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ADDIS ABABA UNIVERSITY COLLEGE OF COMMERCE

DEPARTMENT OF PROJECT MANAGEMENT

Project Title

The Effect of Site Management Tool Use on Project Performance: The Mediating Roles of Planning and Coordination, Monitoring and Control, and Resource Management Processes in Safaricom Ethiopia.

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Submitted date: - 9-May-26

DECLARATION

I hereby declare that the thesis/dissertation entitled The Effect of Digital Tool on Project Management Processes and Performance: The Case of Safaricom Ethiopia Rollout Project, submitted in partial fulfillment of the requirements for the degree of Master of Arts in Project Management at BAIS, Addis Ababa University, is my original work and has not been submitted to any other institution for the award of any degree or certificate. All sources of assistance and support received during the course of this study have been duly acknowledged.

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EXAMINERS' APPROVAL OF THESIS

This is to certify that the thesis prepared by Lidya Amare, entitled the effect of digital Tool on project management processes and Performance: the case of Safaricom Ethiopia rollout project is submitted in partial fulfillment of the requirement for Degree of Masters of art in project management complies with the regulation of the University and meets the accepted standards with respect to originality and quality.

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ACRONYMS/ABBRIVATIONS

SMT ---- Site Management Tool

PMP ----- Project Management Processes

PP ------Project Performance

Pla ------Planning and Coordination

Mon ----- Monitoring and Control

Res ------ Resource Management

SAR ---- Site Acquisition Report

CW ----- Civil Work

ABSTRACT

In a large-scale telecom network rollout project, it is essential to have effective project management, especially in dynamic and complex operational environments. After entering the market in 2021, Safaricom Ethiopia initially relied on manual monitoring and documentation methods for network deployment projects, which led to having fragmented records, limited on-site visibility and delays in decision-making which has affected project performance. To address these challenges a digital platform called Site Management Tool (SMT) was introduced to provide a centralized documentation system, improve planning and coordination and enhance resource utilization. The impact of the SMT implementation on project management processes (PMP) and project performance (PP) in Safaricom Ethiopia was examined using a mixed-method case study approach involving both quantitative and qualitative data. Quantitative data were collected through structured questionnaires and SMT system-generated operational records, while the qualitative data were obtained through open-ended responses from project managers, site supervisors, vendors, quality assurance personnel and project execution team who had SMT accounts and daily interaction with the system. The data were analyzed using IBM SPSS Statistics, PROCESS Macro Version 5.0, independent sample t-test and thematic analysis using Excel. The findings revealed that SMT usage had a significant positive effect on PMP and PP. The results further showed that PMP, specifically planning and coordination (Pla), monitoring and control (Mon), and resource management (Res), fully mediated the relationship between SMT usage and PP, with resource management emerging as the strongest predictor of PP. The qualitative findings supported the quantitative results by indicating improvements in real-time monitoring, workflow coordination, reporting efficiency, accountability, and resource utilization following SMT implementation. Overall, the study concludes that the effectiveness of digital transformation tools in telecom projects is primarily realized through their ability to improve internal project management processes. The findings contribute to digital transformation and project management literature by providing empirical evidence on the mediating role of project management processes and also offer practical insights for telecom organizations seeking to improve project performance through digital project management systems.

Key Words: - Digital Project Management, Site Management Tool (SMT), Telecom Network Rollout, Project Management Processes (PMP), Project Performance (PP)

CHAPTER ONE

1.1 Introduction

1.2 Background of study

Project management plays a critical role in planning, monitoring and execution of activities in organizations to achieve defined objectives within defined time, cost and quality constraints. In recent years there has been a rise in project sizes and complexity, which have become a challenge for the application of traditional project management approaches, especially in environments that are characterized by multiple projects running simultaneously across geographically distributed teams (Marnewick & Marnewick, 2022; Ezeigweneme et al., 2023).

As organizations start to grow and operate in a more dynamic and competitive environment, traditional or manual project management methods have proven to be insufficient in supporting timely decision-making, effective coordination, and monitoring performance accuracy. This has caused many organizations to undergo digital transformation, to enhance their project management capabilities and reduced the project failure rate (Marnewick & Marnewick, 2022; Saarikko, Westergren & Blomquist, 2020).

In project management context digital transformation involves the integration of various digital tools and platforms that support project management processes like planning, monitoring, communication, documentation, and decision-making processes. The adoption of such digital tools will allow us to track project activities in real-time more accurately and also it will increase transparency, improve data accuracy, enhance coordination among stakeholders and at the sane time reduce inefficiencies and operational bottlenecks. Prior studies have indicated that the implementation of a digital project management system can significantly change the work processes of organizations by maximizing the benefits of improved transparency, accountability, and responsiveness in project work. These improvements are particularly useful in industries that undertake large-scale projects (Saarikko, Westergren & Blomquist, 2020).

The telecommunication industry is among the sectors experiencing rapid technological changs, with high level of competition and extensive infrastructure development. The telecom operators often manage multiple large-scale rollout projects involving numerous stakeholders, strict regulatory requirements, and high expectations for quality and speed (Marnewick & Marnewick, 2022). Therefore, it is essential to have effective project management to ensure propre coordination, resource allocation, and continuous monitoring of network rollout activities (Ezeigweneme et al., 2023).

These challenges are further amplified in developing countries, where telecom Implementation projects can be subjected to other limitations like scale complexity, socio-economic restrictions

and security related disruptions. Such conditions can make it even harder to monitor implementation progress, manage various project activities, and maintain consistent documentation standard in developing countries. Further studies that are conducted in similar context have indicated that the lack of having integrated digital project management systems can lead to fragmented records, delay in decision-making, and reduced oversight, thereby undermining project performance (Ezeigweneme et al., 2023; Gebreyesus, Thakkar & Mena, 2024).

In Ethiopia, the telecommunication sector underwent a significant structural transformation following the liberalization of the market, with the goal of ensuring the introduction of competition on the market, as well as increasing telecommunication coverage in the country. As part of this reform, Safaricom Telecommunication Ethiopia was awarded a telecommunication license for the nationwide operating in July 2021 (Ethiopian Communication Authority & Ministry of Finance, 2021).

Safaricom Ethiopia launched its operations with the aim of rolling out its network infrastructure and staring operation within a short period. Nevertheless, the exercise was faced by some of the challenges that existed in the Ethiopian socio-economic environment. Despite these challenges, the firm has managed to register impressive success by deploying more than 3000 network sites as of early 2025, in addition to providing mobile telephone services, data service, and as well as fiber optic connectivity, they have introduced the mobile money transfer services through M-PESA (Safaricom Ethiopia, 2025; Telecom Review Africa, 2025).

Safaricom Ethiopia during its initial phase it was heavily depended on manual project tracking and documentation methods, which covered spreadsheets, email communication, paper-based records, and basic online collaboration tools. Although these methods allow coordination, they led to fragmented documentation, scattered records, and challenges in tracking project progress status, verifying the work completion, and ensuring quality compliance factors that hindered the efficient execution of projects (Lakhamraju, M.V., 2025).

To address these issues, Safaricom Ethiopia introduced a digital tool called a Site Management Tool (SMT), which is a technological solution which provides centralized documentation related to projects and facilitate tracking. It also supports optimizing the resource allocation, and quality management. The introduction of the SMT represents the shift from manual to digital project management system, which provides an opportunity to examine how digital project management tools can influence the project management processes in large-scale telecommunication rollout projects.

1.3 Statement of the problem

Telecommunications organizations are confronted with the situation where they must deal with various complex projects simultaneously, hence producing a large volume of data that need to be validated, tracked and reported. However prior studies indicated that many organizations find it difficult to integrate their operational systems with modern digital tools, creating fragmented records, bottlenecks, and operational inefficiencies (Lakhamraju, M.V., 2025; Saarikko, Westergren & Blomquist, 2020).

Evidence from empirical studies also indicates that the absence of an integrated digital project management system can limit the ability of the organizations to effectively monitor project progress, to maintain quality compliance, and reduce delay in decision-making in a complex network rollout environment (Ezeigweneme et al. 2023).

In the case of Safaricom Ethiopia network rollout project, the use of manual processes like emails communications, spreadsheets, and standalone collaboration platforms were used to monitor site progress and confirm the work accomplished by different suppliers and subcontractors. Since there was no integrated platform to store project-related documentation, there were challenges associated with the follow-up on project tasks and auditing the work accomplished.

The SMT is introduced as a solution to overcome the challenges with a digital solution that integrated all the necessary aspects. However very little is known about the effect of the SMT in terms of managing projects on the deployment of the Safaricom Ethiopia network. There is a lack of studies that examine the Impact of SMT on project speed, documentation quality, milestone management, and on the trust building mechanisms for validating contractor deliverables.

This is a vital knowledge gap that needs for systematic investigation. Therefore, this study seeks to examine the effect of the Site Management Tool (SMT) on project management processes and project performance in the Safaricom Ethiopia network rollout projects to provide insights into what digital transformation can accomplish to boost project performance. With the aim of generating empirical evidence to inform both the academic research and practical implementation of digital project management tools in the telecommunication sector.

1.4 Research Questions

- What effect does SMT usage have on project management processes in Safaricom Ethiopia network rollout projects?
- What effect does SMT usage have on project performance in Safaricom Ethiopia network rollout projects?
- Do project management processes mediate the relationship between SMT usage and project performance?
- What challenges are encountered during the implementation and use of SMT in Supporting project management activities at Safaricom Ethiopia?

1.5 Research objectives

1.5.1 General Objective of the Study

To assess the effect of implementing a digital system called Site Management Tool (SMT) on project management processes in Safaricom Ethiopia's network rollout projects and its impact on the Project Performance.

1.5.2 Specific Objective of the Study.

- To examine the effect of SMT usage on project management processes in Safaricom Ethiopia network rollout projects.
- To determine the effect of SMT usage on project performance in Safaricom Ethiopia network rollout projects.
- To examine the mediating effects of project management processes on the relationship between SMT usage and project performance.
- To identify challenges encountered during the implementation and use of SMT in Safaricom Ethiopia network rollout projects.

1.6 Significance of the study

This study is significant in evaluating how the transition from a manual tracking and documentation system to a digital system called Site Management Tool (SMT) has impacted the performance of Safaricom Ethiopia's network rollout projects.

The Study will examine how SMT has impacted project resources allocation, planning and coordination, and monitoring and control, which are critical for effective project execution in complex telecom rollout environments (Marnewick & Marnewick, 2022; Saarikko, Westergren & Blomquist, 2020; Lakhamraju, M.V., 2025). It will also assess the experiences and insights of project managers, rollout teams, site supervisors, vendors, and subcontractors who use the site management tool. The findings will contribute to identifying whether SMT has addressed the challenges such as delays on the project schedule, communication gaps, and the effect it has on the resource utilization. This study offers insights into how the tool can affect the real-time visibility and the preliminary acceptance test result (Lakhamraju, M.V., 2025; Chen et al., 2025).

The result of this research is expected to be valuable for Project Managers, site Supervisors, quality and acceptance team and auditing by helping them strengthen their workflow, accountability and improve decision-making by providing accurate and centralized data. The research contributes to the knowledge of digital project management for newly emerging telecom operators by offering the impact of organizations transitioning from a manual system to a digital system.

1.7 Scope of the study

This study is focusing on evaluating the impact of transitioning form manual system to the digital site management tool (SMT) within Safaricom Ethiopia's network rollout projects. The scope is limited to activities and processes directly related to project monitoring, documentation management, milestone tracking, vendor work confirmation, site acceptance, and preliminary test acceptance (PAT) and the impact it has on the project life cycle.

The study has only covered projects under Safaricom Ethiopia Network Rollout, such as the Site Acquisition, Civil works, Power connections & telecom equipment implementations, colocations, and fiber optic deployment (Outside plants) projects. These projects represent the core and most complex activities in rollout projects, making them ideal for evaluating the SMT effectiveness. The study is focused only on the practical application and its effect on project management so it will not include the architecture of the Site Management tool.

The scope includes project activities related to planning and coordination, monitoring and control, resource management and system-based tracking of rollout activities, which are recognized as key activities in digital project management frameworks and are relevant to network rollout project management lifecycle (Marnewick & Marnewick, 2022; Chen et al., 2025)

1.8 Limitations of the study

This study focuses solely on Safaricom Ethiopia’s network rollout projects. Results or findings could not be generalized because different telecom firms apply different structures and different tools at different levels of organizational maturity.

The research utilizes project managers, site supervisors, contractors, and vendors' responses to research questions modeled using open-ended questions or other techniques. The responses form the participants may be subject to personal bias, selective memory, or reluctance to highlight internal challenges as noted in prior studies on digital project management adoption, which can affect the accuracy of the findings, and also since SMT is a relatively new tool, some features may still be under development or undergoing refinement so observations made during this study may not reflect the tools full potential (Lakhamraju, M.V., 2025; Chen et al., 2025).

And It's possible that during the manual documentation from some document went missing, and the data might be inconsistent or incomplete. This could make it challenging to compare the manual system and the digital SMT thoroughly and accurately.

1.9 Organization of the study

There are five chapters in the paper. In Chapter One, the backdrop of the study is introduced, the problem statement is described, the objectives of the paper are set, definitions of several key terms are provided, and the importance and scope of the study are briefly discussed. Literature is the focus of Chapter 2 review, which examines the relevant literature in depth. The research approach that will be used for this study is endorsed and briefly explained in Chapter Three. The display and analysis of data are covered in Chapter 4. Finally, Chapter Five presents this study's results and recommendations.

Chapter Two

Literature Review

2.1 Introduction

In this chapter theoretical and empirical literatures, relevant to the impact of digital project management tools on the project management processes and project performance are reviewed. It also considers the manual versus digital documentation and tracking systems and the use of digital tools in the telecom network rollout projects.

2.2 Meaning and Nature of Digital Project Management System.

Over the past decades, the concept of digital transformation has gained prominence in academic, industry and practitioners circles as a means to address issues such as coordination and performance challenges that are observed when manual system is used. As explained by Vial (2019), digital transformation refers to the integration of digital technologies into all aspects of an organization's operations, fundamentally changing how the work is carried out and values are created (Vial, 2019). Literature on digital transformation states that digitalization is the integration of digitals and interconnected data system into operational processes to improve coordination, transparency, and control rather than a complete organizational overhaul (Brennen and Kreiss, 2016).

In the context of project management, digitalization relates to the adoption of software tools, and integrated systems that support project management processes such as planning and coordination, monitoring and control and resource management throughout project lifecycle. Digitalization is more than mere use of software, as emphasized by Vial (2019), it reflects the restructuring of operational processes, decision-making, and organizational role around digital system. These kinds of restructuring in telecom rollout projects will allow project teams to track activities in real time, improve transparency, enhance data accuracy, and facilitate coordination among geographically dispersed stakeholders. Prior studies indicate that such systematics significantly alter work processes by improving accountability, responsiveness, and control over project execution (Saarikko, Westergren & Blomquist, 2020).

Digitalization in project management can be understood across several key dimensions that are critical for successful projects in various industries such as the Safaricom Ethiopia network rollout projects. (Whyte and Lobo, 2010, Hart et al., 2017, GSMA, 2020). Some of the key dimensions are as mentioned below;

- Tool Implementation and integration: - The use of integrated project management platforms and mobile filed applications that enable seamless data exchange and coordination across project teams (GSMA,2020).

- Data and Information Flow: - the success of digitalization depends on how the information is captured, shared and used. Digitalization places high emphasis on data quality, accuracy, completeness, timelines and interoperability to enable to make informed decisions. (Hazen et al., 2014, Oesterreich and Teuteberg, 2016).
- Organization and Human Capabilities: Digitalization requires organizational change, including development of new skills, governance and cultural adaptation to fully utilizes the advantage of using digital tools. (Bharadwaj et al., 2013). This shows that advanced tools will not have impact on the improvement of the challenges faced without the trained people and proper organizational processes. (PMI, 2017).

From a theoretical perspective digitalization is socio-technical in nature, this means that digital systems can influence both the technological process and organizational dynamics. Meaning the digital tool such as SMT will provide dashboards that give the project managers visibility into field performance, and project teams who previously relied on manual checklist and email submission now report progress through digital systems. This transitions form manual to digital system not only affect operational tasks but also reshapes decision-making, organizational roles, and the distribution of responsibility by enabling real-time data access and integrated reporting (Orlikowski, 2000 and Leonardi, 2011).

A Fundamental feature of digitalization is its iterative and evolving nature, meaning that it continuously adapts a new technology and integrates into organizational process (ITU, 2018; GSMA, 2020). However, in the context of this study, digitalization is considered mainly in terms of its role in improving project management processes through structured digital systems rather than advanced technologies such as artificial intelligence (AI).

Recent empirical studies further support the importance of digitalization in addressing the complexity of large-scale projects such as telecom infrastructure projects. Ezegweneme et al. (2023), in their comparative review of telecom project management processes across Africa and the United States, it Emphasize that modern telecom projects are characterized by high level of technical complexity, regulatory pressure and stakeholder diversity. They highlighted that traditional or manual project management approaches are becoming increasingly inadequate and stress the growing role of digital tools in improving coordination, risk management, and project control.

Similarly, Gebreyesus, Thakkar and Mena, (2024), in the case of study done on the Ethio Telecom's network infrastructure expansion project, they have demonstrated that project success is strongly dependent on effective management of schedule, cost, scope, communication, procurement and stakeholders. In their findings they show that weaknesses in these traditional project management areas often leads to delays, cost overrun, and coordination challenges. These study highlights that the integration of digital tools improves core project management functions, which in turn enhances project performance.

Taking into consideration the above two studies, they offer significant academic evidence in backing the postulation that digitalization, which is operationalized through digital technology, is very essential in influencing changes in project management processes in telecommunication networks rollout projects such as that of Safaricom Ethiopia. By transitioning from traditional or manual fragmented processes to integrated, real-time and data driven systems, digitalization enables greater transparency, faster decision-making, centralized documentation system and improved control access across the entire project life cycle (Gebreyesus, Thakkar and Mena; 2024; Ezegweneme et al., 2023).

2.2.1 Manual Documentation and Tracking System Vs Digital

Project documentation and tracking are central to effective project management, particularly in large-scale and multiple-stakeholder environment such as telecommunication network rollout projects. Manual documentation systems, including spreadsheets, emails, paper-based records, and standalone communication tools, have been widely used to for monitoring and reporting of projects activities. Some studies have indicated that these manual approaches often result in fragmented documentation, delayed information flow, limited visibility of project status and cause challenges in verifying the work completion and ensuring auditability (Saarikko, Westergren & Blomquist, 2020; Ezeigweneme et al., 2023).

Some empirical evidence further suggests that the absence of integrated digital documentation system will weakens team coordination, slows decision-making, and reduces oversite in complex project environment (Ezeigweneme et al., 2023; Gebreyesus, Thakkar and Mena; 2024). In contrast, digital documentation and tracking system will have a centralized project data, will enables for real-time reporting, improve transparency, accountability, and increase control across geographically dispersed teams (Marnewick & Marnewick, 2022; Saarikko, Westergren & Blomquist, 2020).

Other studies on digital project management adoption have also highlighted that digital system enhance documentation accuracy, standardization, and traceability, thereby supporting to have improved project monitoring, quality compliance, and auditing processes (Lakhamraju, M.V., 2025; Gebreyesus, Thakkar and Mena; 2024). This comparison between manual and digital documentation system provides a conceptual foundation for evaluating the effectiveness of the Site Management tools (SMT) in Safaricom Ethiopia's network rollout projects.

2.3 Importance of Digitalization for Telecom Network Rollout Project Management

The Importance of digitalization for telecom rollout projects such as the Safaricom Ethiopia network rollout projects, cannot be overstated. Telecom operators today face intense competitive pressure to deploy network sites rapidly whiles maintaining the high service quality, manage both capital and operation expenditure efficiently and comply with the regulatory requirements (Ezeigweneme et al., 2023, Gebreyesus, Thakkar and Mena, 2024, PMI, 2017).

This is where digitalization proves to be of great efficiency in facilitating these needs by improving project planning, by ensuring the execution of highly accurate and coordination systems and improving decision-making approaches through accurate data availability. In the telecom context the use of comprehensive digital platforms enables managers to monitor tower development activities in real-time and make rapid adjustments regarding upcoming issues, thus ensuring better performance of project and minimizing delays and expenses (Vial, 2019; Brennen and Kreiss, 2016; Ezeigweneme et al., 2023 and GSMA 2020).

2.3.1 Strategic and Operational Drivers

Telecommunications companies are often licensed under terms of roll-out requirements within a specific timeframe, such that effective planning and proper monitoring of the process for successful roll-out is necessary. Studies, show that telecom rollout projects require structured planning and continuous monitoring to ensure compliance, coordination and meeting deadlines. Digital tools support in successful monitoring of the roll-out process and effective planning, by providing a way where the companies are be able to analyze alternatives of roll-out processes before and during the execution (Ezeigweneme et al 2023; Marnewick & Marnewick, 2022)

Strategically, when operators can roll out network sites faster in response to the demand and competition, they gain an advantage in customer acquisition and market shares growth Moreover, the strategic use of digital transformation can result in improved financial performance by reducing cost variances and improving resource utilization (Saarikko, Westergren & Blomquist, 2020; Ezeigweneme et al 2023).

Operationally, telecom rollout projects have a complex operation, involving thousands of sites, multiple vendors, subcontractors and logistic chains. Digital tools can go a long way to address these challenges by enabling project teams to capture progress in real time and automating most tasks, also reducing manual mistakes and improving transparency (PMI, 2017). Additionally, standardized digital workflow improve consistency in task execution and documentation, reducing rework and enhancing overall project performance (Marnewick & Marnewick, 2022; Ezeigweneme et al 2023).

2.3.2 Decision-making and Quality Assurances.

Digitalization in telecom deployment projects have several advantages. One of which is improving decision-making in uncertain situations. The idea of real-time data analytics helps remote managers realize situations earlier and provide mitigations, hence improving decision-making for instance, if a cluster of towers in a particular region experiences higher than average delays in civil work, predictive analytics within the digital tool can flag this pattern, enabling the reallocation of resources or escalation to senior management before schedule slippage occurs (Davenport, 2018).

Digital system also increases quality assurance during tower erection by embedded standardized checklist that enforces best processes during structure and equipment installation, where an automated quality control module can reject an incomplete submission, and recommend the right

timeliness in remedies and escalation. These features can reduce rework, improve first-time quality metrics, and ensure the technical standard of compliance are met (Davenport, 2018, Jarrahi, 2018).

2.4 Scope, Processes, and Components of Digitalization in Telecom project.

In the context of Safaricom Ethiopia network rollout, digitalization extends across the full project life cycle from initiation, Planning, executing, monitoring, control and closure. Rather than operating as a standalone tool, digital systems can function as integrated platforms that connects planning activities such as site identification and radio frequency (RF) design with execution phase including site acquisition, civil work, tower erection, site energizing and equipment installation (PMI, 2017; Saarikko, Westergren & Blomquist, 2020; Marnewick & Marnewick, 2022).

During the execution digital tools can support getting real-time field data, while also supporting the monitoring and control of the progress, it has the capabilities to provide continuous visibility into schedule performance, resource utilization, quality compliance and overall project status across geographically dispersed sites. In the closing phase the digital tool can help with structured handover by consolidating as-built documents, test results and compliance records for smooth transition from execution to operations (PMI, 2017; Marnewick & Marnewick, 2022).

2.4.1 Planning and Execution of Integration

This planning phase lays the groundwork throughout the entire telecommunication network launch process, since it is at this level that the most critical decision in terms of the site and network layout , allocation of network assets, and leasing of the site and acquiring the permit are all made, this analysis determines the site to be established using radio frequency propagation analysis, demand analysis, and geographical mapping mentioned below (PMI,2017; GSMA, 2020; ITU, 2018).

Digital planning tools such as GIS software, RF planning software, and related platforms, improve the planning efficiency by offering the ability to analyze the area that lack signal and the resources needed for the backhaul before physical implementation (Whyte, 2010). The effectiveness of planning is further enhanced when outputs such as site location, budget, spectrum parameters, and vendor selection are integrated directly into execution workflows. This creates continuity between planning and implementation, making planning data dynamic input for scheduling, budgeting, and risk assessment rather than static documentation (Uhlemann et al., 2017).

2.4.2 Monitoring, Control and Workflow Automation

The monitoring and controlling activities are continuous throughout the telecom rollout lifecycle and are essential for ensuring that execution remains within the planned objective. Digital tools can support this function by providing interactive dashboards that present key performance indicators (KPIs) such as schedule variance, budget utilization, quality performance, and safety indicators in real time (Davenport, 2018, and Jarrahi, 2018).these dashboards allow project manager, team leaders and executives to filter and analyze performance data by responsible team, date, region, vendor, subcontractors, scope , phase and achieved milestones enabling early identification of trends, deviations or emerging risks (Uhlemann et al., 2017).

If a group of sites which are visited have repeated quality failure during the integration phase, using digital tools project managers can be enabled to drill down into specific tasks, team members, or responsible stakeholders, allowing targeted corrective action rather than broad, reactive interventions (Davenport, 2018 and Jarrahi, 2018).

2.4.3 Documentation and Handover Process

Integration testing, commissioning, and handover represents the final stage of telecom rollout projects. After the completion of CW and installation activities, systems such as antennas, power units, and transmission equipment are tested to ensure compliance with performance and safety standards (ITU, 2018; PMI, 2017).

Digitalization improves this stage by replacing fragmented manual records with centralized digital documentation. Test results, configuration parameters, acceptance checklist, and fault logs are recorded within the integrated system which can ensure the accuracy, traceability, and immediate availability of information to stakeholders (Love et al, 2004; Uhlemann et al., 2017).

The handover process involves transferring all site documentation, including as-built records, test results, and compliance certificates to the operation team. Digital tools facilitate this process by acting as centralized repositories that ensure continuity of information and reduce operational inefficiencies after project closure (Muller, 2017).

2.4.4 Components of Digitalized Project Management System.

Effective digitalization in telecom rollout projects require the integration of technological, procedural, governance, and human components rather than reliance on individual tools. (Saarikkoo, Westergren & Blomquist, 2020; Ezeigweneme et al., 2023).

- Digital Tools and Platforms: - These tools allow for better coordination and synchronization of projects related tasks and events through integrated platforms of the planning output and the execution and monitoring inputs (Bharadwaj et al., 2013; GSMA, 2020)
- Standardize Data Models: - these make sure that the information is recorded consistently across all the project phase and stakeholders. Such consistency can improve data reliability, enable meaningful collection of project information and support informed managerial decision making (Oestrerreich and Teuteberg, 2016)
- Automated Workflows: - they enforce correct task sequence and mandatory data capture at each stage of the rollout process. By embedding procedural logic into the digital workflows system, they reduce human error, prevent task omission and improve compliance with defined project standards (Oestrerreich and Teuteberg, 2016 and PMI, 2017)
- Governance and Quality Controls: - The data integrity and quality is ensured by key process like Audit trails, access control and validation rules. These controls are critical

for the success of the telecom projects (PMI, 2017, and Oestrerreich and Teuteberg, 2016)

- Human Capabilities: Digitalization is heavily dependent on human capability, such as the digital literacy, data interpretation skills and adaptive project management processes. Research emphasizes that organizations realize the full benefit of digital system only when project teams are equipped to use, interpret and act on digital information effectively (Bharadwaj et al., 2013).

The integration of all the above components will enable end-to-end visibility, control and coordination across the telecom rollout lifecycle, addressing the scale, complexity, and regulatory demands of modern network deployment project ((Saarikkoo, Westergren & Blomquist, 2020; Ezeigweneme et al., 2023).

2.5 Theoretical Background

2.5.1 Project Management Theory

Project management theory provides the framework for understanding and identifying the methods and knowledge areas that are used to achieve project objectives. It is focused on how project manager uses the methods, tools and techniques to achieve the project objective within the specified constraints which include defined timeline, budget, and quality standard. In the telecom project management sector which involves multiple sites, complex logistics and many stakeholders, having a structured project management is critical to ensuring efficient and cost-effective delivery (Kerzner, 2019; Rodrigues et al., 2024).

According to the study done by Kerzner in 2019 and Archibald and Prado in 2014 have stated that project management theory is guided by key knowledge areas, which includes the scope, time, cost, quality, communication, risk, procurement and stakeholder management. The integration and coordination of the knowledge areas is critical for the success of the project. Also, study conducted by Muller in 2017 states that effective integration and coordination across these areas is vital for large-scale and technological complex projects as in the telecom rollout projects (Kernzer, 2019, Rodrigues et al., 2024; Muller, 2017).

The Project management theory also highlights the importance of standardizing methodologies and processes to reduce uncertainty and improve predictability. As stated by Kerzner, the use of structured process helps to align project activities with organizational goals and stakeholder's expectations (Kerzner, 2019). These can be further improved by digital tools which allows for a real-time monitoring, report automation, and enhance communication across project teams (Kerzner, 2019, Rodrigues et al., 2024; Muller, 2017).

In conclusion the project management theory can provide insight on how digital tools can enhance planning, monitoring, coordination and control in the telecom network rollout projects.

2.5.2 Socio-Technical System (STS) Theory.

The Socio-Technical System Theory (STS) is the theory which creates the framework for understanding the interaction between the social elements and the technological components within the organization. It also states that the technical system and the human system can't operate in isolation, instead they have to be aligned to give effective support to improve the project performance (Ahlemann et al., 2013). In the telecom rollout project, which is considered to have a complex technical system, the project success is dependent on the coordination of the project team, processes and organizational structure.

STS Theory emphasizes that digital tools like project management software and communication platforms can support projects effectively to achieves their objectives when they are integrated with human and organizational factors. If there is a misalignment or resistance to the adoption of the digital tool by the project teams, it can lead to a lot of errors, inefficiencies, and misunderstanding of the project objective, but if the social and technical system were designed in a way to complement each other there would be an improvement in coordination, adaptability and helps to minimize the time taken to make decisions (Ahlemann et al., 2013).

When it comes to the telecom sector, the STS theory provides an insight into how digitalization can influence project management processes. If project teams can use digital tools to capture the site progress, report issues and coordinate resources across multiple locations there would be increase in the project performance. The effective integration of the socio-technical assures that the digital tools can enhance real-time monitoring, facilitate communication among stakeholders and reduce delay caused by misunderstanding (Ahlemann et al., 2013). The theory also highlights the importance of organizational process, user training, and cultural adoption in increasing the value of the digital technologies (Saarikko, Westergren & Blomquist, 2020).

By considering the STS theory the study notes that the digitalization is not merely a matter of implementing software and hardware but it is also the careful consideration of the human, organizational and technical factors of the project management. This also gives a robust theoretical foundation for examining how digitalization can support improving the project management processes in planning, monitoring, communication and coordination in the telecom rollout projects (Trist & Bamforth, 1951; Saarikko, Westergren & Blomquist, 2020).

2.5.3 Technological Acceptance Model (TAM)

The Technological Acceptance Model (TAM) provides an insight on the conceptual framework on how individuals adopt and use the technological systems within an organization. This model was first developed in 1989 by Davis; The TAM suggests that the probability of the technological adoption is primarily determined by two perceptions; which are the perceived usefulness and perceived ease of use. The perceived usefulness refers to the degree to which a user believes that a system will enhance their job performance and the perceived ease of use refers to the degree to which a user expects the system to be free of effort. These two concepts are critical when

introducing a new digital tool where there is a disruption in the workflows, it gives an insight in the user acceptance.

In Telecom projects, TAM provides a useful insight on how to examine the interaction between the digital system and the project teams and other stakeholders, that is designed to facilitate project management processes. The adoption of digital tools like the scheduling software or automated reporting system, it depends on both the technical functionality of the tools and also on the perceptions and attitudes of the individual users. If the users perceived the tools in way that can support improve the efficiency and decision-making capabilities, the users are more likely open to integrate them into their daily project operation, resulting an overall improvement in planning, monitoring, and coordination process (Saarikko, Westergren & Blomquist, 2020).

Furthermore, TAM highlights the importance of user-centered design and user training to have successful implementation of digital technologies. If the user perceived the tools as difficult to use, overly complex and misaligned with the workflow of the project requirements, they are less likely to be adopted even if they are technically sophisticated. This concept is also supported by the socio-technical approach which highlights that the success of digitalization is dependent on both the technological and the social context in operates in (Ahlemann, 2013).

By considering the TAT this study notes that the impact of digitalization on project management processes is mediated by the user perception. It also notes that digitalization can improve the coordination, monitoring and decision-making if the user and stakeholders are actively engaging with the digital tools. In conclusion the TAM provides an important foundation for analyzing the perception of usefulness and the ease of use on the effectiveness of digital project management processes in the telecom network rollout projects (Saarikko, Westergren & Blomquist, 2020).

2.5.4 Integration of Theories and Relevance to the Study

The study has taken under consideration the three key theoretical perspectives which are the Project Management Theory, Socio-Technical System (STS) Theory, and Technological Acceptance Model (TAM). Each of these theories provide a unique insight into the role of digitalization in project management processes. The Integrating these theories can allow for a multidimensional understanding of how digital tools and systems influence the planning, monitoring, coordination, communication, and decision-making processes in telecom network rollout projects (Kerzner, 2019;Saarikkoo, Westergren & Blomquist, 2020).

Project Management Theory establishes the foundation of a project by defining core project management processes and knowledge areas, and also by highlighting the structure approaches necessary to achieve project objective (Kerzner, 2019; Archibald and Prado, 2014; Muller, 2017). The STS Theory emphasizes that digital tools are insufficient without their alignment with people and organizational factors. A combination of these two theories highlights that digitalization should not only focus on procedural but also on socio-technical aspects of project management and ensure the significant positive changes in performance (Ahlemann et al., 2013).

As per Davis (1989) the TAM provides further supports this claim by explaining the human behavioral dimensions of technology adaptation It Clarifies that the impact of digital tools on project management processes is mediated by user's perception of usefulness and the ability to be understood.

The integration of these studies can assist on the development of the conceptual framework. It can link digitalization to specific project management processes and outcomes for the telecom network rollout projects. considering these studies and using them to understand the frameworks ensures that the empirical investigation is guided by collective understanding of the relationship between technology, organizational process and human factors.

2.6 Empirical Review

2.6.1 Digitalization and project management processes

Digitalization is becoming an important factor in enhancing the project management processes and project outcomes in different sectors. Many empirical studies have concluded that digital tools are effectively supporting project management activities such as planning, scheduling, monitoring, risk management and date driven decision-making. The digital tool supports the project team to work more efficiently by improving information flow, reducing manual work and supporting coordination among the stakeholders (Ezeigweneme et al., 2023; Marnewick & Marnewick, 2020).

Study done by Ezeigweneme in 2023 shows that the use of digital platforms for planning, tracking schedule, and risk management is essential in reducing error and delays by enabling tracking in real-time and effective coordination of project tasks (Ezeigweneme et al., 2023). Similarly, the study done in 2020 by Saarikkoo, Westergren, and Blomquist demonstrated that the integration of digital tools into the project workflow improves collaboration and knowledge sharing, which supports faster and more effective project execution (Saarikkoo, Westergren, & Blomquist, 2020).

The empirical study conducted by Chen in 2025 also demonstrated that organization that have successfully embed digital system into their project management processes have experienced in improving of monitoring, performance analysis and early identification of potential risk. This allows project managers to take corrective actions at an early stage and in a result it improved project control (Chen, 2025).

However, another empirical study conducted by Marnewick and Marnewick in 2020 and Ochieng and Price in 2010, states that the benefit of digitalization is dependent on organizational and human factors. It notes that the organizational readiness, and the ability of project teams to adapt to new digital tools are critical for the successful implementation of the tools. In order to have improvement in project performance, having adequate training and the alignment between digital tools and project management processes is critical (Marnewick & Marnewick, 2020; Ochieng & Price, 2010).

All the above-mentioned empirical studies have suggested that digitalization improves project management processes by enhancing coordination, transparency, and data driven decision-making. But they also stated that digital tools must be properly integrated into project management process supported by organizational readiness and adequate training.

2.6.2 Digitalization in Telecom Infrastructure projects.

Digitalization plays a big role in enhancing project management processes specifically within the telecom infrastructure projects. Which are often complex, resource-intensive and geographically dispersed. Study conducted in 2023 by Ezeigweneme observed that digitalization has a big role in enhancing project management processes specifically within the telecom and infrastructure projects. This study states that digital tools can improve the coordination of multiple stakeholders, the processes transparency, and support effective resource allocation. All of which are critical for the successful delivery of the telecom infrastructure projects (Ezeigweneme et al., 2023)

Similarly, studies done by Saarikkoo, Westergren, and Blomquist (2020) have highlighted that the strategic benefits of digitalization in infrastructure projects. stating that digital tools can encourage knowledge sharing and improve collaboration across dispersed teams, enhancing organizational agility and the ability the mange complex projects, Chen (2025) further supported that integration of digital system with existing project management processes enables predictive monitoring, performance analytics and early risk identification, thereby improving project control and reducing cost overruns (Saarikko, Westergren, & Blomquist, 2020; Chen et al., 2025)

The empirical studies done by Ochieng and Price in 2010 and Marnewick and Marnewick in 2020, have concluded that digitalization improves communication and coordination among multiple stakeholders, including contractors, engineers, clients and so on. In large scale projects like telecom rollout projects, these capabilities are essential to ensure all responsible stakeholders are aligned and have access to accurate and timely information in result reducing misunderstanding and delays (Ochieng & Price, 2010; Marnewick & Marnewick, 2020). Other studies conducted by Muriithi and Crawford in 2003 and Love 2004, also have concluded that project management tools support infrastructure projects by standardizing reporting, enabling central oversight, and facilitating rapid problem resolution across multiple sites (Muriithi & Crawford, 2003; Love et al., 2004).

Taking into consideration all these empirical studies, it can be concluded that digitalization enhances both operational efficiency and strategic project management capabilities in telecom and infrastructure projects. It can also be stated that digital tools are not only and administrative aid but also essential instruments for coordinating complex activities, improving communication, and ensuring timely project delivery. But the studies also underline that the successfulness of digitalization depends on organizational readiness, alignment with project management processes and having an adequate training.

2.6.3 Digitalization in Developing Countries/ Africa

The Impact of Digitalization in project management processes can vary significantly across the developing countries like Africa due to contextual factors such as infrastructure limitation, technological readiness and workflow capabilities. Some of the empirical studies highlight the opportunities and challenges faced when conducting a complex project in developing countries (Ezeigweneme et al., 2023; Gebreyesus, Thakkar & Mena, 2024).

In 2010 a study conducted by Ochieng and Price found that in developing countries challenges such as the lack of internet connectivity, standardized process and limited stakeholders' engagement can hinder the effective use of digital tools in project management. They also indicated that despite these constraints, their study showed that the project management that invested in appropriate amount of training and support system experienced a noticeable amount of improvement in communication, monitoring and decision-making (Ochieng and Price, 2010). In another study conducted by Love et in 2016 stated that digitization in Africa's construction and infrastructure projects has enhanced transparency, accountability, enabling oversights and reduced the risk of delay and also showed reduction in resource mismanagement (Love et al., 2016).

Additional studies conducted in 2020 by Saarikko, Westergren, and Blomquist also noted that the cross-cultural and organizational factors can influence the adoption and perceived usefulness of digital tool supporting that the need for contextual-sensitivity and implementation strategies when it comes to the digital tools under consideration (Saarikko, Westergren, & Blomquist).

In a study conducted in Ethiopia by Gebreyesus, Thakkar, and Mena in 2024 found that digitalization system enhanced efficiency and coordination, but their study stated that the effectiveness was strongly influenced by the level of organizational readiness and the familiarity of the staff with digital platforms (Gebreyesus, Thakkar, & Mena, 2024). Similarly, a study conducted in Kenya back in 2003 by Muriithi and Crawford stated that limitation in ICT infrastructure and digital literacy constrained the potential benefits of digital project management system especially in a large-scale project (Muriithi & Crawford, 2003).

In conclusion, these empirical studies have emphasized that digitalization has the potential to significantly enhance the project management processes in developing countries, especially in a large-scale project such as the telecom network rollout project, however, the effectiveness of the digital tools is dependent on organizational readiness, local conditions, infrastructure support and contextual adaptation.

2.6.4 Summary of key Findings and Research Gaps.

The empirical review is noted with the following observations on the impact of digitalization on project management processes in a large-scale project such as the telecom network rollout project. In various studies digital tools and platforms have proven to be effective in planning, monitoring, coordination and data driven decision-making. Ezeigweneme et al. (2023) and Gebreyesus, Thakkar, and Mena (2024) have demonstrated that digital platforms enable for effective project

progress tracking in real-time, allocation of allocation, and increase the workflow transparency. Similarly, Saarikkoo Westergren and Blomquist (2020) and Chen (2025), have pointed out that digitalization reinforces collaboration, knowledge sharing, and responsiveness of the project team.

From the review it is also indicated that the benefit of digitalization is very dependent on circumstances. According to Marnewick and Marnewick (2020), Ochieng and Price (2010), and Muriithi and Crawford (2003), the effectiveness of digitalization is influenced by the limitation of infrastructure, workforce skill, and organizational readiness. And according to Love (2016) and Aaltonen and Kujala (2016), digitalization can enhance the accountability and strategic decision-making, but these gains are maximized only when the systems are integrated with established project management processes and adapted to the local environment.

Despite having all these positive findings, there are several research gaps too, some of which are listed below: -

- First while there is empirical evidence on digitalization in general project contexts, few studies focus specifically on the impact of digitalization on telecom network rollout projects. Which has many complexities such as geographically dispersed sites, multiple vendors, and strict deployment deadlines.
- Second, most studies emphasize the operational advantages of digital tools but offer limited understanding of the mechanisms through which digital tools influence project performance outcomes.
- Thirdly, there are limited studies using both subjective (Survey based) and objective (system generated) data to validate findings, which limits the robustness of existing evidence.

These gaps show the need for more empirical investigation into the influence of digitalization on project management processes in telecom network rollout projects, especially in Ethiopian context. This study aims to fill these gaps by investigation in what ways the digital tools influence the planning, Monitoring, Coordination, Communication, and decision-making during Safaricom Ethiopia's network rollout projects. It is primarily a case study which will hopefully benefits academically and also provide practical guidance for implementing digital project management systems in complex telecom environments.

2.7 Conceptual Framework of the Study

This Study develops a conceptual framework to analyze the association between the use of a digitalized tool called Site Management Tool (SMT) and the project performance in the telecom network rollout projects at Safaricom Ethiopia.

The independent variable in the framework is the SMT usage. The SMT is likely to enhance the performance of projects by improving the efficiency and effectiveness of project management processes.

Project Management Processes (PMP) taken as a mediating variable. PMP is a multidimensional construct that consists of three key dimensions which are the planning and coordination, monitoring and control, and resource management. SMT is expected to enhance these processes to enhance the project performance.

The dependent variable for this study is the project performance which is quantified in terms of deliverable quality, time and cost performance measured in one constructed variable. In general, the framework indicates that SMT has an indirect positive effect on the project performance by increasing project management processes.

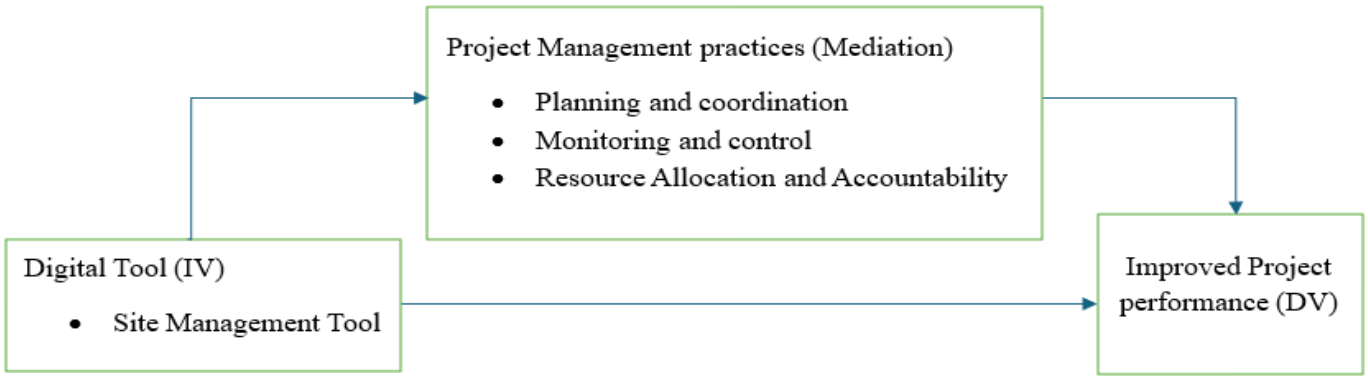


Figure 2.1 Conceptual Model for The Impact of Digital Tool on Project Management

2.8 Hypothesis of the study

Based on the conceptual framework and literature review, the study tested the following hypotheses: -

- H1: Site Management Tool (SMT) usage has a significant positive effect on project management processes.
- H2: Site Management Tool (SMT) usage has a significant positive effect on project performance.
- H3: Project management processes have a significant positive effect on project performance.
- H4: Project management processes mediate the relationship between SMT usage and project performance.

1. CHAPTER THREE

Research Methodology

3. 1 Introduction

This chapter focuses on the research methodology that will be employed in the study, aimed at examining the influence of the Site Management tool (SMT) on Project Management processes during Safaricom Ethiopia network rollout project.

Research methodology, design, target population, sampling size, technique, data collection method and procedure will also be presented. The data validity and reliability, data analysis and ethical consideration will be also included.

3.2 Research design and approach

This Study will adopt a convergent mixed-methods case study design to examine the influence of the Site Management Tool (SMT) on project management processes at Safaricom Ethiopia. The mixed-method approach will merge quantitative and qualitative research. Which in turn allows a comprehensive assessment to be made not only to measurement the project outcomes but also the stakeholders experience (Creswell, 2014). Such approach is fitting in assessing a digital project management tool. It demands the use of not only the objectives metrics like project timelines, resource utilization, document accuracy but also the understanding of how the project team perceive, adopt and engage with the digital tool.

The Case study design allows for an in-depth investigation of contemporary phenomena within a real-life context Safaricom Ethiopia's network rollout project provides a suitable case due to its large-scale, involvement of multiple vendors and the adoption of the centralized digital site management tool. The study will focus on this specific organization setting, which enables us to capture the complexity and nuances of digital transformation in project management that may not be evident in broader surveys or generalized studies (Yin, 2018).

The quantitative component of the research will focus on measurable indicators of project performance. Structured questionnaires will be administered to project managers, site supervisors from both the Safaricom Ethiopia on the rollout project and the vendors operating under it to collect numerical data related to these indicators. Descriptive statistics and correlation analyses will later be used to examine the relationship between the usage of the SMT and project management outcomes. The measurable indicators of the project performance include -

- Efficiency of project monitoring and tracking
- Documentation Accuracy and completeness
- Allocation and utilization of resources
- Progress in meeting project milestones

The qualitative component will involve open-ended questions. The questions will be planned to explore the following points,

- Experience in using SMT
- Challenges and limitations encountered during implementation of the SMT
- Perceived benefits and improvements observed compared to the manual tracking systems
- Any suggestion for optimizing the Site Management Tool to improve the project management processes.

The combination of both the qualitative methods and quantitative methods will ensure triangulation, where qualitative findings help explain the quantitative results and vice versa, strengthening the credibility and reliability of the study (Bryman, 2016; Yin 2018).

3.3 Description of Study Variables

The variables in this study will be divided into three categories of variables which are the dependent, independent and mediating variables depending on their roles in determining the impact of the SMT on project management processes in Safaricom Ethiopia. The knowledge of these variables is essential for designing the data collection methods, measuring the outcomes and making sure the study is aligned with its objectives.

The Site Management tool, is a digital platform adopted by Safaricom Ethiopia to facilitate project planning, allocation of resource, progress tracking, managing changes and documentation during the execution of network rollout project

The independent variable for the SMT implementation is expected to influence the dependent variables related to project Performance through the project management processes, including planning, documentation, resource management, communication, and monitoring, While prior literature identifies several moderating factors such as user acceptance, socio-technical alignment, and infrastructure constraints, this study does not statistically test moderating effects (Saarikko, Westergren & Bloquist, 2020; Orlikoweski, 2000).

3.3.1 Independent Variable

The variables that are expected to influence the project management outcomes are taken as the independent variable. Which in this study is the implementation of the Site Management Tool (SMT). This is supported by previous study which stated that the adoption of digital tools significantly influences project efficiency, decision-making, and collaboration in telecom project management (Ezeigweneme et al., 2023).

In this study the independent variables in the operation stage of the of SMT will be measured in terms of:

- Frequency of use by project teams
- Extent of functionality utilized (such as tracking, documentation and reporting)

- The level the project managers, site supervisors, and the project teams are adopting to the SMT.

3.3.2 Dependent Variables

The dependent variable of this study is project performance. The outcomes expected from the influence of SMT implementation are reflected through changes in project management processes in line with the research questions and objectives outlined on the above chapters, and they will be consistent with the literature highlighting the benefit of digital project management tools in enhancing project performance (Gharib, 2019).

Project performance will be measured as a composite construct reflecting overall project success. Indicators include efficiency in project completion, adherence to timelines, quality of output, and overall effectiveness of project execution.

3.3.3 Mediating variables

The mediating variable in this study is Project Management Processes (PMP), which represents the mechanisms through which SMT usage influences project performance. These processes are viewed as an abstract construct that includes several dimensions identified in the literature as indicators of effective digital project management processes (Gharib, 2019). For the analysis, the identified dimensions will be aggregated into a single composite measure of project management processes.

The dimensions of project management processes include -

- Project planning and Coordination; - this will measure effective coordination and the efficiency in creating, monitoring, and adjusting project timelines also the ability to prioritize and allocate resources effectively.
- Monitoring and Control; - this will be used to measure the visibility of real-time project progress and the accuracy of milestones tracking and adherence to quality standards.
- Resource Management: - this will measure strategics distribution resource across the project tasks to ensure optimal efficiency.

3.4 Descriptive of the Study Area and Target Population

3.4.1 Descriptive of the Study Area

The proposed study will be conducted within Safaricom Ethiopia, focusing on the organization's network rollout projects. Following the licensing in July 2021, Safaricom Ethiopia is actively deploying telecom infrastructures all around Ethiopia, including telecom towers, outside plant fiber optic networks and relevant telecom equipment's, across multiple regions of Ethiopia. These rollout projects are known to require complex coordination among project teams, vendors, subcontractors, and regulatory authorities.

In this study the boundaries are defined by Safaricom Ethiopia's network rollout project implementation after the introduction of the Site Management tool, by focusing on project level planning, monitoring, and execution activities (Yin, 2018; Patton, 2015; Ezegweneme et al., 2023).

The introduction of the SMT has Caused a considerable break from the manual tracking and documentation system to a digital project management system. This setup offers a unique opportunity to observe the impact of digital transformation on the details of the project planning, monitoring and operation within a large-scale telecom rollout project. The network rollout projects vary in scale, scope, complexities and geographical locations providing the study with the potential to collect a variety of experiences and project outcomes.

3.4.2 Description of Target Population

The target population comprises all individuals directly involved in Safaricom Ethiopia's network rollout projects who interact with SMT or are directly affected by its implementation. The study focused on 85 SMT users, who are involved in the workflow influenced by the SMT and also have hands-on experience using SMT. By selecting these groups, the study was able to gather insights on the effectiveness of the of SMT implementation, the perceptions, the challenges and advantages reported by key stakeholders of the SMT.

The key stakeholders included -

- 19 Project Managers: - who are responsible for planning, monitoring, and coordination of multiple rollout projects.
- 21 Project Team Members: - telecom project experts that are responsible for validating the documentation and following up on the progress of the vendor.
- 13 Site Supervisors: - who are responsible for the daily construction of the towers, installation of the equipment and quality assurance activities.
- 22 Vendor/Subcontractors: - who are mostly responsible for the execution of project tasks such as the site acquisition, civil works, power connections, and telecom equipment deployment.
- 10 Quality Assurance and Acceptance Team; - are responsible for tasks such as conducting audits, validating sites, and conducting preliminary acceptance tests (PAT) to ensure compliance with predefined and aligned project standards

3.5 Sampling Technique / Methods and Sample Size

3.5.1 Sampling Technique

For this study, a purposive (criterion based) sampling method will be employed to select participants who are directly involved in Safaricom Ethiopia's network rollout projects and interact with the site management tools. Purposive sampling, also known as judgmental or selective sampling, is appropriate when the researcher wants to focus on specific individual who have relevant knowledge, experience, or insight regarding the study phenomena rather than relying on

random selection which include individuals with little or no interaction with the site management tool (Creswell, 2014; Patton, 2015; Bryman, 2016; Yin 2018).

3.5.2 Sampling Size

The sample size of the study would encompass all the 85 employees currently employed by Safaricom Ethiopia Telecommunication P.L.C under the network rollout department which are interacting with the SMT in a daily basis. The study employed a census sampling technique whereby all the 85 employees in the network rollout department will be included in the study due to the manageable population size, ensuring full representation of the target group(Creswell, 2014).

3.6 Data Collection; – Source, Type and Instruments

In this study the multi-source data collection strategy will be used to examine the impact of the Site Management Tool (SMT) on project management processes within Safaricom Ethiopia's network rollout project. The recent studies on digital transformation in project management emphasize that the evaluation of digital tools requires the integration of user generated data system-based evidence in order to capture both operational outcomes and user experiences (Ezeigweneme et al.2023).

3.6.1 Sources of Data

The study is planned to use both the primary and secondary data sources

- **Primary Data**: - this data will be collected from the major stakeholders directly involved in the network rollout projects such as the project managers, site supervisors, vendors and subcontractors. These stakeholders will be the ones that interact with SMT at different stages of the project lifecycle, so they will be able to provide insights into how the system influences the planning, Monitoring, coordination, documentation, and quality management. Recent empirical study highlights the importance of gathering data from multiple stakeholder groups when assessing digital project management system, particularly in complex and multi-actor environments such as the telecom deployment infrastructure (Ezeigweneme et al., 2023; Gebreyesus, Thakkar and Mena, 2024).
- **Secondary Data**; - this data will be obtained from existing project-related documents and SMT-generated records, including site progress report, acceptance document, workflow logs, and performance dashboards. It is observed that system generated data is increasingly recognized as a critical source of objective evidence when evaluating the effectiveness of digital project management tools (Chen et al., 2025)

3.6.2 Types of Data

In this study both the quantitative and qualitative data will be collected.

- **Quantitative Data:** - This are the data that includes indicators that are used to measure the project performance and process efficiency. Using these indicators the study can assess to

what extent is the SMT contributing to the improvement of project control and transparency. prior studies highlight that quantitative measures are essential for evaluating the performance outcomes of digital project management systems (Chen et al., 2025).
The indicators used for quantitative data will include progress tracking, documentation accuracy, communication efficiency and also adherence to project schedules while using the SMT.

- **Qualitative Data:** - this data will be used to capture the experience of the participants, their perceptions and their opinion on the use of the SMT. This includes the on perceived benefit, challenges, adoption barriers, and areas for improvement experienced. These data will be used to understand how digital tools can influence the daily project management processes and the decision-making process which can't be measured numerically (Gebreyesus, Thakkar and Mena et al., 2024).

3.6.3 Data Collection Instruments.

The collection of the required data will be collected using the below listed instruments; -

- **Questionnaires: -** this will be used to collect quantitative data from a wider group of participants. The questionnaires will include items designed to assess perception of SMT's influence on key project managements life cycle. To capture a standardized user assessment of the system performance survey conducted through questionnaire are widely used in previous digital project management studies (Chen et al., 2025; Ezeigweneme et al., 2023).
- **Open-ended questionnaire responses:** This will allow the study to explore more on the user experience while still maintaining consistency across the questions. Previous studies have stated that open-ended questionnaire responses are effective methods to examine the behavioral implication of digitalization in project management context (Gebreyesus, Thakkar and Mena et al., 2024).
- **Document and System Review** – to supplement primary data and provide objective evidence of the process changes and performance outcomes a review of the reports**,** project documentation, and acceptance records that are generated from the SMT will be conducted. Using this system generated data will support the validation of self-reporting findings and enhance the credibility of the digital transformation studies (Chen et al, 2025).

The questionnaires were developed using a construct-based adaptation approach, whereby measurements construct and indicators identified in prior validated studies on digital project management system were used as the basis for items development. Due to the absence of published questionnaires in most prior studies the questions were not directly adopted. The questions were designed based on the similar construct of planning and coordination efficiency, monitoring and control, and resource utilization (Ezeigweneneme et al., 2023; Chen et al. 2025; Gebreyesus, Thakkar, & Mena, 2024). The reliability and validity of the questionnaire items will be ensured as described in Section 3.7.

3.7 Data Analysis; – Model, Techniques and Software

3.7.1 Data Analysis Approach.

The Data collected by the quantitative and qualitative sources will be systematically analyzed to evaluate the impact of the SMT has on the project management processes and project performance. To use both data a mixed-method approach will be used, where the quantitative data will provide a measurable outcome and objective evidence of SMT's impact while the qualitative data will be providing a contextual insight into the user experiences, challenges, and perceptions (Creswell, 2014).

The study will employ Triangulation, where the result from the quantitative data is compared with qualitative insights to validate findings and identify the data can support or contradict each other. This integration can provide a general understanding of SMT's impact on project management and combining the measurable improvements with human experiences and perceptions (Creswell, 2014; Ezeigweneme et al., 2023).

3.7.2 Quantitative Data Analysis

The Quantitative data collected from the questionnaires and system logs will be analyzed using descriptive and inferential statistical techniques. The analysis will be conducted using statistical package for the social sciences (SPSS) or Jamovin, which can provide robust tools for statistical calculation and data visualization. These techniques can be defined as (Creswell, 2014; Patton, 2015; Bryman, 2016): -

- **Descriptive Analysis**: - this helps to measure the mean, median, mode, standard deviation and percentages which will summarize the usage of SMT, performance metrics, documentation accuracy, and resource allocation efficiency. Descriptive analysis will provide a clear picture of project management performance during the SMT implementation, and the perceived improvement on the project performance.
- **Inferential Analysis**: - Techniques such as correlation analysis and, as a supplementary an independent samples t-test will also be used to compare project performance before and after SMT implementation to determine the relationship between SMT usage and project management outcomes, Project performance indicators such as SAR duration, CW duration, and On-air duration will also be used for pre- and post-SMT comparison analysis. The analysis will be used to identify whether the introduction of the SMT has a statistically significant effect on project performance.

3.7.3 Qualitative Data Analysis

Thematic analysis will be used to analyze Qualitative Data collected from semi-structured interviews and document review, which is used for identifying recurring patterns and meanings within participants experience. The data will be managed and analyzed using excel or manual coding, depending on the volume of the data and its complexity of themes. Thematic analysis is suitable for this study because it allows the researcher to understand patterns in participant's

experiences and link them directly to the research objectives, helping to explain how SMT affects project management processes in telecom rollout projects. The process will involve (Creswell, 2014; Bryman, 2016); -

- Familiarization; - Transcribing interviews and reviewing responses to identify patterns and to have a general sense.
- Coding; - Labeling meaningful pieces of information related to SMT like usage, challenges, and benefits to organize that data in to measurable chunks for analysis.
- Theme Development; - by grouping related codes or tags into broader categories called themes it can reflect recuring concepts such as efficiency, collaboration, and documentation improvement.
- Interpretation; - by analyzing the themes and linking them to the research objectives and quantitative findings, it can provide a comprehensive understanding of SMT's impact.

3.8 Reliability and Validity Analysis

In the Context this study, establishing reliability and validity is critical to ensuring that the data collected and findings of the study are consistent, trustworthy, and represent the actual impact of the SMT on project management processes. Such are consistent with mixed-method research and case study analysis and justify the proposed research's rigor and trustworthiness. (Bryman, 2016; Yin, 2018). The detailed analysis results are explained more in chapter 4.

3.8.1 Reliability

Reliability refers to the consistency of measurement, meaning that if the study were repeated under similar conditions, similar results would be obtained (Bryman, 2016). To ensure reliability in this study the following are considered: -

- **Internal Consistency**: - To ensure that measurement of the questionnaire item is reliable, the study will apply the Cronbach's alpha to verify the internal consistency of the quantitative data, collected by the means of Likert-scale (Gliem & Gliem, 2003). If the internal consistency coefficient value based on Cronbach's alpha is above 0.7 the outcome is considered reliable.
- **Standardized Procedures**: - To make sure that all the participants have similar experience the study will follow a standard procedure during data collection. Ensuring that all the participants receive the same clear questionnaires and guidance. Making the questionary whether in form the interview or being filled out fair and to help limit the bias of the interviewer (Creswell, 2014; Bryman, 2016).

3.8.2 Validity

Validity ensures that the research instruments measure what they are intended to measure (Creswell, 2014). The following measures will be taken to enhance validity; -

- **Content Validity**: - questionnaires and interview guides will be developed based on the research objectives, research questions, and literature review. The instruments will be formally or informally reviewed by the experts in project management with experience in digital transformation to ensure that they will be relevant and complete (Creswell, 2014; Bryman, 2016).
- **Construct Validity**; - this will be ensured through factor analysis (EFA) and construct-based adaptation process, where each questionnaire item will be explicitly mapped to constructs identified in the studies conceptual framework and supported by prior studies. To ensures that the items accurately reflect the desired concepts and not isolated perceptions (Creswell, 2014; Bryman, 2016). Abstract project management constructs such as planning efficiency, monitoring accuracy, and resource utilization will be measured based on existing metrics derived from established metrics from related prior studies (Ezeigweneme et al., 2023).
- **Triangulation**: - combining data from questionnaires, interviews, and system reports will enhance validity by allowing cross-verification of findings. This will reduce bias and provides a more general understanding of SMT's impact on project management processes (Creswell, 2014; Bryman, 2016).

3.9 Ethical Consideration

All the research participants included in this study will be appropriately informed about the purpose of the research and their willingness and consent will be secured before the commencement of distributing questionnaire. Regarding the right to privacy of the respondents, the study will maintain the confidentiality of the identity of each participant. In all cases, names will be kept confidential thus collective names like, "respondents" can be used.

2. CHAPTER FOUR

4.1 Introduction

This Chapter presents the analysis and findings of the study on the impact of digital transformation, specifically the Site Management Tool (SMT), on project management processes and performance in Safaricom Ethiopia network rollout projects.

The Analysis follows descriptive statistical, reliability and validity test, inferential statistics (Correlation, regression, mediation, diagnostics test), and qualitative thematic analysis. Data was analyzed using IBM SPSS Statistical and PROCESS V5.0 applications, while qualitative response were analyzed using thematic analysis.

4.2 Response Rate and Demographic Information of the Respondents

4.2.1 Survey Response Overview

A total of 85 questionnaires was distributed to respondents involved in the Safaricom Ethiopia network rollout projects. Out of these, 76 responses were returned, resulting rate of 89.4%. All closed-ended questions were fully completed while response to open-ended questions were partially completed and analyzed in Section 4.10.

Response rate = (Returned response / Distributed) X 100

= (76/85) X 100 = 89.4%

Distributed	Returned	Completed Closed ended	Open-ended Partially Completed	Response Rate
85	76	76	Partially completed	89.4%

Table 2.1 Survey Response Summary

According to Mugenda (1999), a response rate of 50% is considered adequate, 60% is regrade as good, and any rate above 70% is classified as a very good; therefore a 89.4% response rate can be interpreted as excellent.

4.2.2 Demographic Information of Respondents and Frequency of Distribution

This section represents respondents' profile in terms of age, gender, experience, digital tool expertise and project location.

Variable	Category	Frequency	Percent (%)
Age	18–24	4	5.3
	25–31	53	69.7
	32–38	14	18.4

	39–45	5	6.6
Gender	Male	46	60.5
	Female	30	39.5
Experience in Telecom	Less than 2 years	9	11.8
	2–5 years	46	60.5
	6–10 years	14	18.4
	More than 10 years	7	9.2
Experience with PM Tools	Very Low	1	1.3
	Low	3	3.9
	Moderate	25	32.9
	High	29	38.2
	Very High	18	23.7
Primary Project Location	Urban	51	67.1
	Sub-Urban	13	17.1
	Rural	11	14.5
	Deep Rural	1	1.3

Table 2.2 Demographic characteristics of respondents

As shown in table 4.2 the majority of respondents were from age 25-32 years (69.7%), indicating a relatively young workforce. In terms of gender male respondents contribute 60.5%, while females accounted for 39.5%. In terms of the project location most respondents were involved in urban projects (67.1) followed by Sub-urban and rural areas.

Regarding the professional experience, most respondents (60.5%) had a 2–5-year experience in telecom/network rollout projects suggesting a moderately experienced sample. In addition, respondents reported having a generally high familiarity with digital management tools, with the majority indicating moderate to very high experience levels. This is further supported by the statistics in table 4.3, where the mean score result showed a 3.79 (SD=0.90) reflecting an overall high competency.

Variable	N	Mean	Median	Mode	Std. Deviation
Level of Experience with PM Tools	76	3.79	4	4	0.9

Table 2.3 Summary of statistics for digital tool experience

Overall, the demographic profile suggested that the data was collected from relevantly knowledgeable professionals with practical experience in both telecom projects and digital tools.

4.3 Reliability and Validity of Measurement Instrument

Reliability and validity are essential in ensuring the quality of a research instrument. As noted by Johann Mouton (2001), they enhanced the credibility and usefulness of research findings.

4.3.1 Reliability Analysis

In this study, reliability was assessed using Cronbach's Alpha to evaluate the consistent of the measurement scale. According to Hair et al. (2019), values above 0.70 are acceptable, those above 0.80 are good and above 0.90 are excellent, the results show that all constructs have Cronbach's Alpha value greater than 0.70, indicating acceptable to excellent reliability.

Construct	Cronbach's Alpha	Interpretation
SMT Usage	0.901	Excellent
Planning _PMP	0.857	Good
Monitoring _PMP	0.907	Excellent
Resource Mgmt. _PMP	0.911	Excellent
Project Performance	0.915	Excellent

Table 2.4 Reliability Statistics

Additionally, the "alpha if item deleted" values were lower than the overall Cronbach's Alpha coefficients, indicating that no items would improve the reliability if removed. This supported that retention of all items within their respective constructs (Hair et al.2019).

4.3.2 Validity of Measurement Instrument

Validity was ensured through questionnaires design, expert review, and alignment with the conceptual framework. Developed in Chapter Two.

- **Content validity**: - the questionnaires were developed directly from the study objectives and research variables. Each construct was fully covered using multiple related items to ensure Completeness. The instrument was reviewed by academic and field experts in project management and digital transformation from Safaricom Technology PMO departments. Their feedback was used to improve clarity and remove unclear wording.
- **Triangulation**: - findings from the questionnaire were compared with open-ended responses and to the results found form the t-test using the system extracted data. Both data sources showed similar patterns, This consistency increased confidence in the results.

4.3.2.1Construct Validity

Construct validity was assessed using theoretical items mapping and exploratory factor analysis (EFA). All questionnaire items were developed based on the conceptual framework. The rotated components matrix was examined to identify the underlying structure of the measurement items, items with high loading (greater than 0.5) on the same component were grouped together and interpreted based on their conceptual similarity.

According to Hair et al. (2019), the KMO value above 0.80 indicates meritorious sampling adequacy, while significant Bartlett's test ($P < 0.05$), confirms the suitability of the data for factor

analysis. Additionally, factor with eigenvalues greater than 1 and a cumulative variance exceeding 60% are considered acceptable, with factors loading above 0.50 regraded as practically significant (Hair et al., 2019).

For the PMP measurement items the kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was 0.878, indicating excellent suitability of the data for factor analysis, while Bartletts test of Sphericity was significant (X^2 = 1404.699, p < 0.001), confirming that correlation among items were sufficient for factor extraction.

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.878
Bartlett's Test of Sphericity	Approx. Chi-Square	1404.669
	df	210
	Sig.	<.001

Table 2.5 Factor analysis result for PMP

Using principal component analysis with Varimax rotation, three components with eigenvalues greater than 1 were extracted, explaining a cumulative variance of 70.59%.

Total Variance Explained

Component	Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	11.863	56.489	56.489	6.128	29.179	29.179
2	1.768	8.418	64.908	5.044	24.018	53.197
3	1.193	5.682	70.590	3.652	17.393	70.590

Extraction Method: Principal Component Analysis.

Table 2.6 Total variance for PMP

The analysis revealed three distinct components for the PMP. The first component includes items related to project monitoring, progress tracking and control which is labeled as the “Monitoring and control), the second component comprised items associated with resource allocation, utilization, and accountability and these was labeled as “Resource Management” lastly for the third component include items related to planning, coordination and scheduling this was labeled as “Planning and Coordination”.

Factor analysis conducted for SMT and PP result show that for SMT KMO = 0.828, and for PP KMO = 0.824 both having a significant Bartlett’s test (p < 0.01) confirming suitability with eigenvalues greater than 1. SMT explains 72.115% of the variance, while PP explained 60.908%. All items loaded strongly on their respective factors, indicating that each set of items measure a

single underlying construct, so the SMT was combine in one variable and the PP in another for further analysis.

Variable	KMO Value	Bartlett's Test (Sig.)	No. of Factors	Variance Explained	Result
SMT (SMTU)	0.828	0	1	72.12%	Unidimensional (Single construct)
Project Performance (PP)	0.824	0	1	60.91%	Unidimensional (Single construct)

Table 2.7 Factor analysis results for both the SMT and PP.

Overall, the results of the exploratory factor analysis indicate that all constructs met the recommenced thresholds for construct validity. Specifically, KMO values exceeded 0.80, Bartlett's test was statistically significant, having eigenvalues were greater than 1, total variance explained exceeded 60%, and all factors loading were above 0.50.

In conclusion, construct validity was successfully established for all study variables. The measurement model is therefore valid and suitable for further statistical analysis.

4.4 Descriptive Statistics of Study Variables

This section presents the descriptive statistical analysis of the main study variables used in the research. The analysis was conducted using IBM SPSS Statistics, including the mean, standard deviation, minimum, and maximum values for each construct.

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
SMTU	76	1.00	5.00	4.5789	.60361
PP	76	1.00	5.00	4.3158	.63338
Pla	76	1.00	5.00	4.3596	.76355
Res	76	1.00	5.00	4.2105	.73168
Mon	76	1.00	5.00	4.4492	.61443
Valid N (listwise)	76				

Table 2.8 Descriptive Statistics of Study Variables

As stated by Mohammad Zaidan and Ali Bagheri (2009), a five-point Likert scale's mean values can be interpreted as low when the mean value is below 3.40, moderate when value is between 3.40-3.79 and high when the value is above 3.80. Based on this classification, the result of the study indicates that all the variables have high mean values (above 4.0), suggesting a generally strong agreement among respondents regarding SMT usage, project management processes and project performance.

4.5 Correlation Analysis

Pearson correlation analysis was conducted to examine the relationship between SMT usage, project performance (PP) and project management processes (PMP) dimensions which are the planning and coordination (Pla), monitoring and controlling (Mon), and resource management (Res). According to Schober et al. (2018), correlation coefficients between 0.40-0.69 indicate moderate relationship, while values between 0.70-0.89 indicate a strong relationship. Also, Field (2018) and Pallant (2020) recommend interpreting correlation based on the magnitude and statistical significance ($p < 0.05$). The results indicate that all key study variables are positively and significantly correlated at the 0.01 significance level.

The findings show that SMT usage has a positive correlation with PP ($r = 0.672$, $p < 0.001$), indicating that increased use of SMT is associated with improved PP outcomes. SMT is also positively correlated and significantly correlated with all dimensions of PMP including planning and coordination ($r = 0.659$, $p < 0.01$), resource management ($r = 0.609$, $p < 0.01$), and monitoring and control ($r = 0.731$, $p < 0.01$). among these the strongest relationship is observed between SMT usage and monitoring and control suggesting that SMT particularly enhanced real-time tracking and control mechanisms in project execution.

Correlations

		SMTU	PP	Pla	Res	Mon
SMTU	Pearson Correlation	1	.672**	.659**	.609**	.731**
	Sig. (2-tailed)		<.001	<.001	<.001	<.001
	N	76	76	76	76	76
PP	Pearson Correlation	.672**	1	.840**	.854**	.765**
	Sig. (2-tailed)	<.001		<.001	<.001	<.001
	N	76	76	76	76	76
Pla	Pearson Correlation	.659**	.840**	1	.663**	.666**
	Sig. (2-tailed)	<.001	<.001		<.001	<.001
	N	76	76	76	76	76
Res	Pearson Correlation	.609**	.854**	.663**	1	.634**
	Sig. (2-tailed)	<.001	<.001	<.001		<.001
	N	76	76	76	76	76
Mon	Pearson Correlation	.731**	.765**	.666**	.634**	1
	Sig. (2-tailed)	<.001	<.001	<.001	<.001	
	N	76	76	76	76	76

**. Correlation is significant at the 0.01 level (2-tailed).

Table 2.9 Correlation Matrix

Furthermore, the results indicate that all PMP dimensions have strong positive correlations with project performance. planning and coordination ($r = 0.840$, $p < 0.01$), resource management ($r = 0.854$, $p < 0.01$), and monitoring and control ($r = 0.765$, $p < 0.01$) are all significantly associated with improved PP. among these, resource management shows the strongest relationship with project PP, followed by planning and coordination, and monitoring and control.

Overall, the correlation results provide preliminary evidence supporting the study's conceptual framework, indicating that SMT usage is associated with enhanced project management processes, which in turn are strongly related to improved project performance.

4.6 Diagnosis Tests

4.6.1 Linearity Test

The linearity assumption was assessed using a scatterplot of standardized predicted values against standardized residuals (See Figure 4.3). The plot was used to determine whether the relationship between the IV (SMT usage) and the DV (PP) follows a linear pattern. The result show that the data points are randomly and evenly distributed around the Horizontal axis, without showing any clear curvature or systematic deviation. This suggests that the relationship between the study variables is approximately linear, and the linearity assumption required for regression analysis is satisfied (Field, 2018; Pallant, 2020; Hair et al., 2019).

4.6.2 Multicollinearity

Multicollinearity diagnostics were conducted to assess the independence of predictor variables. The results were assessed using Variance Inflation Factor (VIF) and tolerance values. According to established guidelines, tolerance value below 0.10 and VIF values above 10 indicate serious multicollinearity, while VIF values above 5 may suggest moderate concern (Hair et al., 2019; Field, 2018). The findings show that all the variables fall well within acceptable thresholds.

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Tolerance	VIF
1	(Constant)	.313	.204		1.532	.130		
	SMTU	-.058	.066	-.055	-.874	.385	.402	2.489
	Pla	.340	.051	.410	6.724	<.001	.430	2.327
	Res	.402	.050	.465	8.067	<.001	.482	2.077
	Mon	.245	.067	.238	3.682	<.001	.384	2.605

a. Dependent Variable: PP

Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions				
				(Constant)	SMTU	Pla	Res	Mon
1	1	4.961	1.000	.00	.00	.00	.00	.00
	2	.017	17.301	.51	.01	.16	.18	.00
	3	.010	22.231	.03	.02	.44	.80	.01
	4	.008	25.682	.44	.19	.39	.01	.31
	5	.005	32.466	.02	.79	.00	.00	.67

a. Dependent Variable: PP

Table 2.10 Multicollinearity Test Result and Coefficients

4.6.3 Normality Test

Normality testing is performed to evaluate whether the residuals are normally distributed. This assumption is assessed through visual examination of histograms and normal probability plot.

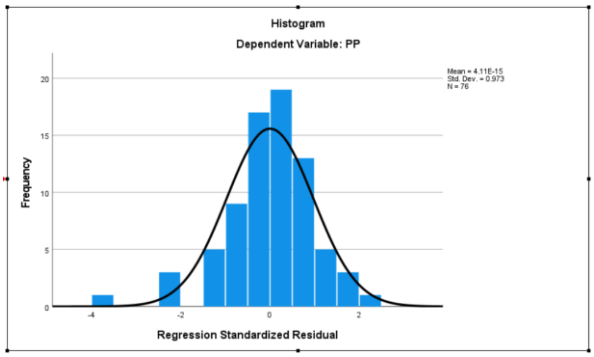


Figure 2.1 Histogram and P-Plot

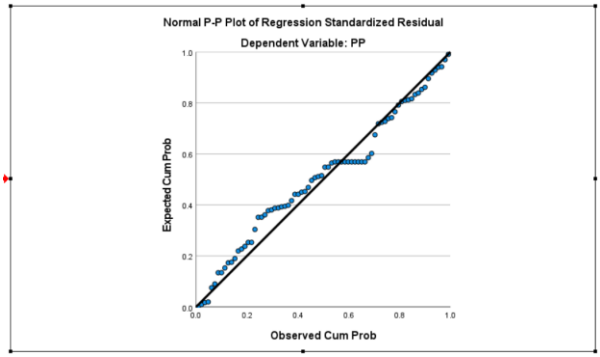


Figure 2.2 Normal probability plots

Although the data exhibited some deviations from normal in terms of skewness and kurtosis, Pearson correlation was used as the primary analysis due to its robustness to moderate violations of normality (Field, 2018). To further validate the results, a parallel Spearman's rank-order correlation analysis was conducted and since the findings from both methods were highly consistent in terms of direction and statistical significance, indicating that the non-normality did not substantially affect the relationship between the variables and that the results are reliable.

4.6.4 Homoscedasticity

The Homoscedasticity assumption was evaluated using a scatterplot of standardized predicted values against standardized residuals.

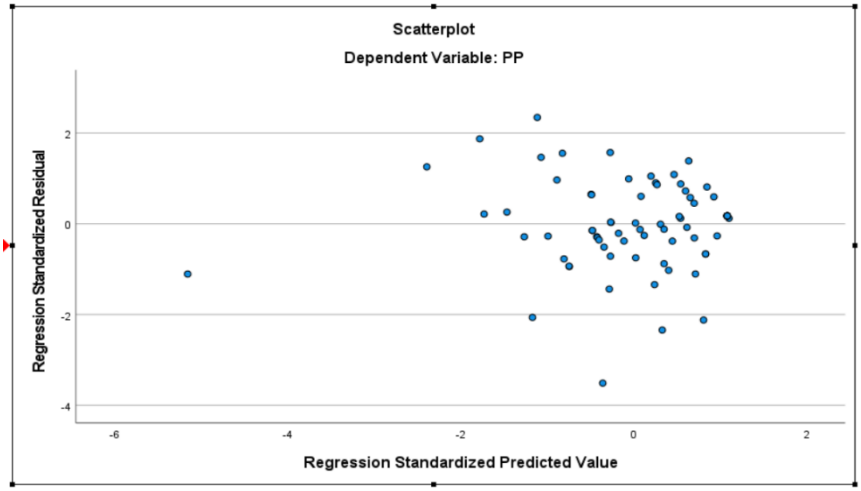


Figure 2.3 Scatterplot of Standardized Residuals vs Standardized Predicted Values (Linearity and Homoscedasticity Test)

The Scatterplot of standardized residuals against standardized predicted values indicate that the residuals were randomly dispersed around the horizontal axis, without exhibiting and clear pattern, curvature, or funnel shape. This indicate that the variance of residuals is constant across all levels of predicted values confirming that the assumption of homoscedasticity is satisfied (Field, 2018; Hair et al., 2019).

Overall, the diagnostics test confirmed that all key regression assumptions, including linearity, normality, homoscedasticity, and absence of multicollinearity were satisfied. Therefore, the data were considered suitable for further regression and mediation analysis.

4.7 Regression Analysis

This Study used a combination of simple liner regression, multiple regression and multivariate regression techniques to test the direct and indirect effects.

The interpretation of the regression results was based on established threshold from Hair et al., (2019) for R2 and Field (2018) where R2 values of 0.25 indicate weak, 0.50 moderate, and 0.75 explanatory power and for effect size Schober et al. (2019) standard was referred where standardized beta coefficients above 0.50 represents strong effects.

4.7.1 Regression Analysis: Effect of SMTU on Project Performance (PP) (Model 1)

This section presents the regression results for the direct effect of SMT usage on PP.

- **Model Summary**; - indicates a strong relationship between SMT usage and PP, With R = 0.672 and R^2 = 0.452, shows that SMT usage explain the 45.2% of the variation in PP. The adjusted - R^2 (0.444) confirms the stability of the model.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.672[a]	.452	.444	.47215	.452	60.970	1	74	<.001

a. Predictors: (Constant), SMTU

Table 2.11 Model summary form SMT's Impact on PP

- **ANOVA (Model Significance);** - results shows that the regression model is statistically significant (F = 60.970 and p < 0.001), indicating that SMT usage can predict project performance.

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	13.592	1	13.592	60.970	<.001[b]
	Residual	16.496	74	.223		
	Total	30.088	75			

a. Dependent Variable: PP

b. Predictors: (Constant), SMTU

Table 2.12 Effect of SMTU on PP ANOVA

- **Coefficients (effect of SMT); -** indicates that SMT usage has a significant positive effect on PP (B= 0.705, β = 0.672, t = 7.808, and p < 0.001). This implies that an increase in SMT usage leads to an improvement in PP.

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	1.086	.417		2.605	.011	.255	1.918
	SMTU	.705	.090	.672	7.808	<.001	.525	.885

a. Dependent Variable: PP

Table 2.13 Effect of SMTU on PP Coefficient

4.7.2 Regression Analysis: Effect of SMTU on PMP (Model 2)

In this section model 2 was examined by running 3 separate regressions to understand the relationship of SMT and PMP.

A. **Model 2A; - SMT's Effect on Planning and Coordination (Pla)**

- **Model Summary; -** results show that the relationship between SMT usage and Project planning and coordination is moderately strong, With R = 0.659 and R2 = 0.434, show that SMT usage explains the 43.4% of the variation in Planning and coordination. The adjusted - R2 (0.434) confirms the stability of the model.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.659[a]	.434	.426	.57824	.434	56.772	1	74	<.001

a. Predictors: (Constant), SMTU

Table 2.14 Model 2A (SMT impact on Planning and Coordination)

- **ANOVA (Model Significance);** - results shows that the regression model is statistically significant (F = 56.772, and p < 0.001), indicating that SMT usage can significantly predict project planning and coordination.

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	18.982	1	18.982	56.772	<.001[b]
	Residual	24.743	74	.334		
	Total	43.725	75			

a. Dependent Variable: Pla

b. Predictors: (Constant), SMTU

Table 2.15 Effect of SMTU on Pla ANOVA

- **Coefficients (effect of SMT); -** indicates that SMT usage has a significant positive effect on Pla (B= 0.833, β = 0.659, t = 7.535, and p < 0.001). this implies that increase in SMT usage leads to an improvement in Project planning and coordination.

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			95.0% Confidence Interval for B	
		B	Std. Error	Beta	t	Sig.	Lower Bound	Upper Bound
1	(Constant)	.543	.511		1.064	.291	-.475	1.561
	SMTU	.833	.111	.659	7.535	<.001	.613	1.054

a. Dependent Variable: Pla

Table 2.16 Effect of SMTU on Pla Coefficient

B. **Mode2B; - SMT's Effect on Resource Management and accountability (Res)**

- **Model Summary; -** results show that the relationship between SMT usage and resource management processes are moderately strong, With R = 0.609 and R2 = 0.371, shows that SMT usage explain the 37.1% of the variation in resource

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.609[a]	.371	.363	.58418	.371	43.655	1	74	<.001

a. Predictors: (Constant), SMTU

Table 2.17 Model 2B (SMT impact on Resource Management)

management processes. The adjusted - R2 (0.363) confirms the stability of the model.

- **ANOVA (Model Significance);** - results show that the regression model is statistically significant (F = 43.655, and p < 0.001), indicating that SMT usage can significantly predict resource management processes in project execution.

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	14.898	1	14.898	43.655	<.001[b]
	Residual	25.254	74	.341		
	Total	40.152	75			

a. Dependent Variable: Res

b. Predictors: (Constant), SMTU

Table 2.18 Effect of SMTU on Res ANOVA

- **Coefficients (effect of SMT); -** indicates that SMT usage has a significant positive effect on Res (B= 0.738, β = 0.609, t = 6.607, and p < 0.001). this implies that increase in SMT usage leads to an improvement of resources allocation and utilization efficiency in project.

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			95.0% Confidence Interval for B	
		B	Std. Error	Beta	t	Sig.	Lower Bound	Upper Bound
1	(Constant)	.830	.516		1.607	.112	-.199	1.858
	SMTU	.738	.112	.609	6.607	<.001	.516	.961

a. Dependent Variable: Res

Table 2.19 Effect of SMTU on Pla Coefficient

C. Model 2C; - SMT's Effect on Monitoring and Control (Mon)

- **Model Summary; -** results show that the relationship between SMT usage and project monitoring and control processes are moderately strong, With R = 0.731 and R2 = 0.535, shows that SMT usage explains the 53.5% of the variation in monitoring and control processes. The adjusted - R2 (0.529) confirms the stability of the model. For more information refer table 4.25.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.731[a]	.535	.529	.42177	.535	85.171	1	74	<.001

a. Predictors: (Constant), SMTU

Table 2.20 Model 2C (SMT impact on Monitoring and Control)

- **ANOVA (Model Significance);** - results show that the regression model is statistically significant ($F = 85.171$, and $p < 0.001$), indicating that SMT usage can significantly predict monitoring and control processes.

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	15.151	1	15.151	85.171	<.001[b]
	Residual	13.164	74	.178		
	Total	28.314	75			

a. Dependent Variable: Mon

b. Predictors: (Constant), SMTU

Table 2.21 Effect of SMTU on Mon Coefficient

- **Coefficients (effect of SMT); -** indicates that SMT usage has a significant positive effect on Mon ($B = 0.745$, $\beta = 0.731$, $t = 9.229$, and $p < 0.001$). this implies that increase in SMT usage leads to an improvement in tracking, control, and real-time monitoring of project.

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	1.040	.373		2.790	.007	.297	1.782
	SMTU	.745	.081	.731	9.229	<.001	.584	.905

a. Dependent Variable: Mon

Table 2.22 Effect of SMTU on Mon Coefficient

In conclusion, the regression analysis for model 2 confirms that SMT usage has a statistically significant positive effect on all the dimensions of PMP. Including planning and coordination, resource management, and monitoring and control. Among these, monitoring and control exhibit the strongest influence, followed by planning and coordination, and resource management. This indicates that SMT plays a critical role in improving project control, coordination, and execution efficiency in network rollout projects.

4.7.3 Regression Analysis: Effect of PMP dimensions on PP (Model 3)

- **Model Summary; -** results show that the relationship between PMP and PP are very strong, With R = 0.941 and R2 = 0.885, show that PMP explains 88.5% of the variation in PP. The adjusted - R2 (0.880) confirms the stability of the model. For more information refer table 4.26.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.941[a]	.885	.880	.21899	.885	185.134	3	72	<.001

a. Predictors: (Constant), Mon, Res, Pla

Table 2.23 Model (PMP impact on PP)

- **ANOVA (Model Significance);** - results show that the regression model is statistically significant (F = 185.134, and p < 0.001), indicating that PMP can significantly predict PP.

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	26.635	3	8.878	185.134	<.001[b]
	Residual	3.453	72	.048		
	Total	30.088	75			

a. Dependent Variable: PP

b. Predictors: (Constant), Mon, Res, Pla

Table 2.24 Effect of PMP on PP ANOVA

- **Coefficients (effect of SMT); -** indicates that PMP has a significant positive effect on PP. the results suggest that resource management has the strongest influence (β = 0.457), followed by planning and coordination (β = 0.397), and monitoring (β = 0.211).

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	.247	.189		1.303	.197	-.131	.624
	Pla	.329	.049	.397	6.735	<.001	.232	.426
	Res	.396	.049	.457	8.043	<.001	.298	.494
	Mon	.218	.059	.211	3.706	<.001	.101	.335

a. Dependent Variable: PP

Table 2.25 Effect of PMP on PP Coefficient

4.7.4 Model Fit

Model fit analysis was conducted to assess how well the regression model explains the relationship between the study variables. The model summary statistics are used to evaluate the explanatory power of the models.

- **Model 1 (SMT's Impact on PP); -** SMT explains 45.2% of the project performance outcomes. The model is statistically significant (sig. (P) < 0.01), indicating that SMT has a meaningful direct effect on project performance outcomes. Although SMT usage shows significant in model 1, its effect is insignificant when the mediation is introduced.
- **Model 2 (SMT's Impact on PMP); -** SMT explains 43.4% of the planning and coordination, 37.1% of the resource management and control and 53.5% of the monitoring and control of the project management processes. All three models are statistically significant (sig. < 0.01), indicating that SMT has a meaningful direct effect on project management processes process.
- **Model 3 (PMP's Impact on PP); -** PMP explains 88.5% of the project performance outcomes. The model is statistically significant (sig. < 0.01), indicating that PMP has a meaningful direct effect on project performance outcomes
- **Model 4 (Mediation Effect) -** SMT and PMP explain 88.6% of the project performance. The model is statistically significant (sig. < 0.01), indicating that SMT will have a meaningful effect project performance outcome when it is mediated by PMP.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.942[a]	.886	.880	.21935	.886	138.586	4	71	<.001

a. Predictors: (Constant), Mon, Res, Pla, SMTU

Table 2.26 Model for mediation effect

In conclusion, the model fit results show that the study framework is statistically sound. SMT significantly affects the PMP, while PMP has a stronger influence on PP, Although SMT has a direct effect on PP, its main impact is indirectly through PMP, indicating that SMT improves PP mainly by strengthening PMP.

4.7.5 Summary of Regression Analysis

The regressions analysis was conducted to examine the nature strength, and direction of relationships between SMT usage, project management processes and project performance. The results reveal a consistent pattern across all models. SMT usage has a significant positive relationship with project performance and strong positive effect on all dimensions of project management processes, However, project management processes emerge as the strongest predictor of project performance, explaining a large proportion of its variation. The how and why of the relationship will be explained by the mediation analysis in section 4.8.

4.8 Mediation Analysis: Effect of SMT+ PMP on PP (Model 4)

The mediation analysis was conducted to examine whether PMP mediates the relationship between SMT usage and the PP. The analysis was performed using PROCESS macro for SPSS (Version 5.0), applying Model 4, incorporating three parallel mediators. The model is constructed using the below variables

- Independent variables – Site Management Tool (SMT)
- Dependent Variables – Project Performance (PP)
- Mediators Variables --- 3 dimensions of Project Management Processes (PMP); - Planning and Coordination (Pla), Resource Management (Res) and Monitoring and Control (Mon)

The mediation analysis was interpreted following the framework of Hayes (2018), which emphasizes that indirect effects as the primary mechanism in mediation analysis, and Baron and Kenny (1986), who defined a full mediation as the condition where the direct effect becomes statistically insignificant when the mediator is included.

The mediation analysis results are interpreted as below: -

1. **Total Effect of SMT usage on Project performance**: - The total effect model examines the overall relationship between SMT usage and project performance without considering

mediating variables and the results are consistent with model 1 test results (β = 0.705, p < 0.05) suggesting that increased utilization of SMT contributes to improved project performance outcomes in Safaricom Ethiopia Network rollout project. However, when mediators are included, the effect becomes insignificant as shown below.

2. **Direct Effect of SMT usage on Project Performance; -** when the mediating variables are included in the model, the direct effect of SMT usage on project performance becomes statistically insignificant (β = 0.002, P > 0.05). This indicates that SMT usage does not directly influence project performance when project management processes are accounted for suggesting the presence of mediating mechanisms.
3. **Indirect Effects (Mediation Analysis);** - the total indirect effect of SMT usage on project performance through the combined mediators is positive and statistically significant (β = 0.703, p < 0.05). This confirms that project management plays a crucial role in transmitting the effect of SMT usage on project performance.

```
************** TOTAL, DIRECT, AND INDIRECT EFFECTS OF X ON Y **************

Total effect of X on Y
     Effect         se          t          p       LLCI       ULCI
      .7053      .0903     7.8083     .0000     .5253     .8852

Direct effect of X on Y
     Effect         se          t          p       LLCI       ULCI
     .002       .0662      .6344      .3850     -.0879      .1718

Indirect effect(s) of X on Y:
          Effect     BootSE   BootLLCI   BootULCI
TOTAL      .7031      .1557      .4163     1.0183
Pla        .2636      .0737      .1328      .4308
Res        .2772      .0715      .1662      .4466
Mon        .1624      .0722      .0657      .3442

************************ ANALYSIS NOTES AND ERRORS ************************

Level of confidence for all confidence intervals in output:
  95.0000

Number of bootstrap samples for bias-corrected bootstrap confidence intervals:
  5000

------ END MATRIX -----
```

Figure 2.4 Mediation Analysis results

The findings suggest that SMT usage enhance key project management processes specifically planning and coordination, resource management, and monitoring and control which leads to improved project performance. Resource management (with values β = 0.277, 95% [0.166, 0.447]) emerges as the most influential pathway followed by planning and coordination (with values β = 0.264, 95% [0.133, 0.431]) and lastly monitoring and control (with values β = 0.162, 95% [0.066, 0.344]).

It is important to note that the total effect of SMT usage on project performance (β = 0.705) is slightly higher than the indirect effect (β = 0.703). This difference is expected, as the total effect represents the sum of both direct and indirect effects (Hayes, 2018).

Total Effect (c) = Direct effect (c') + Indirect effect (a x b) _____ (Hayes, 2018).

$$0.705 = 0.002 + 0.703 \sim 0.705\text{-}0.703 = 0.002$$

The small difference (0.002) indicates that nearly all the effect of SMT usage on PP is carried through the mediating variable satisfying the Hayes's (2018) interpretation of full mediation, which emphasizes that mediation is established when the indirect effect accounts for the majority of the total effect, regardless of small difference between coefficients (Hayes, 2018).

The overall result implies that effectiveness of digital transformation tools such as SMT lies not in their direct impact on project performance outcomes, but in their ability to strength internal project management processes indicating full mediation, as the direct effect of SMT becomes insignificant while indirect effects remain significant as per Baron &Kenny (1986). This finding is consistent with digital transformation theory, which suggests that the value of digital technologies is realized through organizational and process-level changes rather than direct performance effects (Vial, 2019).

4.9 Independent Samples t-Test Analysis

Secondary validation analysis was conducted using system-generated operational metrics conducted independent sampling t-test analysis to examine whether there is a statistically significant difference between project performance between pre-SMT and post-SMT implementation projects. The analysis focused on the three key performance indicators mainly on the duration of the activities in the Safaricom network rollout projects such as the SAQ duration, CW duration, and On-Air duration. This analysis provides additional objective evidence of SMT impact using project-level performance indicators.

The data was extracted from the Site Management tool which were controlled for key characteristics such as site location, tower height, tower type, project team and project scale, 19 sites were identified from both pre-SMT and post-SMT each that satisfy the mention characteristics.

Group Statistics					
	SMT_Group	N	Mean	Std. Deviation	Std. Error Mean
SAR Duration	Pre-SMT	19	152.58	82.770	18.989
	Post-SMT	19	52.89	11.055	2.536
CW Duration	Pre-SMT	19	43.32	12.512	2.871
	Post-SMT	19	29.58	6.585	1.511
On-Air_Duration	Pre-SMT	19	86.95	57.293	13.144
	Post-SMT	19	45.58	7.471	1.714

Table 2.27 Group Statistics

Independent Samples Test										
		Levene's Test for Equality of		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
SAR Duration	Equal variances assumed	35.14	0	5.2	36	0	99.684	19.157	60.83	138.537
	Equal variances not assumed			5.2	18.64	0	99.684	19.157	59.54	139.833
CW Duration	Equal variances assumed	1.89	0.178	4.24	36	0	13.737	3.244	7.158	20.316
	Equal variances not assumed			4.24	27.26	0	13.737	3.244	7.084	20.39
OnAir_Duration	Equal variances assumed	18.45	0	3.12	36	0.004	41.368	13.255	14.49	68.251
	Equal variances not assumed			3.12	18.61	0.006	41.368	13.255	13.59	69.151

Table 2.28 Independent Samples t-Test Results

The independent sampling t-test results indicate that implementation of the Site Management Tool (SMT) has led to a statistically significant improvement in project performance. The observed reductions in project duration across the key phases suggests that SMT contributes to more efficient execution of telecom networks rollout activities. These improvements reflect the ability to enhance project planning and coordination, monitoring and control and resource management, enabling teams to manage tasks more effectively and reduce delays throughout the project life cycle. This finding aligns with established project management literature, which associates reduced project cycle time with improved process efficiency and better coordination of project activities (Kerzner, 2019; Oesterreich & Teuteberg, 2016). Furthermore, the use of system generated operational data provides additional objective validation of the findings, supporting the triangulation of qualitative results (Yin, 2018).

The overall findings confirms that SMT (digital tool) plays a critical role in improving the project efficiency and supports the adoption of digital tools as a means of strengthening project management processes which leads to improvement of project performance (Vial, 2019). This finding is consistent with the findings of the quantitative analysis.

4.10 Qualitative Data Analysis

4.10.1 Thematic Analysis of SMT usage

Thematic analysis was conducted following the framework of Braun and Clarke (2006), involving data familiarization, coding, theme development. The table below shows the themes developed and the key words used to group them into the respective themes.

THEME	Mapped to	Key words	Interpretations
THEME 1	SMT (System centralization)	Centralized platform Single source of truth Integrated workflows Reduced fragmentation	SMT provides a unified platform for managing documents tracking site progress, and coordinating stakeholders, eliminating the inefficiencies associated with fragmented manual system and established a single source of truth across projects.
THEME 2	enhanced Monitoring and control	Real-time tracking Progress visibility Accountability Transparency	Respondents emphasized real-time tracking, improved transparency, and increased accountability, and this aligns with quantitative findings where monitor and control showed the strongest relationship with SMT usage
THEME 3	Improved planning and coordination	Better scheduling Faster reporting Workflow alignment Reduced delays	respondents noted that improvement in planning and coordination including fast reporting, better scheduling and streamlined workflows, which contributed to reduces delays and improved project execution
THEME 4	enhanced Resource Management	Better allocation Reduced idle time Data-driven decisions Performance tracking	It was indicated that SMT improved resource allocation efficiency, reduced idle time and increased reliance on data-driven decisions
THEME 5	improved Project Performance	Faster delivery Reduced delays Improved efficiency Better quality & accountability	respondents also have indicated that this collective improvement contributed to improvement of project performance outcomes, including fast project completion, improved efficiency and stronger coordination among stakeholders.
THEME 6	system challenges and limitations	Connectivity issues System downtime Data accuracy problems Limited flexibility Training gaps Offline capability	Several challenges and recommendations were also identified which is include in the chapter 5.

THEME 7	Recommendations for improvement	Training programs	
		Integration	
		Better dashboards	
		Performance upgrades	

Table 2.29 Thematic analysis result

The Thematic analysis findings strongly support and reinforce these results. Respondents consistently emphasized the role of SMT in enhancing real-time monitoring, improving visibility, and strengthening accountability which aligns with the quantitative findings that monitor and control exhibited the strongest relationship with SMT usage. Similarly, improvement in planning, coordination, and workflow efficiency identified in the qualitative data confirms the significant positive relationship between SMT usage and planning and coordination processes. This find demonstrates methodological triangulation, which enhances the validity and reliability of the study results (Creswell, 2018).

The qualitative findings also highlighted improved resource allocation, reduced idle time and increased reliance on data-driven decision-making. These insights directly support the qualitative results, where resources management was identified as the most influential predictors of project performance. This confirms that effective resource management serves as a critical mechanism through which SMT contributes to improved project outcomes (Vial 2019).

Additionally, respondents indicated that the combined improvements in monitoring, planning, and resource management led to enhanced project performance, including fast delivery, improved efficiency, and better coordination this is consistent with mediation analysis, which revealed that the direct effect of SMT on project performance become insignificant when project management processes are introduced indicating full mediation.

In conclusion, the qualitative findings proved contextual depth and practical explanation for the statistical strong relationships identified in the quantitative analysis. This convergence of results demonstrates a strong triangulation.

4.11 Summary of the hypothesis Test

Hypothesis	Relationship	Empirical Basis (Quantitative + Qualitative)	Result	Decision
H1	Using SMT has a significant positive effect on project management processes.	Regression and correlation results show a significant positive relationship; qualitative data confirms improvements in planning, monitoring, communication, documentation, and resource allocation through SMT.	Significant positive effect	**Supported**
H2	Using SMT has a significant positive effect on project performance.	Quantitative results indicate a positive influence of SMT on performance indicators; respondents also reported improved efficiency, faster delivery, and better coordination due to SMT adoption.	Positive total effect observed (full mediation)	**Supported**
H3	Effective Project management processes have a significant positive effect on project performance	Statistical analysis shows strong positive relationship; qualitative evidence confirms that improved planning, tracking, and coordination lead to better project execution and outcomes.	Significant positive effect	**Supported**
H4	Project management processes mediate the relationship between SMT usage and project performance.	Mediation analysis indicates that the effect of SMT on performance is largely transmitted through project management processes; qualitative findings reinforce that SMT improves performance mainly by enhancing PMP processes.	Significant mediation effect	**Supported**

Table 2.30 Hypothesis analysis

4.12 Discussion of Findings

The findings of this study demonstrate that SMT usage has a significant positive effect on PMP and PP in Safaricom Ethiopia network rollout projects. The results indicate that increased use of SMT improves planning and coordination, monitoring and control, and resource management, which subsequently enhances PP outcomes. These findings support that digital transformation literature. Which argues that that digital technologies improve organizational performance by enhancing coordination, information flow, and operational efficiency (Vial, 2019).

The study also revealed that monitoring and control had the strongest relationship with SMT usage suggesting that SMT plays a critical role in improving real-time tracking, transparency, accountability, and reporting during project execution. The qualitative findings further support this result, as the respondents emphasized that after SMT was implement there was a significant

improvement in visibility, faster reporting and better workflow coordination. These findings are consistent with the work if Harold Kerzner (2019), who emphasized that effective monitoring and control systems are essential for successful project execution.

The findings also show that PMP have a strong positive effect on PP, with resource management emerging as the strongest predictor. This implies that effect resource allocation and utilization are important divers for a successful telecom rollout project. Respondents also indicated that SMT improved resource tracking, reduced delays and supporting the data-driven decision- making consistence with the qualitative findings.

The mediation analysis, confirmed that PMP fully mediate the relationship between SMT usage and PP. the direct effect of SMT on PP becomes insignificant after introducing the mediation variables, while the indirect effect remained significant. This indicates that SMT improves PP mainly through strengthening planning and coordination, monitoring and control, and resource management processes. These findings are supported by mediation framework proposed by Andrew F. Hayes (2018) and is consistent with digital transformation theory, which suggest that the value of digital tools is realized through process level improvement greater than direct performance outcomes alone (Vial, 2019).

Overall, the findings suggest that the effectiveness of digital transformation tools such as SMT depends on their ability to strengthen internal project management processes suggesting that organizations should focus not only on technology adoption, but also on improving project management capabilities to maximize project performance outcomes.

3. CHAPTER FIVE

5.1 Summary of Findings

The key findings of the study on the impact of the Site Management Tool (SMT) on project management processes and performances in the Safaricom Ethiopia network rollout projects are summarized as below; -

- The study has established that using SMT has a strong and statistically significant positive effect on project management processes. All the measured dimensions of the project management processes including planning and coordination, monitoring and control, and resource management were all positively affected by SMT usage.
- There was also a positive relationship between SMT usage and project performance suggesting that SMT has a significant direct effect on the project performance in the absence of mediators and this effect becomes insignificant when PMP is introduced as a mediator.
- Project management processes have emerged as a very strong and significant predictor of project performance. Among the PMP dimensions, planning and coordination, monitoring and control and resource management have emerged as the most influential predictors of the project performance highlighting their critical role in the successful project execution.
- Mediation analysis showed that project management processes completely mediate the relationship between SMT use and project performance. the direct effect of SMT on project performance was insignificant when the mediator is present. The research found that SMT use is related to project performance via improving project management processes.
- The independent sample t-test using was conducted using the system generated data which offered further operational evidence of the effect of SMT. The result showed that post-SMT projects had a significantly lower duration in the execution of the SAR, civil work construction and the on-air deployment compared to the pre-SMT project, confirming improved project efficiency after SMT adoption.
- The qualitative findings supported the quantitative results. Respondents consistently reported that SMT improved PMP dimensions, however challenges such as system limitation, training gaps and internet connectivity issues were also identified.

5.2 Conclusion of the Study

This study concludes that the implementation and use of the Site Management Tool (SMT) have significantly enhanced project management processes and project performance in Safaricom Ethiopia's network rollout projects. These findings confirm that SMT plays a crucial role in the improvements on how projects are planned, monitored, coordinated and documented.

However, SMT does not directly impact the project performance, instead its impact is fully realized through its influence on project management processes. This indicates that the effect of SMT on

project performance is fully mediated by project management processes, indication that SMT improves performance indirectly through strengthening core PMP.

The study further concludes that effective project management processes particularly in planning and coordination, monitoring and control, and resource management are the strongest drivers for an improved project performance. Therefore, the success of digital tools like SMT depends not only on their implementation but also on how effectively they enhance these core management processes.

Overall, the study confirms that Digital transformation in project environment is most effective when it taken as to strengths managerial processes rather than being viewed as a direct performance driver. The findings are aligned with studies that indicate digital tools primarily enhance project outcomes by strengthening core project management functions such as planning, coordination and monitoring (Chen et al., 2025; Marnewick & Marnewick, 2022). Similarly, digital infrastructures have been shown to improve the coordination and control mechanisms in project environment (Whyte & Lobo, 2010), while broader digital transformations research emphasizes that value creation is often realized through intermediate organizational processes rather than direct effects (Vial, 2019).

5.3 Recommendations

Based on the findings of this study and the open-questions, the following recommendations are made; -

- **Increase the integration of SMT into project planning and coordination activities;** - the study found that found that planning and coordination significantly mediate the relationship between SMT utilization and project performance. Therefore, Safaricom Ethiopia should strength the use of SMT during project planning, scheduling, task assignment, milestone tracking, and stakeholder coordination activities. Ensuring that project planning information is centrally managed through SMT can improve communication, coordination efficiency, and execution consistency across project sites.
- **Expand the use of SMT for monitoring and control functions; -** the findings also indicate that monitoring and control play a significant role in improving PP. Project teams should maximize the use of SMT's monitoring capability, including progress tracking, issue escalation, milestone verification can facilitate faster decision-making and improve project over sites.
- **Strengthen resource management through SMT-enabled process**: - The study established that resource management contributes significantly to PP. Safaricom Ethiopia should therefore utilize SMT more extensively for resource planning, allocation, utilization tracking, and performance monitoring to enhance visibility of resource availability.
- **Align SMT implementation with project management process improvement initiatives**; - The mediation result demonstrates that the benefits of SMT are realized primarily through improvements in project management processes. Accordingly,

management should focus not only on increasing system utilization, but also strengthening planning and coordination, monitoring and control, and resource management processes. Investments in technology should be accompanied by process improvement initiatives to maximize project performance outcomes.

5.4 Research Limitations and Areas for Future Research

5.4.1 Limitation of the Study.

The following are few limitations of the study that must be taken into an account when analyzing the results; -

- Firstly, the study was conducted within a single organization, i.e. Safaricom Ethiopia Rollout Department. Hence, the findings may not be fully generalized to other organizations of similar nature as well ae in other industries with different operational structures and levels of digital maturity.
- Secondly, the results heavily relied on self-reported responses collected through questionnaires. There may be respondent's bias introduced as respondents may provide their own interpretation of the questions posed, or may overestimate or underestimate the effectiveness of SMT.
- Thirdly. Although system-generated operational data was used in the t-test analysis, some limitations may exist due to inconsistencies or incomplete historical records between pre and Post SMT.
- Lastly, the study focused primarily on the use of and impact of SMT and did not examine other potential influencing factors like the technological, human, organizational and infrastructure factors that may also impact project performance.

5.4.2 Areas for Future Research

Based on the limitations and findings of this study, the following areas are recommended for future research; -

- Future studies should consider conducting comparative analysis across multiple telecommunication companies to improve generalizability of the findings.
- Researchers should further examine mediation mechanisms between digital tools and project performance in different organizational contexts.
- Longitudinal studies should be conducted to assess the long-term effect of the SMT or similar digital tools on project management processes and project performance over time.
- Further research could explore the integration of SMT with other digital technologies such as IR tools and artificial intelligence-based project management systems.
- In-depth qualitative studies using semi-structured interviews and case study approaches could provide richer insights into user experience, organizational and infrastructure challenges and considerations as moderation factors.

- Future studies may also explore additional performance dimensions such as cost efficiency, stakeholder satisfaction, and risk management effectiveness in relation to digital project management tools.

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APPENDIX

QUESTIONARIES

Dear participants, I'm a postgraduate student in Addis Ababa University studying for a Master of Arts in Project Management. As part of the requirement for the master's degree, I am currently engaged in thesis research titled " The Effect of Digitalization on Project Management Processes: The Case of Safaricom Ethiopia Rollout Project." This self-administered survey's primary goal is to collect the data required to research the procedures and difficulties you encounter while using the digital tools called the SMT. Your information will only be used for academic purposes and will be kept private. Furthermore, your responses will only be presented in aggregate, and no single result will be traceable back to the individual respondent. I once again thank you for your participation and if you have any questions or close concerns, please do not hesitate to contact me directly.

Sincerely,

Lidya Amare

Instructions

1. Please respond to all questions.
2. Tick (√) in the appropriate box where you believe your answer is
3. Fill out the space with your responses to the open-ended questions

Section A: Demographic Questions

1. Your role in Safaricom Ethiopia network rollout projects
   ☐ Project Manager
   ☐ Site Supervisor
   ☐ Team Member from Safaricom
   ☐ QA / Acceptance Team
   ☐ Vendor/Subcontractor
   ☐ Others
2. Which age group are you in?
   ☐ 18-24
   ☐ 25-31
   ☐ 32-38
   ☐ 39-45
   ☐ above 45
3. Gender
   ☐ Male
   ☐ Female
4. How many Years of experience do you have telecom/network rollout projects
   ☐ Less than 2 years
   ☐ 2–5 years
   ☐ 6–10 years
   ☐ More than 10 years
5. Primary project location
   ☐ Urban
   ☐ Sub-urban
   ☐ Rural
   ☐ Deep Rural
6. How do you rate your level of experience with digital project management tools
   ☐ Very low
   ☐ Low
   ☐ Moderate
   ☐ High
   ☐ Very high

Section B: Questions Directly Related to the Study Kindly Give your expert opinion on the information provided by ticking (√) on a scale of 1 to 5

1	2	3	4	5
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

No	SMT Adoption and Usage	1	2	3	4	5
1	I use the Site Management Tool (SMT) regularly in my daily project activities.					
2	SMT is integrated into most of the project management processes in my team.					
3	I use multiple functionalities of the SMT (tracking, documentation, reporting).					
4	SMT is easy to use and understand.					
5	SMT is useful in supporting my project-related tasks.					
	Project Planning and Coordination	1	2	3	4	5
6	SMT has improved the project planning and scheduling accuracy.					
7	SMT helps to effectively track project timelines					
8	SMT supports with timely identification of schedule delays.					
9	SMT has improved coordination during project planning stages.					
10	SMT enhances coordination between internal teams and vendors/subcontractors.					
11	SMT improves information sharing across project stakeholders.					
	Monitoring, Progress Tracking, and Quality Control	1	2	3	4	5
12	SMT provides with real-time visibility of project progress.					
13	SMT has improved the accuracy of progress reporting.					
14	SMT enables efficient quality checking and site verification.					
15	SMT supports timely corrective decision-making by management.					
16	SMT improves the completeness of project documentation.					
17	SMT standardizes documentation processes across projects.					
18	SMT provides easy access to real-time project records.					
	Allocation and Utilization of Resource and Accountability	1	2	3	4	5
19	SMT improves planning and allocation of project resources.					
20	SMT has improved utilization of materials and workforce.					
21	SMT reduces resource wastage during project execution.					
22	SMT improves accountability among project stakeholders.					
23	SMT makes it easier to track responsibilities and deliverables.					
24	SMT enhances transparency in vendor/subcontractor performance.					
	Project Performance	1	2	3	4	5
25	SMT contributes to improved project completion time.					
26	SMT contributes to reducing project delays.					
27	SMT contributes to improving the quality of project deliverables.					
28	SMT contributes to improving cost efficiency in project execution.					
29	SMT contributes to improving overall project success.					
30	SMT contributes to enhancing stakeholder satisfaction with project outcomes.					
	Challenges in SMT Implementation	1	2	3	4	5
31	Poor internet connectivity affects effective use of SMT.					

32	Limited training affects proper utilization of SMT.					
33	Resistance to change from manual system to SMT has impacted its adoption rate					
34	SMT meets the requirements of the project					
	Improvement and Recommendations	1	2	3	4	5
35	Additional training would improve SMT effectiveness.					
36	Enhancing the SMT functionalities would improve project performance.					
37	SMT should be further customized for telecom rollout projects.					

38. How has the implementation of the Site Management Tool (SMT) changed the way project planning, monitoring, and tracking are carried out in Safaricom Ethiopia's network rollout projects?

39. In your experience, how has the adoption of SMT has affected documentation management system, communication, and coordination among project teams, vendors, and subcontractors compared to the previous manual system?

40. How did the adoption of SMT influenced the resource allocation, utilization, and decision-making on the implementation of the project?

41. What are some of the challenges or limitations you have experienced when using SMT in network rollout projects?

42. What are the improvements you recommend enhancing the effectiveness of SMT in supporting project management activities?