a labour-efficient site layout plan are perceived as essential for streamlining workflow, minimising movement and material handling, and reducing idle time (Gurmu, 2021).

2.9 Challenges faced by SME contractors regarding on-site labour productivity

2.9.1 Human Resource Management Challenges

Human Resource (HR) management is crucial in attracting, developing, and maintaining a skilled and motivated workforce to achieve organisational objectives (Teo, Sarpin, Seow & Shafii, 2022). HR management is critical for SME contractors since they rely on the workforce and some work as labour-only contractors (Egbebi, 2024; Harney, Gilman, Mayson & Raby, 2022). SME contractors face a myriad HR management challenges that significantly impact productivity in construction projects (Egbebi,2024). One of the important challenges highlighted by scholars is the lack of skilled labour, worsened by an ageing workers and not enough younger workers joining the field (Hamza *et al*., 2022; Windapo, 2016. Ameh & Daniel, 2017). Wilkinson, Johnstone, and Townsend (2012) posit that the skills shortage increased competition for available talent, driving up payroll costs and affecting project timelines. Construction industry is characterised by high labour turnover as construction work is seasonal and nature of employment is temporary as is evident in projects followed by labour shortages that act as impediments to the delivery of projects (Egbebi, 2024). In addition, Egbebi (2024) opined that skilled workers often migrate between companies for better pay or conditions, leading to team instability. Moreover, safety related challenges remain critical, with construction workers facing higher workplace injury risks than other sectors (Teo *et al*., 2022).

Ameh and Daniel (2017) emphasised labour transportation issues to and from construction sites. Some construction sites are in remote areas, making it difficult to ensure timely and reliable transportation for workers (Assaad *et al*., 2023). Hasan, Baroudi, Elmualim, and Rameezdeen (2018) concurred that delays in transportation could lead to increased idle time for workers, affecting overall project timelines and productivity. Odesola and Idoro (2014) highlighted labour alcoholism as one of the issues affecting on-site labour productivity teams.

Additionally, Jagtap and Tidke (2019) reported labour absenteeism due to not being allowed to enter sites because of alcohol consumption. Almamlook, Bzizi, Al-Kbisbeh, Ali and Almajiri (2020) highlighted labour conflicts resulting from wage disagreements, work conditions, and benefits. Labour conflicts and disputes can result in strikes affecting on-site productivity.

2.9.2 Financial management challenges

The financial issues present the SME contractors with problems that impede on-site labour productivity. As an example, Megersa (2020) explains that SME contractors possess diminished accessibility to finances that gives the rise to the fact that SME contractors experience difficulties to find skilled workers, as well as train workers to increase on-site productivity. It was noted by Bolton *et al.* (2022) and Cumberlege, Botha and Bentley (2018) that payment issues are usually in terms of late payment, no payment or under-payment to the certified work leading to the development of a cash flow issues by the contractors. Consequently, the SME contractors fail to retain skilled labourers because of delayed payments by the client, existence of fierce competition with larger-scale firms, and issues on job fulfilment, remuneration, or career development prospects (Bilan *et al.,* 2020). Besides, it also became evident to ILO (2019) that one of the greatest difficulties with which emerging local contractors have to struggle is the access to the proper equipment because of the lack of capital resources. A significant 80% SME contractor failure is cited by Anugwo and Shakantu (2020) in premature exits of market entry of such firms within the first five years of operations due to poor financial management behaviour in these market players.

2.9.3 Regulatory Management Compliance Challenges

Complying with various regulations, including tax laws, labour laws, safety and environmental regulations, and quality regulations, can be overwhelming to SME contractors (Nyaga Githae, Hagir & Alowo, 2024). Piratla *et al*. (2024) concurred that securing permits for utility connections, such as electricity, can also cause delays in construction projects, reducing productivity. Masango (2020) opined that some SME contractors use unskilled labour for activities that need skilled workers because they do not adhere to the Building Industry Bargaining Council (BIBC), resulting in slow production due to rework. SME contractors, especially emerging contractors, are more likely to face work stoppage, fines, and rework due to not complying with regulatory requirements (Mbambe, 2020; Aigbavboa & Thwala, 2014b). According to Mashwama, Aigbavboa and Thwala (2019), some SME contractors tend to avoid other regulatory requirements since there are some costs involved. Furthermore, Azman *et al*. (2024) highlighted that changes in a country's institutional regulation can contribute to the productivity changes of construction firms over the long term but are often overlooked in construction productivity research.

SHEQ compliance remains a critical challenging area for SME contractors (Reiner,2011). Regarding safety, Amoah and Mlenzana (2021) report that many SME contractors fail to allocate sufficient funds for PPE in tendering stages, resulting in unsafe working conditions and exposure to injuries. Additionally, the SME contractors experience serious challenges in organising quality processes, such as site level quality, benchmark quality, and continuous improvement (Nyakala, Pretorius & Vermeulen, 2020). The SME contractors lack skilled staff to execute and expedite the requirements of the National Building Regulations, South African National Standards (SANS) or South African Bureau of Standards (SABS) on site (Mazibuko, Simpeh & Smallwood, 2021). Environmentally, the SME contractors would often forget or ignore taking care of the environment with regard to waste, dust, and site runoff retention (Hasan, Anastasiadis &Spence, 2021). Moreover, Bashir *et al*. (2024) advanced the view that the ISO 14001 environmental management systems are usually expensive and challenging to SME contractors.

2.9.4 Poor Site Management

Effective site management is vital for construction project success the success, and most projects experience inefficiency because of poor site management practices (Sarvari *et al*., 2021; Vigneshwar & Shanmugapriya, 2023). According to Eze *et al*. (2020a) and Amoah and Bikitsha (2022), inadequate planning and scheduling is one of the major causes of low labour productivity on-site. Eze *et al*. (2020b) stressed the importance of realistic and effectively designed schedules, because otherwise there can be overlapping of tasks and as a result multiple delays, unnecessary works, and wasted manpower. There is also poor planning that does not allow the materials to be procured as timely as possible; therefore, the workers end up waiting on materials to be hauled or equipment to be brought in, spending their precious time and resources (Bekele, Mahesh, & Ingle, 2024). According to Wong, Rashidi and Arashpour (2020), the problem with on-site labour productivity is also aggravated by communication failures and team incoherence. Almutairi and Almunifi (2020) have noted that site management that is poor will easily lead to unclear delegation of work and failure of optimal supervision hence leaving the labour at the site not knowing their functions and duties. This may cause mistakes, as well as numerous workflow disruptions. In addition, poor communication with subcontractors and suppliers can result in poor timing overall because the delays in the delivery of services or goods have a ripple effect, and thus other planned actions are affected (Almutairi & Almunifi, 2020).

An often-overlooked but critical aspect of poor site management is inadequate site layout planning, which directly impacts the efficiency of labour and material handling (Spillane *et al*., 2013). According to RazaviAlavi and AbouRizk (2021), a poorly designed site layout creates disorganised work zones, unclear material storage areas, and inefficient routes for workers and equipment leading to congestion, confusion, and safety hazards. Tao *et al*. (2022) emphasise that when materials and equipment are not strategically placed according to workflow, workers waste valuable time navigating the site, increasing idle time and reducing on-site labour productivity. Furthermore, site congestion due to poor site layout planning often contributes to accidents, delays, and duplicated tasks, all of which are signs of ineffective site supervision and oversight (Rapp & Benhart, 2015). As part of comprehensive site management, the layout must be continuously reviewed and adapted to the evolving needs of the project, ensuring smooth movement, timely access to resources, and minimal disruption to workflow (Hansen,2024).

Table 2. 2 Challenges affecting on-site labour productivity in other countries

Country	References	Challenges Affecting Labour Productivity
Libya	(Alshahrani *et al*., 2023)	Omission of labour control; Labour knowledge and ability; Construction technology; Planning of the various disciplines in construction industries; Mistakes in architecture designs.
Zambia	(Ngoma, Mwanaumo & Kaliba, 2024)	Working in heights challenges, poor time management and scheduling, poor project program, being inexperienced and poor working environment.
Sri Lanka	(Manoharan *et al*., 2022)	Late payment of salaries, low salary, absence of training facilities, labour lacks motivation, and evaluation of labour skills is not good.
Yemen	(Alaghbari *et al*., 2019)	Poor material schedule on site, poor leadership and supervision, scarcity of materials, and security challenges.
Singapore	(Van Tam *et al*., 2021)	Lack of supervisor, lack of worker recruitment, high labour turnover rate, employee absenteeism on duty and language problems with foreign workers.
Palestine	(Mahamid, 2013)	Rework, poor communication between project stakeholders, poor financial management by client, the insufficient experienced labour, and insufficient materials
Oman	(Al Alawi *et al*., 2022)	Lack of complete drawings, unfavourable on-site conditions, poor cashflow, inadequate working equipment, and worker absenteeism, as well as the turnover of the workers are all related to worsened artisan status.
Zimbabwe	(Nyoni & Bonga, 2016)	Late or non-payment of workers, lack of capital, not paying suppliers, inadequate skilled labour and inadequate training
India	(Agrawal & Halder, 2020)	Stock of material, technical specification clarity, payment delay, layout at the site, construction process, reworks, weather, skill level, SHE (safety, health and environment), working planning and schedules

2.10 Overview of on-site labour productivity modalities to enhance sustainable project delivery

The on-site labour productivity in construction projects, which is the output relative to the combined input of labour, materials, and equipment, is directly influenced by the effective management of these three key resources. Additionally, technology integration has a huge impact on enhancing on-site labour productivity. Proper management of resources will also make sure that the construction process can be accomplished at an acceptable time and expense in addition to the needed quality standards.

2.10.1.1 Labour Management Strategies

The construction industry is labour intensive; therefore, the most significant asset in the industry is its workforce (Assaad & El-Adaway, 2021). According to Alshahrani *et al*. (2023), on-site labour productivity is vital as it directly affects the total effectiveness and success of construction work. SME contractors highly depend on on-site labour to establish a competitive edge because they depend on labour more than larger contractors (Adebowale & Agumba, 2021). Moreover, effective on-site labour productivity affects the project schedules, costs, the quality of the works, and the potential of SME contractors to win further competitive contracts (Hamza *et al*., 2022). The sustainable management practices described below play a key role in improving effective productivity of labour on the site.

2. 10.1.2 Training and Skills Development

An efficient workforce is among the necessary factors with regard to perseverance and the successful execution of construction projects. Karakhan *et al*. (2023) stressed that through workforce training, construction firms can develop an educated knowledgeable adaptable workforce that will result in better completion of projects, customer satisfaction, and consequently sustainable construction industry development. Furthermore, training assists workers to keep pace with emerging changes in the industry trends and technologies (Walters & Rodriguez, 2019). Moreover, training the construction workforce increases job performance, minimises mistakes, safety precautions and promotes a friendly working culture (Karakhan, Gambatese & Simmons, 2020). Rui *et al*. (2015) also indicate that besides increasing the knowledge of workers, training of workers also enhances morale of the workers and job satisfaction thus leading to an increase in the level of employee engagement and retention. Also, through workforce investments, the companies within the construction industry will be able to attract and maintain competent employees, strengthen the image of their brand, and obtain a competitive advantage in the market (Riyanto & Riyanto, 2021). Mehta *et al*. (2020) indicated that employers cannot afford to keep buying and training fresh workers because it is costly to keep well-educated employees.

Studies points out the importance of work-based training methods in enhancing skills of the workers since it holds significant advantage over the other conventional approaches (Siregar, 2018; Ojha *et al*., 2020). Nonetheless, most construction companies and training providers have adopted a traditional approach, in terms of using lecture-based sessions and tool-box talks instead of work-based training sessions (Ojha *et al*., 2020). There are studies indicating that work-based training can be provided using digital technologies in the photography and videography domain (including virtual reality gaming technologies, 360-degree panorama technologies, and others), and that the assessment of the necessary skills can be carried out when using these technologies (Dickinson *et al.*, 2011; Lin *et al.*, 2018; Manoharan et al. 2024a).

2. 10.1.3 Leadership and Supervisory Strategies

Effective supervisory and leadership practices are pivotal in enhancing on-site labour productivity (Edwin & Calistus, 2023; Manoharan *et al.*, 2024b; Jimoh *et al*, 2017). In addition, there has to be a good relationship and understanding between construction supervisors and on-site labourers as it bolsters motivation, enhances work quality and greater productivity (Manoharan *et al.*, 2024b). Studies indicate the significance of adopting effective supervisory measures to avoid adoption of potentially incorrect construction processes as well as less than optimally performed labour-based operations (Manoharan *et al.*, 2024a; Manoharan *et al.*, 2024b; Jimoh *et al.*, 2017).

Other leadership traits which help supervisors to optimise the capabilities of their employees include excellent decision-making and communicative skills, and abilities to motivate labourers (Jimoh *et al.*, 2017). In addition, the hard-core skills of supervisors can help labourers give their best to achieve greater results, thus exerting a significant impact that is very beneficial to on-site labour productivity (Edwin & Calistus, 2023). Supervision has a straight impact on the successful realisation of construction activities according to the time, budget, and necessary level of completion quality (Manoharan *et al.*, 2024a). On the other hand, lack of proper supervision may translate to mismanagement of labour that may cause inefficiency and other construction problems.

In implementing leadership practices to improve on-site labour productivity, construction supervisors should consider regular training and development to update skills of labourers hence rendering them effective. Effective communication is also likely to improve awareness of task and expectations (Kesavan *et al.*, 2022). Edwin and Calistus (2023) stressed that delegation of duties according to strengths and knowledge, allows labourers to participate in decision-making and problem-solving. Manoharan *et al.* (2024b) highlighted leadership practices such as resolving conflicting situations among labourers within a short time and without discrimination, making right decisions at the right time, delegation of roles together with empowering on-site labour participation and taking of ownership. Moreover, Manoharan *et al.* (2024b) stated that the safety and welfare of workers should be prioritised so that the working process is productive and secure, and monitoring and constructive feedback are needed and can lead to a constant increase in productivity. It is also imperative to have adaptability in the leadership style in response to changing project requirements and labour problems (Dalibi, 2016). Efficient integration of these strategies and supervisory practices guarantees sustainable advantage in the areas of labour productivity as well as successful implementation of construction projects.

2. 10.1.4 Labour motivation

Hayford *et al.* (2022) declare that motivation is what would induce someone to execute a specific behaviour. According to Uka and Prendi (2021) and Lakshan *et al.* (2023), motivation improves productivity. There are two categories of motivation such as intrinsic and extrinsic (Hayford *et al*., 2022). In case of labourers, intrinsic motivation is applicable when they are in a position to work and the individual is satisfied and the labourers are extrinsically motivated by rewarding and promoting the individual, salary, bonuses and other benefits (Ohueri *et al.,* 2018).

The site managers and supervisors should intrinsically motivate on-site labourers by helping them to understand the importance of their roles in the project and highlight how their contributions impact the community and contribute to the infrastructure development (Panuwatwanich, Al-Haadir & Stewart, 2017). According to Thomas (2009), offering opportunities for skill development and training can also intrinsically motivate labourers, allowing them to become proficient in various tasks, and boosting their confidence and motivation.

The company owners and directors can extrinsically motivate on-site labourers by ensuring that labourers receive a fair and competitive salary for their work and by implementing incentives for exceeding targets (Mwangi, 2016). Werner and Balkin (2021) stressed that such kinds of benefit packages as health insurance, retirement, paid vacations can enhance job satisfaction and overall well-being. Additionally, the implementation of programmes that publicly recognize outstanding performance or achievements such as "Employee of the Month" awards or other forms of acknowledgment have the potential to extrinsically motivate on-site labourers (Vivian & Amah, 2024). The creation of pathways for career growth within the company not only motivates but makes labourers last long in the company (Werner & Balkin 2021).

2. 10.2 Material Management Strategies

Material management has a direct impact on on-site labour productivity since most of the construction tasks are material-dependent (Albert, Shakantu & Ibrahim 2021; Yıldız, Güneş & Kıvrak, 2024). Gurmu and Ongkowijoyo(2020), highlight that efficient material management is crucial in enhancing on-site labour productivity by ensuring that the right materials are available at the right time and place, minimising delays and interruptions. In addition, effective management of the materials would imply that the planning, acquisition, handling, and controlling of materials in an organised way in order to be available on time and the in-site uses to be optimised result in labour efficiency and overall project performance (Bekele, Mahesh, & Ingle, 2024). Sogaxa and Simpeh (2022) introduce a list of five material management strategies that lead to the efficient management of this aspect: strict adherence to specifications of material, effective use of material, and effective inventory management system. Effective communication and collaboration between different stakeholders of the project should be prioritised as the essential elements when managing the materials. This includes, making sure that project participants, starting with suppliers and construction site managers down to end-users, were aware of material requirements and delivery date (Eze *et al*., 2020a).

Furthermore, Abkar *et al*. (2024) proposed that proper management of material would minimise waste and rework on the construction sites. On this note, Tafesse (2021) had stated that materials which are not well managed are most likely to be damaged, lost, or installed in a wrong manner resulting in wastage of time and on-site labour productivity. Effective organisation of material management enables the construction crews to reduce mistakes and guarantee effective and precise use of materials used, thus increasing the labour efficiency at the construction site (Gurmu,2020; Bekele, Mahesh, & Ingle, 2024; Güneş & Kıvrak, 2024).

2. 10.3 Equipment Management Strategies

As part of the construction business, equipment and tools serve an essential part as they directly affect the productivity of on-site labour (Chandra *et al*., 2023a; Ranjithapriya and Arulselvan, 2020; Gurmu. and Aibinu, 2017). Chandra *et al*. (2023b) stressed that the wanted production output requires high production equipment availability that is subject to the laws descending out of equipment reliability and maintainability. To increase on-site labour productivity, effective construction machinery practices should be in use (Ranjithapriya & Arulselvan, 2020; Gurmu, Aibinu & Toong Khuan, 2016) in terms of procurement planning, maintenance strategies, productivity analysis, tools tracking, and tools management.

The most appropriate procurement plan of construction equipment is the most essential determination of effective productivity on a construction site. According to Ranjithapriya and Arulselvan (2020), effective procurement planning makes sure that the right machinery will be available when needed, which minimises idle time and delay. Besides, Ranjithapriya and Arulselvan (2020) added that the procurement schedule must be in accordance with the needs, time, and budget of the project so that the managers of the site could predict the number of materials and equipment needed. Gurmu *et al*. (2016) emphasised that the availability of the right equipment when needed goes a long way in improving labour productivity on site. Research has indicated that inadequate procurement planning may cause project delays and cost increase, among other issues, on top of low worker morale, which adversely impacts productivity (Sahu & Mohibullah, 2022).

Construction equipment maintenance plans are essential in avoiding failure of this equipment as this may result in loss of productivity (Chandra *et al.*, 2023). Sahu and Mohibulla (2022) emphasised that maintenance, such as preventative and corrective steps, allows extending the life span of the equipment, reducing downtime and increasing reliability. Chandra *et al.* (2023) revealed that a maintenance control system helps to save money because, in the long run, it allows for estimating the upcoming trouble to come before the process can be halted. Also, real-time monitoring systems, which monitor the equipment health, can help to decrease the downtime and minimise maintenance costs even more (Chandra *et al.*, 2023).

According to Ranjithapriya and Arulselvan (2020), productivity analysis of construction equipment gives the indication of the efficiency and effectiveness of on-site machinery. Nakanishi, Kaneta, and Nishino (2022), state that the process of evaluating equipment productivity involves the process of quantification and evaluation of the equipment output concerning the input application in terms of fuel consumption rate, the cycle times, and material handling activities data. By conducting such analysis, site managers are able to arrive at data-based decisions concerning the use of equipment to ensure optimal performance of the machines leading to greater productivity (Gurmu, Aibinu & Toong Khuan, 2016). Finally, assuming knowledge of equipment productivity indicators would lead to improved scheduling, shrinkage and better resources allocation, these are also correlated with higher labour productivity at the construction sites (Nakanishi, Kaneta & Nishino, 2022).

2. 10.4 Site Management Strategies

2.10.4.1 Health and Safety Culture

safe working conditions in construction sites not only protect workers from harm but also contribute to increased productivity, efficiency, and overall project success (Oswald *et al.*, 2020). According to Khan, Proverbs, and Xiao (2022), safe working conditions on construction sites lead to fewer injuries and illnesses among labourers and staff, resulting in reduced absenteeism leading to a smooth running of a project without interruption caused by absent workers. Wong, Sapuan, and Khan (2023) emphasised that when workers don't have to worry about safety hazards, they can focus their energy and attention on completing tasks efficiently, leading to smoother workflows and faster project completion times.

Unsafe working conditions increase labour turnover resulting in workers going to seek employment elsewhere since they are not feeling safe. Ayodele *et al.* (2020) revealed that accidents and injuries can result in significant downtime on construction sites due to incident investigations, worker recovery or replacement. Safe working conditions reduce the likelihood of accidents, minimising downtime and keeping projects on schedule (Ayodele *et al.*, 2020). Maintaining safe working conditions enhances the reputation of the construction firm and clients are more likely to trust and hire contractors with a track record of prioritising safety, leading to repeat business and positive referrals (Kreuzer, Röglinger & Rupprecht, 2020).

2. 10.4.2 Effective site layout plan

Site layout plan forms one of the key elements of planning process in any construction work because it has a direct impact on transportation within the site, construction logistics, and safety performance (Al Hawarneh, Bendak & Ghanim, 2021). As RazaviAlavi and AbouRizk (2021) emphasise, the site layout plan plays a vital role in influencing cost efficiency, labour productivity, and the safe interaction of critical site elements which are materials, equipment, and personnel. Effective site layout planning involves the strategic placement of facilities to optimise these elements by aligning them with their associated construction activities. According to Tao *et al*. (2022), there are many possible types of facilities present in construction sites, among which there are storage facilities (e.g., formwork storage yards), processing facilities (e.g., carpentry workshops) and residential or administrative facilities (e.g., site offices). The materials, construction equipment and labour are available resources that need to be ferried between these facilities and the buildings being constructed following the workflow of the project. (Tao *et al*., 2022). To enhance efficiency and reduce costs, RazaviAlavi and AbouRizk (2021) advocate for the logical placement of site facilities in locations that minimise the movement of labour and equipment, thereby reducing operational delays and optimising resource allocation.

Furthermore, maintaining a minimum restricted distance between site facilities and buildings is essential for ensuring construction safety and enabling smooth on-site traffic flow. In addition to logistical considerations, site layout planning must also account for factors such as space utilisation, accessibility, site supervision, safety, and the physical constraints of the site including geometry and topography. However, RazaviAlavi and AbouRizk (2021) caution that site layout planning can be particularly complex due to the inherent uncertainties in construction projects and the intricate interdependencies between influencing factors and decision variables. As a result, RazaviAlavi and AbouRizk (2021) recommend the use of simulation-based decision support tools to improve accuracy and enhance decision-making in site layout planning.

2. 10.5 Technology integration/construction 5.0 practices to enhance on-site labour productivity

The Construction 5.0 paradigm is the current stage of industrial progress that is aimed at integrating the expertise of the human specialists forming a joint venture with effective and accurate machines to attain the production solution that is resource-efficient and favored by the clients (Yitmen, Almusaed & Alizadehsalehi, 2023). Zhang *et al.* (2023) agreed that the enhanced Human Resource Collaboration (HRC) during the construction process has been associated with Construction 5.0, and the principle is that the presence of robots would not substitute the role of human workers but supplement their knowledge and skills. The HRC in the construction sector shows that the partnership between humans and robots has gained the high attention based on their abilities to increase productivity, improve safety, and efficiency of construction projects (Garshasbi, Wang, Chen & Ma, 2023). The technologies that can significantly increase the productivity of on-site labour in the context of this study include wearable skeletons, on-site labour robot assistants, labour collaboration smart devices, Virtual Reality (VR)/Augmented Reality (AR), drone systems, and blockchain technology.

The wearable exoskeleton ranks as one of the best technologies that can be used to improve labour productivity on a site (Zhu, Dutta & Dai, 2021). Mahmud *et al.* (2022) identified the use of the wearable exoskeleton as one of the technologies that can reduce tension and damage to various body parts of a person, supporting the joints, distributing the weight, and correcting the posture. Exoskeletons can increase labour power on the job site that involves heavy lifting and pushing/pulling (Faheem *et al*., 2024). A mounted arm exoskeleton suit and chairless chair are two possible solutions in the form of a partially motorised exoskeleton suit that can reduce the occurrence of repetitive stress and muscle injuries caused by movements of the arm in repetitive motions or standing in the same position over extended periods (Zhu, Dutta & Dai, 2021). Faheem *et al*. (2024) emphasised that the exoskeletons have the potential of helping older or physically incompetent labour in the field to continue working longer and attract an increasingly larger and varied workforce than before (Faheem *et al*., 2024). Labour assisting robots could be used in complex and dangerous construction task like deconstruction, moving heavy items and welding. Such smart devices as smart helmets, smart watches, and smart tablets that work using labour collaboration can improve their productivity through enhanced communication, monitoring, and coordination of various tasks (Zhu, Dutta & Dai, 2021). The smartwatches could enable the on-site labour to be able to get task updates by supervisors and health monitoring such as fatigue and heart rate monitoring.

Virtual Reality (VR) and Augmented Reality (AR) can significantly enhance on-site labour productivity by improving training and skill development. By leveraging the capabilities of VR/AR technology, the training team can provide real-time, interactive simulations that offer trainees a profound understanding of complex tasks, machinery operations, and safety protocols. Additionally, VR/AR improves learner recall accuracy and learning retention, and it takes less time to train than traditional training methods (Olbina & Glick, 2023). Nevertheless, the combination of AR/VR technology and conventional learning tools guarantees comprehensive learning experience preventing the lack of connection between theory and practice (Yazdi, 2024). Furthermore, AR/VR help in monitoring of the project, safety control, time requirements and cost control, quality and malfunctions (Ahmed, 2018).. In support, Elghaish *et al*. (2021) described that drone technology has the potential to enhance communication and supervision through the ability to provide an overall image of the activity held on-site, which will allow better team synchronisation. The study by Waqar *et al*. (2023) indicates that drones can be used in large sites to monitor the progress and enhance labour on-site deployment. Moreover, the deployment of drones has the capacity of improving safety, as there is no risk of endangering the lives of on-site labour that is used to conduct an inspection of hazardous places. Hamledari and Fischer (2021) assert that through blockchain technologies, drone technology could be integrated so that accurate payments may be made to the subcontractors and labourers depending on work completed. Moreover, blockchain technology provides an answer since it could be used as a form of secure, transparent, and automated payment system. Wu, Lu and Xu (2022) highlighted that blockchain technology guarantees easy verification of payment records, which contributes to the establishment of trust between employers and workers.

2.11 Theories underpinning on-site labour productivity

The theoretical perspectives such as the Resource-Based View (RBV), the Human Capital Theory (HCT), and the Sustainable Development Theory (SDT), were used in this study to understand on-site labour productivity within the construction industry. RBV, HCT, and SDT constitute the theoretical background through which the enhancement of productivity by SME contractors can be attained to ensure sustainable delivery of construction projects.

According to Pereira and Bamel (2021), RBV is one of the most prevailing theoretical frameworks in strategic management that was postulated by Wernerfelt (1984) and subsequently diversified by Barney (1991). According to RBV theory, competitive advantage and higher performance of a firm is a result of its internal resources which are valuable, rare, inimitable, and non-substitutable (Wibisono & Supoyo, 2023). In the context of SME contractors, the productive on-site labour, the skilled supervision, the technological capability, and the effective site management are some of the strategic resources that have a direct impact on the productivity and long-term competitiveness (Hamza et al., 2022; Adebowale & Agumba 2023a). Once SME contractors can competently recognize, nurture and safeguard these distinctive resources, they can gain long lasting performance benefits within the construction industry. Therefore, the RBV emphasizes the fact that productivity improvement is not a simple action of external market factors but a management of the internal resources and the use of these internal resources to generate value and attain sustainable competitiveness (Wibisono & Supoyo, 2023).

The HCT was initially developed by Becker (1964), and it is a supplement to the RBV as it focuses on people as one of the main assets in the process of generating productivity and innovations (Chadwick, Li, & Na, 2022). According to, Gurmu and Ongkowijoyo, (2020) since that the construction industry is low-technology and labour-intensive in developing countries, human capital development is of the highest priority in the long-term sustainability and socio-economic growth. High quality personnel at all levels professional and technical, supervisory, and labour, is a key to the effective execution of the construction projects (Gurmu, 2021). Hence, to enhance productivity, safety, and quality in construction, training, developing, and retaining an efficient workforce are the cornerstones (Ojha et al., 2020). On this, constant investment to skills development, mentoring, and capacity building increase the efficiency, adaptability and motivation of workers (Sogaxa, Simpeh & Ndihokubwayo, 2021). This is in line with the assumption of HCT that education and experience are capital that can enhance the productivity of an individual and the organisation and therefore allows SME contractors to stay competitive within the dynamic industry environment.

The SDT offers an extended model of connection between economic growth, social equity and environmental protection. SDT is a product of the Brundtland Report (1987), and its main focus is to ensure the current generation satisfies its needs without affecting the future generation to satisfy their needs (Hajian & Kashani, 2021). Sustainable development in the construction industry is manifested in better output of labour on-site and conservation of resources, equitable working conditions and a low ecological footprint (Nadeem, 2023). SME contractors that maximize productivity due to efficient human and material resource management will benefit the economic efficiency, social wellbeing and environmental custodianship that characterizes sustainable project delivery of construction projects (Onu & Mbihwa, 2019).

Taken together, these theoretical approaches provide a combined analysis of the factors that affect the productivity of on-site labour productivity of SME contractors. The RBV proposes how the internal resources and capabilities could be used as a competitive advantage; the HCT shows the necessity of the development of the professional and motivated workforce and the SDT puts the maximization of the productivity into the wider context of the sustainable development goals. Collectively, these theories constitute the conceptual framework, on which the empirical inquiry and offered modalities of productivity of the study are constructed.

2.12 Conceptual Framework

This study develops an effective on-site labour productivity modality for SME contractors to enhance sustainable construction project delivery in the Western Cape of South Africa. To achieve the study's aim, this study investigates SME contractors' perceptions regarding on-site labour productivity, challenges, and factors influencing on-site labour productivity. Based on research data findings, and data analysis, actionable and effective on-site labour productivity modalities will be proposed for SME contractors to sustain their businesses and promote sustainable construction project delivery in the Western Cape.

The perception of SME contractors regarding on-site labour productivity is crucial for developing effective modalities to enhance on-site labour productivity (Sogaxa, Simpeh & Ndihokubwayo, 2021). SME contractors' perspectives enable identification of challenges and opportunities, and the areas for improvement which will result in proposing effective modalities to enhance SME contractors' on-site labour productivity. Furthermore, understanding the existing obstacles hindering labour productivity is crucial for developing effective modalities to enhance on-site labour productivity (Adebowale & Agumba, 2023a). For example, inadequate workforce training is highlighted by many scholars as a challenge faced by SME contractors (Hamza *et al*., 2022; Monoharan *et al*., 2022). Adebowale and Smallwood (2020), asserted that contractors' perceptions of factors influencing on-site labour productivity are important when developing modalities that can enhance on-site labour productivity.

The proposed on-site labour productivity modalities when implemented by SME contractors can enhance SME contractors' on-site labour productivity thus resulting in sustainable construction project delivery. The conceptual framework below provides a structured approach to enhancing on-site labour productivity among SME contractors in the Western Cape CI.

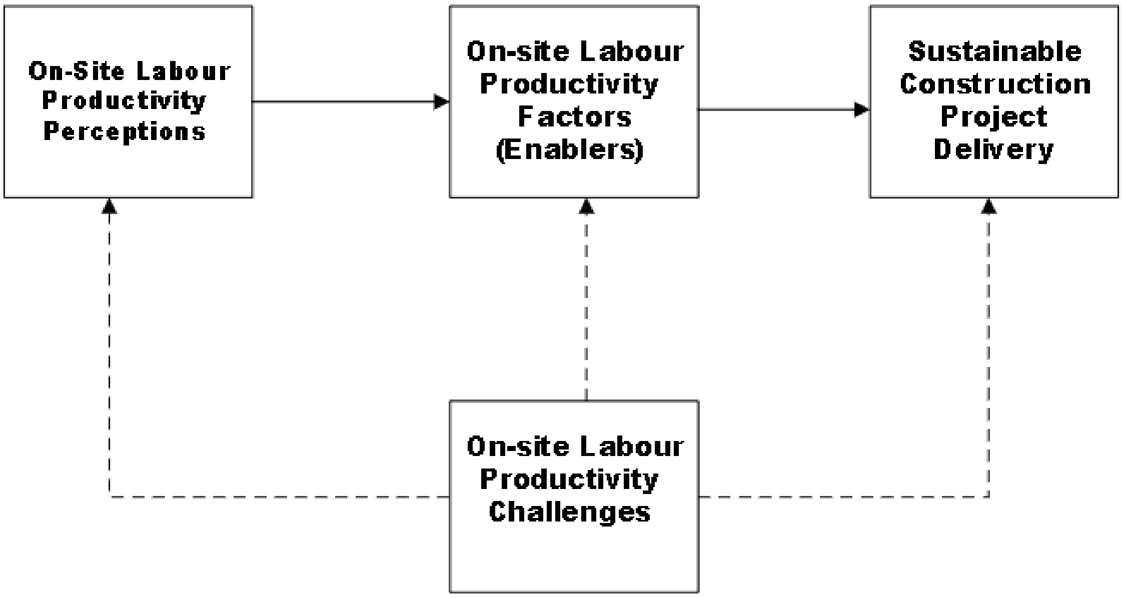

Figure 1. 1 Conceptual framework

2.12 Chapter Summary

This chapter reviewed a topical literature related to on-site labour productivity modalities for SME contractors that are vital to enhance the sustainable construction project delivery. This study pointed out the importance that on-site labour productivity plays in the labour-intensive CI, why it directly affects performance of projects, competitiveness of contractors and the overarching impacts to sustainable development. This chapter discussed the nature of SME contractors in South Africa, their social and economic importance in the country and the challenges that impact their performance such as access to finances, management of human resources, the porous regulatory burden and lack of labour productivity. This study also explored factors that influence on-site labour productivity including availability of materials, the site layout plan, skill levels of labour, supervision and motivation. In order to overcome the defined problems, the chapter suggested progressive measures to be implemented in the scope of labour, material, equipment, and site management. Furthermore, this chapter provided on-site labour productivity modalities for SME contractors to enhance sustainable construction delivery which includes continuous on-site labour training, effective supervision and leadership, and technology integration. Lastly, this chapter provided a conceptual model which would combine the perceptions of contractors, the factors that influence them and the solutions proposed, into a systematic model to enable the SME contractors in the Western Cape to move towards sustainability and productivity in the delivery of projects.

CHAPTER THREE
RESEARCH METHODOLOGY

3.1 Introduction

The review of the existing topical literature has been carried out in chapter 2. In this chapter, the research methodology followed in conducting this research study has been described. The purpose of this study is to offer effective on-site labour productivity modalities for SME contractors within the province of Western Cape in South Africa so as to improve sustainable delivery of construction projects within the province. The study problem, research questions and objectives are taken into consideration in this chapter in order to select a proper methodology. This chapter contains the research methods, design, data analysis and philosophy.

3.2 Research Onion

This study uses the research onion presented in figure 3.1 developed by Saunders *et al*. (2007) in designing and structuring the research methodology. Research onion depicts graphically the different facets of research to be studied and envisaged in a goal to come up with a proper research design (Tengli, 2020). Research onion has five research philosophies concerning the data collection method (Saunders *et al*., 2014). These include positivism, critical realism, interpretivism, postmodernism and pragmatism (Sahay, 2016). Among the five, two decisions of data collection procedures, i.e., research philosophy, and approach to theory development, will be peeled as the most external layers (Tengli, 2020; Sahay, 2016). The two research methods are known as research philosophy and define how one should answer the research questions followed by the other three layers namely methodological choice, research strategies, and time horizon (Melnikovas, 2018). In addition, the different layers of the research onion are inter-connected and dependent (Saunders *et al*., 2014), that is, mid-way through deciding the philosophy to use, the way of research will be affected and, hence, the method of research, time horizon adopted, data collection, and analysis.

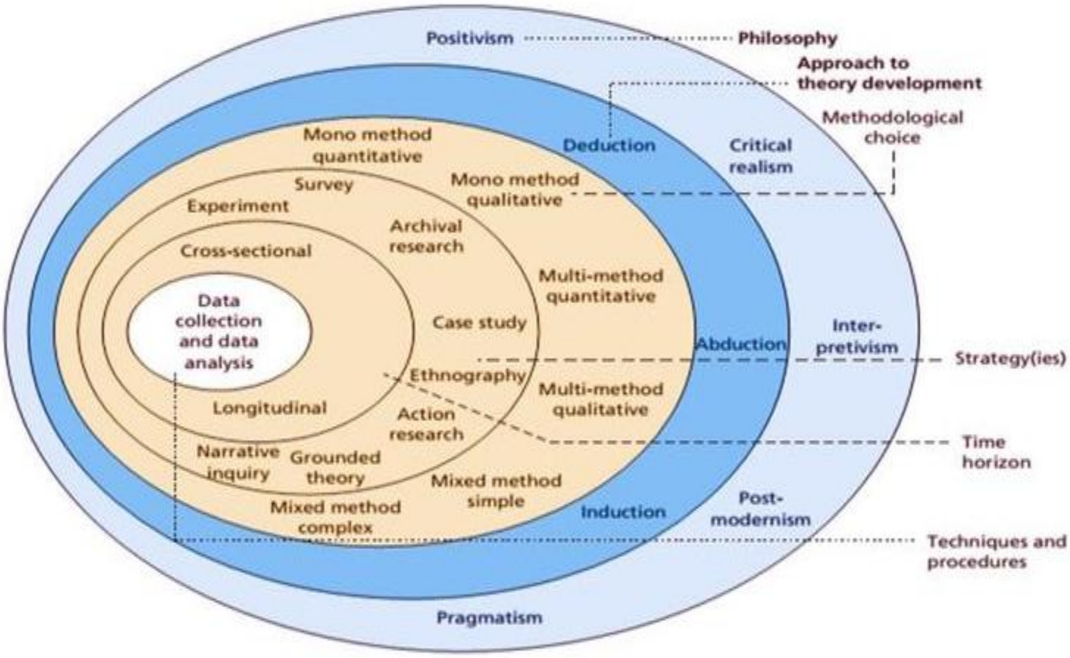

Figure 3. 1 Research onion (Saunders, Lewis & Thornhill, 2019)

3.3 Research Philosophy

According to Saunders and Tosey (2012), research philosophy refers to the notions of nature and the relationships of creating knowledge in a given research environment. In line with Dudovskiy (2022), research philosophy can be described as a position on how one should amass, analyse, and implement data about the topic in question. Philosophy of research is very important as it guides the researcher to think of a method of conducting the research investigation and it also aids in thinking of other research undertaken by fellow researchers (Azungah, 2018). Many research philosophies are found to be positivism, realism, interpretivism, and pragmatism and have their unique ontological and epistemological assumptions (Creswell & Creswell, 2018).

This study adopts a positive research philosophy, as it aligns with the use of structured quantitative methods to objectively analyse on-site labour productivity among SME contractors in the Western Cape. Positivism is based on the idea that knowledge should be derived from observable and measurable facts, allowing for statistical analysis and generalisable findings (Mnkasi & Acheampong, 2012). This approach ensures that data collection remains independent of researcher bias, enhancing reliability and validity. By using positivism, the study can systematically assess labour productivity factors, identify trends, and provide evidence-based recommendations for improving sustainable construction project delivery.

3.4 Approach to theory development.

Saunders *et al*. (2014) identify three research approaches: induction, deduction, and abduction. The inductive approach develops theories based on collected data, moving from specific observations to broader generalisations (Azungah, 2018). In contrast, the deductive approach begins with existing theories and applies them to specific contexts through a structured research strategy (Azungah, 2018). Abduction involves forming the most plausible explanation based on incomplete observations (Saunders, Dietz & Thornhill, 2018).

This study adopts a deductive approach as it aligns with positive research philosophy and facilitates the systematic exploration of established theories to address the research objectives and questions. The deductive method is suitable because it allows for structured data collection through questionnaires, enabling an objective analysis of factors influencing on-site labour productivity among SME contractors in the Western Cape (Bryman & Bell, 2022). Furthermore, the support for using a deductive approach arises from the fact that the study collected and reviewed existing theories and models related to enhancing on-site labour productivity for SME contractors to improve sustainable construction project delivery. By drawing on these theoretical foundations, the study formulated key factors influencing on-site labour productivity and sought to identify the most effective factors through empirical testing using quantitative methods. This approach ensures a logical progression from theory to observation, allowing theoretical propositions to be tested and validated within the context of SME contractors in the Western Cape.

3.5 Methodological Choice of the Study

This study adopts a quantitative approach, as it is well-suited for analysing measurable factors influencing on-site labour productivity among SME contractors in the Western Cape. According to Cresswell and Creswell (2018), quantitative research allows for objective data collection, numerical measurement, and statistical analysis, making it ideal for identifying patterns, trends, and relationships. The use of structured questionnaires enables a systematic evaluation of productivity factors, ensuring data reliability and comparability. Through application of a quantitative study, the study aims to generate empirical insights that can inform strategies for improving on-site labour productivity and enhancing sustainable construction project delivery.

Though the study is mainly quantitative, it acknowledges that the qualitative approaches might be used in supplementing quantitative results by adding the insight to the context and behavioural aspects of productivity, including interviews or focus groups (Cilliers, 2021). The qualitative methods may be useful in further studies aimed at investigating the experience of SME contractors in terms of lived and management perceptions potentially not represented by numerical data in a comprehensive manner. The quantitative design was however chosen because it offers measurable, generalisable and statistically valid outcomes based on the positivist orientation of the study (Cresswell, 2018).

3.6 Research Strategy of the Study.

The research strategy is a structured plan that guides the collection and analysis of data, ensuring systematic execution and high-quality results (Dinnen, 2014). Common research strategies include case studies, surveys, historical research, action research, experimental studies, and theoretical research. In quantitative studies, surveys are widely used through questionnaires or structured interviews to collect measurable data efficiently.

This study adopts a survey strategy, as it aligns with the deductive research approach and the chosen quantitative methodology. Surveys are an effective and economical method for gathering large amounts of structured data from a representative sample (Bryman & Bell, 2022), making them suitable for assessing factors influencing on-site labour productivity among SME contractors in the Western Cape. Furthermore, survey strategy enables the collection of reliable, standardised data that can be analysed statistically, facilitating the identification of trends and correlations. Additionally, surveys provide empirical insights that can support evidence-based recommendations for improving on-site labour productivity to enhance sustainable construction project delivery.

3.7 Time Horizon of the Study.

This layer of the research onion defines the study's time horizon, distinguishing between longitudinal studies, which involve repeated data collection over an extended period to observe changes over time, and cross-sectional studies, which capture data at a single point in time (Mardiana, 2020). Given the nature of this study, a cross-sectional approach is most suitable. This study assesses the current perceptions, practices, and challenges related to on-site labour productivity among SME contractors in the Western Cape at a specific moment, rather than tracking changes over time. Furthermore, according to Spector (2019) a cross-sectional design allows for efficient data collection within a limited timeframe, making it a practical choice for this study. Additionally, the cross-sectional approach also facilitates the identification of trends, relationships, and patterns within the targeted population, providing valuable insights that can inform industry practices without requiring prolonged observation (Mardiana,2020). Therefore, based on the fifth layer of the research onion, this study adopts a cross-sectional strategy to ensure a focused and time-effective analysis.

3.8 Target population, sampling technique and size

3.8.1 Population Size of the Study

The population of this study comprises active SME contractors in the Western Cape province, registered with the Construction Industry Development Board (cidb) under the General Building (GB) category, specifically within SME grades 1 to 6. However, the number of active SME contractors on the cidb fluctuates daily due to continuous registrations, upgrades, and dormancies (Wentzel, Fapahunda & Haldenwang, 2022). Table 2 presents the distribution of SME contractors registered under the cidb GB category, with 978 contractors in grade 1, 178 in grade 2, 91 in grade 3, 128 in grade 4, 60 in grade 5, and 87 in grade 6. Furthermore, table 2 shows the total of 1522 of SME contractors registered under the cidb GB category in the Western Cape province of South Africa. Enhancing on-site labour productivity for these contractors is critical, as it not only improves their operational sustainability but also contributes to the broader goal of sustainable construction project delivery in the Western Cape.

Table 3. 1 Population size

cidb Grade	No. of SMEs in GB
1 GB	978
2 GB	178
3 GB	91
4 GB	128
5 GB	60
6 GB	87
Total	**1522**

cidb (2024)

3.8.2 Sampling technique of the study

This study employed a stratified random sampling technique to ensure that SME contractors across all cidb grades were proportionally represented (Nguyen *et al*., 2021) The population of SME contractors in the Western Cape under the GB category ranges from Grades 1 to 6, as presented in Table 3.1. Since the number of contractors varies significantly across these grades, simple random sampling could lead to underrepresentation of certain groups(Zhao, 2021). Therefore, stratified random sampling was adopted to improve representativeness and accuracy.

In this approach, the population was divided into six strata corresponding to cidb grades 1–6. The number of contractors sampled from each stratum was proportional to its size relative to the total population (1522 contractors). For instance, since Grade 1 contractors represent approximately 64% of the total population (978 out of 1522), 64% of the total sample of 307 was allocated to Grade 1 contractors, and similar ratios were applied for the other grades.

Within each stratum, participants were then randomly selected to avoid bias and ensure that all active contractors within the cidb database had an equal probability of inclusion (Babbie, 2008). This proportional stratified random sampling method strengthened the reliability, precision, and generalisability of the findings, as it captures variations across different contractor categories, thereby providing a more accurate reflection of the target group (Creswell & Creswell, 2018; Alvi 2016).

3.8.3 Sample Size for the Study

According to Mujere (2016), the sample size refers to the number of individuals or units that a researcher includes in a study to conclude the entire research population. Cochran's formula is used to determine the sample size in this study because, since it provides a statistically reliable method for selecting an adequate sample from a larger population, particularly when the population size is large or unknown (Oribhabor & Anyanwu, 2019). According to Hasan and Kumar (2024), Cochran's formula ensures that the sample size is sufficient to achieve the desired level of precision and confidence while minimising errors in estimation. Given that this study focuses on SME contractors in the Western Cape Province, Cochran's formula assisted in determining an optimal sample that accurately represents the population without unnecessary oversampling or undersampling.

The above is Cochran's formula is used to determine sample size of this study:

$$\boldsymbol{n_0} = \frac{\boldsymbol{z^2 \cdot P \cdot (1 - P)}}{\boldsymbol{e^2}}$$

Where:

$\boldsymbol{n_0}$ = The initial sample size.

$\boldsymbol{z}$ = Which corresponds to the desired confidence level (1.96 for 95% confidence, 2.58 for 98% confidence)

$\boldsymbol{P}$ = The estimated proportion of the population that has the attribute of interest (if unknown, 0.5 is often used to maximize the sample size

$\boldsymbol{e}$ = The desired level of precision (margin of error).

In this study, the confidence level ($\boldsymbol{z}$) is 95%, a standard choice in many studies and provides a good balance for confidence and precision (Morey *et al*., 2016). Estimated proportion ($\boldsymbol{P}$) is 0.5 since the true proportion is unknown. Furthermore, a margin error ($\boldsymbol{e}$) of 5 % was adopted since it is commonly used in survey studies (Hsieh & Perri, 2021).

The sample size is computed as follows:

$$\boldsymbol{n_0} = \frac{\mathbf{1.96^2 \cdot 0.5 \cdot (1 - 0.5)}}{\mathbf{0.05^2}}$$

= 384.16

The population is not finite, resulting in the initial sample size being readjusted using the following formula:

$$\boldsymbol{n} = \frac{\boldsymbol{n_0}}{\mathbf{1} + \left(\frac{\boldsymbol{n_0} - \mathbf{1}}{\boldsymbol{N}}\right)}$$

Where:

$\boldsymbol{n}$ = Adjusted sample size

$\boldsymbol{N}$ = Population size

Adjusted sample size is computed as follows:

$$\boldsymbol{n} = \frac{\mathbf{384,16}}{\mathbf{1} + \left(\frac{\mathbf{384.16 - 1}}{\mathbf{1522}}\right)}$$

= 306.89, rounded off to nearest whole number is 307

Based on the above calculations, the size of the research sample is 307 respondents who are grade 1 to grade 6 GB SME contractors in the Western Cape.

3.9 Research Techniques and Procedures of the Study

This is the last layer of Saunders's research onion, contributing significantly to the study's overall reliability and validity (Saunders & Tosey, 2012), which explains how the data used in the research is collected and analysed (Costa, 2022). Furthermore, this layer covers the target population, the sampling technique, the sample size, the data analysis tools, sample limitations, the research reliability, and validity. Moreover, the data collected could be primary data or secondary data (Bryman & Bell, 2022).

3.9.1 Primary Data Collection

This study uses survey questionnaires as the major source of data collection and the questionnaires are sent to research participants through email. Costa (2022) states that primary data collection implies collecting first-hand information only through those who were directly exposed to it. Primary data can be collected based on diverse techniques which are commonly referred to as interviews, surveys, observations, and case studies (Cresswell & Creswell, 2018). Survey questionnaires were selected as the most appropriate instruments in this study because they are efficient in the collection of quantitative data. The methodology facilitated the researcher to gather firsthand information from the participants on regards to on-site labour productivity modalities that would assist SME contractors to improve sustainable construction project delivery in the Western Cape Province

3.9.2 Secondary Data Collection

The research gathers secondary data by comprehensively studying the literature on the relevant sources that are already available through books, academic journals, reports, weblogs and newspapers This is because, according to Maione (2023), literature review can be valuable since it helps amass greater understanding on the subject or topic of the study, gap areas in knowledge and give theoretical insight of the study. This study was made possible by analysing the available literature on on-site labour productivity of SME contractors and thereby contextualising finding within the research frameworks and industry trends.

3.9.3 Research instruments

Sukmawati (2023) defines instrumentation as the techniques or instruments or procedures that are used in gathering research data. Moreover, Sukmawati (2023), emphasized the fact that instrumentation is one of the essential points in quantitative research since it immediately influences the validity and reliability of the data.

3.9.4 Questionnaire Design

The following section elaborates on the questionnaire design, which must be based on a deep understanding of the research topic and questions to be addressed in the study. This study made use of structured questionnaires distributed to respondents. A structured questionnaire is one whose questions are predetermined and asked exactly (Karunarathna, Gunasena, Hapuarachchi & Gunathilake, 2024). Furthermore, the use of the structured questionnaire is suitable for this study since questionnaires are comparative low-cost approach to reach a wider spectrum of participants. Moreover, the questionnaire can be closed ended or open ended.

This study adopts closed-ended questions since it is suitable for quantitative research, allowing the researcher to collect structured data that can be easily quantified and analysed statistically. The survey questionnaires formed five sections namely: **Section 1:** Consists of biographical and demographic details of all the respondents including age, academic qualification, work experience, job positions, and cidb grade category in GB of the organisation. **Section 2,3,4,5**: Consists of a set of questions targeting construction site management teams of SME contractors, such as owner, directors, quantity surveyors, site technicians, site agents, and foreman about the three objectives of the study. Section 2 focuses on perceptions regarding on-site labour productivity, section 3 focuses on SME contractors' challenges regarding on-site labour productivity, section 4 covers factors in enhancing effective on-site labour productivity, and lastly section 5 covers SME contractor's modalities for enhancing on-site labour productivity.

Using a 5-point Likert scale, the target respondents were requested to rate from 1 to 5 (Not important = 1, Slightly important = 2, Moderately important = 3, Important = 4, and Very important = 5) perceptions regarding on-site labour productivity; (Minor = 1, Near minor = 2, Sometime = 3, Near major = 4, and Major = 5) to rate SME contractors' challenges regarding on-site labour productivity; (1=less impact to 5=high impact) to rate factors in enhancing effective on-site labour productivity; (Strongly disagree = 1, Disagree = 2, Neutral =3, Agree = 4, and Strongly agree = 5) to rate SME contractor's modalities for enhancing on-site labour productivity.

3.9.5 Question Administration

Prior to data collection, gatekeeping permission is obtained from the cidb to access a verified list of active SME contractors registered under the GB category within grades 1 to 6 in the Western Cape Province. Upon receiving approval, the Google Form questionnaire is distributed directly by the researcher via email to SME contractor management teams, including owners, project managers, site agents, quantity surveyors, and foremen.

According to Saunders *et al*. (2014), the researcher could present and collect the questionnaires. It is crucial that a cover note specifying the time of collection be included with the questionnaires. The researcher estimates that completing the questionnaire will not take more than 20 minutes. Compared to direct survey, the online questionnaire is timesaving and cost effective (Salama, Uzunboylu & Muti, 2020). Additionally, site management teams are often busy and with an online questionnaire respondents can use their available spare time to participate in the survey.

3.10 Data analysis of the Study

The Statistical Package of Social Sciences (SPSS) version 29 software is employed in this study to analyse quantitative data collected using survey questionnaires. Data analysis refers to a statistical procedure through which conclusion is made on the summarised data gathered using intellectual reasoning so as to realise the study goals (Schabenberger & Gotway, 2017). According to Habes and Pasha (2021), SPSS is highly efficient and manageable in analyzing any quantitative data. In SPSS, central tendency of data is ranked quite well and a comparison between groups can be done easily on mean scores or standard deviation (std) (Argyrous, 2011). This study uses both descriptive statistics analysis and inferential statistics analysis.

3.10.1. Descriptive statistics

Descriptive statistics involve summarising and organising data to highlight its essential features, providing a clear dataset overview without making inferential conclusions (Coolidge, 2012). According to Myers, Well and Lorch (2013), descriptive statistics include measures of central tendency (mean, median, mode), variability (range, variance, standard deviation), and frequency distributions, which collectively describe the data's central point, spread, and overall patterns. Therefore, the researcher employs descriptive analysis to analyse collected quantitative data about on-site labour productivity modalities for SME contractors to enhance sustainable construction project delivery. For the purpose of this study, Mean Ranking (MR) and Relative Importance Index (RII) are adopted to rank the perceived significance of various factors influencing on-site labour productivity, as rated by respondents on a 5-point Likert scale.

3.10.1.1 Mean Ranking

This study employs the mean ranking technique as a statistical tool to evaluate and compare the perceived significance of various factors influencing on-site labour productivity among SME contractors in the Western Cape province. According to Creswell and Creswell (2018), mean ranking is a statistical technique used to evaluate and compare the relative importance of multiple variables by calculating their average scores, whereby each factor is assigned a mean value derived from the aggregated responses of a sample population. The mean ranking method assigns a mean value (MV) to each variable based on participants' Likert-scale responses and ranks them from highest to lowest to reflect their relative importance (Harpe, 2015). In the 5-point Likert scale used in this study, 1 was subtracted from 5, which equals 4; after that, the 4 was divided by 5, equalling 0.8, which becomes the MV range. Thus, the MV range for "not important," "minor," "less impact," or "strongly disagree" becomes >1.00 ≤ 1.80; "slightly important," "slightly major," "slight impact," or "agree" becomes >1.80 ≤ 2.60; "moderately important," "moderate," "moderate impact," or "neutral" becomes >2.60 ≤ 3.40; "important," "major," "high impact," or "disagree" becomes >3.40 ≤ 4.20; and "very important," "very major," "very high impact," or "strongly agree" becomes >4.20 ≤ 5.00. These intervals were used to interpret the MV derived from respondents' perceptions across the various scales applied in the study. Through mean ranking, the study systematically prioritised the factors that are most influential, as perceived by the respondents. This helped to identify critical areas for the formulation of targeted recommendations to improve on-site labour productivity for SME contractors.

3.10.1.2 Relative Importance Index

The Relative Importance Index (RII) is a descriptive statistical technique commonly used in quantitative studies to rank factors based on respondents' perceptions (Karthik & Kameswara Rao, 2022). This study adopts RII to assess SME contractors' perceptions of various factors affecting on-site labour productivity, summarising and ranking these perceptions in a structured way, without making inferential conclusions (Myers, Well & Lorch, 2013). Furthermore, the RII is a widely utilizsed statistical method in construction management research, particularly effective for ranking factors based on respondents' perceptions (Gebrehiwet & Luo, 2017; Karthik & Kameswara Rao, 2022). According to Holt (2014), RII is suitable for data collected through Likert-scale questionnaires, as it transforms ordinal responses into a continuous scale ranging from 0 to 1, facilitating comparative analysis among various factors. RII calculates a score for each factor by considering the frequency and weight of responses, then standardising it against the maximum possible score (Gebrehiwet & Luo, 2017). Sogaxa (2024) highlighted that RII enables straightforward comparison between different variables, making it highly effective in studies that seek to identify the most influential factors among a broad range of options.

3.10.2. Inferential statistics

Inferential statistics involve drawing conclusions or making predictions about a larger population based on a sample of data, which is summarised using descriptive statistics (Hair *et al*., 2019). For the purpose of this study, inferential statistics validated the data collected through Factor Analysis (FA). This study adopted factor analysis as the primary inferential statistical technique.

3.10.2.1 Factor Analysis (FA)

Factor Analysis (FA) is a statistical technique to employed to detect groups of related variables that form independent clusters within a larger dataset (Shrestha, 2021). The main reason for using FA, according to Pallant (2020), is to reduce a large dataset into a smaller number of uncorrelated latent factors that explain the interrelationships among the response variables. Pallant (2020) indicated that for generating factors that characterise the structure of the variables in the analysis involves two main techniques which are FA, and principal component analysis (PCA). According to Pallant (2020), FA and PCA share several similarities and are frequently used interchangeably by researchers to create fewer linear combinations of the original variables that retain most of the variation in the correlation structure. The distinction between FA and PCA lies in their treatment of variance (Brown, 2009). FA uses a mathematical model to identify underlying factors based solely on the shared (common) variance among observed variables (Lu, 2025; Brown,2009). In contrast, PCA transforms the original variables into a reduced set of linear combinations that incorporate the total variance, including both common and unique components (Lu, 2025). SPSS was used to conduct FA with PCA used as the extraction method to analyse on-site labour productivity challenges confronted by SME contractors, and on-site labour productivity modalities for SME contractors to enhance sustainable construction project delivery in the Western Cape.

Moreover, Pallant (2020) asserts that the sample size and the strength of the relationships among the variables primarily influence the suitability of a dataset for FA. Regarding sample size, discrepancy still exists among authors on how large a sample should be for FA and PCA. Tabachnick, Fidell and Ullman (2019) suggest that a sample size of at least 100 is considered acceptable for FA and PCA. However, larger samples (preferably over 300) are more desirable for stable and reliable results. For this study, a sample size of 307 was used which is good for FA and PCA, as suggested by Tabachnick, Fidell and Ullman (2019). Concerning the strength of the relationship among the variables, the Kaiser-Meyer-Olkin (KMO) measure and Bartlett's Test of Sphericity were employed to check the sample adequacy, confirming that FA was appropriate for this study. Furthermore, the factor loading cut-off was set at 0.30, as recommended by Pallant (2020).

3.10.2.1.1 Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy

Shrestha (2021) indicates that Kaiser-Meyer-Olkin (KMO) test is a statistic tool applied to determine the adequacy of data to FA. KMO represents the punctuality of a sample in each variable and the model as a whole, which is the percentage of variance between variables that could be explained by quality of commonality (Nkansah, 2018). The greater proportion shows that the variables have enough common variability and therefore can be analyzed using FA. As Napitupulu, Kadar and Jati (2017) and Pallant (2020) point out, values of KMO can be any number between 0 and 1, with the threshold of at least 0.6 being generally accepted to ensure that a FA can be continued. To factor in the measure of sampling adequacy in this research, the survey employed the KMO test to ascertain that the data analysis was within the expectations in terms of sampling adequacy criteria, thus justifying the suitability of the factor analysis as the statistical method of choice.

3.10.2.1.2 Bartlett's test of sphericity

The Bartlett's Test of Sphericity is a statistical procedure used to determine whether the correlation matrix significantly differs from an identity matrix, where variables are uncorrelated (Field, 2024). According to Shrestha (2021), Bartlett's Test of Sphericity assesses whether the relationships among variables are strong enough to justify the use of FA. Hair *et al*. (2019)

emphasise that a significant result ($p < 0.05$) indicates the presence of sufficient correlations among variables, suggesting that data reduction through FA is appropriate. Similar to the KMO test, Bartlett's Test was applied in this study to confirm the sampling adequacy and ensure the appropriateness of FA (Tabachnick, Fidell & Ullman, 2019).

3.11 Data Treatment

The study collects data through structured survey questionnaires from SME contractors in the Western Cape to address four objectives. Objective 1 examines contractors' perceptions of skilled labour and management practices, with results summarized using mean rankings and presented in text and tables. Objective 2 investigates challenges affecting on-site labour productivity, analysed through mean rankings and factor analysis, and presented in text, tables, and graphs. Objective 3 identifies factors that could enhance effective labour productivity in sustainable construction, using mean rankings and presented in text and tables. Objective 4 explores recommended modalities to improve on-site labour productivity, analysed with mean rankings and factor analysis, and presented in text, tables, and graphs.

3.12 Validity Test

The pre-test method is utilised in this study to enhance the validity of the survey instrument assessing on-site labour productivity among SME contractors in the Western Cape. The questionnaire was pre-tested with 10 members of the management teams of SME contractors. Saunders *et al*. (2014) indicated that Pre-testing is crucial for refining the questionnaire by identifying ambiguities, redundancies, and potential misinterpretations before full-scale data collection. Face and content validity were established through expert review by two academic supervisors and three construction industry professionals who examined the questionnaire items for clarity, relevance, and alignment with the study objectives (Bryman, 2016). Their feedback informed revisions to wording, sequencing, and response scales to improve precision and comprehension. Additionally, Construct validity was enhanced through a pilot study involving a small group of SME contractor representatives who were not part of the main survey (Babbie, 2008). The pilot test enabled the researcher to assess whether the items appropriately captured the latent variables related to on-site labour productivity, management practices, and sustainability. Feedback from this process confirmed that the questionnaire adequately represented the theoretical dimensions underpinning the study. This iterative process minimised errors and improved data accuracy, leading to more reliable and valid findings (Creswell & Creswell, 2018). Adoption of the Pre-Test method in the study strengthened its methodological rigour, and ensured that the final survey instrument effectively captures the factors influencing on-site labour productivity of the SME contractors.

3.13 Reliability Test

Cronbach's Alpha is utilised in this research study to assess the reliability of the survey instrument measuring on-site labour productivity among SME contractors in the Western Cape. Reliability is defined by Saunders *et al*. (2014) as the consistency and stability of an instrument in producing similar results under repeated conditions. According to Bryman (2016), Cronbach's Alpha is a widely accepted statistical measure that evaluates internal consistency, determining whether multiple items measuring the same construct produce coherent responses. Babbie (2008) emphasises that a Cronbach's Alpha coefficient of 0.7 or higher is generally considered acceptable for demonstrating strong internal reliability. Specifically, coefficient values below 0.6 are deemed unacceptable, values around 0.7 reflect low reliability, values between 0.8 and 0.9 indicate moderate reliability, and values approaching or exceeding 0.9 are considered indicative of high reliability (Izah, Sylva & Hait, 2023).

In this study, the reliability of different sections of the questionnaire was tested through pilot testing and subsequent main data analysis to ensure measurement consistency. The pilot test involved a sample of SME contractor representatives who were not part of the main study. Their responses were analysed to identify ambiguous or inconsistent items, which were refined prior to the final survey administration. The Cronbach's Alpha coefficients obtained during pilot testing ranged from 0.78 to 0.91, demonstrating strong internal consistency and confirming that the items reliably measured the intended constructs. The results were further validated after the main data collection phase, where similar coefficient ranges were observed across major sections such as management practices, human capital development, supervision, and on-site labour productivity.

3.14 Chapter Summary

Chapter Three detailed the research methodology adopted to investigate effective on-site labour productivity modalities for SME contractors in the Western Cape. The study followed the Research Onion framework, employing a positivist philosophy and a deductive approach within a quantitative methodological design. A survey strategy and cross-sectional time horizon were used to collect empirical data from a population of 1,522 SME contractors registered under the cidb GB category (grades 1–6). A sample size of 307 was determined using Cochran's formula, and stratified random sampling ensured representativeness. Data were collected through online structured questionnaires and analysed using SPSS. Descriptive statistics (including mean ranking and RII) and inferential statistics (particularly FA) were employed to interpret the data. The validity of the research instrument was confirmed through pre-testing, while Cronbach's Alpha ensured reliability. This methodological approach ensured rigorous data collection and analysis, enabling the study to generate credible findings and propose practical on-site labour productivity modalities for SME contractors to enhance sustainable construction project delivery in the Western Cape.

CHAPTER FOUR
DATA ANALYSIS AND DISCUSSION OF FINDINGS

4.1 Introduction

This chapter represents the analysis of data collected via a survey questionnaire from the SME contractors' management teams. Furthermore, the quantitative data collected is analysed using statistical techniques, with findings interpreted and comprehensively discussed.

4.2 Response Rate

The online survey questionnaire was distributed to the management teams of active SME contractors operating within the Western Cape Province. Out of the 307 questionnaires distributed via email, 155 were fully completed and returned, resulting in a response rate of 50.5%.

4.3 Profile of Respondents

According to Table 4.1 out of 155 respondents, 50.3% were females and 49.7% were males. In addition, Table 4.1 shows an increasing female participation in a traditionally male-dominated construction industry, reflecting industry and gender inclusivity. In terms of the age group respondents, Table 4.1 indicates the distribution of the age group of the 155 respondents. It is observed that the percentage of respondents who fell in age group of 26 to 30 was about 44.5%, 35% in the age group of 18 to 25 years, 11.6% in the age group of 31 to 35 and 4.5 % in the age bracket of 36 to 40, 1.9% in the age bracket of 41 to 45 and 0.6 % within 46 to 50. This shows that most respondents were young professionals, reflecting that SME contractors employ younger individuals. In addition, the findings show a relatively low number of older respondents, which could indicate a high turnover rate or limited career longevity within SME contractors

Regarding qualifications of respondents, Table 4.1 shows that most of the respondents with a degree qualification makes up the highest percentage of the sample size (53.5%) followed by respondents with diploma qualification intake as 35.5%. Table 4.3 also shows that there were about 5.2% of respondents with Matric, 3.2% with Masters, and 2.6% with Trade Test. The findings suggest that SME contractors prioritise hiring individuals with a tertiary qualification. However, only 2.6% hold a trade test qualification, which may highlight a gap in technical skill recognition within SME contractors. Regarding the working experience of respondents, Table 4.1 has captured the applicable experience of the respondents with reference to the management and running of construction projects. It is observed that 68.4% of respondents possess pertinent experience within the range of 1 to 5 years, 19.1 % of respondents have smaller ties with less than a year experience in construction projects, 7.7% between 6 to 10 years and 4.5 % have experience of either 11 or 20 years, the others with 5.1 % having higher experience of over 20 years. It is clear that SME contractors favour graduates, as a significant number of projects are managed by respondents with less experience in the industry, with 68.4% having between 1 and 5 years of experience. Second, 19.1% of respondents have less than one year of experience showing that SME contractors also employ more students doing in-service training or work-integrated learning. In addition, the limited number of respondents with 10 years of experience may highlight challenges in retaining experienced personnel with SME contractors.

Concerning qualification of respondents, Table 4.1 clearly shows that about 41.9% of the respondents were quantity surveyors, followed by a notable 18.1% who were site technicians. In addition, 12.9% of respondents were site agents, 9% were foremen, and 5.8% were owners or directors. This suggests that SME contractors' projects are mostly run by quantity surveyors. In addition, the findings show few responses from senior decision-making roles since only 5.8% of respondents were owners or directors. In relation to cidb grading of the companies that respondents work on, Table 4.1 shows the cidb grading of their respective companies where the respondents work. It is important to note that 32.3% of the firms were classified as grade 6, the second biggest proportion was 18.7% of the firms that were grouped as grade 1. Moreover, the percentage of the firms belonging to the grade 3 category was 17.4 %. Moreover, 12.3% firms belonged to grade 4, 11.6% firms belonged to grade 5 and only 7.7% firms belonged to grade 2. It is clear that SME contractors (grade 6) employ more professionals compared to entry-level contractors (grade 1). In addition, the results indicate that larger SME contractors have a greater workforce capacity, possibly due to their ability to secure larger projects, whereas grade-one firms have more owner-driven operations.

Table 4. 1 Profile of respondents

Category		Frequency	Percentage	Cumulative Percentage
Gen-der	Female	78	50.3	50.3
	Male	77	49.7	100.0
	Total	155	100.0	
Age group	18-25	57	36.8	36.8
	26-30	69	44.5	81.3
	31-35	18	11.6	92.9
	36-40	7	4.5	97.4
	41-45	3	1.9	99.4
	46-50	1	0.6	100.0
	Total	**155**	**100.0**	
Highest Qualification	Degree	83	53.5	53.5
	Diploma	55	35.5	89.0
	Master's (MSc)	5	3.2	92.3
	Matric	8	5.2	97.4
	Trade Test	4	2.6	100.0

	Total	**155**		
Experience	1- 5 years	106	68.4	68.4
	11-20 years	7	4.5	72.9
	6-10 years	12	7.7	80.6
	less than 1 year	30	19.4	100.0
	Total	**155**	**100.0**	
Role in the organisation	Construction Manager	19	12.3	12.3
	Foreman	14	9.0	21.3
	Owner/Director	9	5.8	27.1
	Quantity Surveyor	65	41.9	69.0
	Site Agent	20	12.9	81.9
	Site Technician	28	18.1	100.0
	Total	**155**	**100.0**	
cidb grading	Grade 1	29	18.7	18.7
	Grade 2	12	7.7	26.5
	Grade 3	27	17.4	43.9
	Grade 4	19	12.3	56.1
	Grade 5	18	11.6	67.7
	Grade 6	50	32.3	100.0
	Total	**155**	**100.0**	

4.4 Cronbach's Alpha coefficients

The Cronbach’s Alpha coefficients reported in Table 4.2 demonstrate satisfactory internal consistency, thereby meeting established reliability testing requirements. These results confirm that the questionnaire items were internally coherent and capable of producing stable, replicable findings suitable for quantitative analysis in construction management research.

Table 4. 2 Cronbach's Alpha coefficients

Item	**Objective**	**Heading**	**No. of variables**	**Cronbach’s alpha**	**Rank**
1	Perceptions Regarding On-site Labour Productivity	Skilled labour	5	.865	Moderate
		Contractors’ Management practices to enhance on-site labour productivity	7	.940	High
		Sum	**12**	**0.903**	
2	SME Contractor’s Challenges Regarding On-site Labour Productivity	Human Resource Management Challenges	6	.897	Moderate
		Construction Material Challenges	6	950	High
		Financial Challenges	6	.938	High
		Site Management Challenges	5	958	High
		Regulatory Compliance Challenges	5	.916	High
		External Challenges	5	.887	Moderate
		Sum	**33**	**0.924**	
3	Factors in Enhancing Effective On-site Labour Productivity	Skill level of workers	5	.929	High
		Motivation	5	.931	High
		Training and development	5	.936	High
		External Factors	5	.936	High
		Client and stakeholder influence	6	920	High

		Sum	**26**	**0.930**	
4	SME Contractor's Modalities for Enhancing On-site Labour Productivity	Site Management Modalities	7	.955	High
		Leadership and Supervisory Modalities	6	.940	High
		Technology integration / Construction 5.0 practices	7	.950	High
		Material Management Modalities	6	.942	High
		Machinery management modalities	5	.924	High
		Sum	**31**	**0.942**	

4.5 Perceptions regarding on-site labour productivity

4.5.1 Skilled labour

The respondents were asked to indicate the importance of skilled labour as a factor in enhancing on-site labour productivity and sustainable construction project delivery within their organisation. A 5-point scale was used to rate each factor, where: Not Important = 1, Slightly Important = 2, Moderately Important = 3, Important = 4, and Very Important = 5.

The five skilled labour variables yielded a Cronbach's Alpha of 0.865, indicating acceptable reliability, as the coefficient exceeds the 0.6 threshold. Table 4.3 shows that continuous training and skill development ranked highest as a key factor in enhancing sustainable construction project delivery (MV=4.11; RII=0.82). Job satisfaction followed closely as a significant factor (MV=4.05; RII=0.810). The adaptation of new technologies was also identified as an essential contributor to on-site labour productivity and sustainable construction project delivery (MV=3.99; RII=0.797). However, the retention of skilled labour ranked the lowest (MV=3.46; RII=0.693). All skilled labour factors fall within the 'Important' category (MV >3.40 and ≤4.20). It should be noted that combined mean value for all factors was 3.80, highlighting the collective importance of these factors in sustainable construction project delivery.

Table 4. 3 Skille labour

Skilled labours ***N………………………………155*** ***Cronbach's Alpha…………………0.865***	Mean	Std.	RII	Rank
Continuous training and skill development	4.11	0.944	0.82	1
Job satisfaction	4.05	0.945	0.810	2
Adaptation with new technology	3.99	1.000	0.797	3
Recruitment of skilled labour	3.95	0.972	0.790	4
Retention of skilled labour	3.46	1.224	0.693	5
Average	3.80			

4.5.2 Contractors' management practices

The respondents were also asked to assess the significance of contractors' management practices in enhancing on-site labour productivity and sustainable construction project delivery. The same 5-point scale was used for rating each factor where: Not important = 1, Slightly important = 2, Moderately important = 3, Important = 4, and Very important = 5.

The seven contractors' management practice variables yielded a Cronbach's Alpha of 0.940, indicating high reliability. According to table 4.4, compliance with SHEQ (Safety, Health, Environment, and Quality) ranked as the highest factor in enhancing on-site labour productivity and sustainable construction project delivery (MV=4.26; RII=0.852), followed by clear instructions and directives MV of 4.18. On-time labour payment was also a notable factor (MV=4.10; RII=0.819). Conversely, incentives and rewards ranked the lowest (MV=3.69; RII=0.738). Contractors' management practice factors were generally rated as 'Important' (MV >3.40 and ≤4.20); however, SHEQ compliance rated as 'Very important' (MV>4.20 ≤ 5.00). The overall combined mean value for these factors was 3.98, underscoring their significance in improving on-site labour productivity and sustainable construction project delivery.

Table 4. 4 Contractors' management practices to enhance on-site labour productivity

Contractors' management practices to enhance on-site labour productivity. ***N…………………………………155*** **Cronbach's Alpha…………………0.940**	**Mean**	**Std.**	**RII**	**Rank**
Compliance with SHEQ (Safety, Health, Environment and Quality)	4.26	0.882	0.852	1
Clear instructions and directives	4.18	0.915	0.836	2
Labour-efficient site layout plan	4.10	0.945	0.819	3
On-time on-site labour payment	4.10	0.938	0.819	4
Availability of resources	4.06	1.008	0.812	5
Skilled-based on-site labour allocation	3.99	0.933	0.797	6
Incentives and Rewards	3.69	1.010	0.738	7
Average	3.98			

4.6 SME Contractor's Challenges Regarding On-site Labour Productivity

4.6.1 Human resource challenges

The respondents were asked to indicate the level of impact of human resource challenges on on-site labour productivity in their project success. A 5-point scale was used to rate each factor on a scale of Minor (1) to Major (5).

The six human resource challenge variables yielded a Cronbach's Alpha of 0.897, indicating acceptable reliability, as the coefficient exceeds the 0.6 threshold. Table 4.5 shows that high labour turnover ranked as the highest human resource challenge impacting on-site labour productivity in project success, with MV of 3.55. Labour alcoholism ranked the second human resource challenge in on-site labour productivity impacting project success, with a MV of 3.52. Furthermore, negligence of labour is a notable human resource challenge in on-site labour productivity impacting project success, with a MV of 3.46. However, table 4.5 shows that transporting problems of labour ranked the least as the human resource challenge impacting on-site labour productivity in project success. Most human resource challenges were rated as ' major ' such as high labour turnover, labour alcoholism, and negligence (MV>3.40 and ≤4.20). However, transporting problems, ageing labour, and labour conflict fall within the ' Moderate ' category (MV >2.60 ≤ 3.40). It should be noted that the combined MV is 3.40. This highlights the significance of human resource challenges in on-site labour productivity, impacting project success.

Table 4. 5 Human resource challenges

Human Resource Management Challenges ***N……………………………….155*** **Cronbach's Alpha…………………0.897**	**Mean**	**Std.**	**Rank**
High labour turnover	3.55	1.042	1
Labour alcoholism	3.52	1.416	2
Negligence of labour	3.46	1.383	3
Ageing on-site labour	3.39	1.102	4
Labour conflict	3.30	1.364	5
Transporting problems of labour	3.24	1.310	6
Average	3.40		

4.6.2 Construction material management challenges

The respondents were also asked to identify construction material management challenges impacting on-site labour productivity in their project success. A 5-point scale was used to rate each factor, on a scale of Minor (1) to Major (5).

The six-construction material management challenge variables yielded a Cronbach's Alpha of 0.950, indicating high reliability. Table 4.6 shows that late delivery of construction materials ranked as the most significant construction management challenge impacting on-site labour productivity, with an MV of 3.63, followed by poor material handling, with an MV of 3.48. Furthermore, table 4.6 shows that improper material storage was ranked the lowest, with an MV of 3.26. Material challenges like late delivery, poor handling, and running out of materials were viewed as 'major' (MV >3.40 ≤ 4.20). However, improper storage and ineffective distribution were rated as 'Moderate' (MV >2.60 ≤ 3.40). The overall combined MV was 3.45, indicating significant material management challenges impacting on-site labour productivity in project success, hindering sustainable construction project delivery.

Table 4. 6 Construction material management challenges

Construction Material Management Challenges ***N…………………………………155*** **Cronbach's Alpha…………………0.950**	**Mean**	**Std.**	**Rank**
Late delivery of construction material	3.63	1.279	1
Poor material handling	3.48	1.245	2
Running out of material on site	3.43	1.304	3
Ineffective material distribution on-site	3.39	1.322	4
Incorrect material specification	3.37	1.344	5
Improper material storage	3.26	1.237	6
Average	3.45		

4.6.3 Financial management challenges

The respondents were asked to indicate the level of impact of financial management challenges on on-site labour productivity in project success. A 5-point scale was used, ranging from Minor (1) to Major (5).

The six-financial management challenge variables yielded a Cronbach's Alpha of 0.938, indicating high reliability. According to table 4.7, payment delays by clients ranked as the most significant financial challenge impacting on-site labour productivity in project success, with a MV of 3.59, followed by financial limitations to invest in labour training, with an MV of 3.58. Table 4.7 also shows that errors in labour payments ranked the lowest, with an MV of 3.28. Most financial management challenges were seen as 'major', including payment delays and training investment limit (MV >3.40 ≤ 4.20). However, errors in labour payments were considered 'Moderate impact'(MV >2.60 ≤ 3.40). The overall combined mean value was 3.44, highlighting the impact of financial management challenges on on-site labour productivity in project success, hindering sustainable construction project delivery.

Table 4. 7 Financial management challenges

Financial Management Challenges ***N…………………………………155*** **Cronbach's Alpha…………………0.938**	**Mean**	**Std.**	**Rank**
Payment delay by client	3.59	1.273	1
Financial limitation to invest in labour training	3.58	1.289	2
Delays in labour payments	3.54	1.306	3
Inadequate budget to hire skilled labour	3.53	1.311	4
Lack of cashflow projections	3.46	1.330	5
Errors in labour payments	3.28	1.338	6
Average	3.44		

4.6.4 Site management challenges

The respondents were asked to indicate the level of impact of site management challenges on on-site labour productivity in their project success. A 5-point scale was used to rate each factor, ranging from Minor (1) to Major (5).

The six-site management challenge variables yielded a Cronbach's Alpha of 0.958, indicating high reliability. Table 4.8 reveals that ineffective communication with labour ranked as the most significant site management challenge impacting on-site labour productivity, with an MV of 3.46. Furthermore, Table 4.8 shows that scope changes affecting on-site labour productivity ranked second, with an MV of 3.45. Additionally, insufficient on-site supervision was identified as a notable site management challenge affecting on-site labour productivity, with an MV of 3.38. However, poor site layout planning was ranked as the least significant site management challenge, with an MV of 3.26. Ineffective communication and scope changes were seen as 'major'(MV >3.40 ≤ 4.20). However, supervision, skilled site managers, planning, and layout planning were rated 'Moderate' (MV >2.60 ≤ 3.40). The overall combined mean value for these challenges was 3.36, emphasising their collective impact on on-site labour productivity for sustainable construction project delivery.

Table 4. 8 Site management challenges

Site Management Challenges ***N……………………………….155*** **Cronbach's Alpha…………………0.958**	**Mean**	**Std.**	**Rank**
Ineffective communication with labour	3.46	1.373	1
Scope change	3.45	1.280	2
Insufficient on-site supervision	3.38	1.388	3
Inadequately skilled site managers	3.35	1.422	4
Poor planning and scheduling	3.34	1.439	5
Poor site layout plan	3.26	1.436	6
Average	3.36		

4.6.5 Regulatory compliance challenges

The respondents were asked to indicate the level of impact of regulatory compliance challenges on the on-site labour productivity in their project success. A 5-point scale was used to rate each factor, ranging from Minor (1) to Major (5).

The five regulatory compliance management challenge variables yielded a Cronbach's Alpha of 0.916, indicating high reliability. Table 4.9 indicates that strict adherence to SHEQ regulations ranked highest as the regulatory compliance challenge affecting on-site labour productivity, with an MV of 3.59, followed by delays in approval of permits with an MV of 3.52. Delays due to passing inspections were also a significant regulatory compliance challenge impacting on-site labour productivity, with an MV of 3.43. However, the complexity of regulations ranked the lowest, with an MV of 3.28. SHEQ adherence, permit delays, and inspection delays were seen as 'major' (MV >3.40 ≤ 4.20). The complexity of regulations was 'Moderate' (MV>2.60 ≤ 3.40). The overall combined mean value was 3.44, highlighting their impact as regulatory compliance challenges in on-site labour productivity for sustainable construction project delivery.

Table 4. 9 Regulatory compliance challenges

Regulatory Compliance Challenges ***N…………………………………155*** **Cronbach's Alpha…………………0.916**	**Mean**	**Std.**	**Rank**
Strict adherence to SHEQ (Safety, Health, and Environment, Quality)	3.59	1.273	1
Delays in approval of necessary permits	3.52	1.255	2
Delays due to passing inspections	3.43	1.334	3
Compliance with labour laws	3.41	1.404	4
Complexity of regulations	3.28	1.283	5
Average	3.44		

4.6.6 External challenges

The respondents were asked to indicate the level of impact of external challenges impacting on-site labour productivity in their project success. A 5-point scale was used to rate each factoron a scale of Minor (1) to Major (5).

The five external challenge variables yielded a Cronbach's Alpha of 0.887, indicating acceptable reliability, as the coefficient exceeds the 0.6 threshold. Table 4.10 shows that extreme weather conditions were ranked the highest as external challenge impacting on-site labour productivity, with an MV of 3.71. Additionally, Market instability ranked as the second external challenge impacting on-site labour productivity, with an MV of 3.43. Furthermore, changes in government regulations and regulations are notable external challenges impacting on-site labour productivity, with an MV of 3.40. However, design complexity was the least external challenge impacting on-site labour productivity, with an MV of 3.38. Extreme weather and market instability were rated 'major' (MV >3.40 ≤ 4.20). Other challenges like design complexity were interpreted as 'Moderate' (MV>2.60 ≤ 3.40). It should be noted that the combined MV is 3.55, highlighting the significance of these external challenges in on-site labour productivity for sustainable construction project delivery.

Table 4. 10 External challenges

External Challenges ***N…………………………………155*** **Cronbach's Alpha…………………0.887**	**Mean**	**Std.**	**Rank**
Extreme weather conditions	3.71	1.151	1
Market instability	3.43	1.075	2
Change in government policies and regulations	3.40	1.188	3
Public strikes	3.40	1.277	4
Design complexity	3.38	1.147	5
Average	3.55		

4.7 Factor analysis

4.7.1 Identifying the key challenges impacting on-site labour productivity of SME Contractors

This study utilized the FA as a method to identify the most impactful challenges affecting the on-site labour productivity of the SME contractors in their project's success. All 34 challenges were assessed to determine the ones that can have the most significant effect. FA was undertaken to minimise and sort the most influential issues that affected on-site labour productivity in the SME contractors. This evaluation was also done to ascertain that the quantitative analysis was consistent. Also, PCA was imposed so that the significant variables can be extracted.

4.7.1.1 Kaiser-Meyer-Olkin (KMO) adequacy and Bartlett's test

Shrestha (2021) asserts that the significance of the study could be tested through three different steps of FA. The KMO and Bartlett test of Sphericity was used to establish the most relevant on-site labour productivity issues facing SME contractors in Western Cape province of South Africa. Table 4.11 reveals that KMO and Bartlett test of sphericity are required as the minimum requirement of the data to be regarded as significant in carrying out the factor analysis. According to Napitupulu, Kadar and Jati (2017) and Pallant (2020), in the case of Significant factor analysis, a value of KMO that falls between 0 and 1 is required; whereby, the lowest value is recommended as 0.60. Moreover, Shrestha (2021) discloses that the Bartlett test estimates the quality of the connections between the variables so that it is reasonable to utilize FA. To be deemed significant and appropriate the Bartlett test should be related to the significance level of $p<0.005$ in the case of FA (Shrestha,2021). According to table 4.10, KMO is equal to 0.946 so the conditions needed are fulfilled because the value is greater than the required level of KMO which is 0.60. Moreover, Table 4.11 shows that the Bartletts test level of sphericity is $p=0.001$ that is lower than the maximum admitted level of $p<0.005$. Such results confirm the satisfaction of the minimum requirements of FA as suggested by Pallant (2020).

Table 4. 11 KMO and Bartlett's Test of SME contractors' on-site labour productivity challenges

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.946
Bartlett's Test of Sphericity	Approx. Chi-Square	5632.354
	Df	561
	Sig.	<.001

4.7.1.2 Principal components of SME contractors' on-site labour productivity challenges

After assessing the significance of the variables, the next step involved is factor extraction. In research, common factor extraction methods include the KMO criterion, which identifies factors as significant when their eigenvalues exceed 1; Cattell's scree test, which keeps all factors appearing above the “elbow” point on the scree plot; and Horn’s parallel analysis, which evaluates eigenvalues by comparing them to those from randomly generated datasets of the same dimensions (Yong & Pearce, 2013).

PCA was employed in this study to determine the most significant challenges affecting on-site labour productivity of SME contractors. The KMO criterion was used to determine significant factors, focusing on those with eigenvalues thaexceeds 1. As shown in Table 4.12, four factors met this criterion, with eigenvalues of 20.262, 2.021, 1.299, and 1.069, and accounted for 59.593%, 5.945%, 3.280%, and 3.145% of the variance, respectively. Therefore, collectively these four factors explain 72.503% of the total variance, highlighting the key challenges impacting on-site labour productivity in SME contractors' efforts toward sustainable construction project delivery as presented in Table 4.12.

Table 4. 12 Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	20.262	59.593	59.593	20.262	59.593	59.593
2	2.021	5.945	65.538	2.021	5.945	65.538
3	1.299	3.820	69.357	1.299	3.820	69.357
4	1.069	3.145	72.503	1.069	3.145	72.503
5	.917	2.698	75.201			
6	.851	2.502	77.703			
7	.779	2.292	79.995			
8	.716	2.106	82.101			
9	.623	1.832	83.934			
10	.508	1.495	85.428			
11	.441	1.298	86.726			
12	.415	1.222	87.948			
13	.402	1.184	89.132			
14	.381	1.121	90.253			
15	.323	.949	91.202			
16	.284	.835	92.037			
17	.272	.800	92.836			
18	.244	.717	93.553			
19	.237	.698	94.251			
20	.219	.643	94.894			
21	.204	.600	95.494			
22	.198	.582	96.076			
23	.170	.501	96.577			
24	.158	.464	97.041			
25	.150	.441	97.482			
26	.141	.416	97.897			
27	.130	.381	98.279			
28	.114	.335	98.614			
29	.099	.291	98.906			
30	.096	.283	99.188			
31	.084	.247	99.435			
32	.078	.229	99.664			
33	.076	.223	99.887			
34	.038	.113	100.000			
Extraction Method: Principal Component Analysis.						

According to Napitupulu, Kadar, and Jati (2017), components with eigenvalues exceeding 1 are considered the most significant factors affecting on-site labour productivity of SME contractors. Figure 4.1 presents Cattell's scree test, which visually determines the number of significant components by pinpointing those positioned above the "elbow" in the scree plot.

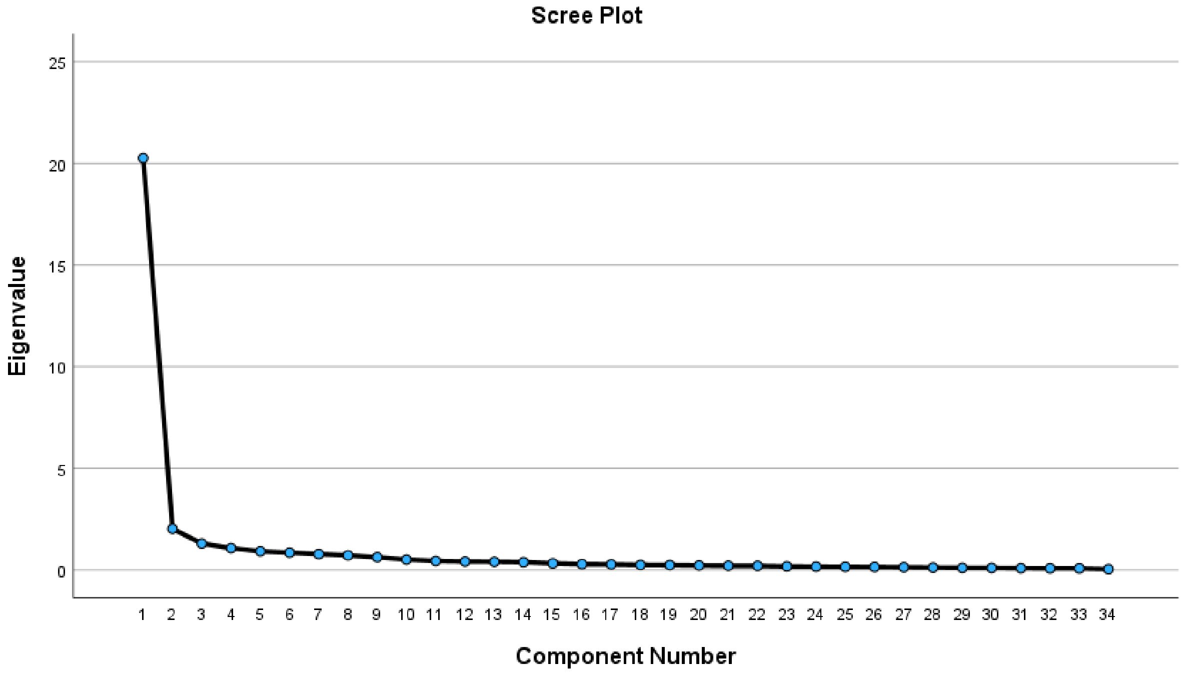

Figure 4. 1 Catell's scree plot on challenges impacting on-site labour productivity of SME contractors project success

4.7.1.3 Summary of factor analysis on SME contractors' on-site labour productivity challenges

A total of 34 variables were analysed to determine the key challenges affecting on-site labour productivity among SME contractors in achieving sustainable construction project delivery. This study employed PCA as the primary tool for factor analysis. To ensure the suitability of the dataset for factor analysis, the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's test of sphericity were conducted, as shown in Table 4.10.

The KMO value was 0.946, exceeding the recommended threshold of 0.60 (Shrestha, 2021), indicating that the dataset was suitable for factor analysis. Additionally, Bartlett's test of sphericity was significant at $p = 0.001$, which is below the recommended threshold of $p = 0.005$, confirming the presence of adequate correlations among the variables. Component loading was assessed using the component matrix for four extracted components. As shown in Table 4.13, all factor loadings were above 0.30, while variables with loadings below this threshold were excluded from further analysis. According to Pallant (2020), suppressing values less than 0.3 in factor analysis helps to highlight only the significant relationships between variables and factors, making the results more interpretable. This practice reduces clutter in the factor loading matrix, allowing for clearer identification of key variables contributing to each factor (Pallant, 2020). The results from Table 4.13 shows four (4) components with loadings greater than 0.3 in the rotated component matrix, namely component 1 *"poor site layout plan"*, component 2 "*negligence of labour*", component 3 *"change in government policies and regulations*", and component 4 *"compliance with labour laws".*

Table 4. 13 Component matrix

	Component			
	1 **Poor site layout plan**	**2** **Negligence of labour**	**3** **Change in government policies and regulations**	**4** **Compliance with labour laws**
Poor site layout plan	.866			
Poor planning and scheduling	.860			
Incorrect material specification	.849			
Inadequately skilled site managers	.847			
Improper material storage	.842			
Insufficient on-site supervision	.840			
Poor material handling	.837			
Ineffective material distribution on-site	.835			
Ineffective communication with labour	.827			
Errors in labour payments	.824			
Lack of cashflow projections	.824			
Delays in labour payments	.823			
Late delivery of construction material	.819			
Complexity of regulations	.817			
Inadequate budget to hire skilled labour	.813			
Delays due to passing inspections	.813			
Running out of material on site	.802			
Financial limitation to invest in labour training	.800			
Scope changes	.793			
Delays in approval of necessary permits	.793			
Design complexity	.776			
Payment delay by client	.752			
High labour turnover	.605			
Negligence of labour		.542		
Transporting problems of labour		.517		

Labour alcoholism		.459		
Labour conflict		.474		
Ageing on-site labour		.354		
Change in government policies and regulations			.485	
Public strikes			.426	
Market instability			.359	
Extreme weather conditions			.322	
Compliance with labour laws				.360
Strict adherence to SHEQ (Safety, Health, and Environment, Quality)				.344
Extraction Method: Principal Component Analysis.				
a. 4 components extracted.				

4.8 Factors in Enhancing Effective On-site Labour Productivity

4.8.1 Skill level of workers

The respondents were asked to evaluate the impact of the skill level of workers as a factor in enhancing on-site labour productivity. A 5-point scale was used to evaluate each factor (less impact (1) to high impact (5).

The five-skill level of workers variables yielded a Cronbach's Alpha of 0.929, indicating high reliability. According to table 4.14, problem-solving ranked as the most influential skill level of worker as factor in enhancing on-site labour productivity, with an MV of 4.08 and RII of 0.815. Additionally, experience ranked as the second skill level of worker factor in enhancing on-site labour productivity (MV=4.00; RII=0.800), followed by teamwork and collaboration (MV of 4.00; 0.800) However, technical proficiency ranked the lowest as the skill level of worker factor in enhancing on-site labour productivity (MV=3.78; RII=0.756). The results show that all skill-level factors were rated within the 'High impact' category (MV >3.40 to ≤4.20). Even the lowest-rated factor, technical proficiency, remained in the 'High impact' category. The overall combined mean value for these factors was 3.95, highlighting the critical role of these factors in improving on-site labour productivity for sustainable construction project delivery.

Table 4. 14 Skill level of workers

Skill level of workers ***N………………………………155*** **Cronbach's Alpha…………………0.929**	Mean	Std.	RII	Rank
Problem-solving	4.08	1.066	0.815	1
Experience	4.00	1.019	0.800	2
Teamwork and collaboration	4.00	1.038	0.800	3
Education	3.90	1.123	0.779	4
Technical proficiency	3.78	1.180	0.756	5
Average	3.95			

4.8.2 Motivation

The respondents were asked to evaluate the impact of motivation as a factor in enhancing on-site labour productivity. A 5-point scale was used to evaluate each factor (less impact (1) to high impact (5)).

The five-skill level of workers variables yielded a Cronbach's Alpha of 0.931, indicating high reliability. According to table 4.15, job security ranked highest among motivation factors for enhancing on-site labour productivity (MV=3.96; RII=0.792), followed by fair compensation and benefits (MV=3.88; RII=0.775). Additionally, table 4.15 shows that work-life balance was also a significant factor in enhancing on-site labour productivity (MV=3.77; RII=0.755). However, incentives and rewards ranked the lowest, with an MV of 3.59 and RII of 0.719. All motivation factors were rated in the 'High impact' category (MV>3.40 ≤ 4.20). The overall combined mean value for motivation factors was 3.77, emphasising the importance of these factors in enhancing on-site labour productivity for sustainable construction project delivery.

Table 4. 15 Motivation

Motivation ***N…………………………………155*** **Cronbach's Alpha…………………0.931**	**Mean**	**Std.**	**RII**	**Rank**
Job security	3.96	1.178	0.792	1
Fair compensation and benefits	3.88	1.124	0.775	2
Work-life balance	3.77	1.066	0.755	3
Adequate labour amenities	3.66	1.090	0.732	4
Incentives and rewards	3.59	1.188	0.719	5
Average	3.77			

4.8.3 Training and development

The respondents were asked to evaluate the impact of training and development as a factor in enhancing on-site labour productivity. A 5-point scale was used to evaluate each factor (less impact (1) to high impact (5)).

The five-training and development variables yielded a Cronbach's Alpha of 0.936, indicating high reliability. Table 4.16 reveals that health and safety training ranked as the most crucial training and development factor in enhancing on-site labour productivity, with an MV of 4.15 and RII of 0.831. Additionally, table 4.16 reveals that health and safety training was followed by leadership and supervisory training (MV=4.03; RII=0.805), and continuous training (MV=4.01; 0.803). However, skill development programmes ranked the lowest, with an MV of 3.97 and RII of 0.797. The overall combined mean value for these factors was 4.03, indicating the strong impact of structured training initiatives on on-site labour productivity for enhancing sustainable construction project delivery.

Table 4. 16 Training and development

Training and Development ***N………………………………….155*** **Cronbach's Alpha…………………0.936**	**Mean**	**Std.**	**RII**	**Rank**
Health and Safety training	4.15	1.027	0.831	1
Leadership and supervisory training	4.03	1.075	0.805	2
Continuous training	4.01	1.081	0.803	3
On-the-job Training	3.98	0.943	0.796	4
Skill development programmes	3.97	0.987	0.797	5
Average	4.03			

4.8.4 External factors

The respondents were asked to evaluate the impact of external factors in enhancing on-site labour productivity. A 5-point scale was used to evaluate each factor (less impact (1) to high impact (5)).

The five-external factors variables yielded a Cronbach's Alpha of 0.936, indicating high reliability. Table 4.16 shows that favourable construction site conditions ranked highest as an external factor in enhancing on-site labour productivity (MV=4.00; 0.800), followed by an efficient supply chain (MV= 3.93; 0.786). Additionally, table 4.17 indicates that favourable weather conditions were also ranked as a significant external factor in enhancing on-site labour productivity (MV=3.81; 0.763). However, table 4.17 also shows that no protests ranked lowest (MV=3.72; RII=0.745). External factors were generally perceived to have a 'High impact' (MV >3.40 ≤ 4.20). The overall combined mean value was 3.85, highlighting the significant impact of these external factors in enhancing on-site labour productivity for sustainable construction project delivery.

Table 4. 17 External factors

External factors ***N………………………………….155*** **Cronbach's Alpha…………………0.936**	**Mean**	**Std.**	**RII**	**Rank**
Favourable construction site conditions	4.00	1.105	0.800	1
Efficient supply chain	3.93	1.117	0.786	2
Favourable weather conditions	3.81	1.161	0.763	3
Supportive government policies	3.81	1.199	0.763	4
No protests	3.72	1.297	0.745	5
Average	3.85			

4.8.5 Client and stakeholder influence

The respondents were asked to evaluate the impact of client and stakeholder influence in enhancing on-site labour productivity. A 5-point scale was used to evaluate each factor (less impact (1) to high impact (5)).

According to table 4.18, on-time payment for completed work ranked as the most influential as a client and stakeholder influence factor in enhancing on-site labour productivity (MV=4.00; 0.800), followed by engagement with the community (MV=3.94; 0.787), and early inspection of completed work (MV=3.94; RII=0.787). However, table 4.17 also indicates that advance payments to the contractor ranked the lowest (MV=3.71; RII=0.742). All client and stakeholder factors were interpreted as having a 'High impact' on labour productivity (MV >3.40 ≤ 4.20). The overall combined mean value was 3.88, reinforcing the importance of financial reliability and early stakeholder engagement in enhancing on-site labour productivity for sustainable construction project delivery.

Table 4. 18 Client and stakeholder influence

Client and Stakeholder Influence ***N……………………………….155*** **Cronbach's Alpha…………………0.920**	**Mean**	**Std.**	**RII**	**Rank**
On-time payment for the completed work	4.00	1.105	0.800	1
Engagement with the community	3.94	1.079	0.787	2
Early inspection of the completed work	3.94	1.118	0.788	3
Effective communication among project stakeholders	3.91	1.181	0.782	4
Offering early completion bonuses	3.75	1.188	0.750	5
Advance payments to the contractor	3.71	1.184	0.742	6
Average	3.88			

4.9 SME Contractor's Modalities for Enhancing On-site Labour Productivity

4.9.1 Site management modalities

The respondents were asked to rate their level of agreement on site management modalities influencing on-site labour productivity for SME contractors to achieve sustainable construction project delivery. A 5-point scale was used to evaluate each of the modalities, where Strongly disagree = 1, Disagree = 2, Neutral =3, Agree = 4, and Strongly agree = 5

The eight site management modality variables yielded a Cronbach's Alpha of 0.955, indicating high reliability. Table 4.19 reveals that effective supervision of tasks ranked highest as site management modality influencing on-site labour productivity for SME contractors to achieve continuous project success, with an MV of 4.19, followed by regular inspections of the quality of work, with an MV of 4.12, and monitoring progress regularly, with an MV of 4.07. However, table 4.19 shows that offering early completion bonuses ranked the lowest, with an MV of 3.75. The overall combined mean value was 4.00, highlighting the importance of strong supervision and regular inspections in improving on-site labour productivity for SME contractors to achieve sustainable construction project delivery.

Table 4. 19 Site management modalities

Site Management Modalities ***N…………………………………155*** **Cronbach's Alpha…………………0.955**	**Mean**	**Std.**	**Rank**
Effective supervision of tasks	4.14	1.076	1
Regular inspections of the quality of work	4.12	1.081	2
Monitoring progress regularly	4.07	1.039	3
On-site health and safety culture	4.06	1.112	4
Effective labour scheduling	4.01	1.054	5
Proper resource allocations	4.00	1.111	6
Strategically designed	3.85	1.088	7
Offering early completion bonuses	3.75	1.188	8
Average	4.00		

4.9.2 Leadership and supervisory modalities

The respondents were asked to rate their level of agreement in leadership and supervisory modalities influencing on-site labour productivity for SME contractors to achieve sustainable construction project delivery. A 5-point scale was used to evaluate each of the modalities, where Strongly disagree = 1, Disagree = 2, Neutral =3, Agree = 4, and Strongly agree = 5.

The seven leadership and supervisory modality variables yielded a Cronbach's Alpha of 0.940, indicating high reliability. Table 4.20 reveals that delegating tasks based on team members' strengths and expertise ranked the highest as a leadership and supervisory modality influencing on-site labour productivity for SME contractors to achieve successful project delivery (MV of 4.08). Additionally, table 4.20 shows that making informed and timely decisions was ranked second as a leadership and supervisory modality influencing on-site labour productivity for SME contractors to achieve project success, with also an MV of 4.08. Monitoring progress regularly followed closely with an MV of 4.07, while encouraging on-site labour participation in decision-making ranked the lowest, with an MV of 3.98. The overall combined mean value was 4.04, emphasising the importance of strategic delegation and communication in enhancing on-site labour productivity for SME contractors to achieve sustainable construction project delivery.

Table 4. 20 Leadership and supervisory strategies

Leadership and Supervisory Modalities ***N…………………………………155*** **Cronbach's Alpha…………………0.940**	**Mean**	**Std.**	**Rank**
Delegate tasks based on the team members' strength and expertise	4.08	1.110	1
Making informed and timely decisions	4.08	1.156	2
Monitoring progress regularly	4.07	1.039	3
Strong communication protocols between supervisors and on-site labour	4.05	1.224	4
Strong communication protocols between supervisors and consultants	4.03	1.151	5

Addressing on-site labour conflicts promptly and fairly	4.01	1.184	6
Encourage on-site labour participation in decision making and problem solving	3.98	1.137	7
Average	4.04		

4.9.3 Technology integration/construction 5.0 practices

The respondents were asked to rate their level of agreement in technology integration/construction 5.0 practices influencing on-site labour productivity for SME contractors to enhance sustainable construction project delivery. A 5-point scale was used to evaluate each of the modalities, where Strongly disagree = 1, Agree = 2, Neutral =3, Disagree = 4, and Strongly agree = 5.

The seven-technology integration/construction 5.0 practice modality variables yielded a Cronbach's Alpha of 0.950, indicating high reliability According to table 4.21, drone technology to monitor progress on-site ranked highest as technology integration modality influencing on-site labour, with an MV of 3.76, followed by monitoring construction equipment through telematics, with an MV of 3.66 and blockchain technology for labour payments, with an MV of 3.66. However, training through Virtual Reality (VR) and Augmented Reality (AR) ranked lowest, with an MV of 3.50. The overall combined mean value was 3.63, indicating that while technology adoption is beneficial, its implementation remains moderate among SME contractors.

Table 4. 21 Technology integration/ Construction 5.0 practices

Technology integration / Construction 5.0 practices ***N……………………………….155*** **Cronbach's Alpha…………………0.950**	**Mean**	**Std.**	**Rank**
Drone technology to monitor progress on site	3.76	1.334	1
Monitoring construction equipment through telematics	3.66	1.250	2
Blockchain technology for labour payments	3.66	1.260	3
Labour collaboration through smart devices	3.62	1.218	4
Enhancing labour's physical strength with smart exoskeleton	3.61	1.286	5
Labour robotic assistant	3.61	1.297	6
Labour training through Virtual Reality (VR) and Augmented Reality (AR)	3.50	1.245	7
Average	3.63		

4.9.4 Material management modalities

The respondents were asked to rate their level of agreement in material management modalities influencing on-site labour productivity for SME contractors to achieve sustainable construction project delivery. A 5-point scale was used to evaluate each of the modalities, where Strongly disagree = 1, Disagree = 2, Neutral =3, Agree = 4, and Strongly agree = 5

The six material management modality variables yielded a Cronbach's Alpha of 0.942, indicating high reliability. Table 4.22 reveals that proper training on material handling ranked highest as a material management modality influencing on-site labour productivity for SME contractors to achieve successful construction project delivery, with an MV of 4.02. This was followed by material usage monitoring with an MV of 3.96 and efficient disposal of material waste and recycling on-site, with an MV of 3.93. However, E-procurement of material ranked lowest, with an MV of 3.86. The overall combined mean value was 3.93, highlighting the significance of these material management modalities in improving on-site labour productivity for SME contractors to enhance sustainable construction project delivery.

Table 4. 22 Material management modalities

Material management modalities ***N………………………………155*** **Cronbach's Alpha…………………0.942**	**Mean**	**Std.**	**Rank**
Proper training on material handling	4.02	1.102	1
Material usage monitoring	3.96	1.062	2
Efficient disposal of material waste and recycling on site	3.93	1.106	3
Adherence to required material specifications	3.93	1.140	4
Frequent auditing of the material stock	3.89	1.102	5
E-procurement of material	3.86	1.051	6
Average	3.93		

4.9.5 Machinery management modalities

The respondents were asked to rate their level of agreement in machinery management modalities influencing on-site labour productivity for SME contractors to achieve sustainable construction project delivery. A 5-point scale was used to evaluate each of the modalities, where Strongly disagree = 1, Disagree = 2, Neutral =3, Agree = 4, and Strongly agree = 5

The 5 machinery management modality variables yielded a Cronbach's Alpha of 0.924, indicating high reliability. According to table 4.23, hiring skilled and certified operators ranked the highest as a machinery management modality influencing on-site labour productivity for SME contractors to enhance sustainable construction project delivery, with an MV of 4.23, followed by regular machinery maintenance with an MV of 4.07. Furthermore, table 4.19 shows that keeping backup machinery spares was also critical, with an MV of 3.99. However, table 4.22 reveal that selection of multi-purpose machinery and tools ranked lowest, with an MV of 3.95. The overall combined mean value was 4.04, underscoring the importance of these material management modalities in improving on-site labour productivity for SME contractors to enhance sustainable construction project delivery.

Table 4. 23 Machinery management modalities

Machinery management Modalities ***N………………………………155*** **Cronbach's Alpha…………………0.924**	**Mean**	**Std.**	**Rank**
Hiring skilled and certified operators	4.22	0.989	1
Regular machinery maintenance	4.07	1.064	2
Keeping backup machinery spares	3.99	1.114	3

Fuel management system	3.97	1.145	4
Selection of multi-purpose machinery and tools	3.95	1.047	5
Average	4.04		

4.9 Factor analysis

4.10.1 Identifying the most significant on-site labour productivity modalities for SME Contractors to enhance sustainable construction project delivery

This study adopted FA to identify the most significant on-site labour productivity modalities employed by SME contractors to enhance sustainable construction project delivery. A total of 21 on-site labour productivity modalities were evaluated to determine the most critical factors. FA was conducted to simplify and categorise these modalities, allowing for a more structured understanding of their impact. Additionally, FA was performed to ensure the consistency and reliability of the quantitative analysis. Furthermore, PCA was used as the extraction method to identify the key variables contributing to on-site labour productivity.

4.10.1.1 KMO adequacy and Bartlett's test

The analysis of data on on-site labour productivity modalities for SME contractors in sustainable construction project delivery indicated that the KMO measure of sampling adequacy was 0.943, exceeding the recommended threshold of 0.60. This confirms that the sample was appropriate for factor analysis. Additionally, Bartlett's test of sphericity was significant at $p = 0.001$, demonstrating sufficient correlations among variables for factor analysis. These results validate the suitability of the dataset for further statistical analysis, as presented in Table 4.24.

Table 4. 24 KMO and Bartlett's Test of on-site labour productivity modalities for SME contractors to enhance sustainable construction project delivery

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.943
Bartlett's Test of Sphericity	Approx. Chi-Square	5346.742
	Df	465
	Sig.	<.001

4.10.1.2 Principal components of on-site labour productivity modalities for SME contractors to enhance sustainable construction project delivery.

With the adoption of PCA, the FA extracted four latent factors with eigenvalues exceeding 1 from 31 on-site labour productivity modalities for SME contractors to enhance sustainable construction project delivery. Table 4.25 presents eigenvalues of the extracted components as 17.950, 2.331, 2.116,1.252, thus explaining 57.904% of the variance.

Table 4. 25 Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings[a]
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
1	17.950	57.904	57.904	17.950	57.904	57.904	6.276
2	2.331	7.520	65.424	2.331	7.520	65.424	12.460
3	2.116	6.824	72.248	2.116	6.824	72.248	14.004
4	1.252	4.038	76.286	1.252	4.038	76.286	12.859
5	.895	2.888	79.174				
6	.746	2.405	81.579				
7	.584	1.885	83.464				
8	.481	1.553	85.017				
9	.410	1.322	86.339				
10	.399	1.286	87.625				
11	.379	1.222	88.847				
12	.338	1.090	89.937				
13	.320	1.033	90.970				
14	.301	.970	91.940				
15	.288	.928	92.867				
16	.234	.755	93.622				
17	.221	.713	94.336				
18	.210	.677	95.013				
19	.187	.602	95.614				
20	.185	.595	96.210				
21	.161	.520	96.730				
22	.149	.480	97.210				
23	.134	.433	97.642				
24	.121	.389	98.031				
25	.114	.366	98.398				
26	.105	.337	98.735				
27	.093	.300	99.035				
28	.088	.284	99.319				
29	.082	.264	99.583				
30	.079	.254	99.837				
31	.051	.163	100.000				
Extraction Method: Principal Component Analysis.							
a. When components are correlated, sums of squared loadings cannot be added to obtain a total variance.							

Additionally, Cattell’s scree test was used to determine the appropriate number of components to retain, with the results displayed in Figure 4.2. This test identifies the components that explain the most variance within the dataset, ensuring that only the most significant factors are considered. The extracted components align with the findings presented in Table 4.23, further validating the analysis.

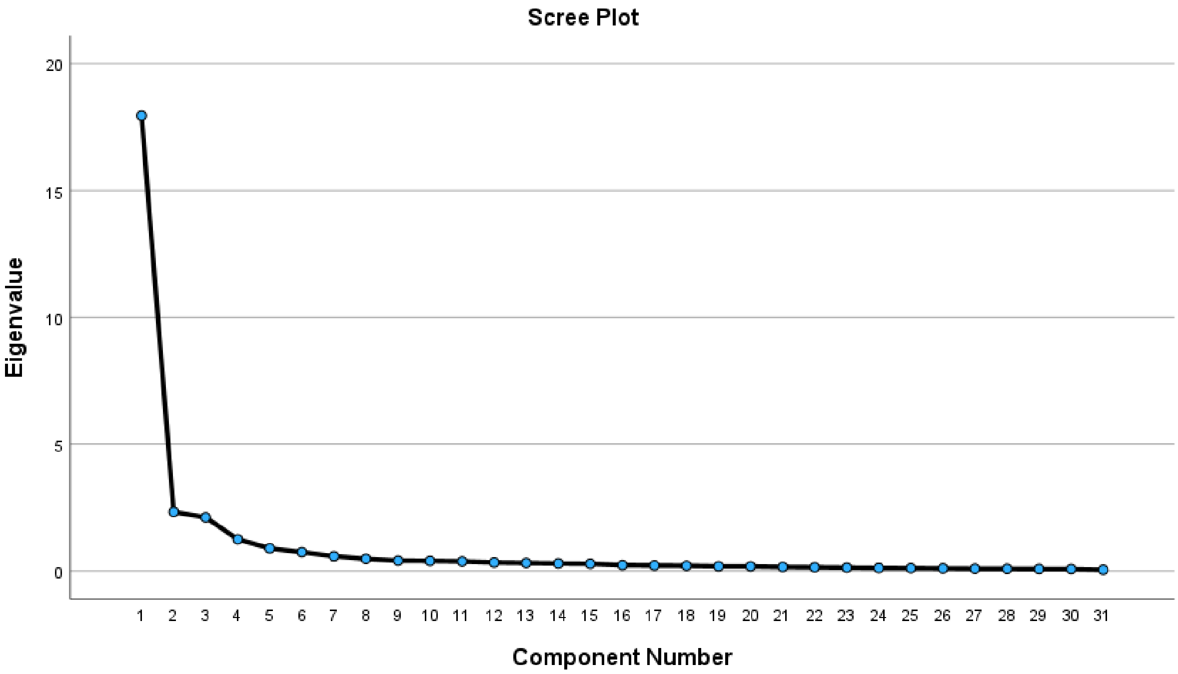

Figure 4. 2 Catell's scree plot on on-site labour productivity modalities

4.10.1.3 Factor analysis summary of productivity modalities for SME contractors

In this study, 24 variables were examined to determine the key on-site labour productivity modalities that could support SME contractors in achieving sustainable construction project delivery. PCA was applied as the chosen method for FA. The KMO measure of sampling adequacy and Bartlett's test of sphericity were also conducted, as shown in Table 4.25. Bartlett's test produced a significant result (p = 0.001), which is below the recommended threshold of p = 0.005. Component loading was carried out using the component matrix across four components. As presented in Table 4.26, all loadings exceeded the 0.30 threshold, with any variables scoring below 0.30 being excluded. According to Pallant (2020), suppressing values less than 0.3 in FA helps to highlight only the significant relationships between variables and factors, making the results more interpretable. This practice reduces clutter in the factor loading matrix, allowing for clearer identification of key variables contributing to each factor (Pallant, 2020). The results from Table 4.26 show four (4) components with loadings greater than 0.3 in the rotated component matrix, namely component 1 "*effective supervision of tasks*", component 2 "*monitoring construction equipment through telematics*", component 3 "*Labour robotic assistant*", and component 4 "*Addressing on-site labour conflicts promptly and fairly*".

Table 4. 26 Component matrix

	Component			
	1 Effective supervision of tasks	**2 Monitoring construction equipment through telematics**	**3 Labour robotic assistant**	**4 Address-ing on-site labour conflicts promptly and fairly**
Effective supervision of tasks	.843			
Regular inspections of the quality of work	.826			
Monitoring progress regularly	.819			
On-site health and safety culture	.801			
Effective labour scheduling	.798			
Proper training on material handling	.796			
Proper resource allocations	.788			
Strong communication protocols between supervisors and on-site labour	.787			
Frequent auditing of material stock	.780			
Strong communication protocols between supervisors and consultants	.779			
Efficient disposal of material waste and recycling on site	.774			
Drone technology to monitor progress on site	.773			
Material usage monitoring	.772			
Regular machinery maintenance	.759			
Adherence to required material specifications	.746			
Hiring skilled and certified operators	.740			
Selection of multi-purpose machinery and tools	.729			
Fuel management system	.727			
Keeping backup machinery spares	.723			
E-procurement of material	.720			
Strategically designed	.685			
Monitoring construction equipment through telematics		.449		
Labour training through Virtual Reality (VR) and Augmented Reality (AR)		.445		
Blockchain technology for labour payments		.415		
Enhancing labour's physical strength with smart exoskeleton		.414		

Labour collaboration through smart devices		.397		
Labour robotic assistant			.396	
Addressing on-site labour conflicts promptly and fairly				.434
Delegate tasks based on team members' strengths and expertise				.367
Encourage on-site labour participation in decision making and problem solving				.351
Making informed and timely decisions				.345
Extraction Method: Principal Component Analysis.				
a. 4 components extracted.				

4.11 Discussion of findings

The primary aim of this study is to provide on-site labour productivity modalities for SME contractors to enhance sustainable construction project delivery in the Western Cape province of South Africa, as indicated earlier in the study. This section of the study presents discussions relative to perceptions regarding on-site labour productivity, SME contractor's challenges regarding on-site labour productivity, factors in enhancing effective on-site labour productivity, and SME contractor's modalities for enhancing on-site labour productivity.

4.11.1 Perceptions regarding on-site labour productivity

4.11.1.1 Skilled labour

The analysis of respondent data indicates that continuous training and skills development emerged as the most influential skilled labour factor in enhancing on-site labour productivity, thereby supporting sustainable construction project delivery (MV= 4.11; RII= 0.82). This finding is reinforced by Sogaxa, Simpeh, and Ndihokubwayo (2021), who emphasise that sustained investment in on-site training programmes is vital for the successful execution of projects by SME contractors. Moreover, Van Tam *et al*. (2021) assert that the presence of skilled labour significantly improves workmanship and overall construction productivity.

According to Table 4.3, job satisfaction was identified as the second most important factor contributing to skilled labour productivity (MV = 4.05; RII = 0.810). This finding is supported by Zhao *et al*. (2025), who found that skilled on-site labour typically reports higher job satisfaction levels. Similarly, Rotimi *et al*. (2023) note that upskilling initiatives not only enhance worker motivation but also improve labour retention in construction projects. Voordt and Jensen (2023) further argue that job satisfaction plays a pivotal role in driving productivity among site workers. Another significant factor highlighted was the adaptation of new technologies, which respondents perceived as a vital enabler of on-site labour productivity enhancing sustainable construction outcomes (MV = 3.99; RII = 0.797). According to Ross, McGregor and Swales (2024), technology adoption is essential for on-site labour productivity improvement.

4.11.1.2 Contractors' management practices

According to table 4.4, compliance with SHEQ ranked as the highest SME contractor management factor in enhancing on-site labour productivity and sustainable construction project delivery (MV=4.26; RII=0.852). This finding aligns with the assertion of Ayodele *et al*. (2020) that compliance with Safety, Health, Environment, and Quality (SHEQ) standards is not only a legal obligation but also a productivity enabler (Ayodele *et al*., 2020). Asad *et al*. (2022) highlight the critical role that well-defined SHEQ policies and implementation procedures play in strengthening organisational performance among SME contractors. Additionally, Mugwagwa (2021) reveals that on-site labour should be assigned specific SHEQ roles to promote accountability and embed SHEQ principles into daily site operations. According to table 4.3, clear instruction and directives are identified as the second contractor's management practice in enhancing on-site labour productivity (MV=4.10; RII=0.819). Oladiran and Onatayo (2019) state that clear instructions and directives from the site management reduces confusion, rework, time wastage, leading to improved on-site labour productivity. Additionally, Table 4.3 reveals On-time labour payment as a significant contractor's management practice factor in enhancing on-site labour productivity for sustainable construction project delivery. This participant view resonates with Bake and Makinde (2021) who indicated that on-time payment of on-site labour affects motivation, attendance, and overall morale. This finding also aligns with their finding that delays in wage disbursement are perceived to contribute to high absenteeism and reduced on-site labour productivity.

4.11.2 SME Contractor's Challenges Regarding On-site Labour

4.11.2.1 Human Resource Challenges

High labour turnover was the most significant factor (MV = 3.55), followed by labour alcoholism (MV = 3.52) and negligence (MV = 3.46), all of which were rated as having a major impact (MV >3.40 ≤ 4.20). These findings align with Egbebi (2024), who noted that labour instability, particularly in the form of turnover and absenteeism, is widespread among SME contractors due to the temporary nature of construction work and the lure of better compensation elsewhere. Furthermore, alcohol consumption among on-site labour poses serious risks to productivity and safety, as reported by Odesola and Idoro (2014), who asserted that such behaviour often results in absenteeism and site entry denial. Ageing labour and transportation problems, though rated as moderate challenges, also hinder on-site labour productivity. Assaad *et al*. (2023) observed that transporting labourers to remote construction sites is frequently unreliable, leading to idle time and scheduling inefficiencies. Additionally, labour conflicts, arising from wage disagreements and poor working conditions, further disrupt site operations (Almamlook *et al.*, 2020).

4.11.2.2 Construction Material Challenges

Material-related issues were shown to significantly influence labour productivity, with late delivery of materials (MV = 3.63) and poor material handling (MV = 3.48) identified as the most pressing concerns. These findings are echoed by Bekele, Mahesh and Ingle (2024), who emphasised that untimely procurement and mismanagement of materials frequently lead to delays, idle labour, and increased project costs. Running out of materials mid-project (MV = 3.43) also featured prominently, which aligns with prior research indicating that poor inventory control and miscommunication with suppliers often contribute to project delays (Sarvari *et al.*, 2021). While challenges such as improper storage and ineffective distribution were rated moderately, their cumulative effect can still be significant. According to Ameh and Daniel (2017), inadequate material storage compromises site safety and efficiency. The high reliability score (Cronbach's Alpha = 0.950) further supports the consistency of these responses, indicating that SME contractors commonly struggle with logistical material management, which in turn affects on-site labour performance.

4.11.2.3 Financial Management Challenges

Financial challenges also had a considerable impact on on-site labour productivity, with payment delays from clients (MV = 3.59) and limited budgets for labour training (MV = 3.58) emerging as the most severe. These results resonate with Bolton *et al*. (2022), who highlighted that delayed payments and poor cash flow management significantly hinder SME contractors' ability to maintain operations and pay on-site labour promptly. Megersa (2020) also pointed out that restricted access to finance affects SME contractors' ability to invest in on-site labour training. Additionally, the inability to project cash flows and the occurrence of labour payment errors, though rated as moderate, further compound financial uncertainty (ILO, 2019). This financial fragility weakens SME contractors' competitiveness and their ability to retain qualified personnel, undermining efforts to deliver sustainable and timely construction projects (Anugwo & Shakantu, 2020).

4.11.2.4 Site Management Challenges

Table 4.7 revealed that ineffective communication with labour (MV = 3.46) and scope changes (MV = 3.45) are key site management issues impeding productivity. These results are supported by Almutairi and Almunifi (2020), who found that unclear communication often leads to role confusion, mistakes, and workflow disruptions. Similarly, Wong, Rashidi and Arashpour

(2020) explained that breakdowns in coordination between teams and subcontractors increase the risk of errors and delays. Insufficient supervision (MV = 3.38) and a shortage of skilled site managers (MV = 3.35) were also identified as significant, albeit moderate, contributors to reduced on-site labour productivity. Amoah and Bikitsha (2022) assert that inadequate supervision leads to unproductive on-site labour and rework. Additionally, poor site layout and ineffective scheduling cause delays and reduce the efficient use of on-site labour (Eze *et al.*, 2020).

4.11.2.5 Regulatory Compliance Challenges

Regulatory compliance challenges were also found to be significant, particularly the strict adherence to SHEQ standards (MV = 3.59) and delays in permit approvals (MV = 3.52). These findings are in agreement with Nyaga Githae, Hagir and Alowo (2024), who noted that navigating complex regulatory frameworks, including labour and environmental laws, is a major challenge for SME contractors. Masango (2020) further observed that non-compliance with bodies like the Building Industry Bargaining Council (BIBC) often results in the employment of unskilled labour, leading to rework and slow progress. Moreover, Mashwama, Aigbavboa and Thwala (2019) noted that some SME contractors deliberately avoid regulations due to cost implications, risking fines, stoppages, and reputational damage. Although the complexity of regulations (MV = 3.28) was considered moderate, its implications are far-reaching, particularly when compounded by frequent changes in institutional frameworks, which Azman *et al*. (2024) argue can significantly affect long-term on-site labour productivity.

4.11.2.6 External Challenges

Among external challenges, extreme weather conditions ranked highest (MV = 3.71), indicating their severe effect on on-site labour productivity. This finding is in line with Assaad *et al*. (2023), who reported that inclement weather causes frequent project delays and exposes workers to unsafe conditions. Market instability (MV = 3.43) and changes in government regulations (MV = 3.40) were also found to influence labour efficiency. These macroeconomic and policy-related fluctuations create uncertainty in pricing, resource availability, and planning (Azman *et al*., 2024). Public strikes and design complexity, though ranked slightly lower, still pose moderate challenges. Such externalities are often beyond the control of SME contractors but require strategic mitigation planning. Overall, with a combined mean of 3.55, these external issues underscore the vulnerability of SME contractors to broader environmental and economic forces, reinforcing the importance of resilience planning in project execution.

4.11.2.7 Components discussion

Poor site layout plan (Component 1)

This component explained the largest proportion of the total variance (59.593%) and consisted of highly loading variables related to planning inefficiencies, material handling, supervision, and financial coordination. Key items included “poor site layout plan” (0.866), “poor planning and scheduling” (0.860), “incorrect material specification” (0.849), “inadequately skilled site managers” (0.847), “improper material storage” (0.842), and “insufficient on-site supervision” (0.840). The clustering of these variables suggests that ineffective site layout and resource allocation remain the most significant challenges impacting on-site labour productivity for SME contractors. This component reflects the findings of RazaviAlavi and AbouRizk (2021), who stressed the importance of layout optimisation through simulation tools, and Archer (2016), who associated poor site layout planning with increased delays and cost overruns. Furthermore, Spillane *et al*. (2013) indicated that poor site layout planning directly affects the efficiency of labour deployment and material handling. A poorly designed site layout typically leads to disorganised work zones, ambiguous material storage areas, and inefficient routing of personnel and equipment resulting in congestion, confusion, and potential safety risks (RazaviAlavi & AbouRizk, 2021). Tao *et al*. (2022) stress that when materials and equipment are not placed strategically according to workflow patterns, workers spend excessive time navigating the site. This contributes to increased idle time, delayed task execution, and overall reductions in on-site productivity.

Negligence of labour (Component 2)

This component accounted for 5.945% of the total variance and included variables indicative of workforce behavioural and demographic challenges. Key items included “negligence of labour” (0.542), “transporting problems of labour” (0.517), “labour conflict” (0.474), “labour alcoholism” (0.459), and “ageing on-site labour” (0.354). These variables point to recurrent issues in SME construction settings, such as poor discipline, absenteeism, disputes, and a lack of skilled younger workers. The findings are consistent with Manoharan *et al*. (2022), who identified negligence and poor labour management as critical contributors to labour inefficiencies. Poor labour management protocols are a primary factor contributing to labour negligence resulting in issues such as alcoholism, disputes, and absenteeism. Unplanned labour transportation, often a symptom of poor project management, frequently leads to late arrivals and absenteeism, which in turn reduces on-site labour productivity. Furthermore, Alyew *et al*. (2020) linked these challenges to a lack of structured training, weak supervisory control, and limited team motivation strategies.

Change in government policies and regulations (component 3)

This component explained 3.820% of the variance and included macro-level external risks affecting on-site labour productivity. Key variables included “change in government policies and regulations” (0.485), “public strikes” (0.426), “market instability” (0.359), and “extreme weather conditions” (0.322). These findings suggest that SME contractors are significantly affected by unpredictable political, environmental, and economic changes that delay project timelines and disrupt workforce availability. This supports Nyaga, Hagir and Alowo (2024), who found that policy instability and inadequate stakeholder communication amplify operational risk in SME contractors. In addition, Aigbavboa and Thwala (2014a or b???) emphasised the vulnerability of SME contractors to external shocks due to their limited resilience and strategic planning resources. The results from this component highlight the importance of government engagement, regulatory clarity, and support mechanisms tailored for SME contractors’ adaptation to changing conditions.

Compliance with labour laws (Component 4)

Although contributing a smaller proportion of the variance (3.145%), this component remains operationally significant. It included “compliance with labour laws” (0.360) and “strict adherence to SHEQ regulations” (0.344), pointing to the regulatory pressures faced by SME contractors. While these legal frameworks are designed to protect workers, their implementation can pose administrative and financial burdens for SME contractors lacking dedicated HR or legal departments. Masango (2020) notes that many SME contractors operate informally or semi-formally, often lacking structured HR departments. A key challenge lies in non-compliance with the Building Industry Bargaining Council (BIBC), which governs wages, benefits, and working conditions for construction workers in many South African provinces (BIBC, 2024). The infrastructure news (2024) reports non-compliance with the BIBC remains widespread among SME contractors, primarily due to limited awareness of obligations and the administrative load of registration, reporting, and contributions. This not only violates statutory obligations but also creates a fragmented labour environment where workers may feel exploited or experience insecure conditions that reduce morale and increase labour turnover (Masango, 2020).

4.11.3 Factors in Enhancing Effective On-site Labour Productivity

4.11.3.1 Skill level of workers

Table 4.13 reveals problem-solving ranked as the most influential as a skill level of workers in enhancing on-site labour productivity (MV=4.08; RII=0.815). This finding aligns with Manoharan *et al*. (2022) who emphasised problem-solving skills among on-site labour for productivity improvement. Table 4.13 revealed experience as second significant skill level of worker factor in enhancing on-site labour productivity (MV=4.00; RII=0.800). This finding corresponds to Bamfo-Agyei, Thwala and Aigbavboa (2022a) who highlighted that experience of on-site labour as a significant contributor to on-site productivity. Teamwork and collaboration were also identified by respondents as the skill level of work factor in enhancing on-site labour productivity (MV of 4.00; 0.800). This finding is supported by Adebowale and Agumba (2023a) who emphasised effective teamwork and good working relationships in enhancing contractors' productivity.

4.11.3.2 Motivation

Table 4.14 revealed that job security is the most significant motivation factor in enhancing on-site labour productivity (MV=3.96; RII=0.792). This finding corresponds to Bierman *et al.* (2016) who emphasised the critical role of job security in enhancing organisational commitment and improving on-site labour productivity. This finding also corresponds to Eventus *et al.* (2024) who noted that job security enhances on-site labour productivity by reducing deliberate slowdowns aimed at extending employment duration. Fair compensation and benefits is the second significant motivation factor in enhancing on-site labour productivity (MV=3.88; RII=0.775). This finding aligns with Gabriel, Jaffu and Ismail (2024) who reported that fair compensation significantly enhances on-site labourers' motivation and commitment, leading to improved time performance of projects. Work life balance is also a significant motivation factor in enhancing on-site labour productivity (MV=3.77; RII=0.755). This finding aligns to Apraku *et al*. (2020) who emphasised that work life balance plays a crucial role in enhancing on-site labour productivity. Furthermore, Vigneshwar and Shanmugapriya, (2023) highlighted that when on-site labour maintains a healthy balance between their personal and professional lives, they tend to exhibit higher levels of commitment, reduced stress, and increased motivation.

4.11.3.3 Training and development

Table 4.15 revealed that health and safety is the most significant training and development factor in enhancing on-site labour productivity (MV=4.15 and RII=0.831). This find resonates with Zakari *et al*. (2025) and Wong, Sapuan and Khan (2023) who emphasised the importance of safety training of on-site labour enhancing on-site labour productivity. Zakari *et al*. (2025) indicate that safety training reduces site stoppages resulting from accidents and non-compliance with safety regulations, thereby contributing to enhanced on-site productivity. The second significant training and development factor in enhancing on-site labour productivity is leadership and supervisory and training (MV=4.03; RII=0.805). This finding aligns with Manoharan *et al*. (2024a) who emphasised training of site management in soft and technical skills in increasing productivity in construction sites. Continuous training was also found to be a significant training and development factor in enhancing on-site labour productivity

(MV=4.01; 0.803). This finding is consistent with Manoharan *et al*. (2024a) who highlighted the importance of continuous work-based training in improving operational skills, and behavioural changes, leading to enhanced on-site labour productivity. Lasty, The HCT supports these findings by linking training and workforce development to improved performance

4.11.3.4 External factors

Table 4.16 presents favourable construction site conditions as a most significant external factor in enhancing on-site labour productivity (MV=4.00; 0.800). The finding aligns with Momade *et al*. (2023) and Adebowale and Agumba (2023c) who emphasised on-site conditions that can enhance on-site labour productivity such as availability of material, adequate site access and logistics, suitable working space, environmental and climatic conditions. The second significant external factor in enhancing on-site labour productivity is efficient supply chain (MV= 3.93; 0.786). This finding aligns with Awaad *et al*. (2024) who emphasised the impact of material supply chain in enhancing on-site labour productivity. Awaad *et al*. (2024) highlighted that efficient material supply chain ensures timely delivery of material in the required quantities helping contractors to enhance on-site productivity. Favourable weather conditions were also revealed as a significant external factor in enhancing on-site labour productivity (MV=3.81; 0.763). This finding is in agreement with Larsson and Rudberg (2023) who highlighted weather conditions that can enhance on-site labour productivity such as absence of precipitation, moderate temperatures, and low wind speeds.

4.11.3.5 Client and stakeholder influence

Table 4.17 revealed that on-time payment for the completed work is the most significant client and stakeholder influence factor in enhancing on-site labour (MV=4.00; 0.800). This finding is consistent with the assertion of Al Alawi (2021) that on-time payment of the completed work enhances construction productivity, ensuring financial stability, and facilitating timely payments to labour and suppliers. The second significant client and stakeholder influence factor is engagement with community (MV=3.94; 0.787). This finding conforms with the assertion of Aigbavboa and Akinradewo (2023) that community involvement can lead to improved working conditions, increased productivity, and economic benefits. Aigbavboa and Akinradewo (2023) also noted potential negative impacts if engagement with community is ignored such as protests, conflicts over employment and deterioration of stakeholder relationships and trust. Lastly, data analysis shows early inspection of the completed work to be also a significant client and stakeholder influence factor in enhancing on-site labour productivity (MV=3.94; RII=0.787). This finding is consistent with the assertion of Ibrahim, Zayed and Lafhaj (2024) that early inspection of the completed work are key performance indicators (KPIs) that contribute to quality assurance and timely project delivery, thus enhancing on-site labour productivity.

4.11.4 SME Contractor's Modalities for Enhancing On-site Labour Productivity

4.11.4.1 Site Management Modalities

The findings indicate that effective supervision of tasks (MV = 4.14), regular inspections (MV = 4.12), and monitoring progress (MV = 4.07) are key site management modalities positively influencing on-site labour productivity. These are consistent with Manoharan *et al*. (2024), who emphasises that strong site supervision ensures tasks are completed on time and to the required standards. The importance of maintaining a safe working environment (MV = 4.06) also supports findings by Oswald *et al*. (2020), who highlighted that safety culture reduces injury-related delays and absenteeism. Moreover, Khan, Proverbs and Xiao (2022) noted that safe conditions boost worker morale and productivity, further improving project outcomes. Proper resource allocation and scheduling (MV ≥ 4.00) enable seamless coordination of labour and materials, minimising idle time and maximising efficiency (Kreuzer, Röglinger & Rupprecht, 2020).

4.11.4.2 Leadership and Supervisory Modalities

Leadership and supervisory strategies were shown to be pivotal, with delegating tasks based on team strengths and making timely decisions both scoring a high MV of 4.08. These findings echo Manoharan *et al*. (2024), who emphasised that assigning tasks aligned with worker expertise enhances efficiency and motivation. Jimoh *et al*. (2017) and Edwin and Calistus (2023) highlighted that strong decision-making, effective communication, and fair conflict resolution are essential for enhancing on-site labour productivity. Additionally, encouraging participation in decision-making, though slightly lower (MV = 3.98), reflects modern leadership approaches that promote empowerment and team cohesion (Kesavan *et al*., 2022).

4.11.4.3 Technology Integration/Construction 5.0 Practices

Although technology adoption was moderate (combined MV = 3.63), drone usage for site monitoring ranked highest (MV = 3.76), followed by telematics and blockchain (MV = 3.66). These results mirror the views of Yitmen, Almusaed and Alizadehsalehi (2023), who described Construction 5.0 as a paradigm shift enabling human-machine collaboration to enhance on-site labour productivity. The use of drones, as noted by Waqar *et al*. (2023), improves site supervision, safety inspections, and progress tracking. Blockchain technology, meanwhile, ensures secure, transparent, and dispute-free labour payments (Wu, Lu & Xu, 2022). Lower scores for VR/AR training (MV = 3.50) suggest underutilisation despite its proven effectiveness in workforce skill development (Olbina & Glick, 2023). This suggests that while SME contractors acknowledge the benefits of digital tools, more effort is needed to integrate and capitalise on emerging technologies for optimal on-site labour productivity.

4.11.4.4 Material Management Modalities

Proper training on material handling (MV = 4.02) and monitoring material usage (MV = 3.96) was identified as the top modalities for enhancing on-site labour productivity. These findings are consistent with Gurmu and Ongkowijoyo (2020) and Bekele, Mahesh and Ingle (2024), who emphasised that timely availability and proper use of materials reduce delays and rework. Efficient waste disposal and adherence to specifications (MV = 3.93) also result in easy operations and minimising site congestion. The significance of communication and collaboration in material logistics is highlighted by Eze *et al*. (2020a), who asserted that coordinated material flow ensures optimal on-site labour performance. Collectively, the results validate that strategic material management reduces idle time, ensures task continuity, and supports efficient resource utilization, thus driving sustainable construction outcomes.

4.11.4.5 Machinery Management Modalities

Machinery management was rated highly (combined MV = 4.04), with hiring certified operators (MV = 4.22) and conducting regular maintenance (MV = 4.07) being top-ranked strategies. This is aligned with findings by Chandra *et al*. (2023), who argued that reliable, well-maintained equipment enhances on-site labour performance by preventing operational disruptions. Effective procurement and equipment tracking, as recommended by Ranjithapriya and Arulselvan (2020), ensure that machines are available when needed, reducing delays and improving scheduling. Furthermore, preventive maintenance, including backup machinery and spare parts (MV = 3.99), was shown to reduce downtime and avoid productivity losses (Sahu, & Mohibullah, 2022). These findings affirm that proactive machinery management is essential for maintaining high levels of on-site labour productivity, especially on SME-managed construction sites with limited redundancy capacity.

4.11.4.6 Component discussion

Effective supervision of tasks (Component 1)

This component explained the largest proportion of the total variance and consisted of 20 strongly loading variables (all > 0.72). Key items included “effective labour scheduling” (0.798), “proper resource allocation” (0.788), “strong communication protocols” (0.787), “material usage monitoring” (0.772), and “on-site health and safety culture” (0.801). These findings highlight that the productivity of labour on-site is primarily influenced by competent supervision, effective planning, and consistent communication between supervisors, consultants, and workers. This aligns with Manoharan *et al*. (2024), who found that clear supervisory instructions and real-time monitoring significantly improve task execution. This component reinforces the notion that optimal site performance depends on an integrated approach to labour coordination, training, material handling, and task audits

Monitoring construction equipment through telematics (Component 2)

This component included variables related to technology integration, such as “telematics systems” (0.449), “VR/AR labour training” (0.445), and “blockchain-based labour payments” (0.415). The clustering of these factors suggests a growing emphasis among SME contractors on embracing Construction 5.0 paradigm to improve site monitoring and labour management. Though still emerging, these tools facilitate data-driven decisions, reduce inefficiencies, and enhance transparency in labour output and payment processes. This supports previous work by Khan, Huang, Onstein and Liu (2022) who argued that the adoption of digital tools boosts project efficiency and lowers operational risks.

Labour robotic assistant (Component 3)

This factor focused on automation and smart augmentation, and was defined by items such as “labour robotic assistant” (0.396), “smart exoskeletons” (0.414), and “smart device collaboration” (0.397). These findings suggest that although such technologies are still in nascent use among SME contractors, there is a recognised potential for robotics and wearable tech to enhance on-site labour productivity by reducing physical fatigue, improving precision, and lowering occupational hazards. The inclusion of this component aligns with research by Bock and Linner (2015), who emphasised the future role of robotic systems in improving productivity, safety, and ergonomics on construction sites.

Addressing on-site labour conflicts promptly and fairly (Component 4)

This component included items related to conflict resolution, such as “addressing labour conflicts promptly” (0.434), “delegating tasks based on expertise” (0.367), and “labour participation in decision-making” (0.351). These findings reflect the importance of interpersonal dynamics and inclusive management practices in maintaining productivity. Construction sites are high-pressure environments, and unresolved disputes can significantly disrupt the flow of production. The proactive resolution of grievances, team empowerment, and participatory decision-making enhance worker morale and reduce downtime. This is consistent with Emuze and Smallwood (2013), which underscores the role of fair conflict resolution mechanisms in fostering collaborative site cultures.

4.12 Chapter Summary

Chapter Four presented the analysis and discussion of data collected from 155 respondents representing SME contractors in the Western Cape. The chapter began by outlining the demographic profile of respondents, which showed a high proportion of young professionals with degree or diploma qualifications and limited years of experience. The findings highlighted that continuous training, job satisfaction, and adaptation to new technologies were the most critical skilled labour factors influencing on-site productivity. In terms of management practices, compliance with SHEQ standards and clear communication were rated most important. Multiple challenges to productivity were identified through descriptive and factor analysis, with poor site layout, labour negligence, external disruptions, and compliance burdens emerging as key inhibitors. FA validated four principal components contributing to productivity constraints, explaining over 72% of the total variance. Additionally, the chapter explored five categories of productivity enhancement strategies for worker skills, motivation, training, external conditions, and stakeholder influence with health and safety training and on-time payments ranked most impactful. Finally, SME contractor modalities such as effective task supervision, technology integration (e.g. telematics and robotics), and fair conflict resolution were identified as critical for improving on-site labour productivity. FA confirmed these groupings, demonstrating that holistic supervision, smart construction tools, and inclusive leadership practices are pivotal to enhancing sustainable project delivery. The chapter concludes by reinforcing the interconnectedness of human, managerial, and technological factors in shaping on-site labour productivity outcomes for SME contractors. Lasty, the findings align with the RBV, HCT, and SDT, which collectively emphasise the role of internal resources, workforce development, and sustainable practices in achieving long-term productivity and competitiveness.

CHAPTER FIVE
CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter presents the conclusions of the study and highlights the limitations encountered during the course of the study, recommendations and suggested areas for future research regarding on-site labour productivity modalities for SME contractors to enhance for sustainable construction project delivery in the Western Cape province.

The preceding chapters provided detailed insights into the aim and objectives of the study. The primary aim of this research was to establish and recommend effective modalities that can enhance on-site labour productivity among SME contractors, thereby contributing to sustainable project delivery in the Western Cape province. To accomplish this aim, the following research objectives were formulated:

- To determine perceptions of SME contractors regarding on-site labour productivity in the Western Cape province;
- To investigate on-site labour productivity challenges faced by SME contractors in the Western Cape province;
- To identify factors that could enhance effective on-site labour productivity in sustainable construction project delivery; and
- To investigate and propose the modalities that can be recommended for SME contractors to enhance on-site labour productivity in sustainable construction delivery.

In pursuit of these objectives, a quantitative research approach was adopted. This quantitative approach was supported by the administration of a structured questionnaire to the management teams from SME contractors operating in the Western Cape.

5.2. Operational framework of the study

The figure 5.2 below shows the operation framework of the study. In a bid to improve the on-site labour productivity of the SME contractors it is imperative first to establish their perceptions, of determinants that play the most roles on on-site labour productivity, and challenges that the SME contractors are facing regarding on-site labour productivity. Bearing this in mind, the study establishes and recommends use of effective modalities to respond to these issues and enhance efficiency of on-site labour.

On-site labour productivity can be improved with the introduction of effective modalities of improving productivity on-site. In its turn, this advantage leads to the improvement of the total performance of SME contractors, which translates to higher profitability, more rational resource utilisation, and working under safer and more favourable conditions. Finally, these have consequences of facilitating and enhancing sustainable delivery of construction projects.

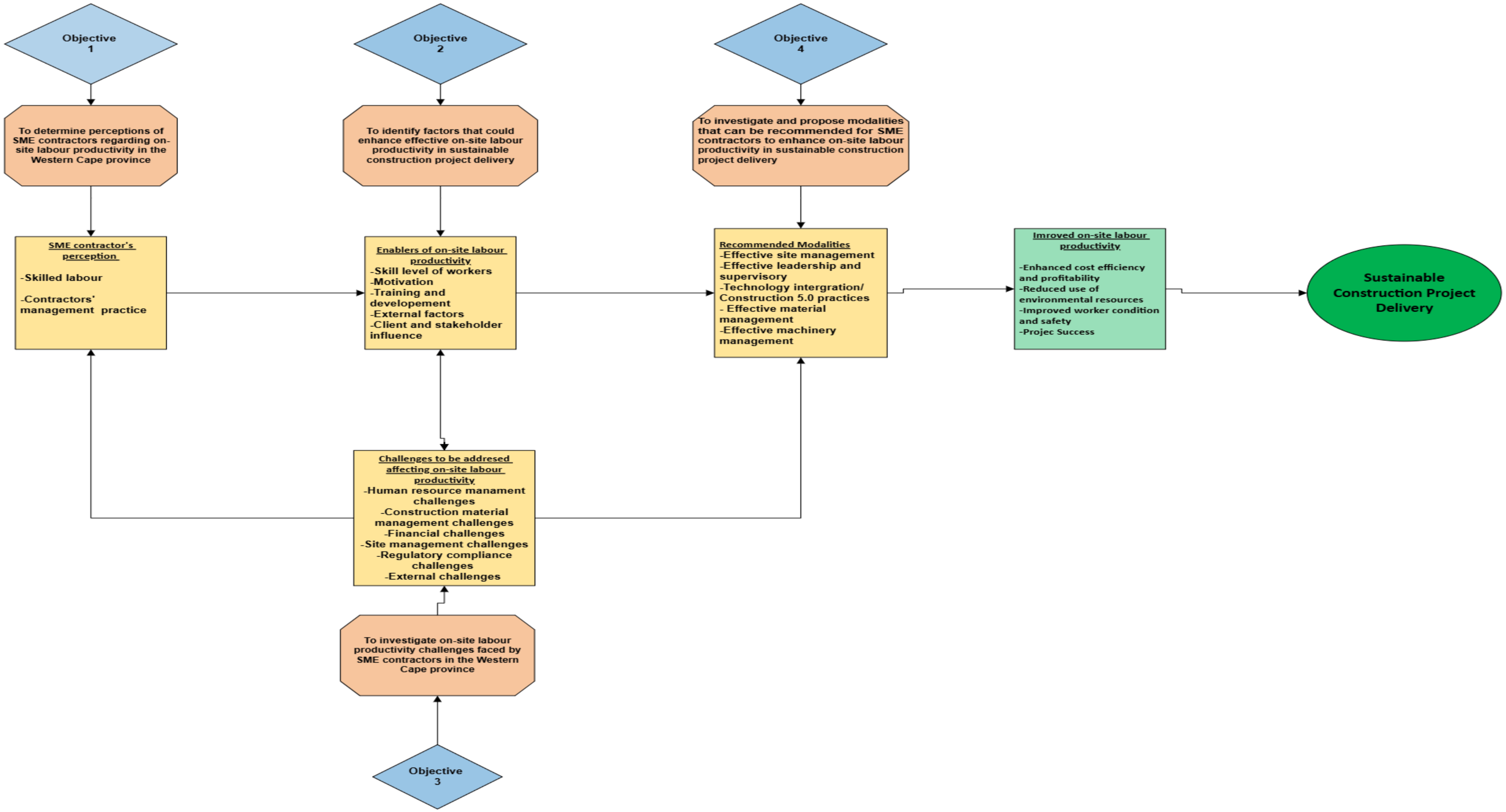

Figure 5. 1 Operational framework

5.3 Conclusions of on-site labour productivity modalities for SME contractors in the Western Cape.

5.3 .1 Perceptions of SME contractors regarding on-site labour productivity

The analysis showed that the SME contractors in the Western Cape have informed and experience-based perceptions toward the determinants of the on-site labour productivity. Skilled labour turned out as the most influential, with continuous training and skills development ranked at the top (MV = 4.11; RII = 0.82), which highlights the necessity of systematic proceedings to promote upskilling. This conclusion corresponds well with the current literature in terms of stressing the importance of the factor of workforce competency and versatility to workplace efficiency. Another important factor was job satisfaction (MV = 4.05; RII = 0.81) implying the necessity of proper motivating factors and favourable working conditions to maintain long-term labour productivity. Also, the implementation of the new technologies, although ranked slightly lower (MV = 3.99; RII = 0.797), was also considered as crucial to the modernisation of SME contractors' operations and to the improvement of productivity. Compliance with the Safety, Health, Environment, and Quality (SHEQ) standards attained the highest scores (MV = 4.26; RII = 0.852) among other practices in contractor management, and this is because it is both a legal issue and also a productivity booster. Factor analysis further supported these findings, with "Effective Supervision of Tasks" and "Monitoring Construction Equipment" loading strongly, confirming that SME contractors' perceptions are closely tied to key productivity-enhancing site and management practices. These insights validate that SME contractors are aware of the drivers of productivity and are poised to adopt practices aligned with industry best standards.

5.3.2 On-site Labour Productivity Challenges Faced by SME Contractors

This study determined that the SME contractor in the Western Cape is faced with a complex combination of challenges that have compromised on-site labour productivity. The issues concerning the human resources were high labour turnover (MV = 3.55), alcoholism (MV = 3.52), and negligence (MV = 3.46), which are perceived to have extensive influences on the on-site labour productivity of the site. Such issues are characteristic of lack of support in the workforce and could lead to a call to enhance the recruitment, welfare of workers and management controls. Other barriers to construction management, more specifically material delivery (MV = 3.63) and material handling (MV = 3.48), were also found to be critical barriers. Other restrictions to on-site labour productivity are financial constraints that include slow payment by clients (MV = 3.59) and limited budgets in training (MV = 3.58). Systemic weakness in the planning and coordination is reflected in management problems of the sites such as poor communication (MV = 3.46) and change in scope (MV = 3.45). Factor analysis identified "Poor

Site Layout Plan" as the leading component, explaining 59.6% of the variance and encompassing interconnected issues like improper planning, inadequate supervision, and material mismanagement. The environmental and macroeconomic risk exposure of SME contractors is further supported by external factors, especially the extreme weather (MV = 3.71). All this evidence suggests that the on-site loss of productivity is never caused by individual factors but a combination of interdependent problems that cannot be solved using a management intervention in a stand-alone manner.

5.3.3 Factors Enhancing Effective On-site Labour Productivity

In order to improve on-site labour productivity to enhance sustainable construction delivery, the study has located a range of human, managerial and environmental factors all justified by high MV and RII values. Under workforce capability, problem-solving was the most sought-after skill (MV = 4.08; RII = 0.815). The next common skills required were experience and teamwork (MV = 4.00; RII = 0.800 both). This implies that, besides technical training, interpersonal and cognitive skills are also important for on-site labour. Labour morale is tied to productivity as the top two ranks in terms of motivation were job security (MV = 3.96; RII = 0.792) and fair compensation (MV = 3.88; RII = 0.775). The most important training-related factor was health and safety training (MV = 4.15; RII = 0.831), as the SHEQ-related items had been heavily loaded in the factor analysis. Also, external drivers such as favourable site conditions (MV = 4.00; RII = 0.800) and effective supply chain (MV = 3.93; RII = 0.786) were observed to support easy implementation of projects. These findings confirm that maximising on-site labour productivity is not only connected with the increment of production but with overall outlook which includes issues regarding the personal capability, team dynamics, safety at the workplace, logistical preparedness and motivation of a workforce. The multifaceted characteristics of such improvement factors aid the development of stratified implementations aimed at different levels of project implementation.

5.3.4 Recommended Modalities for Enhancing On-site Labour Productivity

According to the synthesis of the findings, a group of practical and data-driven modalities adjusted to the reality of the work of SME contractors had been proposed in the study. Areas of observable site management, including the presence of good supervision (MV = 4.14) and regular inspection (MV = 4.12), topped the list, which implies the necessity of powerful daily oversight practices. In leadership, other practices were found to be crucial, such as delegation of work within the team, according to their strengths, and making timely decisions (both MV = 4.08), in favour of a more strategic and participatory approach to management. The integration of technology, which is at a moderate stage so far (MV = 3.63), created potential due to the usage of drones (MV = 3.76) and telematics (MV = 3.66), that helped to monitor the scenes and simplify the on-site condition of the labour force. The management of material and machinery were also prominently expressed with certified operators (MV = 4.22) and maintenance planning (MV = 4.07) as the first priorities. The results of factor analysis presented important aspects as the greatest responsibilities, including sound supervision of tasks and monitoring of equipment via telematics, which means that the ability to manage the operation is based on the instant control and effective use of resources. Overall, the suggested modalities incline towards competence-based oversight, fair leadership, digitalisation and logistical precision as the prime factors in building successful and enduring on-site labour operative, able to promote overall results in the form of sustainable project performance.

5.4 Summary of Conclusions

In conclusion, the study bridged a major gap evident in the South Africa construction industry because it has provided on-site labour productivity modalities to the SME contractors to enhance sustainable construction project delivery in the Western Cape. As confirmed in the study, on-site labour productivity depends on a variety of connected factors such as availability of skilled labour, training, practices of contractor management, and facilitating site circumstances which are all underpinned by a high score of MV and RII. The problems noted are both internal (like inadequate supervision and labour turnover) and external (like harsh weather and excessive regulation) implying that the response approach should be systems oriented. The suggested modalities based on quantitative findings and substantiated by factor analysis serve as the guide to SME contractors on how to increase their efficiency of work. These modalities go beyond the traditional managerial activities as they combine technology, human resource development and stakeholders' involvement. Their implementation will not only enhance project delivery outcomes but also contribute to the long-term sustainability and competitiveness of SME contractors in the South African built environment.

5.5 Limitations

The study was based on the Western Cape province of South Africa and focused on SME contractors in the General Building (GB) categories that are registered under the cidb with a grading level that consists of 1 to 6. Although such a focus allowed a more feasible and precise study within a specific context, it became problematic when it came to the generalisability of the results in other provinces. The data collection process was also faced with problems, especially the need to get the responses of the SME contractor management personnel who in most cases were very busy, with limited time in most cases due to tight project schedules and duties. Some of the potential participants did not manage to find enough time to fill in the questionnaires and a few of them partially completed the questionnaire or even did not return the questionnaires and these were not included in the analysis. In addition, the research could not be extended to a wider sample across the country because of practical constraints in time and financial resources.

5.6 Recommendations

Based on the findings and conclusions of this study on enhancing on-site labour productivity for SME contractors in the Western Cape, the following recommendations are proposed to support sustainable construction project delivery and business growth:

- Invest in training programmes: SME contractors should implement sustained training for both skilled and general labour, covering technical skills, safety compliance, communication, teamwork, and problem-solving. Upskilled labour improves efficiency, reduces errors, and enhances site performance.

- Prioritise health and safety: Contractors should develop safety plans, enforce the use of personal protective equipment (PPE), and conduct regular toolbox talks and site inspections. A strong safety culture protects workers and reduces project delays and legal risks.

- Strengthen site supervision: Project managers and foremen should be empowered in leadership, delegation, and monitoring of productivity. Effective supervision minimises time wastage, ensures timely performance, and allows early detection of site challenges.

- Optimise material and equipment management: Contractors should implement strategic procurement, proper storage, and monitoring to reduce waste and shortages. Machinery should be maintained and operated by qualified personnel to avoid breakdowns and production losses.

- Enhance labour motivation and retention: Establish stable working conditions, fair contracts, and regular wage payments. Additional incentives, recognition programmes, and support services (e.g., transport or meals) improve morale and commitment.

- Ensure effective communication: Project teams should receive clear guidance from site managers, timely updates on drawings and specifications, and regular briefings to reduce errors and rework.

- Improve planning and scheduling: Daily, weekly, and monthly programmes should be maintained and updated using tools such as Gantt charts, checklists, and scheduling apps to improve transparency and task execution.

- Address labour conflicts promptly: Introduce grievance procedures and regular meetings to resolve disputes fairly, maintaining team cohesion and productivity.

- Adopt strategic leadership practices: Clarify project goals, involve staff in decision-making, and align tasks with workers' strengths to build accountability, confidence, and overall productivity.

- Incorporate technology and innovation: Gradual implementation of digital tools, time-tracking apps, project management software, and minimal automation (e.g., site monitoring devices) can improve labour processes with minimal costs.

- Leverage external support: Government and industry organisations should provide training grants, streamlined regulations, affordable technology, and mentorship programmes to improve compliance, capacity, and competitiveness.

- Prepare for external risks: Develop flexible working schedules, site insurance, contingency plans, and maintain good relations with regulators and communities to manage weather, strikes, or regulatory changes.

- Engage clients and stakeholders: Promote regular progress meetings, timely approvals, and open communication to align expectations and maintain stable productivity.

- Monitor performance: Conduct periodic productivity audits and site evaluations to track labour output and identify areas for improvement.

- Build regulatory capacity: Contractors should maintain compliance records, liaise with regulatory bodies, and consult industry federations or experts to ensure adherence to labour and environmental regulations.

5.7 Areas for future research

The limitations of this study would be overcome by future studies that can further encompass studies in other provinces in South Africa to enable a bigger comparative analysis of on-site labour productivity issues and resolutions of different geographical and regulatory environments. Also, the studies should examine the long-term contribution of embracing digital technologies and Construction 5.0 tools to the productivity of labour amongst small and medium sized contractors. The area of research can also be directed to the development of the productivity level of the benchmarking of the small contractors, or the study of the influence of the client-contractor relationships and the governmental procurement policies in determining the effectiveness of the labour on the level of the site.

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ANNEXURES

ANNEXURE A: QUESTIONNAIRE OF THE STUDY

Cape Peninsula University of Technology

Faculty of Engineering and the Built Environment

Department of Construction Management and Quantity Surveying

Bellville Campus

7535

November 2024

TO WHOM IT MAY CONCERN

Dear Sir/Madam

LETTER OF INVITATION FOR RESEARCH SURVEY

I hereby invite you to participate in my research project, which is a Master of Construction study being conducted at the Cape Peninsula University of Technology (CPUT). The research topic is ***"On-site Labour Productivity Modalities for Small and Medium Enterprises to Enhance Sustainable Construction Project Delivery in the Western Cape Province of South Africa".***

This study aims to develop on-site labour productivity modalities for Small and Medium Enterprises to enhance sustainable construction project delivery in the Western Cape province of South Africa. Completing this questionnaire will not take more than 15 minutes of your time. Your responses will be anonymous and confidential. Please do not write any identifying information (your name, address, company name, etc.) on your survey.

Your participation in this study is completely voluntary. Please note that there will be no compensation or reward for participating in this study. If you choose to participate, you may decide to discontinue participation at any time.

Should you have any questions, please feel free to send an email to mtshyongama@gmail.com / sogaxaa@cput.ac.za or call/text on 062 138 3983/ 021 959 6007.

Thank you in advance.

Yongama Mtshakaza (Master of Construction Candidate)

Athenkosi Sogaxa (Principal Supervisor)

QUESTIONNAIRE SURVEY

SECTION 1: BIOGRAPHICAL INFORMATION

1. Please indicate with **X** your gender:

Female	**Male**

2. Please indicate with **X** your age bracket:

Age Bracket															
18-25		26-30		31-35		36-40		41-45		46-50		51-55		56 and above	

3. Please indicate with **X** your highest education/qualification**.**

Below matric	Matric	Trade Test	Diploma	Degree	Masters (MSc)	Other

If '**other'** please specify ________

4. Please indicate with **X** your experience in construction projects:

0-5		6-10		11-15		16+	

5. Please indicate with X your current position:

Owner/Director	Construction Manager	Quantity Surveyor	Site Agent/Technician	Foreman	Site Technician	Other

If '**othe**r' please specify __________

6. Kindly indicate with **X** the cidb grade in the GB category that your organisation is registered in:

cidb category of (GB)	
Grade 1	
Grade 2	
Grade 3	
Grade 4	
Grade 5	
Grade 6	

SECTION 2: Perceptions Regarding On-site Labour Productivity

7. Please indicate the level of importance of on-site labour productivity factors in enhancing sustainable construction project delivery within your organisation. Use the following 5-point scale to rate each factor: Not important = 1, Slightly important = 2, Moderately important = 3, Important = 4, and Very important = 5

Factor	1	2	3	4	5
7.1 Skilled labour					
7.1.1 Recruitment of skilled labour					
7.1.2 Retention of skilled labour					
7.1.3 Continuous training and skill development					
7.1.4 Job satisfaction					
7.1.5 Adaptation with new technology					
7.3 Contractors' Management practices to enhance on-site labour productivity					
7.2.1 Availability of resources					
7.2.2 On-time on-site labour payment					
7.2.3 Incentives and rewards					
7.2.4 Skill-based on-site labour allocation					
7.2.5 Clear instructions and directives					
7.2.6 Compliance with SHEQ (Safety, Environment, and Quality) requirements					
7.2.7 Labour-efficient site layout plan					

SECTION 3: SME Contractor's Challenges Regarding On-site Labour Productivity

8. On a scale of Minor (1) to Major (5), please indicate the impact of the following challenges to your on-site labour productivity in your project success. Please note: Minor = 1, Near minor = 2, Sometime = 3, Near major = 4, and Major = 5.

Challenges	1	2	3	4	5
8**.1 Human Resource Management Challenges**					
8.1.1 High labour turnover					
8.1.2 Ageing on-site labour					
8.1.3 On-site labour alcoholism					
8.1.4 Negligence of on-site labour					
8.1.5 On-site labour conflict					
8.1.6 Transporting problems of on-site labour					
8.2 Construction Material Challenges					
8.2.1 Late delivery of construction materials					
8.2.2 Incorrect material specification					
8.2.3 Improper material storage					
8.2.4 Running out of material on site					
8.2.5 Poor material handling					
8.2.6 Ineffective material distribution on site					
8.2 Financial Challenges					
8.2.1Payment delays by client					
8.2.2 Delays in labour payments					
8.2.3 Errors in labour payments					
8.2.4 Lack of cashflow projections					
8.2.5 Financial limitations to invest in labour training					

8.2.6 Inadequate budget to hire skilled labour					
8.3 Site Management Challenges					
8.3.1 Ineffective communication with on-site labour.					
8.3.2 Insufficient on-site supervision					
8.3.3 Poor planning and scheduling					
8.3.4 Poor site layout plan					
8.3.5 Scope changes					
8.3.6 Inadequate skilled site managers					
8.4 Regulatory Compliance Challenges					
8.4.1 Complexity of regulations					
8.4.2 Delays in approval of necessary permits					
8.4.3 Delays due to passing inspections					
8.4.4 Strict adherence to SHEQ (Safety, Health, Environment, and Quality).					
8.4.5 Compliance with labour laws					
8.5 External Challenges					
8.5.1 Extreme weather conditions					
8.5.2 Market instability					
8.5.3 Design complexity					
8.5.4 Public strikes					
8.5.5 Change in government policies and regulations					

SECTION 4: Factors in Enhancing Effective On-site Labour Productivity

On a scale of 1 (less impact) to 5 (high impact) please evaluate how the following factors enhance on-site labour productivity

Factors		Less impact…………………………………High impact				
		1	2	3	4	5
9.1 Skill level of workers						
9.1.1	Technical proficiency					
9.1.2	Teamwork and collaboration					
9.1.3	Experience					
9.1.4	Education					
9.1.5	Problem-solving					
9.2 Motivation						
9.2.1	Incentives and rewards					
9.2.2	Adequate labour amenities					
9.2.3	Work-life balance					
9.2.4	Fair compensation and benefits					
9.2.5	Job security					
9.3 Training and development						
9.2.1	Continuous training					
9.2.2	Skill development programs					
9.2.3	On-the-job Training					
9.2.4	Leadership and supervisory training					
9.2.5	Health and Safety training					
9.3 External Factors						
9.3.1	Favourable weather conditions					
9.3.2	No protests					
9.3.3	Efficient supply chain					
9.3.4	Supportive government policies					
9.3.5	Favourable construction site conditions					
9.4 Client and stakeholder influence						

9.4.1	Effective communication among project stakeholders					
9.4.2	On-time payment for the completed work					
9.4.3	Early inspection of the completed work					
9.4.4	Advance payments to the contractor					
9.4.5	Engagement with the community					
9.5.6	Offering early completion bonuses					

SECTION 5: SME Contractor's Modalities for Enhancing On-site Labour Productivity

9. On a scale of Strongly disagree (1) to Strongly agree (5), please rate your level of agreement on the following modalities influencing on-site labour productivity for SME contractors to achieve sustainable construction delivery. Please note: Strongly disagree = 1, Disagree = 2, Neutral =3, Agree = 4, and Strong agree = 5

Modalities	1	2	3	4	5
10.1 Site Management Modalities					
10.1.1 Strategically designed site layout					
10.1.2 Proper resource allocation					
10.1.3 Effective labour scheduling					
10.1.4 Regular inspections of the quality of work					
On-site health and safety culture					
10.1.5 Effective supervision of tasks					
10.1.6 Monitoring progress regularly					
10.2 Leadership and Supervisory Modalities					
10.2.1 Strong communication protocols between supervisors and on-site labour					
10.2.2 Strong communication protocol between supervisors and consultants.					
10.2.3 Delegate tasks based on team members' strengths and expertise					
10.2.4 Encourage on-site labour participation in decision making and problem solving					
10.2.5 Addressing on-site labour conflicts promptly and fairly					
10.2.6 Making informed and timely decisions					
10.3 Technology integration / Construction 5.0 practices					
10.3.1 Labour training through Virtual Reality (VR) and Augmented Reality (AR)					
10.3.2 Labour collaboration through smart devices (e.g., tablets, wearable tech, or smart helmets)					
10.3.3 Enhancing labour's physical strength with Smart exoskeletons					
10.3.4 Labour robotic assistant (e.g., lifting robots, deconstruction robots, or welding robots)					
10.3.5 Monitoring construction equipment through telematics					
10.3.6 Blockchain technology for labour payments					
10.3.7 Drone technology to monitor progress on site					

10.4 Material Management Modalities					
10.4.1 E-procurement of materials					
10.4.2 Frequent auditing of material stock					
10.4.3 Material usage monitoring					
10.4.4 Proper training on material handling					
10.4.5. Efficient disposal of material waste and recycling on-site					
10.4.6 Adherence to required material specifications					
10.5 Machinery management modalities					
10.5.1 Regular machinery maintenance					
10.5.2 Selection of multi-purpose machinery and tools					
10.5.3 Fuel management system					
10.5.4 Hiring skilled and certified operators					
10.5.5 Keeping backup machinery spares					

Thank you for contributing to developing on-site labour productivity modalities for SME contractors to enhance sustainable construction project delivery in the Western Cape Province of South Africa.

ANNEXURE B: DATA COLLECTION PERMISSION

(PTY) Ltd
Milanimaqhawe Services

MILANIMAQHAWE SERVICES (Pty) Ltd.

Postal Address: 16645 Diya Street, Philippi, 7750

Head Office: M506 Site B, Khayelitsha, 7784

Tel. 073-126-8461 / 065-946-5539

Email: milanimaqhawe@gmail.com

2024-06-19

TO WHOM IT MAY CONCERN

This serves as an agreement for Mr. Y Mtshakaza's request, to do research titled On-site Labour Productivity Modalities for Small and Medium Enterprises to Enhance Sustainable Construction Project Delivery in the Western Cape Province of South Africa in our construction sites.

Kind Regards

Trevor Matshaya

ANNEXURE C: LIST OF PUBLICATIONS