



Exploring ICT adoption for project implementation in the North West Department of Public Works

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DECLARATION

I Aobakwe Precious Mogamisi declare herewith that the mini-dissertation entitled Exploring ICT adoption for project implementation in the North West Department of Public Works, which I herewith submit to the North-West University in partial compliance with the requirements set for the degree: Master of Business Administration is my own work, has been text-edited in accordance with the requirements and has not already been submitted to any other university.

Signature

A. Mogamisi

November 2025

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ABSTRACT

The integration of Information and Communication Technology (ICT) in public sector construction management has become essential for enhancing operational efficiency, governance, and service delivery. In the North West Department of Public Works (NW DPW), insufficient ICT integration intensifies delays, cost overruns, and inefficiencies, compromising the department's capacity to execute vital infrastructure projects. This report assesses the degree of ICT use in the NW DPW, identifies obstacles to its execution, and suggests practical measures for digital transformation.

This study adopts a qualitative research methodology based on an interpretivist paradigm, utilising a case study approach to examine the department's ICT practices, operational issues, and systemic constraints. The data collection comprised semi-structured interviews with major stakeholders, augmented with organisational records and reports. Thematic study identified fragmented ICT adoption, structural opposition, and training deficiencies as the principal obstacles. Nonetheless, achievements in experimental initiatives, advocacy from junior personnel, and comparisons with international best practices underscore substantial prospects for transformation.

The findings highlight the transformative capacity of ICT in augmenting project governance, enhancing operational efficiency, and promoting socio-economic development through initiatives such as the Expanded Public Works Programme. Strategic recommendations encompass capacity enhancement, leadership involvement, and focused investments in digital infrastructure. By conforming to international norms and promoting a culture of innovation, the NW DPW can surmount its problems and excel in sustainable and efficient public sector construction management.

This study enhances the dialogue on ICT adoption in developing countries, providing a framework for the digital transformation of public sector institutions in South Africa and beyond.

Keywords: Information and Communication Technology(ICT), ICT Adoption, Digital transformation, Construction Projects, Project Management, Public sector construction management, Infrastructure development

LIST OF ABBREVIATIONS

Abbreviation	Explanation
AI	Artificial Intelligence
BMI	Building Information Modelling
DOI	Diffusion of Innovations Theory
DT	Digital Twins
EPWP	Expanded Public Works Programme
ERP	Enterprise Resource Planning
ICT	Information and Communication Technology
IoT	Internet of Things
NW DPW	North West Department of Public Works
PEOU	Perceived Ease of Use
PU	Perceived Usefulness
TAM	Technology Acceptance Model
TRA	Theory of Reasoned Action
UTAUT	Unified Theory of Acceptance and Use of Technology

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Figure 2.1: A Model of Five Stages in the Innovation-Decision Process

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CHAPTER 1: INTRODUCTION

The construction industry has traditionally been slower to adopt and integrate advanced technologies compared to other sectors, which have experienced significant advancements in digital transformation. However, the growing complexity of infrastructure projects and the increasing demand for sustainable development have amplified the need for the construction sector to embrace digital tools. Technologies such as Building Information Modelling (BIM), the Internet of Things (IoT), and Digital Twins (DT) are reshaping traditional practices, enhancing lifecycle management, and improving operational efficiency (Alvarenga et al., 2024). Despite these advancements, the construction industry continues to face notable challenges, including high implementation costs, inadequate digital literacy, resistance to change, and fragmented organisational structures (Trang, 2024).

Globally, the maturity of digital transformation in the construction sector varies significantly. For instance, China's construction industry operates at a defined level of maturity, signalling potential for further growth, whereas Russia's sector faces systemic barriers such as outdated infrastructure and limited strategic planning (Stepanov et al., 2024). In contrast, digital transformation is increasingly recognised as a critical driver of competitiveness and sustainability, particularly in developing economies (Mottaeva, 2024). The ability to use digital tools has become essential for improving efficiency, safety, and environmental sustainability within the sector (Malik, 2023).

In South Africa, the adoption of Information and Communication Technology (ICT) in construction projects, particularly within the public sector, remains limited. This underutilisation of ICT has hindered project performance, resulting in delays, cost overruns, and inefficiencies in service delivery (Camngca et al., 2022; Murwira & Bekker, 2017). The North West Department of Public Works (NW DPW), responsible for implementing infrastructure projects across the North West Province, exemplifies these challenges. Despite its mandate to drive socio-economic development through initiatives like the Expanded Public Works Programme (EPWP), the NW DPW continues to face significant hurdles, including outdated project management practices, limited ICT adoption, and persistent budgetary constraints (Murwira & Bekker, 2017).

The integration of ICT into public sector construction projects has the potential to address these challenges by improving decision-making, aligning projects with strategic objectives, and fostering a culture of innovation and continuous improvement (Issa et al., 2023; Eliwa et al., 2022). For example, tools such as BIM and digital twins enable better asset management and operational transparency, as demonstrated in global contexts like Italy and New Zealand (Alvarenga et al., 2024). However, the NW DPW's reliance on manual processes and fragmented communication systems has limited its ability to capitalise on these benefits, necessitating a strategic approach to digital transformation.

This study explores the adoption and utilisation of ICT within the NW DPW, examining the barriers to its implementation and assessing its potential to enhance project outcomes. By investigating these dynamics, the research aims to provide actionable recommendations to support the department's digital transformation journey and contribute to the broader discourse on ICT integration in public sector construction projects.

1.1 BACKGROUND TO THE STUDY

The construction industry plays a pivotal role in global socio-economic development, driving infrastructure expansion, urbanisation, and sustainability initiatives. However, the sector has historically struggled with inefficiencies, low productivity, and resistance to change, issues that digital transformation aims to address. Technologies such as Building Information Modelling (BIM), the Internet of Things (IoT), and Digital Twins (DT) have revolutionised project lifecycle management, operational efficiency, and safety (Osorio-Gomez et al., 2024; Alvarenga et al., 2024). These innovations are increasingly recognised as critical tools for modernising the construction industry and addressing challenges such as environmental sustainability and resource optimisation (Mottaeva, 2024).

Despite these advancements, the pace of digital transformation varies significantly across regions. Developed nations, such as China, exhibit a more mature integration of digital tools, whereas developing economies face systemic challenges, including inadequate infrastructure, limited technical skills, and high implementation costs (Zhao, 2024; Stepanov et al., 2024). For instance, in Russia, organisational resistance, data security concerns, and policy gaps have slowed digital adoption (Stepanov et al., 2024). Similarly,

the fragmented and project-based nature of the construction sector globally presents a structural barrier to seamless digital transformation (Cidik & Boyd, 2022).

In the public sector, digital transformation is increasingly prioritised to improve service delivery, operational efficiency, and transparency. The integration of tools such as SAP systems, e-procurement platforms, and digital governance frameworks has been pivotal in streamlining processes and fostering cross-departmental collaboration (Abdul-Azeez et al., 2024). However, the public sector faces unique barriers, including the digital divide, stakeholder resistance, and cybersecurity risks (FEROUALI et al., 2024). For instance, Tanzania's public infrastructure projects highlight the role of ICT in enhancing governance and decision-making but also demonstrate the challenges posed by limited ICT literacy and organisational inertia (Issa et al., 2023).

South Africa's construction sector, particularly in the public domain, reflects many of these challenges. The North West Department of Public Works (NW DPW), a key player in infrastructure development within the province, faces significant barriers to ICT adoption. These include reliance on manual processes, inadequate ICT training, and fragmented communication systems, which collectively hinder project performance (Camngca et al., 2022). While initiatives such as the Expanded Public Works Programme (EPWP) aim to drive socio-economic development through infrastructure projects, their impact is often diminished by delays, cost overruns, and poor project governance (Murwira & Bekker, 2017).

Globally, digital transformation in the construction sector is viewed as a pathway to addressing critical challenges such as project inefficiencies and climate resilience. Emerging technologies, including cloud-based solutions, artificial intelligence, and IoT, are reshaping industry practices, enabling better resource management, and reducing environmental impacts (Malik, 2023). However, the successful integration of these tools depends on overcoming barriers such as excessive costs, lack of leadership, and organisational resistance (Trang, 2024).

In the context of the NW DPW, addressing these barriers is imperative to modernising its operations and aligning with global best practices in ICT adoption. This study situates itself within this critical discourse, aiming to explore the extent of ICT adoption within the

NW DPW, identify the barriers to its implementation, and propose strategies to enhance its utilisation.

1.2 PROBLEM STATEMENT

The construction industry is undergoing a global transformation as digital technologies such as Building Information Modelling (BIM), the Internet of Things (IoT), and Digital Twins (DT) redefine project management and operational efficiency. Despite these advancements, the adoption of digital tools in public sector infrastructure projects remains limited, particularly in developing regions such as South Africa. In the North West Department of Public Works (NW DPW), responsible for implementing and maintaining critical infrastructure across the province, this digital gap is acutely felt.

The NW DPW faces numerous operational challenges, including delays in project execution, cost overruns, and inefficiencies in service delivery. These issues stem, in part, from a reliance on outdated manual processes, inadequate communication systems, and limited adoption of digital technologies (Murwira & Bekker, 2017; Camngca et al., 2022). For instance, project management practices in the department heavily depend on physical paperwork and in-person meetings, which hinder timely decision-making and exacerbate resource constraints.

Moreover, systemic barriers such as a lack of ICT training, organisational resistance, and corruption further complicate the adoption of digital tools within the department (Murwira & Bekker, 2017; Issa et al., 2023). The COVID-19 pandemic exposed and intensified these challenges, highlighting the department's inability to adapt to remote communication and digital project monitoring (Camngca et al., 2024). As a result, infrastructure projects in the province often fail to meet functional requirements, leading to public dissatisfaction and, at times, community protests due to inadequate service delivery.

Globally, digital transformation has been shown to improve project governance, transparency, and efficiency in public sector construction projects (FEROUALI et al., 2024). However, the NW DPW's underutilisation of ICT tools represent a missed opportunity to align with these global best practices and address its operational inefficiencies. Without strategic interventions, the department risks further compounding its existing challenges, undermining its mandate to deliver essential infrastructure and

drive socio-economic development through initiatives such as the Expanded Public Works Programme (EPWP).

This study seeks to address this critical gap by investigating the extent of ICT adoption within the NW DPW, identifying the barriers to its implementation, and proposing actionable strategies to enhance digital transformation. By doing so, the research aims to contribute to the modernisation of the department's operations, improve project performance, and align its practices with global standards in public sector construction management.

1.3 RESEARCH AIM AND OBJECTIVES

1.3.1 Research aim

The primary aim of this study is to evaluate the adoption and utilisation of Information and Communication Technology (ICT) within the North West Department of Public Works (NW DPW) in South Africa. The research seeks to identify the barriers hindering ICT adoption, assess its impact on project performance, and propose actionable strategies to enhance digital transformation within the department.

1.3.2 Research objectives

To achieve the stated aim, the study is guided by the following objectives:

1. To assess the current extent of ICT adoption within the NW DPW, focusing on its integration into project management and decision-making processes.
2. To identify the barriers to ICT adoption in the NW DPW, including organisational, technical, financial, and cultural challenges.
3. To evaluate the impact of limited ICT adoption on project timelines, costs, and overall service delivery in the NW DPW.
4. To propose strategic recommendations for improving ICT adoption and digital transformation within the NW DPW, aligning these strategies with global best practices and the department's socio-economic development goals.

1.4 RESEARCH APPROACH

This study employs a qualitative research methodology grounded in an interpretivist paradigm. The interpretivist approach is well-suited to exploring the subjective experiences, perspectives, and contextual realities of stakeholders within the North West Department of Public Works (NW DPW) regarding the adoption and utilisation of Information and Communication Technology (ICT). By focusing on the meaning individuals attach to their experiences, this approach facilitates a nuanced understanding of the organisational and cultural factors influencing ICT adoption (Bryman, 2016).

A case study design was selected as the research strategy, enabling an in-depth examination of the NW DPW's operational environment, ICT practices, and associated challenges. The case study method is particularly effective for investigating complex phenomena within their real-life context, providing detailed insights into the barriers and opportunities associated with digital transformation in public sector construction management (Yin, 2018).

The data collection process primarily relies on semi-structured interviews with purposively selected participants, including project managers, contractors, and departmental staff. These interviews are designed to capture diverse perspectives on the department's current ICT utilisation, the challenges impeding its adoption, and potential solutions. Additional data sources, such as organisational reports and policy documents, will supplement the primary data to enhance the study's robustness and triangulate findings.

Thematic analysis will be employed to analyse the qualitative data, following the approach outlined by Braun and Clarke (2006). This method involves systematically identifying, organising, and interpreting patterns or themes within the dataset. Thematic analysis is particularly suited to studies aiming to explore complex organisational issues, as it allows for the emergence of themes grounded in the data while aligning with the research objectives. To ensure the rigour of the analysis, measures such as member checking and reflective commentary will be employed (Lincoln & Guba, 1985).

This research approach provides a robust framework for examining the complexities of ICT adoption within the NW DPW. It enables the study to generate actionable recommendations for overcoming barriers and enhancing the department's digital

transformation journey, contributing both to academic discourse and practical improvements in public sector construction management.

1.5 QUESTIONS GUIDING THE STUDY

To address the research aim and objectives, the following research questions have been formulated:

1. What is the current extent of ICT adoption within the North West Department of Public Works (NW DPW), and how is it integrated into project management processes?
2. What are the primary barriers hindering the adoption and utilisation of ICT in the NW DPW, and how do they impact the department's digital transformation efforts?
3. How does the limited adoption of ICT influence project timelines, costs, and service delivery within the NW DPW?
4. What strategies can be proposed to enhance ICT adoption and digital transformation within the NW DPW, aligning with global best practices and addressing the department's specific challenges?

These research questions provide a structured framework for the study, guiding the exploration of ICT adoption within the NW DPW. Each question corresponds directly to the research objectives and is designed to ensure a focused and comprehensive investigation.

1.6 SCOPE AND DELIMITATIONS OF THE STUDY

1.6.1 Scope of the study

The scope of this study is defined by its geographic, thematic, and organisational focus:

Geographic scope:

The study is confined to the North West Province of South Africa, specifically focusing on the operations of the North West Department of Public Works (NW DPW). It examines the department's infrastructure projects across its four districts, including urban centres such as Mahikeng and Rustenburg, as well as rural areas.

Thematic scope:

The study centres on the adoption and utilisation of Information and Communication Technology (ICT) in construction project management. It investigates the extent of ICT adoption, the barriers to its implementation, and its impact on project performance, including timelines, costs, and service delivery.

Organisational scope:

The research is limited to the NW DPW and does not extend to other governmental departments or private sector entities. The focus is on ICT practices within the department and their implications for public sector infrastructure delivery.

1.6.2 Delimitations of the study

To ensure a focused and feasible investigation, the study is subject to the following delimitations:

Focus on qualitative insights:

The study employs a qualitative methodology to explore the subjective perspectives of stakeholders within the NW DPW. It does not include a quantitative analysis of ICT adoption metrics or broader statistical data.

Exclusion of technical performance evaluation:

While the study examines the extent of ICT adoption, it does not evaluate the technical performance or functionality of specific ICT tools or platforms used by the department.

Temporal scope:

The research is based on data collected during a specific period and does not account for potential changes in ICT adoption practices or policies that may occur after the study's completion.

Focus on infrastructure projects:

The study focuses on ICT use in construction and infrastructure projects managed by the NW DPW and does not address other operational areas of the department, such as procurement or facilities management.

These delimitations ensure that the research remains well-defined and manageable while recognising the boundaries within which the findings can be generalised. By maintaining this focus, the study aims to generate actionable insights that are both relevant and practicable for the NW DPW

1.7 SIGNIFICANCE OF THE STUDY

This study is significant for its potential contributions to academic knowledge, public sector practices, and societal development. By focusing on the adoption and utilisation of Information and Communication Technology (ICT) in the North West Department of Public Works (NW DPW), the research addresses critical gaps in understanding how digital transformation can enhance public sector infrastructure delivery.

1.7.1 Academic contribution

The study contributes to the growing body of literature on digital transformation in the construction industry, particularly within the public sector in developing economies. While existing research often focuses on private sector advancements or developed countries (Osorio-Gomez et al., 2024), this study highlights the unique challenges faced by public sector organisations in South Africa. By exploring barriers such as organisational resistance, limited ICT literacy, and fragmented communication systems, the research provides new insights into the socio-technical dynamics of ICT adoption.

1.7.2 Practical implications

The findings of this study have practical relevance for the NW DPW and other public sector organisations in similar contexts. By identifying key barriers to ICT adoption and proposing actionable strategies for improvement, the research offers a roadmap for enhancing operational efficiency, reducing project delays, and improving service delivery. These practical insights can guide decision-makers in implementing effective ICT solutions and optimising resource allocation.

1.7.3 Societal relevance

Infrastructure development is integral to socio-economic growth, particularly in rural and semi-urban areas of South Africa. The adoption of ICT in public sector construction projects has the potential to improve service delivery, foster job creation, and enhance the quality of life for residents in the North West Province. By addressing inefficiencies in the NW DPW, the study supports broader national goals, such as poverty alleviation, sustainable development, and economic empowerment.

1.7.4 Policy development

The study's findings can inform policymakers on the systemic challenges hindering ICT adoption in public sector infrastructure projects. By proposing evidence-based strategies for digital transformation, the research has the potential to influence the development of more robust policies and frameworks, fostering a culture of innovation and collaboration across government departments.

Through its focus on the intersection of technology management and public sector infrastructure delivery, this study makes a meaningful contribution to both academic discourse and real-world practice. By addressing the specific challenges faced by the NW DPW, it lays the groundwork for broader discussions on ICT adoption and digital transformation in public sector construction projects.

1.8 STRUCTURE OF THE DISSERTATION

This dissertation is structured into five chapters, each contributing to a comprehensive examination of the research problem:

Chapter 1: Introduction

This chapter establishes the foundation of the study, providing an overview of the research background, problem statement, research approach, aim and objectives, research questions, significance, scope, and delimitations. It situates the study within the context of digital transformation in the public sector and outlines the structure of the dissertation.

Chapter 2: Literature review

The literature review critically examines existing research on ICT adoption and digital transformation within the construction industry, with a specific focus on public sector applications. The chapter explores theoretical frameworks, global best practices, and the unique challenges faced by developing economies, identifying gaps in the existing literature that the study aims to address.

Chapter 3: Research methodology

This chapter outlines the research design and methodology adopted for the study. It provides a detailed description of the qualitative approach, the interpretivist paradigm, and the case study method. The chapter also discusses the data collection process, including semi-structured interviews and supplementary document analysis, and explains the thematic analysis method employed for data interpretation. Ethical considerations and measures to ensure research rigour are also presented.

Chapter 4: Findings and discussion

This chapter presents the key findings from the data collected through interviews and document analysis. The findings are organised thematically, addressing the research questions and objectives. The discussion contextualises these findings within the broader academic and practical literature, highlighting insights, implications, and areas for further exploration.

Chapter 5: Conclusions and recommendations

The last chapter summarises the key findings and their implications for the NW DPW, as well as the broader discourse on ICT adoption in public sector construction projects. It offers actionable recommendations for overcoming barriers to ICT adoption and achieving digital transformation. The chapter also acknowledges the limitations of the study and provides suggestions for future research.

This structure ensures a logical and systematic progression, guiding the reader through the research process from problem identification to actionable solutions.

1.9 CHAPTER SUMMARY

Chapter 1 has established the foundation for this study by providing a comprehensive introduction to the research topic. It outlined the background to the study, emphasising the critical role of digital transformation in enhancing efficiency and service delivery in the construction industry, particularly within the public sector. The chapter identified the problem of limited ICT adoption in the North West Department of Public Works (NW DPW) and its implications for infrastructure project performance and socio-economic development in the region.

The research aim, objectives, and guiding questions were presented to provide a clear framework for the investigation, while the research approach outlined the qualitative methodology employed to explore the challenges and opportunities associated with ICT adoption. The chapter also highlighted the significance of the study in contributing to academic knowledge, public sector practices, and policy development. The scope and delimitations defined the boundaries of the research, ensuring its focus and feasibility, while the structure of the dissertation outlined the logical progression of the study.

This chapter sets the stage for the subsequent chapters. Chapter 2 will critically review the existing literature on ICT adoption and digital transformation in the construction industry, focusing on public sector challenges and opportunities. This review will identify gaps in the literature and establish the theoretical framework underpinning the study, providing the foundation for the empirical investigation presented in later chapters.

CHAPTER 2 LITERATURE STUDY

The purpose of this chapter is to critically engage with existing literature on digital transformation and ICT adoption, with a particular focus on its implications for the construction industry and public sector infrastructure projects. By examining global trends, theoretical frameworks, and the unique challenges faced by developing economies such as South Africa, this chapter aims to establish a comprehensive foundation for the study. The literature review provides the context necessary to understand the complexities of ICT adoption within the North West Department of Public Works (NW DPW) and highlights the gaps this research seeks to address.

The chapter is structured as follows: it begins by presenting the theoretical frameworks underpinning the study, including the Technology Acceptance Model (TAM) and Diffusion of Innovations Theory (DOI), to provide insights into the dynamics of technology adoption. It then explores global trends in digital transformation in the construction industry, highlighting key technologies, critical success factors, and barriers encountered in various contexts. The review further examines the role of ICT adoption in the public sector, with a focus on global and regional perspectives, including South Africa's construction sector and the NW DPW.

The chapter also investigates the specific challenges and opportunities associated with ICT adoption in public infrastructure projects, linking these to broader trends in digital transformation. Finally, it identifies gaps in the existing literature, providing a rationale for the study's focus and empirical approach.

This literature review is guided by the study's aim to evaluate the adoption and utilisation of ICT in the NW DPW. It addresses the research objectives, which include assessing the current extent of ICT adoption, identifying barriers to its implementation, and proposing strategies to enhance digital transformation within the department. By critically engaging with the literature, this chapter informs the research methodology presented in Chapter 3 and ensures a rigorous and contextualised approach to the investigation.

2.1 THEORETICAL FRAMEWORK

Theoretical frameworks are critical for understanding the multifaceted challenges and opportunities associated with ICT adoption and digital transformation in the construction

industry. This study employs two primary frameworks: the Technology Acceptance Model (TAM) and the Diffusion of Innovations (DOI) Theory. These frameworks provide complementary perspectives on the factors influencing technology adoption at both individual and organisational levels.

2.1.1 Technology Acceptance Model (TAM)

The Technology Acceptance Model (TAM), developed by Davis (1989), is a foundational framework for understanding the determinants of technology adoption and use. Grounded in the Theory of Reasoned Action (TRA) by Fishbein and Ajzen (1975), TAM posits those two primary beliefs—Perceived Usefulness (PU) and Perceived Ease of Use (PEOU)—influence an individual's attitude towards a technology. These attitudes shape behavioural intentions, which determine actual usage.

2.1.1.1 Key constructs of TAM

- **Perceived Usefulness (PU):** Defined as the extent to which a user believes that adopting a specific technology will enhance their job performance. For instance, in the construction industry, tools such as Building Information Modelling (BIM) are more likely to be adopted if users perceive clear productivity benefits (Davis, 1989).
- **Perceived Ease of Use (PEOU):** Refers to the degree to which a technology is perceived as free from effort. Technologies that are intuitive and user-friendly tend to have higher acceptance rates, particularly in sectors like public works where digital literacy may vary significantly among stakeholders (Davis, 1989).

Both constructs are influenced by external variables, such as system design, organisational support, and training. These factors directly affect the user's attitudes towards the technology, shaping their intention to adopt and their actual use (Venkatesh & Davis, 2000).

In managerial contexts, TAM serves as a diagnostic tool for understanding and predicting technology adoption. By assessing PU and PEOU, managers can identify potential barriers to acceptance and implement targeted interventions. For example, if employees perceive a modern technology as complex or burdensome, additional training or system modifications can enhance PEOU, fostering a positive attitude towards adoption.

Similarly, demonstrating tangible benefits, such as cost savings or improved efficiency, can increase PU, thereby encouraging widespread use (Bagozzi, 2007).

Over time, TAM has been extended to address its limitations and to capture a broader range of determinants influencing technology adoption:

- TAM2: Introduced by Venkatesh and Davis (2000), this version incorporates social influence (e.g., subjective norms) and cognitive instrumental processes (e.g., job relevance) to better explain technology acceptance in organisational settings.
- Unified Theory of Acceptance and Use of Technology (UTAUT): Developed by Venkatesh et al. (2003), this model synthesises elements from TAM and other frameworks, adding constructs such as facilitating conditions and social influence to provide a comprehensive view of user behaviour.

These adaptations have increased TAM's applicability across diverse contexts, including the public sector, where organisational culture, stakeholder resistance, and policy constraints often play critical roles in shaping ICT adoption (Vartziotis et al., 2022).

While TAM is widely regarded for its simplicity and predictive power, it has been critiqued for its narrow focus on individual-level factors. Organisational and environmental influences, such as leadership, infrastructure, and economic constraints, are often overlooked (Taherdoost et al., 2024). Moreover, TAM's emphasis on cognitive determinants may fail to capture affective or emotional factors that influence user behaviour, such as trust or fear of obsolescence (Bagozzi, 2007).

In the context of the North West Department of Public Works (NW DPW), TAM provides a valuable lens to examine the adoption of ICT tools. By evaluating PU and PEOU among departmental staff and contractors, this study can identify specific barriers to ICT adoption, such as perceived complexity or a lack of perceived benefits. Additionally, the insights generated through TAM can guide the development of strategies to enhance user acceptance, such as targeted training programmes or tailored system designs.

By focusing on the interplay between individual perceptions and organisational support, TAM aligns closely with the research objectives, providing a robust framework for understanding the challenges and opportunities associated with digital transformation in the NW DPW.

2.1.2 Diffusion of Innovations (DOI) theory

The Diffusion of Innovations (DOI) Theory, developed by Rogers (1962), is a seminal framework for understanding how innovative ideas, technologies, and practices are adopted within social systems over time. This theory provides insights into the processes that drive innovation adoption, the characteristics of adopters, and the role of environmental and organisational contexts. In managerial sciences, DOI is a valuable tool for analysing technology adoption dynamics, particularly in complex organisational environments such as public sector construction management.

2.1.2.1 Core constructs of DOI theory

DOI Theory identifies five key stages in the innovation adoption process as shown in figure 2.1 below:

1. Knowledge: Potential adopters are exposed to an innovation and develop an understanding of its functionality.
2. Persuasion: Adopters form attitudes about the innovation based on its perceived attributes.
3. Decision: Adopters choose to accept or reject the innovation.
4. Implementation: The innovation is put into practice, and adjustments may occur based on real-world use.
5. Confirmation: Adopters seek reinforcement of their decision to continue using the innovation (Rogers, 2003).

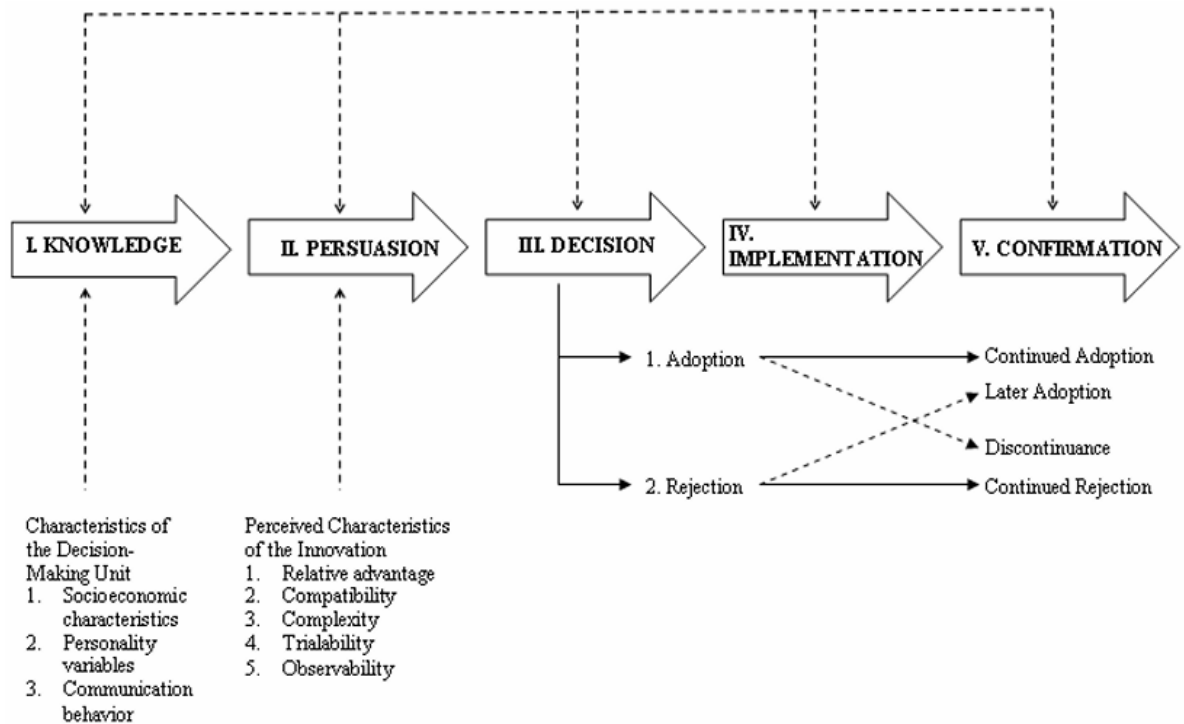


Figure 2.1. A Model of Five Stages in the Innovation-Decision Process (Source: Diffusion of Innovations, Fifth Edition by Everett M. Rogers.

In addition, DOI categorises adopters into five groups based on their willingness to embrace innovation:

- **Innovators**: Risk-takers who are the first to adopt.
- **Early adopters**: Influential individuals who embrace innovation early and drive wider adoption.
- **Early majority**: Pragmatic users who adopt once benefits are evident.
- **Late majority**: Sceptical adopters influenced by peer pressure.
- **Laggards**: Resistant individuals who adopt only when necessary.

These categories highlight the diversity of responses to innovation, which are shaped by individual, organisational, and contextual factors (Ashogbon, 2021).

2.1.2.2 Attributes influencing adoption.

DOI Theory identifies five key attributes of innovations that influence their rate of adoption:

- **Relative advantage:** The perceived superiority of an innovation over existing practices. For example, ICT tools such as Building Information Modelling (BIM) may be adopted if they are seen as improving project efficiency and reducing costs.
- **Compatibility:** The degree to which an innovation aligns with existing values, needs, and organisational practices. Technologies that integrate seamlessly into established workflows are more likely to be adopted (Frei-Landau et al., 2022).
- **Complexity:** The perceived difficulty of understanding and using an innovation. High complexity can impede adoption unless mitigated through training and support.
- **Trialability:** The extent to which an innovation can be tested on a limited basis before full adoption. Pilot programmes often increase confidence in technology adoption.
- **Observability:** The visibility of the innovation's benefits to others. Clear demonstrations of success can accelerate adoption among peers (Rogers, 2003).

In managerial sciences, DOI Theory is instrumental in designing strategies to facilitate technology adoption. For example:

- **Leadership and influence:** Managers can leverage early adopters within their teams to champion ICT adoption, influencing the early and late majority through social proof.
- **Change management:** Understanding the attributes influencing adoption enables managers to address resistance and tailor interventions to organisational needs.
- **Strategic communication:** Highlighting relative advantages and providing observable success stories can increase stakeholder buy-in.

DOI Theory has been successfully applied to public sector projects, where the macro-institutional environment, policy frameworks, and cultural factors significantly influence innovation adoption. For instance, in the context of e-government initiatives, the theory explains how strategic partnerships and organisational culture shape the diffusion of technology (De Vries et al., 2018). Similarly, in public health, DOI has informed the design of tailored strategies for different societal segments to maximise innovation uptake (Iqbal & Zahidie, 2022).

While DOI Theory offers valuable insights, it has been critiqued for its pro-innovation bias, which assumes that all innovations are beneficial and worth adopting (Hidayat & Mukminin, 2022). This bias may overlook the potential drawbacks or unintended consequences of innovation. Additionally, DOI often underemphasises the influence of societal and cultural contexts on adoption, which can be significant in diverse organisational environments (Zreik, 2024). To address these limitations, DOI can be integrated with other frameworks, such as the Social Networks Theory, to provide a more comprehensive understanding of adoption dynamics.

DOI Theory is particularly relevant to this study as it provides a robust framework for analysing the adoption of ICT tools within the North West Department of Public Works (NW DPW). By examining the innovation attributes, organisational culture, and adopter categories, the theory can help identify the factors facilitating or hindering ICT diffusion. For instance, understanding the compatibility of ICT tools with existing workflows or the relative advantage they offer in project efficiency can inform strategies to enhance adoption. Furthermore, DOI's emphasis on the stages of adoption provides a structured approach for evaluating the current state of ICT integration within the NW DPW and identifying opportunities for targeted interventions.

2.1.3 Integration of TAM and DOI frameworks

The integration of the Technology Acceptance Model (TAM) and Diffusion of Innovations (DOI) Theory offers a comprehensive framework for analysing the barriers, drivers, and systemic dynamics influencing ICT adoption within the North West Department of Public Works (NW DPW). While TAM focuses on individual-level perceptions and attitudes towards technology, DOI addresses the broader organisational and contextual factors that impact the diffusion of innovations. Together, these frameworks enable a nuanced understanding of ICT adoption and provide actionable insights to achieve the study's objectives.

2.1.3.1 Relevance to study objectives

This integration aligns directly with the study's aim to evaluate ICT adoption in the NW DPW and propose strategies to enhance digital transformation. Specifically:

Assessing current ICT adoption (Objective 1):

DOI's adoption stages (knowledge, persuasion, decision, implementation, and confirmation) provide a structured approach to evaluating the current state of ICT adoption within the NW DPW. For instance, these stages can help determine whether the department is in the exploratory phase (knowledge) or actively implementing ICT tools (implementation).

TAM's constructs of Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) assess the individual-level acceptance of ICT tools, highlighting whether employees and contractors find these technologies beneficial or challenging to use (Davis, 1989; Venkatesh and Davis, 2000).

Identifying barriers to adoption (Objective 2):

DOI's innovation attributes (e.g., relative advantage, compatibility, complexity) uncover organisational barriers, such as whether ICT systems align with existing workflows or whether their complexity discourages adoption (Rogers, 2003).

TAM's behavioural focus highlights individual barriers, such as low perceived usefulness or limited digital literacy, which may hinder widespread acceptance (Bagozzi, 2007).

Evaluating the impact of limited ICT adoption (Objective 3):

DOI emphasises the importance of relative advantage in understanding the broader organisational implications of limited ICT adoption, such as inefficiencies in project delivery and missed opportunities for cost savings (Sahin, 2006).

TAM complements this by examining how individual resistance or acceptance affects project timelines, budgets, and overall service delivery outcomes.

Proposing strategies to enhance ICT adoption (Objective 4):

DOI's focus on adopter categories (e.g., innovators, early adopters) guides the development of tailored interventions, such as engaging early adopters within the department to champion ICT use.

TAM's actionable constructs inform user-centric strategies, such as targeted training programmes to enhance perceived ease of use and demonstrations of ICT benefits to improve perceived usefulness (Venkatesh et al., 2003).

2.1.3.2 Integration of TAM and DOI: A combined analytical framework

The integration of TAM and DOI bridges the gap between individual behaviours and organisational dynamics, offering a holistic perspective on ICT adoption within NW DPW.

- Understanding the adoption process: DOI's adoption stages provide a roadmap for analysing ICT implementation, while TAM adds granularity by explaining the specific perceptions influencing individual acceptance at each stage. For example, during DOI's "persuasion" stage, TAM assesses whether users perceive ICT tools as useful or overly complex.
- Identifying and addressing barriers: DOI identifies systemic barriers, such as low compatibility with existing workflows or limited trialability, while TAM focuses on individual-level challenges, such as resistance due to perceived difficulty of use. Together, these insights inform strategies that address both user-centric and organisational obstacles.
- Designing interventions: DOI's innovation attributes (e.g., observability and relative advantage) guide the development of organisational strategies to improve the visibility and demonstrable benefits of ICT tools. TAM complements this by focusing on individual-level interventions, such as improving user training to enhance ease of use.
- Evaluating success: DOI assesses organisational progress in ICT adoption through metrics such as adoption rates and systemic integration, while TAM evaluates user satisfaction and sustained behavioural intentions, ensuring long-term viability of ICT use (Kayali & Alaaraj, 2020)

2.1.3.3 Theoretical and practical implications

Integrating TAM and DOI enriches the study's theoretical foundation by combining micro-level user analysis with macro-level organisational dynamics. This dual perspective addresses a gap in existing literature, where studies often focus on either individual perceptions or systemic processes in isolation (Taherdoost et al., 2024; De Vries et al., 2018).

For NW DPW, this integration provides a comprehensive framework for diagnosing barriers to ICT adoption and designing tailored strategies. By linking user-specific interventions with broader organisational reforms, the framework ensures that ICT adoption efforts are context-sensitive, scalable, and impactful.

The integration of TAM and DOI frameworks ensures alignment with the study's objectives by addressing ICT adoption comprehensively evaluating current adoption levels, identifying barriers, assessing impacts, and proposing solutions. This combined approach provides both theoretical depth and practical guidance, making it a valuable tool for analysing and enhancing digital transformation within the NW DPW.

2.2 GLOBAL TRENDS IN DIGITAL TRANSFORMATION IN CONSTRUCTION

Digital transformation is reshaping the construction industry globally, driven by technological advancements that enhance efficiency, sustainability, and cost management. However, the adoption and integration of these technologies vary widely across regions, influenced by organisational, cultural, and infrastructural factors. This section examines global digital transformation trends, focusing on key technologies, critical success factors, and a comparative analysis of successes and challenges. The discussion is framed through the theoretical lenses of the Diffusion of Innovations (DOI) Theory and the Technology Acceptance Model (TAM), highlighting the relative advantage, trialability, and perceived usefulness of digital technologies in construction.

2.2.1 Overview of global digital transformation trends

The construction industry has embraced transformative technologies, including Building Information Modelling (BIM), Digital Twin (DT) technology, Artificial Intelligence (AI), the Internet of Things (IoT), and blockchain. These innovations are pivotal in improving project delivery, optimising resource utilisation, and achieving sustainability goals (Baghalzadeh et al., 2022).

Building Information Modelling (BIM) and Digital Twins (DT) are at the forefront of this transformation. BIM integrates project data into a unified platform, enabling improved collaboration and decision-making, while DT technology extends this capability by creating virtual replicas of physical assets. These digital twins allow real-time monitoring and predictive maintenance, enhancing asset performance and environmental

sustainability (Alvarenga et al., 2024). Artificial Intelligence (AI) further enhances decision-making by automating design processes, enabling predictive analytics, and facilitating smarter investment decisions (Trang, 2024). Similarly, blockchain technology, when integrated with BIM, streamlines cost management, and ensures transparency throughout a project's lifecycle (Celik et al., 2023).

IoT and 5G connectivity have also revolutionised construction processes, allowing smart sensors and devices to monitor energy use, reduce wastage, and improve efficiency. Studies predict that these technologies could reduce energy intensity in construction projects by up to 50% by 2040 (Mottaeva, 2024). Despite these advancements, high implementation costs, data security risks, and organisational resistance remain significant barriers to widespread adoption, underlining the need for strategic planning and cross-industry collaboration.

2.2.2 Comparative Analysis of Successes and Challenges

The degree of digital transformation in construction varies significantly between developed and developing regions. Developed countries like China, Italy, and New Zealand demonstrate elevated levels of digital maturity, underpinned by robust infrastructure, strategic leadership, and supportive regulatory environments. Conversely, regions with lower digital maturity, such as India, Nigeria, and South Africa, face systemic and context-specific challenges that hinder digital adoption.

2.2.2.1 Successes in Developed Countries

In China, the integration of BIM and AI has streamlined project management, resulting in improved efficiency and cost control (Zhao et al., 2024). Italy's adoption of DT technology for national infrastructure projects has enhanced decision-making and long-term asset sustainability (Mimmi, 2024). Similarly, New Zealand's comprehensive training programmes and organisational adaptability have fostered a workforce capable of leveraging advanced digital tools (Chowdhury., 2019). These examples highlight the importance of relative advantage and trialability, as outlined by DOI, in fostering successful digital transformation.

2.2.2.2 Challenges in developing regions.

Regions with lower digital maturity often face barriers such as inadequate infrastructure, limited access to high-speed internet, and low levels of digital literacy. For instance, Nigeria's construction sector is constrained by insufficient funding, regulatory hurdles, and a lack of skilled personnel (Camngca et al., 2024). In South Africa, while digital technologies have gained some traction, systemic issues such as corruption, organisational resistance, and fragmented supply chains significantly impede progress (Emuze et al., 2015). These challenges align with DOI's complexity attribute and highlight TAM's relevance in addressing perceived ease of use and usefulness among end-users.

2.3 ICT ADOPTION IN THE PUBLIC SECTOR

The adoption of Information and Communication Technologies (ICT) has emerged as a cornerstone for modernising public sector operations, enhancing efficiency, service delivery, and transparency. Digital transformation offers significant potential to streamline processes, foster innovation, and improve citizen engagement, making it an essential component of governance in the 21st century (Medel et al., 2023). However, the journey towards ICT adoption in the public sector is fraught with challenges, including organisational resistance, infrastructural limitations, and socio-cultural barriers. This section examines the importance of ICT adoption, explores the barriers to its implementation, and provides case studies from diverse contexts to illustrate successes and persistent challenges. The analysis is underpinned by the Diffusion of Innovations (DOI) Theory and the Technology Acceptance Model (TAM), which provide insights into the adoption stages and user perceptions that influence ICT integration.

2.3.1 Importance of ICT adoption in the public sector

ICT adoption has revolutionised public sector operations globally by enhancing efficiency, accountability, and citizen-centric service delivery. In South Africa's North-West Province, digital platforms and smartphone technology have been pivotal in bridging communication gaps in rural communities, improving socio-economic outcomes and enabling participatory governance (Phalatse, 2022). Similarly, in Thailand, the integration of cloud-based Enterprise Resource Planning (ERP) systems has streamlined infrastructure management, promoted transparency, and reduced inefficiencies (Ramachandran, 2023).

Digitisation also plays a critical role in combating corruption and fostering accountability. For example, India's public healthcare sector has leveraged digital technologies to improve service delivery and reduce fraud, though concerns around data privacy and infrastructure readiness persist (Nurfadilah & Haliah, 2024). Moreover, ICT tools such as blockchain and e-procurement systems have enhanced transparency in public financial management in countries like Kenya and Indonesia, showcasing the transformative potential of digital technologies in public governance (FEROUALI et al., 2024).

2.3.2 Barriers to ICT adoption in the public sector

Despite its benefits, ICT adoption in the public sector encounters numerous barriers that hinder its implementation and sustainability. Stakeholder resistance, often stemming from entrenched bureaucratic practices and cultural inertia, poses a significant challenge. For instance, Indonesia's Surabaya City Office for Population Administration and Civil Registration experienced resistance from employees accustomed to traditional workflows, impeding the adoption of digital systems (Amali et al., 2022).

Digital literacy gaps further exacerbate these challenges, particularly in developing regions where insufficient training limits the ability of public sector employees to effectively utilise ICT tools. In South African public schools, a lack of ICT skills among staff highlights the need for capacity-building initiatives to support technology adoption (Camngca et al., 2022). Infrastructure constraints, including inadequate technical facilities and funding shortages, remain a persistent issue, particularly in rural and resource-constrained settings (Murwira & Bekker, 2017).

These barriers align with the complexity attribute in DOI, which reflects the perceived difficulty of adopting new innovations. Similarly, TAM emphasises the role of perceived ease of use and perceived usefulness in shaping user attitudes towards ICT. Addressing these perceptions through targeted interventions is crucial for overcoming resistance and fostering adoption.

2.3.3 Case studies: Global insights into ICT adoption

2.3.3.1 E-Governance in Greece

The COVID-19 pandemic acted as a catalyst for digital transformation in Greece, which had historically lagged the European average in e-governance. The Greek government introduced innovative digital applications such as electronic prescribing and online vaccination scheduling to maintain service delivery during the crisis. These initiatives overcame logistical barriers, streamlined processes, and improved citizen access to public services. However, challenges such as low adoption rates of e-government platforms and service complexity persist, highlighting the need for continuous user training and infrastructure enhancements (Carmody-Bubb, 2023).

2.3.3.2 Infrastructure digitisation in Qatar

Qatar has made significant progress in digitising public infrastructure through tools like the Baladiya system for municipal services and MARSAD, which assesses ICT accessibility for persons with disabilities (Othman et al., 2023). These efforts have reduced infrastructure costs and enhanced network security, highlighting the potential of cloud computing to address resource constraints. Nevertheless, adoption challenges, including perceptions of security risks and limited user engagement, underscore the importance of fostering trust and inclusivity in digital initiatives (Naji et al., 2024).

These case studies illustrate the interplay between DOI's attributes - relative advantage and trialability - and TAM's constructs of user acceptance. While success depends on demonstrable benefits and ease of implementation, persistent challenges necessitate adaptive strategies tailored to specific organisational and cultural contexts.

ICT adoption is integral to modernising public sector operations, enhancing efficiency, and fostering transparency. While global initiatives demonstrate the potential of digital technologies to transform governance, significant barriers such as resistance to change, infrastructure constraints, and digital literacy gaps remain. Insights from Greece and Qatar highlight the importance of strategic leadership, user-centric design, and capacity building in addressing these challenges. By linking DOI and TAM frameworks, this study underscores the need for a comprehensive approach that aligns technological readiness

with user acceptance, providing a foundation for ICT integration in South Africa's public sector.

2.4 ICT IN THE SOUTH AFRICAN CONSTRUCTION SECTOR

South Africa's construction sector is a vital contributor to economic growth and infrastructure development, yet it remains underperforming in its adoption of Information and Communication Technology (ICT), particularly within public projects. While there are encouraging strides towards digital transformation, systemic and individual barriers continue to impede progress. This section explores the current state of ICT adoption in South Africa's construction sector, examines the barriers to its integration through the lenses of the Diffusion of Innovations (DOI) Theory and the Technology Acceptance Model (TAM), and evaluates government initiatives, such as the Expanded Public Works Programme (EPWP), in addressing socio-economic challenges and supporting ICT integration.

2.4.1 Current state of ICT adoption in South Africa's construction sector

The South African construction sector has begun incorporating advanced ICT tools, with technologies such as Building Information Modelling (BIM), Artificial Intelligence (AI), and cloud computing emerging as potential solutions to longstanding inefficiencies. BIM, for example, has demonstrated the ability to streamline project management, improve collaboration, and optimise resource utilisation. However, its application remains limited due to a lack of competence, client demand, and regulatory enforcement (Murwira & Bekker, 2017). Similarly, AI technologies, which could revolutionise construction processes through predictive analytics and automation, are underutilised, leaving many potential efficiencies unrealised (Camngca et al., 2022).

Public projects in South Africa, often managed through the Department of Public Works, rely heavily on outdated communication and project management systems. This reliance results in inefficiencies such as delays, cost overruns, and mismanagement. Despite the evident need for digital transformation, ICT integration remains sporadic, driven by a few leading firms, while smaller enterprises often lack the resources to invest in digital tools (Phalatse, 2022).

2.4.2 Barriers to ICT adoption

The slow pace of ICT adoption in South Africa's construction sector can be attributed to both systemic and individual barriers. These challenges are interrelated and reflect the complexity of integrating innovation within a fragmented industry.

2.4.2.1 Systemic barriers

Cost constraints represent one of the most significant systemic barriers. The high initial investment required for ICT infrastructure, coupled with limited financing options for small and medium enterprises (SMEs), creates a significant obstacle to widespread adoption. Technological infrastructure issues, such as unreliable internet connectivity and insufficient data integration capabilities, further hinder adoption efforts (Murwira & Bekker, 2017).

The complexity attribute of DOI highlights how the perceived difficulty of using ICT tools can impede adoption. For instance, advanced systems such as BIM and blockchain require specialised skills that are often lacking within the workforce. Similarly, compatibility, another DOI attribute, is a barrier as many ICT solutions are not easily integrated with existing processes and organisational cultures, particularly within public sector projects.

2.4.2.2 Individual barriers

At the individual level, digital literacy gaps and resistance to change are key obstacles. Many employees within the construction sector are unfamiliar with advanced digital tools, leading to apprehension and low confidence in their ability to utilise such technologies effectively. These issues align with TAM's constructs of perceived ease of use (PEOU) and perceived usefulness (PU), which underscore the importance of user attitudes in determining ICT acceptance. Without adequate training and awareness, even the most sophisticated tools are unlikely to be embraced (Amali et al., 2022).

2.4.3 Government initiatives: The Expanded Public Works Programme (EPWP)

The EPWP is a flagship South African initiative aimed at addressing socio-economic challenges, such as unemployment and poverty, through infrastructure development and skills training. While not explicitly designed to promote ICT adoption, the programme

indirectly supports digital transformation by equipping participants with foundational skills that align with the demands of a digital economy (Phalatse, 2022).

Through its focus on job creation and skills development, the EPWP provides opportunities for training in project management and ICT-related competencies. However, its impact on digital transformation is limited by the programme's temporary nature and a lack of long-term support mechanisms. Moreover, the EPWP's implementation often suffers from inefficiencies and inconsistent stakeholder engagement, which undermine its potential to foster systemic change (Murwira & Bekker, 2017).

Despite these challenges, the EPWP demonstrates the government's commitment to addressing socio-economic disparities and building capacity within the construction sector. To maximise its impact on ICT adoption, the programme could incorporate targeted digital training modules and foster stronger partnerships with technology providers and educational institutions.

The South African construction sector is at a crossroads in its digital transformation journey. While there are pockets of progress, particularly in the adoption of BIM and smart construction practices, systemic and individual barriers continue to impede the widespread integration of ICT. Cost constraints, technological complexity, and digital literacy gaps remain significant hurdles, underscoring the need for targeted interventions that address these challenges holistically. Government initiatives like the EPWP play a crucial role in building capacity and addressing socio-economic challenges, but they must be more strategically aligned with the goal of fostering digital transformation. By leveraging global best practices and tailoring solutions to the local context, South Africa's construction sector can move closer to realising the full potential of ICT integration.

2.5 CHALLENGES OF ICT ADOPTION IN PUBLIC INFRASTRUCTURE PROJECTS

The adoption of Information and Communication Technology (ICT) in public infrastructure projects has the potential to transform service delivery, improve project governance, and foster transparency. However, numerous barriers hinder this transformation, ranging from cultural resistance and corruption to an overreliance on manual processes (Modisane & Kruger, 2023). By applying theoretical lenses such as the Technology Acceptance Model

(TAM) and the Diffusion of Innovations (DOI) theory, this section examines how these barriers impact adoption stages and user attitudes. Examples from South Africa and comparable contexts are explored to highlight the persistence of these challenges and their implications for digital transformation in the public sector.

2.5.1 Specific barriers to ICT adoption

The integration of ICT into public infrastructure projects faces significant obstacles. Cultural resistance remains one of the most pervasive barriers, driven by organisational inertia, fear of change, and limited digital literacy among stakeholders. Resistance to digital technologies is often rooted in an entrenched preference for traditional practices, where individuals perceive digital systems as complex and disruptive. The DOI framework identifies complexity as a critical determinant of innovation adoption; technologies perceived as difficult to use are less likely to be adopted (Rogers, 2003).

Corruption is another entrenched challenge in public sector projects. The infrastructure development lifecycle is susceptible to unethical practices, including fraud, collusion, and resource mismanagement. These practices erode public trust, exacerbate inefficiencies, and diminish the perceived usefulness of ICT systems, as explained by the TAM construct of perceived usefulness (Davis, 1989). For example, corruption in South Africa's public procurement processes has undermined the potential of e-procurement systems to enhance transparency and efficiency (Phalatse, 2022).

The reliance on manual processes persists as a significant barrier, particularly in bureaucratic systems where traditional workflows dominate. Paper-based systems not only delay project execution but also impede real-time data collection and decision-making. This reliance exacerbates inefficiencies and hinders the compatibility of new technologies with existing processes, as highlighted by DOI's compatibility construct (Rogers, 2003).

2.5.2 Influence of TAM and DOI on understanding barriers

The theoretical frameworks of TAM and DOI provide valuable insights into the dynamics of ICT adoption barriers. TAM's constructs of perceived ease of use (PEOU) and perceived usefulness (PU) explain how stakeholders' attitudes towards ICT are shaped by their perceptions of its practicality and benefits (Davis, 1989). For instance, manual

processes and low digital literacy reduce the perceived ease of use, discouraging adoption among public sector employees.

Similarly, DOI identifies relative advantage, complexity, and compatibility as key attributes influencing the adoption of innovations (Rogers, 2003). Cultural resistance can hinder the perceived relative advantage of ICT systems, while corruption and bureaucratic inertia increase the complexity of implementing these technologies. Moreover, manual processes create a misalignment between traditional practices and the compatibility of digital tools.

By integrating TAM and DOI, it becomes evident that barriers such as cultural resistance and systemic inefficiencies are not isolated issues but interrelated factors that influence user perceptions and the stages of ICT adoption.

2.5.3 Persistence of barriers in South Africa and similar contexts

South Africa exemplifies the persistence of these challenges in public infrastructure projects. The country's public sector faces cultural resistance due to a lack of digital literacy and the dominance of hierarchical bureaucratic structures. Employees often express apprehension about job security and distrust towards digital systems, reducing their willingness to adopt ICT tools (Camngca et al., 2022).

Corruption further compounds these issues. In public infrastructure projects, procurement processes are often mired in unethical practices, resulting in inefficiencies and increased project costs. For instance, irregularities in the management of public funds and collusion during tender processes have undermined the adoption of digital procurement platforms intended to streamline these operations (Murwira & Bekker, 2017).

The reliance on manual processes is another notable issue. Despite efforts to digitise workflows, many public sector organisations in South Africa continue to use paper-based systems for project monitoring and reporting. This reliance slows down decision-making, limits real-time communication, and prevents the integration of advanced technologies such as Building Information Modelling (BIM) and cloud computing (Phalatse, 2022).

Similar challenges are observed in other developing regions. For instance, in Nigeria, corruption and limited digital infrastructure are significant barriers to ICT adoption, while

in India, low digital literacy and resistance to change hinder the integration of digital solutions in public services (FEROUALI et al., 2024).

2.5.4 Addressing barriers and moving forward

Addressing these barriers requires a multifaceted approach that prioritises capacity building, governance reforms, and stakeholder engagement. Initiatives such as targeted training programs to improve digital literacy, anti-corruption measures, and the modernisation of bureaucratic systems are critical to fostering a culture of digital transformation. Furthermore, aligning ICT initiatives with organisational objectives and enhancing the compatibility of digital tools with existing workflows can significantly improve adoption rates.

The challenges of ICT adoption in public infrastructure projects are deeply entrenched in cultural, organisational, and systemic barriers. By applying TAM and DOI frameworks, it becomes clear that these barriers influence user attitudes and the stages of adoption. The persistence of these challenges in South Africa underscores the need for strategic interventions that address digital literacy, governance, and systemic inefficiencies. Learning from global examples and implementing tailored strategies can enable South Africa's public sector to overcome these barriers and fully harness the potential of ICT in infrastructure development.

2.6 OPPORTUNITIES FOR DIGITAL TRANSFORMATION IN PUBLIC SECTOR CONSTRUCTION

Digital transformation in public sector construction offers significant opportunities to improve governance, operational efficiency, and sustainability (Millard, 2023). By integrating advanced technologies, public sector organisations can optimise project outcomes, address socio-economic challenges, and align with global sustainability goals (Fei et al., 2021). This section explores these benefits, highlights global success stories that demonstrate the perceived usefulness and trialability of such technologies, and provides suggestions for leveraging these opportunities in the South African public sector.

2.6.1 Benefits of digital transformation

2.6.1.1 Improved governance and transparency

Digital transformation enhances governance by providing tools for better project oversight, accountability, and decision-making. Technologies such as blockchain, e-procurement systems, and cloud-based platforms facilitate transparent record-keeping, reduce fraud, and improve stakeholder confidence. For instance, blockchain technology has been successfully implemented in public procurement systems in Kenya to improve transparency and mitigate corruption risks (Camngca et al., 2022).

2.6.1.2 Increased efficiency and cost savings

The integration of Information and Communication Technology (ICT) streamlines administrative processes, reduces redundancy, and automates routine tasks. Building Information Modelling (BIM), digital twins, and AI have demonstrated their ability to enhance construction planning, resource allocation, and real-time monitoring. Studies in Iraq show that BIM adoption has led to substantial cost reductions and efficiency gains in public infrastructure projects (Mottaeva, 2024).

2.6.1.3 Sustainability and climate resilience

Digital transformation supports sustainability by enabling resource optimisation and reducing environmental impact. Digital twins and IoT devices facilitate proactive maintenance and efficient energy management, reducing waste and carbon emissions. The Broadband China Pilot policy demonstrated how digital transformation can significantly lower urban carbon emissions by integrating green technologies and optimising industrial structures (Zhao, 2024).

2.6.2 Lessons from global success stories

2.6.2.1 Perceived usefulness and Trialability (DOI Attributes)

Global success stories provide clear evidence of the perceived usefulness and trialability of digital transformation technologies. South Korea's digitalisation strategy for public construction projects, which aims to fully automate and integrate project information by 2030, exemplifies the tangible benefits of aligning technological initiatives with

organisational goals (Kim et al., 2023). The deployment of pilot projects in South Korea demonstrated measurable improvements in project delivery and cost management, offering valuable lessons for other regions aiming to adopt similar strategies (Park et al., 2023). Moreover, China's integration of Building Information Modelling (BIM) into public construction has highlighted trialability as a key factor in overcoming resistance and fostering innovation (Zhao, 2024).

2.6.2.2 Realising efficiency through AI and Big Data

Countries like the United States and China have effectively leveraged Artificial Intelligence (AI) and big data analytics to enhance project forecasting, resource allocation, and stakeholder communication (Li et al., 2022). The United States, for instance, demonstrated the successful application of predictive analytics in public sector infrastructure, where AI algorithms improved decision-making processes and reduced project delays (Martin et al., 2022). Similarly, China's adoption of big data in urban planning and infrastructure development has shown substantial improvements in operational efficiency and reduced costs (Xu et al., 2023). The ability to trial AI applications in specific project phases has been instrumental in overcoming organisational resistance and realising transformative benefits (Zhu & Han, 2023).

2.6.2.3 Adapting lessons to the South African context

South Africa can adapt these global lessons by emphasising pilot projects that demonstrate the practical benefits of technologies such as BIM and AI in high-priority infrastructure projects. For example, a pilot BIM project in a metropolitan municipality could highlight its value in improving timelines, reducing costs, and ensuring accountability (Camngca et al., 2022). Additionally, adopting AI-driven analytics to monitor project milestones could improve resource allocation and provide real-time insights, further building stakeholder confidence in digital transformation (Moshood et al., 2020).

2.6.3 Leveraging digital transformation opportunities in South Africa

To harness the full potential of digital transformation, South Africa's public sector must address existing challenges and create an enabling environment for ICT integration.

2.6.3.1 Enhancing ICT literacy and capacity building

To foster a culture of innovation, South Africa must invest in ICT literacy and capacity building. Collaborations with educational institutions and private sector organisations can create tailored training programmes to equip public sector employees with the skills needed to adopt and sustain digital technologies (Eliwa et al., 2022). Evidence from Ghana highlights the importance of continuous professional development in driving ICT integration within public sector projects (Amoah & Ayesu-Koranteng, 2022).

2.6.3.2 Strengthening infrastructure and policy frameworks

South Africa must prioritise robust digital infrastructure and supportive policy frameworks to enable successful ICT adoption. High-speed internet access, cloud computing facilities, and energy-efficient solutions should form the backbone of digital transformation initiatives (Mottaeva, 2024). For instance, Kenya's blockchain-enabled public procurement system offers a model for enhancing transparency and efficiency through digital infrastructure (Camngca et al., 2022).

2.6.3.3 Pilot projects for scalable solutions

Pilot projects provide a feasible pathway for testing and scaling digital transformation technologies. South Korea's approach to automating construction administration through pilot programmes demonstrates how early-stage projects can inform long-term strategies (Kim et al., 2023). Similarly, introducing small-scale BIM implementations in South Africa can serve as learning opportunities for broader adoption in public sector construction (Martin et al., 2022).

2.6.3.4 Fostering Public-Private Partnerships

Public-Private Partnerships (PPPs) can accelerate digital transformation by leveraging advanced technologies and expertise. Collaborations with global technology firms can facilitate knowledge transfer and provide the financial resources needed for large-scale digital initiatives. For example, Qatar's collaboration with cloud computing providers highlights the value of PPPs in overcoming resource constraints (Ferouali et al., 2024).

Digital transformation offers a wealth of opportunities to enhance governance, efficiency, and sustainability in public sector construction projects. Global success stories provide

valuable insights into the perceived usefulness and trialability of advanced technologies, demonstrating their potential to address common challenges and deliver measurable benefits. For South Africa, strategic investments in infrastructure, capacity building, and pilot projects are critical for leveraging these opportunities. By adopting a collaborative and adaptive approach, the public sector can align its construction projects with global best practices, fostering innovation and socio-economic development.

2.7 RESEARCH GAPS

The comprehensive review of global and local literature, theoretical frameworks, and case studies reveals several critical research gaps in the context of ICT adoption for public sector construction projects, particularly in developing economies such as South Africa. These gaps, informed by the discussion in this chapter, are articulated below:

2.7.1 Limited Focus on ICT adoption in developing economies.

While much of the literature focuses on ICT adoption in developed economies, there is a paucity of research exploring its application in developing economies, particularly within the context of public sector construction projects. Studies on advanced economies such as South Korea, the United States, and China emphasise the benefits of BIM, AI, and digital twins in improving efficiency and reducing costs. However, limited attention has been paid to understanding how these technologies can be adapted to address the socio-economic and infrastructural challenges prevalent in developing regions like South Africa, where budgetary constraints, poor ICT infrastructure, and low digital literacy persist (Li et al., 2022; Camngca et al., 2022).

2.7.2 Stakeholder dynamics in ICT adoption

The role of stakeholder dynamics, including resistance to change, collaboration, and user engagement, remains underexplored within ICT adoption frameworks such as TAM and DOI. Although these frameworks highlight factors like perceived usefulness, ease of use, and trialability, they often overlook the socio-political and organisational intricacies of public sector environments. For instance, the influence of political will, power dynamics, and community involvement in shaping ICT adoption has not been adequately studied, particularly in the South African context where public sector projects often face scrutiny for inefficiency and lack of transparency (Zhao, 2024; Ferouali et al., 2024).

2.7.3 Organisational culture and resistance

Organisational culture emerges as a significant barrier to ICT adoption in public sector projects, yet research rarely delves deeply into how cultural factors influence digital transformation. Studies highlight that bureaucratic resistance, hierarchical structures, and fear of job displacement often impede adoption. However, there is limited research on strategies to foster an innovation-friendly culture within public organisations in developing economies, particularly in environments like South Africa's Department of Public Works, where entrenched processes and manual practices dominate (Camngca et al., 2022; Moshood et al., 2020).

2.7.4 Interplay between ICT adoption and policy frameworks.

There is a lack of comprehensive analysis on the interplay between ICT adoption and policy frameworks in the public sector. While global examples such as Qatar's e-governance strategies and Kenya's blockchain-enabled procurement systems illustrate the role of supportive policies, little is known about how policy gaps in South Africa affect the scalability and sustainability of digital transformation initiatives. This gap is particularly relevant considering South Africa's fragmented public sector ICT strategies, which often lack alignment with overarching developmental goals (Kim et al., 2023; Martin et al., 2022).

2.7.5 Tailored strategies for ICT integration in South Africa

The literature reveals a pressing need for tailored strategies that address the unique challenges of South Africa's public sector construction projects. These challenges include the over-reliance on manual processes, systemic inefficiencies, and limited ICT resources. Unlike global contexts where digital maturity is high, South Africa requires strategies that prioritise foundational digital skills, low-cost solutions, and scalable pilot projects. Existing studies have not adequately explored how such strategies can bridge the gap between local challenges and global best practices (Li et al., 2022; Ferouali et al., 2024).

2.7.6 ICT for socio-economic impact

While the potential for ICT to drive socio-economic development is well-documented globally, its impact on public sector construction projects in South Africa remains under-researched. There is a gap in understanding how ICT can be leveraged to address localised issues such as unemployment, skills shortages, and rural development through initiatives like the Expanded Public Works Programme (EPWP). The integration of digital transformation into such programmes could provide valuable insights into how ICT can create sustainable socio-economic benefits (Camngca et al., 2022; Moshood et al., 2020).

2.7.7 Empirical evidence on ICT trialability

The DOI framework emphasises trialability as a critical attribute for innovation adoption, yet there is limited empirical evidence on how trialability influences ICT adoption in public sector construction. Case studies from developed economies underscore the importance of pilot projects, but there is insufficient research on their application in developing contexts like South Africa. This gap highlights the need for studies that evaluate the outcomes of small-scale ICT implementations in the South African public sector to build evidence for scalability and adoption (Zhao, 2024; Kim et al., 2023).

These research gaps underscore the need for an integrative approach that combines theoretical insights with practical considerations to advance ICT adoption in public sector construction projects in South Africa. Addressing these gaps requires a nuanced understanding of stakeholder dynamics, organisational culture, and policy frameworks, alongside tailored strategies that align with local socio-economic and infrastructural realities. By bridging these gaps, future research can contribute to the development of effective frameworks and interventions that drive meaningful digital transformation in South Africa's public sector.

2.8 CHAPTER SUMMARY

This chapter has provided a comprehensive review of the literature on ICT adoption and digital transformation in public sector construction projects, with a specific focus on the South African context. Using the Technology Acceptance Model (TAM) and the Diffusion

of Innovations (DOI) framework as analytical lenses, the chapter synthesised key findings related to global trends, challenges, and opportunities.

The literature reveals that digital transformation in construction is driven by advanced technologies such as Building Information Modelling (BIM), artificial intelligence (AI), and the Internet of Things (IoT). Globally, success stories from countries like South Korea and Kenya demonstrate the transformative potential of ICT in improving efficiency, governance, and sustainability. These examples illustrate the perceived usefulness and trialability (DOI attributes) of ICT solutions, highlighting their ability to enhance productivity and resource optimisation.

However, significant barriers persist, particularly in developing economies. These include systemic challenges like fragmented supply chains, inadequate infrastructure, and policy misalignment, as well as individual-level factors such as digital literacy gaps and resistance to change. In South Africa, the public sector construction industry faces additional hurdles, such as corruption, reliance on manual processes, and limited adoption of advanced technologies like BIM and AI. These challenges are compounded by a lack of robust governance frameworks and insufficient capacity-building initiatives.

Despite these challenges, the opportunities for ICT adoption in South Africa's public sector construction projects are immense. Investments in training, infrastructure, and pilot projects can foster innovation, improve project outcomes, and contribute to broader socio-economic development goals. The chapter also identified research gaps in areas such as stakeholder dynamics, organisational culture, and the trialability of ICT, highlighting the need for tailored strategies to address local challenges.

The insights from this literature review directly inform the research methodology outlined in Chapter 3, providing a theoretical and contextual foundation for the study. The TAM and DOI frameworks will guide the qualitative exploration of ICT adoption within South Africa's public sector construction projects. These frameworks offer a robust lens for examining user perceptions, organisational readiness, and systemic barriers.

The identified research gaps underscore the importance of a case study approach, which will enable an in-depth investigation of the challenges and opportunities specific to the North West Department of Public Works (NW DPW). Semi-structured interviews and thematic analysis, informed by the constructs of TAM and DOI, will provide rich qualitative

data to address the study's objectives. This methodological alignment ensures a coherent transition from the literature review to the empirical investigation.

This chapter sets the stage for the subsequent research by identifying critical themes, gaps, and theoretical underpinnings that will shape the study. In Chapter 3, the research design and methods will be detailed, demonstrating how the study will empirically address the issues and opportunities identified in the literature.

CHAPTER 3 – METHODOLOGY

This chapter outlines the research methodology employed to explore the adoption and utilisation of Information and Communication Technology (ICT) within the North West Department of Public Works (NW DPW). The chapter begins by reiterating the study's purpose and research objectives, followed by a detailed discussion of the research design, data collection methods, sampling strategy, and data analysis techniques.

Grounded in a qualitative research methodology and interpretivist paradigm, the study seeks to understand the subjective experiences and perspectives of key stakeholders in the NW DPW. The interpretivist approach provides a nuanced framework for exploring the cultural, organisational, and contextual factors influencing ICT adoption, aligning with the study's aim of identifying actionable strategies to enhance digital transformation in the public sector.

The chapter also addresses ethical considerations and measures to ensure the rigour of the research process, including credibility, dependability, and transferability. The limitations of the research design are acknowledged, ensuring transparency, and fostering an understanding of the study's scope and constraints. The chapter concludes by linking the methodology to the presentation and discussion of findings in Chapter 4, thereby providing a cohesive narrative of the research process.

3.1 RESEARCH DESIGN AND PARADIGM

The study employs a qualitative research methodology, underpinned by an interpretivist paradigm, to explore the complexities surrounding the adoption and utilisation of Information and Communication Technology (ICT) within the North West Department of Public Works (NW DPW). This approach is particularly suited to investigating subjective experiences, cultural nuances, and contextual factors that influence the integration of ICT in public sector construction projects. By focusing on participants' perspectives and the meanings they ascribe to their experiences, the interpretivist paradigm enables a comprehensive understanding of organisational and operational challenges (Bryman, 2016).

3.1.1 Case study as a research strategy

A case study design was selected as the research strategy for this investigation. The case study approach facilitates an in-depth exploration of the NW DPW's operational environment, organisational practices, and the barriers to ICT adoption. Yin (2018) emphasises that case study research is appropriate for examining contemporary phenomena within real-world settings, particularly when the boundaries between the phenomenon and its context are not clearly delineated. This method allows for a rich and holistic analysis of the challenges and opportunities associated with digital transformation in the NW DPW, contributing to both theoretical insights and practical recommendations.

3.1.2 Alignment with Research Objectives

The choice of qualitative methodology and a case study design aligns with the study's objectives to:

- Examine the current state of ICT adoption within the NW DPW.
- Identify the cultural, organisational, and systemic barriers to ICT adoption.
- Propose actionable strategies to enhance digital transformation.

Through the interpretivist lens, the study delves into the lived experiences of stakeholders, capturing their perceptions, attitudes, and contextual realities. This approach ensures that the findings are grounded in the specificities of the NW DPW while contributing to broader discourses on ICT adoption in the public sector.

3.1.3 Rationale for the paradigm

The interpretivist paradigm was selected due to its emphasis on understanding social phenomena through the meanings constructed by individuals. Unlike positivist approaches, which seek generalisable laws, interpretivism values the subjective and socially constructed nature of reality. This paradigm is particularly relevant for studies investigating human-centric challenges, such as resistance to change, organisational culture, and stakeholder dynamics in ICT adoption (Lincoln & Guba, 1985).

3.1.4 Integration with methodology

The interpretivist approach and case study design are integrated using semi-structured interviews and thematic analysis, allowing the study to capture rich, context-specific data. The design prioritises depth over breadth, ensuring that the complexities of ICT adoption within the NW DPW are thoroughly explored and understood. This methodological coherence strengthens the study's validity and enhances its contribution to academic and practical knowledge.

In summary, the qualitative, interpretivist case study design provides a robust framework for investigating ICT adoption within the NW DPW. By combining methodological rigour with an emphasis on context and subjectivity, the research design aligns closely with the study's objectives and theoretical underpinnings, setting the stage for a nuanced and impactful analysis.

3.2 CASE STUDY RESEARCH DESIGN

3.2.1 Justification for a single case study design

A single case study design was selected to enable an in-depth exploration of ICT adoption within the North West Department of Public Works (NW DPW). According to Yin (2018), a single case study is particularly appropriate when the case represents a unique, critical, or revelatory instance of a phenomenon. The NW DPW exemplifies a public sector organisation grappling with the complexities of digital transformation in a resource-constrained environment. This context provides a fertile ground for investigating the barriers and opportunities associated with ICT adoption in public infrastructure projects.

The single case study design aligns with the study's objectives to explore the specific organisational, cultural, and systemic factors influencing ICT adoption. By focusing on a single organisation, the research can achieve a level of depth and detail that would be difficult to attain with multiple cases. This approach allows for a thorough analysis of contextual factors and stakeholder perspectives, providing nuanced insights that contribute to the broader discourse on digital transformation in public sector construction management.

3.2.2 Benefits of using a case study

The case study methodology offers several advantages for this research:

- **Contextual Understanding:** Case studies facilitate the exploration of phenomena within their real-life context, enabling a comprehensive understanding of how organisational culture, stakeholder dynamics, and systemic factors impact ICT adoption (Stake, 1995).
- **Rich Data Collection:** The approach supports the use of multiple data sources, including semi-structured interviews, organisational reports, and policy documents, to triangulate findings and enhance the robustness of the analysis (Yin, 2018).
- **Flexibility:** The case study design accommodates the complexities and variations inherent in real-world phenomena, allowing the researcher to adapt data collection and analysis methods as new insights emerge (Simons, 2009).
- **Practical Relevance:** By focusing on a specific instance, the case study produces actionable insights and recommendations tailored to the unique challenges and opportunities faced by the NW DPW.

3.2.3 Details of the case: The North West Department of Public Works

The NW DPW serves as the single case in this study due to its pivotal role in public infrastructure development and its significant challenges with ICT adoption. The department is responsible for the planning, construction, and maintenance of public infrastructure across four districts and 19 local municipalities in the North West Province. Its operational scope includes the management of provincial roads, government buildings, and public facilities, alongside socio-economic development initiatives such as the Expanded Public Works Programme (EPWP).

The NW DPW operates within a predominantly rural and semi-urban context, characterised by resource constraints, ageing infrastructure, and high levels of socio-economic need. These challenges are compounded by the department's reliance on traditional, manual processes for project management, which limit its ability to deliver services efficiently and effectively. Despite these constraints, the NW DPW is tasked with

implementing infrastructure projects that are critical for economic growth, service delivery, and community development.

3.2.4 Relevance to the study

The NW DPW provides a unique and critical case for examining ICT adoption in public sector construction projects for several reasons:

- **Representative Challenges:** The department's barriers to ICT adoption, including resistance to change, limited ICT literacy, and resource constraints, reflect common issues faced by public sector organisations in developing economies.
- **Strategic Importance:** As a key player in infrastructure development, the NW DPW's success in adopting ICT has significant implications for the socio-economic development of the North West Province and beyond.
- **Policy Implications:** Insights from the NW DPW's experiences can inform policy and strategy for digital transformation across similar organisations in South Africa and other developing countries.

In conclusion, the single case study design offers a powerful framework for investigating the intricacies of ICT adoption within the NW DPW. By focusing on this specific organisation, the study can provide detailed, contextually relevant insights that contribute to both academic understanding and practical solutions for digital transformation in the public sector.

3.3 DATA COLLECTION METHODS

3.3.1 Primary data collection: semi-structured interviews

Semi-structured interviews serve as the primary data collection method for this study. This approach was chosen due to its flexibility and capacity to capture rich, qualitative data reflecting the lived experiences, perceptions, and contextual realities of stakeholders within the North West Department of Public Works (NW DPW). Unlike structured interviews, semi-structured interviews allow for open-ended responses and follow-up questions, facilitating deeper exploration of complex themes such as ICT adoption, organisational culture, and systemic barriers (Bryman, 2016).

Semi-structured interviews are particularly suited to the interpretivist paradigm underpinning this study. They enable participants to articulate their perspectives in their own words, providing nuanced insights into the factors influencing ICT adoption. This method is also effective in uncovering unanticipated issues or themes, ensuring that the data collection process remains responsive to the complexities of the research context (Kvale, 2007). Furthermore, semi-structured interviews create an interactive dialogue between the researcher and participants, fostering an environment conducive to honest and reflective responses.

3.3.2 Selection Criteria for Participants

Participants were purposively selected to ensure representation from diverse roles within the NW DPW and its associated projects. The inclusion criteria focused on stakeholders with direct or indirect involvement in the planning, execution, or management of ICT-related activities. Key categories of participants include:

- **Project Managers:** Responsible for overseeing infrastructure projects, these individuals provide insights into operational challenges and the integration of ICT tools in project workflows.
- **Contractors:** As external collaborators, contractors offer perspectives on the practical application of ICT tools in construction processes and the barriers they encounter.
- **Departmental Staff:** Including policy advisors, IT personnel, and administrative staff, this group contributes an understanding of organisational culture, policy frameworks, and internal capacities for ICT adoption.

The purposive sampling strategy ensures that the data collected reflects the diverse experiences and perspectives within the NW DPW, capturing a holistic view of ICT adoption and its challenges (Campbell, 2020).

Interview Design

The interview protocol was designed to address the study's research objectives and explore themes relevant to ICT adoption, barriers, and opportunities. Key topics and guiding questions include:

- Current ICT practices: “What ICT tools or systems are currently used in your work, and how effective are they in meeting project objectives?”
- Barriers to ICT adoption: “What challenges have you encountered in adopting ICT tools in your role or department?”
- Opportunities for digital transformation: “What potential benefits do you perceive in adopting advanced ICT solutions for public infrastructure projects?”
- Organisational dynamics: “How does the department’s culture or structure influence the adoption of ICT technologies?”
- Policy and support systems: “What role do government policies or external partnerships play in supporting ICT adoption within the NW DPW?”

Interviews will be recorded and transcribed with participants’ consent, ensuring accurate data capture for subsequent analysis.

3.3.3 Secondary data collection

To complement the primary data, secondary data sources, such as organisational reports, policy documents, and other relevant materials, will be analysed. These sources provide contextual information and serve as an additional layer of evidence to support and validate the findings from the interviews.

Use of organisational reports and policy documents

Organisational reports, including project evaluations, ICT strategy documents, and internal memos, offer insights into the operational environment and historical efforts towards ICT adoption. Policy documents, such as national digital transformation strategies and departmental guidelines, provide a framework for understanding the broader policy context influencing the NW DPW’s operations.

Triangulation and complementarity

Secondary data is instrumental in triangulating the primary data, enhancing the study’s validity and reliability (Yin, 2018). For example, interview findings on perceived barriers to ICT adoption can be cross-referenced with organisational reports detailing resource constraints or policy misalignments. This multi-source approach ensures a comprehensive understanding of the research problem while reducing the risk of bias.

In summary, the combined use of semi-structured interviews and secondary data collection methods allows for a robust and nuanced exploration of ICT adoption within the NW DPW. The integration of primary and secondary data enhances the study's credibility and provides a solid foundation for generating actionable recommendations.

3.4 DATA ANALYSIS METHOD

3.4.1 Thematic analysis approach

This study employs thematic analysis as the primary method for analysing qualitative data. Thematic analysis is a systematic approach to identifying, organising, and interpreting patterns or themes within qualitative data, making it particularly suitable for understanding complex organisational and cultural dynamics (Braun & Clarke, 2006). This method aligns well with the study's objectives, as it allows for the emergence of insights grounded in the lived experiences and perspectives of stakeholders in the North West Department of Public Works (NW DPW).

By focusing on themes related to ICT adoption, barriers, and opportunities, thematic analysis facilitates a nuanced understanding of the factors influencing digital transformation in public sector construction projects. Its flexibility in accommodating inductive (data-driven) and deductive (theory-driven) approaches enables the integration of concepts from the Technology Acceptance Model (TAM) and Diffusion of Innovations (DOI) theory, further enriching the analysis.

Step-by-step process for thematic analysis

The analysis will follow the six-step process outlined by Braun and Clarke (2006), ensuring a rigorous and transparent approach:

1. Familiarisation with data: The researcher will transcribe the semi-structured interviews verbatim and review secondary data sources such as organisational reports and policy documents. This stage involves repeated reading and immersion in the data to gain a holistic understanding.
2. Initial coding: Using both inductive and deductive coding strategies, the researcher will identify meaningful units of data. Codes will be assigned to segments of text

that capture relevant aspects of the participants' responses, focusing on ICT adoption, barriers, and opportunities.

3. Searching for themes: The initial codes will be grouped into broader themes that capture patterns or recurring ideas within the data. For example, codes related to "stakeholder resistance" and "organisational culture" may converge under a theme like "cultural barriers to ICT adoption."
4. Reviewing Themes: Themes will be reviewed to ensure they accurately represent the data and align with the research objectives. This involves refining the themes to eliminate redundancy and enhance clarity, ensuring each theme contributes to a cohesive narrative.
5. Defining and naming themes: Once the themes are finalised, the researcher will articulate their scope and focus, ensuring they are clearly defined and appropriately named. For instance, a theme like "Barriers to ICT Adoption" might include sub-themes such as "Cultural Resistance" and "Infrastructure Constraints."
6. Producing the report: The final themes will be integrated into the findings section, supported by illustrative quotes from participants. The report will link these themes to the study's research questions and theoretical frameworks, offering insights into ICT adoption within the NW DPW.

3.4.2 Ensuring validity and reliability

To enhance the validity and reliability of the analysis, the study incorporates several strategies recommended by Lincoln and Guba (1985):

- Member checking: Participants will have the opportunity to review their transcribed interviews and preliminary findings to verify the accuracy and credibility of the interpretations. This process helps to ensure the authenticity of the data and mitigates researcher bias.
- Reflective commentary: Throughout the analysis, the researcher will maintain a reflective journal to document their thoughts, assumptions, and decision-making processes. This practice enhances transparency and allows for critical self-examination, reducing the influence of personal bias on the findings.
- Triangulation: Thematic analysis will be supplemented with insights from secondary data sources, such as organisational reports and policy documents, to corroborate the primary data and strengthen the overall credibility of the findings.

- Audit trail: Detailed records of the coding process, theme development, and analytic decisions will be maintained, providing a clear trail that allows for replication or review by other researchers.

In conclusion, thematic analysis provides a robust and adaptable framework for examining the qualitative data collected in this study. By systematically identifying patterns and themes, the method facilitates an in-depth exploration of the factors influencing ICT adoption within the NW DPW, while rigorous measures ensure the reliability and validity of the analysis.

3.5 ETHICAL CONSIDERATIONS

3.5.1 Ethical approval and compliance with POPIA

This study adheres to the highest ethical standards, aligning with the guidelines set by the North-West University (NWU) Research Ethics Committee. Ethical clearance for the research was obtained prior to data collection, ensuring compliance with institutional and national ethical requirements.

The study also complies with the Protection of Personal Information Act (POPIA), South Africa's legislative framework governing data protection and. In accordance with POPIA, all personal and sensitive information collected during the research will be handled with the utmost confidentiality and stored securely privacy (Republic of South Africa, 2013). Data will be used exclusively for research purposes and will not be shared with third parties without explicit permission.

3.5.2 Informed Consent

Informed consent is a cornerstone of ethical research, ensuring that participants understand the study's purpose, procedures, potential risks, and benefits. All participants were provided with a detailed information sheet outlining:

- The objectives and scope of the study.
- The voluntary nature of their participation.
- Their right to withdraw from the study at any stage without repercussions.
- The measures taken to ensure anonymity and confidentiality.

Participants were required to sign a consent form before the commencement of interviews, indicating their agreement to participate. This process included an opportunity for participants to ask questions and seek clarification to ensure they were fully informed.

3.5.3 Anonymity and confidentiality safeguards

To protect participant identities, the study employs the following measures:

- **Anonymity:** Participants' names and any identifying details will be replaced with pseudonyms in all transcripts, reports, and publications.
- **Confidentiality:** Data will be stored securely in password-protected digital files and locked physical cabinets. Access will be restricted to the researcher and authorised supervisors.
- **Data Retention:** Collected data will be retained for a period of five years for potential academic scrutiny, after which it will be securely destroyed in compliance with POPIA regulations.

3.5.4 Voluntary participation and right to withdraw.

Participation in the study is entirely voluntary, ensuring that individuals feel no coercion or obligation to take part. Participants were explicitly informed of their right to withdraw from the study at any stage, without having to provide a reason and without any adverse consequences. This provision safeguards participants' autonomy and reinforces the ethical integrity of the research.

3.5.5 Mitigating potential risks

While the study poses minimal risks, efforts were made to mitigate any potential discomfort or inconvenience for participants. Interviews were scheduled at times and locations convenient to participants, and sensitive topics were approached with care and professionalism. If any participant experienced discomfort during the interview, they were offered the option to pause or terminate the discussion.

In summary, the study incorporates comprehensive ethical measures to protect participants' rights, privacy, and well-being. By obtaining informed consent, safeguarding anonymity, and confidentiality, and adhering to POPIA regulations, the research ensures ethical compliance and fosters trust with all stakeholders involved.

3.6 TRUSTWORTHINESS

To ensure the trustworthiness of this study, strategies addressing credibility, dependability, and transferability are implemented, consistent with the criteria outlined by Lincoln and Guba (1985).

3.6.1 Credibility

Credibility is achieved through data triangulation, which integrates primary data collected via semi-structured interviews with secondary sources, including organisational reports and policy documents. This multi-faceted approach enhances the robustness of the findings by cross-verifying evidence from diverse perspectives (Bryman, 2016). Furthermore, member checking is employed to improve the authenticity of the data. Participants are invited to review their interview transcripts and provide feedback on interpretations, ensuring that their perspectives are accurately represented and reducing the risk of researcher bias (Shenton, 2004).

3.6.2 Dependability

Dependability is maintained through the establishment of a comprehensive audit trail, which records all methodological decisions, data collection activities, and analytical processes. This transparent documentation allows future researchers to replicate the study, thus ensuring methodological rigour (Nowell et al., 2017). Dependability is further enhanced by engaging in peer debriefing sessions with academic supervisors, who provide critical feedback and external scrutiny of the research process. This collaborative approach strengthens the reliability of the study and ensures alignment with established qualitative research standards (Cope, 2014).

3.6.3 Transferability

Transferability is facilitated through the provision of detailed contextual descriptions of the North West Department of Public Works (NW DPW), its operational scope, and the environment in which ICT adoption occurs. By offering rich, thick descriptions of participants' experiences and the organisational setting, the study enables readers to assess the applicability of its findings to similar contexts (Tracy, 2010). While the single

case study design limits broad generalisability, the depth of contextual detail ensures that key insights can inform practices in analogous public sector entities.

These strategies collectively ensure the trustworthiness of the research, adhering to qualitative research best practices, providing a robust foundation for interpreting, and applying the study's findings.

3.7 LIMITATIONS OF THE RESEARCH DESIGN

3.7.1 Acknowledged limitations.

This study acknowledges several limitations inherent in its research design. Firstly, participants may provide socially desirable responses or underreport challenges due to organisational or personal concerns. This limitation could impact the authenticity and depth of the data collected, as participants may feel constrained by organisational dynamics or fear of repercussions (Bryman, 2016).

Secondly, as a single case study focused exclusively on the North West Department of Public Works (NW DPW), the findings may not be directly generalisable to other public sector contexts or geographical locations. The specific cultural, organisational, and infrastructural characteristics of the NW DPW may not align with those of other entities, limiting the study's external validity (Yin, 2018). However, the inclusion of detailed contextual descriptions aims to provide transferable insights for similar public sector settings.

3.7.2 Mitigation strategies

To address these limitations, several mitigation strategies are implemented. Building rapport with participants is prioritised to create an environment that encourages openness and honesty during interviews. This approach aims to reduce response biases and elicit genuine insights into the challenges and opportunities surrounding ICT adoption (Shenton, 2004). Additionally, the use of secondary data sources, such as organisational reports and policy documents, enables triangulation, and helps mitigate over-reliance on self-reported data.

While the single case study design may constrain generalisability, the study adopts a rigorous analytical approach grounded in established theoretical frameworks, including

the Technology Acceptance Model (TAM) and Diffusion of Innovations (DOI) theory. This integration of broader theoretical perspectives enhances the relevance of the findings, providing a foundation for application in other contexts with similar characteristics (Lincoln & Guba, 1985).

Lastly, the study capitalises on the strengths of the case study design by delving deeply into the complexities of ICT adoption within the NW DPW. This focused approach allows for the capture of rich, nuanced data that may be overlooked in broader studies, offering valuable insights into the specific barriers and enablers of digital transformation in public sector construction management (Stake, 1995).

3.8 CHAPTER SUMMARY

This chapter outlines the methodological framework underpinning the study, from its interpretivist paradigm and qualitative approach to the case study design and data collection methods. Key strategies for ensuring rigour, including credibility, dependability, and transferability, have been detailed alongside ethical considerations that safeguard participants' rights and data integrity. The limitations of the research design have also been acknowledged, with strategies to mitigate these constraints outlined.

The robust methodological foundation established in this chapter provides a basis for the subsequent analysis. Chapter 4 will present the findings derived from the thematic analysis, offering insights into the challenges and opportunities associated with ICT adoption within the NW DPW. This transition marks the progression from methodology to results, advancing the study towards actionable conclusions and recommendations.

CHAPTER 4: RESULTS AND FINDINGS

This chapter presents the findings of the study, offering a detailed analysis of the data collected from semi-structured interviews and supporting secondary sources. The primary aim is to explore the adoption of Information and Communication Technology (ICT) within the North West Department of Public Works (NW DPW). The findings are structured thematically, providing insights into the barriers, opportunities, and organisational dynamics associated with ICT adoption. This thematic organisation ensures alignment with the study's conceptual frameworks - the Technology Acceptance Model (TAM) and Diffusion of Innovations (DOI) - as well as the research objectives and questions.

The study aimed to examine the organisational and cultural factors influencing ICT adoption, identify barriers and opportunities, and develop actionable recommendations to support the NW DPW's digital transformation journey. These aims are addressed through the following research questions:

1. What are the current practices and challenges related to ICT adoption in the NW DPW?
2. How do organisational culture and stakeholder dynamics impact ICT adoption?
3. What opportunities exist for enhancing ICT adoption and utilisation within the NW DPW?
4. How can the TAM and DOI frameworks inform strategies for overcoming barriers and leveraging opportunities in ICT adoption?

To contextualise the findings, this chapter revisits these objectives and research questions, ensuring that the analysis remains focused and relevant. The findings are organised into themes derived from the data, with each theme reflecting core elements of the TAM and DOI frameworks. For example, key findings related to perceived usefulness (PU) and perceived ease of use (PEOU) are linked to TAM, while relative advantage, complexity, and trialability are examined through the lens of DOI.

This structured approach not only facilitates a comprehensive analysis of the data but also provides a foundation for the discussion and recommendations in subsequent chapters. By synthesising participant perspectives, secondary data, and theoretical

insights, this chapter highlights the complexities and nuances of ICT adoption in the public sector construction context of the NW DPW.

4.1 CONTEXTUAL OVERVIEW OF THE NW DPW

The North West Department of Public Works and Roads (NW DPW) is a key provincial entity in South Africa, responsible for managing public infrastructure development and maintenance while addressing socio-economic challenges. Its leadership structure is headed by MEC Elizabeth Mokua and the Head of Department (HOD), Mr. Moses Ikgopoleng Kgantsi. The department is organised into four primary programmes:

- **Administration:** Focuses on providing managerial and administrative support to facilitate effective departmental operations.
- **Public Works Infrastructure:** Oversees the construction and maintenance of government buildings and other public facilities.
- **Transport Infrastructure:** Manages the provincial road network, which spans over 19,000 kilometres, ensuring connectivity and safety.
- **Community-Based Programmes:** Administers initiatives like the Expanded Public Works Programme (EPWP), aimed at promoting job creation and skills development.

These programmes align with the department's mandate to deliver infrastructure services and support socio-economic growth in the province (Provincial Government of South Africa, 2024).

4.1.1 Project management practices and ICT framework

The NW DPW currently relies heavily on traditional project management methods, including paper-based documentation and in-person communication. Although basic ICT tools, such as standard office software, are utilised, the adoption of advanced technologies—such as Building Information Modelling (BIM), cloud-based systems, and the Internet of Things (IoT)—remains minimal. This limited ICT integration has resulted in inefficiencies, including delays, resource mismanagement, and higher risks of errors.

Recognising these shortcomings, strategic documents like the Annual Performance Plan (APP) 2022/2023 identify ICT adoption as a critical priority (North West Department of Public Works and Roads, 2024). Proposed initiatives include:

- Upgrading ICT infrastructure to support project monitoring and management.
- Offering ICT training for departmental staff to enhance digital literacy.

Implementing real-time monitoring systems for improved transparency and accountability (North West Department of Public Works and Roads, 2024b).

4.1.2 Challenges faced by the NW DPW

Despite its strategic importance, the NW DPW faces several operational and systemic challenges that hinder its performance and adoption of digital transformation initiatives:

- Infrastructure backlogs: Persistent delays in project completion adversely impact service delivery and the department's ability to meet developmental targets.
- Budgetary constraints: Limited financial resources restrict investments in ICT infrastructure and training programmes, impeding modernisation efforts.
- Reliance on manual processes: Continued dependence on outdated, paper-based workflows contributes to inefficiencies and inaccuracies.
- Construction disruptions: The rise of "Construction Mafias" poses significant security risks to infrastructure projects, further delaying progress and increasing project costs (Taung Daily News, 2024).

4.1.3 Strategic Initiatives for ICT Integration

To address these challenges, the NW DPW has undertaken several strategic initiatives aimed at digital transformation:

- ICT infrastructure upgrades: Investments in digital tools to enhance project communication and operational efficiency.
- Capacity building: ICT-focused training initiatives to improve staff competency and digital literacy.
- Real-time monitoring: Deployment of systems for tracking project progress, ensuring accountability, and supporting data-driven decision-making.

These initiatives are pivotal for modernising the department's operational framework and addressing inefficiencies while enhancing project outcomes (North West Department of Public Works and Roads, 2024b).

4.1.4 Implications for project management

The integration of ICT has profound implications for the NW DPW's project management practices. Notable benefits include:

- Improved efficiency: Automation reduces delays, optimises workflows, and minimises human error.
- Enhanced transparency: Real-time monitoring fosters accountability and supports informed decision-making.
- Resource optimisation: Digital tools improve the allocation and utilisation of resources, ensuring cost and time efficiencies (North West Department of Public Works and Roads, 2024b).

The NW DPW operates within a complex and resource-constrained environment, grappling with systemic inefficiencies and infrastructural backlogs. However, the department's recognition of ICT as a transformative tool reflects its commitment to addressing these challenges. The strategic initiatives outlined in its planning documents, including ICT infrastructure upgrades and capacity-building programmes, underscore a proactive approach towards digital transformation. While challenges remain, the NW DPW's efforts to modernise its operations are essential for fulfilling its mandate of infrastructure development and improving public service delivery, ultimately fostering socio-economic development in the North West Province.

4.2 THEMATIC ANALYSIS OF FINDINGS

4.2.1 Current State of ICT adoption

This section identifies and explores the barriers to ICT adoption within the North West Department of Public Works (NW DPW), focusing on cultural resistance, reliance on manual processes, and systemic inefficiencies. The analysis is framed using Diffusion of Innovations (DOI) attributes and Technology Acceptance Model (TAM) constructs to provide insights into user attitudes and systemic challenges.

The NW DPW demonstrates partial adoption of ICT, with notable variation in tool usage across projects and departments. Basic tools, such as Microsoft Office Suite (Word, Excel, and PowerPoint), email, and WhatsApp, are widely used for everyday operations. These tools facilitate communication, document sharing, and basic project tracking.

Advanced tools, including Geographic Information Systems (GIS), drones, and project management software, are employed selectively. Their use is often limited to projects where their utility is well understood, and resources permit their application. For example, GIS and drones are highly effective for road inspections and location analysis but are not consistently integrated across all projects.

The department relies on basic cloud storage solutions like Microsoft SharePoint to store and share documents. While SharePoint provides real-time access to data, many workflows remain manual, and the absence of a centralised server undermines consistent data management practices.

Participant 4 noted, *“We use GIS and drones for road inspections, but their use is project-specific and not integrated across the board.”* Participant 5 added, *“SharePoint helps us store and share data in real-time, but manual processes still dominate.”*

4.2.2 Alignment with TAM Constructs: Perceived Usefulness (PU) and Perceived Ease of Use (PEOU)

Perceived Usefulness (PU)

Participants widely acknowledged the utility of ICT in improving efficiency, reducing costs, and enhancing collaboration. Tools like drones and virtual meeting platforms have demonstrated their value by replacing time-intensive manual processes and reducing operational costs. Cloud-based platforms such as SharePoint facilitate real-time access to project files, enabling efficient remote work and collaboration.

Participant 2 explained, *“Drones allow us to inspect multiple sites in one day instead of spending the whole day travelling.”* Participant 6 observed, *“ICT helps us save costs and time. For example, virtual meetings have made it easier to coordinate without travel.”*

Despite these benefits, the full potential of ICT remains unrealised due to infrastructural gaps, budgetary constraints, and insufficient training. Participants frequently highlighted these barriers as limiting the department's ability to maximise ICT's effectiveness.

Perceived Ease of Use (PEOU)

Basic ICT tools such as email, WhatsApp, and Microsoft Teams were consistently described as user-friendly, requiring minimal training. However, advanced tools like GIS and drones are perceived as more complex, necessitating specialised skills and ongoing training. Participants noted that training programmes have improved proficiency in tools such as SharePoint, but gaps remain, particularly among older staff members who are less familiar with modern technologies.

Participant 7 noted, *“Older staff struggle with new tools because they’re used to manual processes.”* Participant 5 added, *“Training has improved our use of SharePoint, but advanced tools still need more focus.”*

Ease of use is further constrained by infrastructural limitations, including unreliable networks and outdated hardware, which exacerbate resistance to adopting modern ICT solutions.

4.2.3 Analysis of DOI stages

Awareness

There is widespread awareness of ICT tools within the department, particularly those with demonstrable utility, such as drones, GIS, and SharePoint. External engagements, including workshops and private sector roadshows, have played an important role in raising awareness about the potential benefits of advanced technologies.

Participant 7 stated, *“Private sector workshops help us understand what ICT tools are available and how they can be used.”*

Persuasion

Staff attitudes towards ICT vary significantly. Younger professionals are more enthusiastic about adopting new technologies, while older staff members exhibit hesitancy due to fears of complexity and a preference for traditional methods. Positive exposure to successful ICT implementations, both internally and externally, has begun to shift these perceptions.

Participant 6 explained, *“The younger staff are eager to learn new tools, but older colleagues find it harder to adapt.”*

Decision

Decisions to adopt ICT tools are often reactive, driven by immediate project needs rather than proactive strategic planning. Budget constraints and a perception among leadership that ICT is a secondary priority further delay adoption.

Participant 6 observed, *“Management prioritises budget for immediate needs over investing in ICT infrastructure.”* Participant 4 added, *“We decide to use GIS or drones only when the project absolutely requires them.”*

Implementation

The implementation of ICT tools is inconsistent across the department. Basic tools like Microsoft Teams and WhatsApp have been widely adopted for communication and collaboration. However, advanced systems such as GIS and project management software remain underutilised due to limited integration and insufficient training.

Participant 5 remarked, *“We’ve implemented SharePoint for document sharing, but many staff still rely on manual processes.”*

Confirmation

Positive outcomes from using tools like drones, GIS, and SharePoint reinforce their value and encourage broader adoption. Participants acknowledged the efficiency and cost savings these tools provide, although these successes have not yet translated into a cohesive departmental strategy for comprehensive ICT adoption.

Participant 2 explained, *“Drones save time and improve safety, so we are planning to use them more often.”* Participant 6 noted, *“Virtual meetings are now a norm, and we’ve seen significant cost savings as a result.”*

The NW DPW has achieved partial success in adopting ICT, particularly in leveraging basic tools for communication and collaboration. However, significant gaps remain in the adoption of advanced systems, data management infrastructure, and staff training. While participants consistently highlighted the perceived usefulness of ICT, its ease of use is constrained by infrastructural and generational challenges. By addressing these barriers and aligning its efforts with the stages of the DOI model, the department can unlock the full potential of ICT to drive efficiency, cost savings, and innovation in public works projects.

4.2.4 Barriers to ICT adoption

This section investigates the barriers to Information and Communication Technology (ICT) adoption within the North West Department of Public Works (NW DPW). The analysis identifies cultural resistance, reliance on manual processes, and systemic inefficiencies as the primary impediments. These barriers are examined through the Diffusion of Innovations (DOI) framework and the Technology Acceptance Model (TAM), providing a comprehensive exploration of their impact on user attitudes and the adoption process.

4.2.4.1 Cultural resistance to ICT adoption

Cultural resistance remains a significant obstacle, particularly among older staff who are hesitant to transition from manual workflows to digital systems. This reluctance stems from familiarity with traditional practices, a fear of redundancy, and misconceptions about the complexity of ICT tools. Staff often perceive ICT as requiring advanced education or expertise, further deterring adoption.

Participant 7 remarked, *“Older staff struggle with new tools because they’re used to manual processes.”* Participant 6 explained, *“People believe technology needs you to be highly educated to use it, which isn’t true but still stops them from trying.”*

This resistance reflects the complexity attribute in DOI, as ICT tools are perceived as difficult to understand and implement. It also negatively impacts the perceived ease of use (PEOU) construct within TAM, restricting progression beyond the persuasion and decision stages of the DOI model. Without targeted interventions to address these cultural barriers, ICT adoption will remain fragmented and inconsistent.

4.2.4.2 Reliance on manual processes

The department’s continued reliance on manual processes, including physical documentation and traditional methods, exacerbates inefficiencies and hinders the transition to ICT-based workflows. This dependency leads to delays in data retrieval, heightened risks of data loss, and duplication of effort.

Participant 5 stated, *“Data management is still largely manual. There’s no centralised server, which makes it difficult to retrieve information.”* Participant 4 added, *“We still rely on physical files for many processes, even though SharePoint could handle it better.”*

This reliance amplifies the complexity of adopting ICT tools, as staff must unlearn ingrained habits before embracing digital solutions. Furthermore, the limited alignment between ICT tools and existing workflows undermines the compatibility attribute in DOI, reducing their perceived utility. Consequently, these barriers restrict the department’s ability to progress through the implementation and confirmation stages of ICT adoption.

4.2.4.3 Systemic inefficiencies

Systemic inefficiencies pose structural barriers to ICT adoption. These include:

- **Network Instability:** Frequent load shedding and unreliable connectivity disrupt ICT operations, particularly in remote areas.
- **Outdated Equipment:** Many systems rely on obsolete software, such as Windows XP, preventing the adoption of modern ICT tools.
- **Budgetary Constraints:** Inadequate funding delays the procurement of essential ICT infrastructure and training resources.

Participant 6 noted, *“The network is unreliable, and load shedding makes it worse. We need stable backup systems.”* Participant 7 commented, *“Budget cuts have pushed back plans to procure software and upgrade systems.”*

These inefficiencies intensify the complexity of adopting ICT tools and limit their compatibility with departmental requirements. They also discourage positive perceptions of ICT, further delaying progress through the DOI model. Without significant investment in infrastructure and resources, these systemic barriers will continue to impede ICT adoption.

4.2.4.4 Analysis of DOI attributes and TAM constructs

Complexity and compatibility (DOI)

Advanced ICT tools, such as Geographic Information Systems (GIS) and drones, are perceived as overly complex, requiring specialised skills and training. Additionally, the poor alignment of these tools with existing workflows creates friction, further reducing their perceived compatibility.

Participant 4 observed, *“Drones and GIS are great, but not everyone is trained to use them, so they end up underutilised.”*

Perceived Usefulness and Ease of Use (TAM)

ICT’s potential to improve efficiency, reduce costs, and enhance collaboration is widely recognised. However, these benefits are overshadowed by infrastructural gaps and skill deficits. Basic tools like SharePoint and Microsoft Teams are seen as useful but require greater integration with organisational processes to maximise their impact.

Participant 2 noted, *“Drones save time and improve safety, so we are planning to use them more often.”* Participant 6 added, *“Everything becomes difficult when you haven’t started using it. Once you’re trained, it becomes easy, but that training isn’t always available.”*

Triability and observability (DOI)

Opportunities to trial ICT tools are limited, and observable successes are confined to specific projects. This restricts momentum in the persuasion and decision stages of DOI, as staff lack exposure to the tangible benefits of ICT.

Participant 3 explained, *“We decide to use GIS or drones only when the project absolutely requires them.”*

Interplay Between DOI and TAM

The relationship between DOI attributes and TAM constructs highlights a complex interplay of barriers that collectively impede ICT adoption:

- Complexity (DOI) undermines PEOU (TAM): The perception that ICT tools are difficult to use discourages adoption, particularly among older staff.
- Compatibility (DOI) influences PU (TAM): Tools that align with existing workflows are seen as more useful, but poor integration limits their effectiveness.
- Trialability and Observability (DOI): Limited opportunities to experiment with ICT tools restrict the development of positive attitudes toward their adoption.

These misalignments between perceived benefits and practical challenges stall progress through the DOI stages and negatively influence user acceptance.

The NW DPW faces substantial barriers to ICT adoption, including cultural resistance, reliance on manual processes, and systemic inefficiencies. These challenges are compounded by perceptions of complexity and limited compatibility, which negatively influence user attitudes and delay the adoption process. Addressing these barriers will require a multifaceted approach:

- Change management: Initiatives to address cultural resistance and encourage positive attitudes toward ICT.
- Infrastructure investment: Upgrades to network connectivity, hardware, and software systems to improve compatibility and reduce complexity.
- Training and Support: Comprehensive training programmes to enhance ease of use and build confidence among staff.
- Demonstration of Success: Opportunities for staff to trial ICT tools and observe their benefits to build momentum for adoption.

By aligning efforts with DOI attributes and leveraging the positive constructs of TAM, the NW DPW can create an enabling environment for ICT adoption, fostering efficiency, innovation, and collaboration across its projects.

4.2.5 Opportunities for digital transformation

This section explores the opportunities for digital transformation in the North West Department of Public Works (NW DPW). It identifies potential benefits, including improved governance, operational efficiency, and resource optimisation, supported by insights from pilot projects and global success stories. These findings are analysed through the Diffusion of Innovations (DOI) framework and Technology Acceptance Model (TAM) to assess user and organisational readiness.

4.2.5.1 Potential benefits of digital transformation

The adoption of digital tools offers significant opportunities for the NW DPW to enhance its operations. One of the most critical benefits lies in improving governance. Participants emphasised that ICT tools can increase transparency, accountability, and decision-making by enabling more reliable data storage and access. For instance, Participant 5 noted, *“Centralised systems like SharePoint ensure that everyone has access to updated project data, reducing miscommunication.”*

Another key benefit is the potential for greater efficiency. Tools such as drones and GIS have demonstrated their ability to save time and improve productivity in specific projects. Participant 2 explained, *“Drones reduce inspection time by half, allowing us to cover more sites in one day.”* Similarly, these tools reduce reliance on manual processes, enabling staff to focus on higher-value tasks.

Resource optimisation is another area where digital transformation can create significant value. Real-time monitoring of costs and resource allocation, facilitated by platforms like Microsoft Teams, reduces waste and supports better budgetary control. Participant 6 stated, *“Virtual meetings on platforms like Teams save travel costs and time, allowing us to focus resources on project delivery.”*

4.2.5.2 Insights from pilot projects and global success stories

Pilot projects within the department highlight the transformative potential of ICT tools. The use of drones and GIS in select projects has yielded tangible results, including reduced costs, enhanced safety, and improved accuracy in road inspections. Participant 4 remarked, *“We’ve used drones and GIS on certain projects, and the results were impressive in terms of time and cost savings.”*

In addition to internal efforts, participants drew inspiration from global success stories and private-sector innovations. For example, integrated design systems and virtual reality (VR) applications in construction projects abroad illustrate how ICT can streamline operations and enhance project planning. Participant 7 noted, *“When we see how ICT is applied internationally or in the private sector, it’s clear we’re missing out on big opportunities.”*

Pilot projects also underscore the importance of trialability and observability in fostering ICT adoption. Allowing staff to test new tools and witness their benefits in controlled settings helps overcome scepticism. Participant 3 explained, *“We decide to use GIS or drones only when the project absolutely requires them.”* However, these successes remain isolated, limiting their influence on broader organisational adoption.

4.2.5.3 Linkages to DOI attributes and TAM constructs

The DOI framework and TAM constructs provide valuable insights into how ICT opportunities are perceived and adopted within the department.

- Relative advantage (DOI): ICT tools offer clear benefits, including increased efficiency, improved safety, and reduced costs. Participant 2 highlighted this advantage, stating, *“Drones save time and improve safety by reducing on-site hours.”*
- Compatibility (DOI): Tools like SharePoint align with departmental goals but face challenges in integrating with entrenched manual workflows. Participant 5 commented, *“SharePoint ensures everyone has access to updated data, but not everyone uses it effectively yet.”*

- Trialability (DOI): Pilot projects provide staff with opportunities to trial ICT tools, which helps build confidence in their effectiveness. Participant 4 observed, *“We’ve used drones on certain projects, and the results were impressive.”*
- Observability (DOI): The benefits of ICT tools are visible in specific projects, but greater dissemination of these successes is needed to influence broader adoption. Participant 7 remarked, *“Seeing how ICT works in the private sector motivates us to explore it more.”*
- Perceived Usefulness (TAM): Participants consistently acknowledged ICT’s potential to improve governance, resource management, and efficiency. Participant 6 stated, *“Virtual meetings save travel costs and time, allowing us to focus resources on project delivery.”*
- Perceived Ease of Use (TAM): Basic tools are seen as user-friendly, while advanced systems require significant training to reduce perceived complexity. Participant 5 noted, *“SharePoint is easy to use once you’re trained, but advanced tools like GIS require more specialised skills.”*

4.2.5.4 User and organisational readiness

User readiness within the NW DPW varies. Younger staff demonstrate enthusiasm and adaptability, indicating a strong willingness to embrace new technologies. Participant 6 noted, *“The younger staff are eager to learn new tools, but older colleagues find it harder to adapt.”* In contrast, older staff often require targeted training to overcome hesitancy and build confidence in using digital systems.

At an organisational level, the NW DPW has shown partial readiness for digital transformation. Tools such as SharePoint, drones, and GIS have been successfully implemented in specific projects. However, systemic inefficiencies, such as unreliable networks and outdated infrastructure, limit the department’s ability to scale these efforts. Participant 6 remarked, *“The network is unreliable, and load shedding makes it worse. We need stable backup systems.”*

Digital transformation presents significant opportunities for the NW DPW to enhance governance, improve efficiency, and optimise resources. Pilot projects and global success stories highlight the relative advantage and trialability of ICT tools, offering a

foundation for broader adoption. However, achieving these benefits requires addressing infrastructural limitations, providing targeted training, and fostering organisational buy-in.

By focusing on DOI attributes such as relative advantage and trialability and leveraging TAM constructs like perceived usefulness and ease of use, the NW DPW can build a robust framework for sustainable digital transformation. A structured approach, supported by visible successes and phased implementation, will enable the department to unlock the full potential of ICT.

4.2.6 Stakeholder dynamics and organisational culture

Stakeholder attitudes and organisational culture play a critical role in shaping ICT adoption within the North West Department of Public Works (NW DPW). This section examines how these factors influence the perceived ease of use, perceived usefulness, and progress through the stages of adoption. Insights are derived from internal dynamics, such as staff attitudes and leadership engagement, and external influences, such as consultant interactions and industry benchmarks.

4.2.6.1 Stakeholder attitudes and their Impact on ICT adoption

Stakeholders within the NW DPW display varied attitudes toward ICT adoption, influenced by their roles, experience levels, and exposure to digital tools. Younger staff members generally exhibit enthusiasm and adaptability, driven by their comfort with technology and eagerness to modernise workflows. Participant 6 observed, *“The younger staff are eager to learn new tools, but older colleagues find it harder to adapt.”* This generational divide in attitudes creates challenges in fostering a unified approach to adoption.

Leadership attitudes also significantly influence adoption rates. Managers and decision-makers often prioritise immediate project needs over long-term investments in ICT infrastructure, which hampers comprehensive adoption. Participant 7 explained, *“The decision-makers see ICT as a ‘nice to have’ rather than a necessity, which is a big problem.”*

Consultants and external stakeholders play a significant role in shaping perceptions of ICT’s value. Interactions with consultants who utilise advanced tools, such as GIS and project management software, often highlight the department’s technological gaps.

Participant 4 noted, *“We depend on consultants for tools we don’t have, which shows us what we’re missing out on.” These interactions can inspire internal stakeholders to advocate for greater ICT adoption.*

4.2.6.2 Organisational culture’s role in shaping ICT adoption

The NW DPW’s organisational culture is characterised by a strong reliance on traditional methods, resistance to change, and uneven support for innovation. This cultural inertia often hinders the adoption of modern technologies, particularly among older staff who are accustomed to manual processes. Participant 7 remarked, *“Older staff struggle with new tools because they’re used to manual processes.”*

A lack of consistent training further reinforces this resistance, as staff who are unfamiliar with ICT tools perceive them as overly complex. Participant 5 observed, *“Advanced tools like GIS require specialised skills, and not everyone feels confident using them.”* This perception of complexity contributes to slower progress through the implementation and confirmation stages of adoption.

Another cultural factor is the department’s hierarchical structure, which sometimes limits bottom-up innovation. Staff who recognise ICT’s potential may hesitate to advocate for its adoption if they perceive a lack of support from leadership. Participant 6 noted, *“Sometimes we have ideas about new tools, but without management backing, it’s hard to make changes.”* These dynamic underscores the importance of fostering an innovation-friendly culture that empowers all levels of staff to contribute to the adoption process.

4.2.6.3 Internal Dynamics and their influence on Perceived Ease of Use (PEOU) and adoption stages

Internal dynamics, including training opportunities, leadership priorities, and peer influence, significantly affect perceptions of ICT’s ease of use. While basic tools like Microsoft Teams and SharePoint are widely regarded as user-friendly, more advanced systems are often perceived as complex due to insufficient training. Participant 5 commented, *“SharePoint is easy to use once you’re trained, but advanced tools like GIS require more specialised skills.”*

Peer influence plays a dual role in shaping perceptions. On the one hand, younger staff members often motivate their peers to explore ICT tools by sharing their own positive experiences. On the other hand, older staff members' resistance to change can discourage their colleagues from adopting modern technologies. Participant 7 remarked, *"If someone senior in the team doesn't see the value of a tool, others tend to follow their lead."*

Leadership engagement is crucial in overcoming these barriers. Managers who actively champion ICT adoption and allocate resources for training help build confidence and reduce perceptions of complexity. Conversely, passive, or indifferent leadership reinforces organisational inertia, delaying progress through the persuasion and decision stages of adoption.

4.2.6.4 External Dynamics and Their Influence on Adoption Stages

External dynamics, including interactions with consultants and exposure to industry benchmarks, create opportunities for the NW DPW to recognise ICT's potential. Consultants who use advanced tools for project management and data analysis often demonstrate the relative advantage of ICT, motivating internal stakeholders to consider similar tools. Participant 4 noted, *"Seeing consultants use drones and GIS shows us how much easier our work could be if we had those tools."*

Exposure to industry benchmarks and private-sector innovations further influences attitudes. Workshops and roadshows often highlight global best practices, demonstrating ICT's effectiveness in improving efficiency and governance. Participant 3 stated, *"When we see how ICT is applied internationally or in the private sector, it's clear we're missing out on big opportunities."*

While these external influences can inspire adoption, their impact is limited by internal constraints such as budgetary restrictions and infrastructure gaps. Participant 6 remarked, *"We see the value in these tools, but without the right infrastructure, it's hard to make them work here."*

Stakeholder dynamics and organisational culture are pivotal in shaping ICT adoption within the NW DPW. Varied attitudes among internal stakeholders, combined with a resistance to change embedded in organisational culture, create significant barriers to

adoption. Leadership priorities, generational divides, and limited training opportunities further complicate efforts to foster a unified approach to ICT integration.

External dynamics, such as consultant interactions and exposure to industry benchmarks, offer valuable opportunities to highlight ICT's relative advantage and observability. However, these influences must be supported by internal readiness to translate inspiration into action.

To address these challenges, the NW DPW must prioritise leadership engagement, foster a culture of innovation, and create mechanisms for peer influence and external learnings to drive adoption. By aligning internal and external dynamics with the stages of the DOI model and addressing perceived complexity through targeted training, the department can create an environment conducive to successful ICT adoption.

4.3 DISCUSSION OF FINDINGS

4.3.1 Synthesis of findings with TAM Framework

The findings from this study align closely with the core constructs of the Technology Acceptance Model (TAM), namely Perceived Usefulness (PU), Perceived Ease of Use (PEOU), and their influence on user attitudes, behavioural intention, and actual use. Below is an in-depth synthesis of the findings using TAM as a guiding framework.

4.3.1.1 Perceived Usefulness (PU)

The study highlights widespread recognition of ICT's potential to improve operational efficiency, governance, and resource management within the NW DPW. Participants consistently emphasised the value of tools such as drones, Geographic Information Systems (GIS), and SharePoint in streamlining processes, reducing costs, and improving decision-making. These benefits align with TAM's assertion that perceived usefulness is a key determinant of technology acceptance.

- Efficiency gains: Tools like drones significantly reduce the time required for inspections and improve the accuracy of data collection.
Participant 2 explained, *"Drones reduce inspection time by half, allowing us to cover more sites in one day."*

- Governance improvements: SharePoint facilitates real-time data sharing and collaboration, reducing miscommunication and ensuring that stakeholders have access to updated project information.

Participant 5 noted, *“Centralised systems like SharePoint ensure that everyone has access to updated project data, reducing miscommunication.”*

- Resource optimisation: Virtual collaboration tools, such as Microsoft Teams, reduce travel costs and allow resources to be reallocated to core project activities.

Participant 6 stated, *“Virtual meetings save travel costs and time, allowing us to focus resources on project delivery.”*

These findings demonstrate that the department views ICT as instrumental in achieving better operational outcomes. However, the full potential of ICT remains unrealised due to infrastructural and cultural barriers that hinder widespread adoption.

4.3.1.2 Perceived Ease of Use (PEOU)

Perceived ease of use emerged as a critical factor influencing attitudes toward ICT adoption. While basic tools like Microsoft Teams and SharePoint were generally regarded as user-friendly, more advanced technologies, such as GIS and drones, were perceived as complex and requiring specialised training.

- User-friendly tools: Basic tools are widely adopted due to their simplicity and accessibility.

Participant 5 remarked, *“SharePoint is easy to use once you’re trained, but advanced tools like GIS require more specialised skills.”*

- Training deficits: Advanced systems are seen as overly complex by users who lack adequate training, which undermines confidence and adoption.

Participant 7 observed, *“Older staff struggle with new tools because they’re used to manual processes.”*

- Generational divide: Younger staff tend to perceive ICT tools as easier to use, reflecting their familiarity with digital platforms. In contrast, older staff often find ICT intimidating, highlighting the need for targeted support.

Participant 6 noted, *“The younger staff are eager to learn new tools, but older colleagues find it harder to adapt.”*

These findings illustrate that while the ease of use of basic tools encourages adoption, perceived complexity in advanced systems creates a significant barrier. This gap between basic and advanced ICT adoption highlights the importance of training and support to bridge the divide.

4.3.1.3 Attitudes toward ICT adoption

The interplay of perceived usefulness and ease of use shapes user attitudes, which in turn influence behavioural intention. Positive attitudes were strongly linked to observed benefits from ICT tools, particularly in pilot projects. However, cultural resistance among certain stakeholder groups tempered overall enthusiasm for adoption.

- Positive attitudes from observed benefits: Participants who experienced the tangible advantages of ICT, such as faster workflows and reduced costs, were more likely to advocate for its broader adoption.

Participant 4 remarked, *“We’ve used drones on certain projects, and the results were impressive in terms of time and cost savings.”*

- Resistance rooted in cultural norms: Older staff, who are accustomed to manual processes, often view ICT as unnecessary or overly complex, contributing to resistance.

Participant 7 commented, *“People believe technology needs you to be highly educated to use it, which isn’t true but still stops them from trying.”*

- Impact of leadership engagement: Support from leadership was found to be inconsistent, with some managers prioritising immediate needs over long-term ICT investments. This lack of advocacy undermines staff confidence in the value of digital transformation.

Participant 7 stated, *“The decision-makers see ICT as a ‘nice to have’ rather than a necessity, which is a big problem.”*

These findings highlight the importance of addressing both cultural resistance and leadership engagement to foster more positive attitudes toward ICT adoption.

4.3.1.4 Behavioural Intention and Actual Use

The relationship between attitudes, behavioural intention, and actual ICT use is evident in the department’s selective adoption of tools. While tools like SharePoint and Microsoft

Teams are widely used, the adoption of advanced systems remains limited to specific projects or stakeholders who are highly motivated.

- Selective adoption: Tools perceived as both useful and easy to use, such as SharePoint, have higher rates of adoption.

Participant 5 stated, *“We’ve implemented SharePoint for document sharing, but many staff still rely on manual processes.”*

- Limited advanced tool use: The adoption of tools like GIS and drones is constrained by their perceived complexity and the lack of training, which limits their use to specialised projects.

Participant 3 explained, *“We decide to use GIS or drones only when the project absolutely requires them.”*

The findings suggest that addressing gaps in training and infrastructure could significantly enhance behavioural intention and actual use of advanced ICT tools.

The findings provide convincing evidence of TAM’s applicability in understanding ICT adoption dynamics within the NW DPW. While perceived usefulness drives positive attitudes, perceived ease of use remains a significant barrier, particularly for advanced tools. Addressing these challenges requires targeted interventions, including training, leadership advocacy, and infrastructure improvements, to enhance both behavioural intention and actual use.

4.3.2 Synthesis of findings with the DOI framework

The Diffusion of Innovations (DOI) framework provides valuable insights into the dynamics of ICT adoption within the North West Department of Public Works (NW DPW). By analysing the findings through DOI’s five key attributes—relative advantage, compatibility, complexity, trialability, and observability—this synthesis highlights the department’s progress and barriers across the innovation adoption process. The findings are further aligned with DOI’s five stages: knowledge (awareness), persuasion, decision, implementation, and confirmation.

4.3.2.1 Relative advantage

Relative advantage refers to the perceived benefits of an innovation compared to traditional methods. In the NW DPW, ICT tools such as drones, Geographic Information Systems (GIS), and SharePoint demonstrated clear advantages in improving efficiency, governance, and resource management. These benefits were particularly evident in pilot projects where ICT tools reduced costs and streamlined workflows.

- Efficiency gains: Participants recognised that drones significantly reduced the time required for road inspections while improving safety and accuracy.
Participant 2 explained, *“Drones reduce inspection time by half, allowing us to cover more sites in one day.”*
- Improved governance: Centralised platforms like SharePoint enhanced collaboration and minimised miscommunication by providing real-time access to project data.
Participant 5 noted, *“SharePoint ensures that everyone has access to updated project data, reducing miscommunication.”*

These findings demonstrate that the NW DPW acknowledges the relative advantage of ICT tools, particularly in specific use cases. However, the perception of these benefits is not yet universal across all stakeholders, limiting broader adoption.

4.3.2.2 Compatibility

Compatibility refers to the extent to which an innovation aligns with existing workflows, values, and infrastructure. ICT tools like SharePoint align well with the department’s goals of enhancing collaboration and governance. However, the continued reliance on manual processes and outdated infrastructure creates friction in integrating ICT into daily operations.

- Misalignment with manual processes: Participants highlighted that while SharePoint is available, many workflows remain manual, limiting its effective use.
Participant 5 stated, *“We’ve implemented SharePoint for document sharing, but many staff still rely on manual processes.”*

- **Infrastructural constraints:** Challenges such as network instability and outdated hardware further reduce ICT compatibility with the department's operational environment.

Participant 6 remarked, *"The network is unreliable, and load shedding makes it worse. We need stable backup systems."*

This misalignment reduces ICT adoption's perceived utility, slowing progress through the decision and implementation stages.

4.3.2.3 Complexity

Complexity refers to the degree of difficulty in understanding and using an innovation. The findings revealed that basic tools like Microsoft Teams and SharePoint are perceived as easy to use, while advanced systems such as GIS and drones are considered overly complex. This perception creates a significant barrier, particularly among older staff and those lacking training.

- **Ease of Use for Basic Tools:** Participants found tools like Microsoft Teams intuitive and accessible, contributing to their widespread use.

Participant 5 commented, *"SharePoint is easy to use once you're trained, but advanced tools like GIS require more specialised skills."*

- **Challenges with Advanced Tools:** GIS and drones were viewed as requiring extensive training and technical expertise, which discouraged their adoption.

Participant 7 observed, *"Older staff struggle with new tools because they're used to manual processes."*

The perception of complexity reinforces resistance to ICT adoption, particularly during the persuasion and decision stages.

4.3.2.4 Trialability

Trialability reflects the ability to test an innovation on a small scale before full implementation. Pilot projects within the NW DPW, such as using drones and GIS for road inspections, demonstrated ICT's potential and provided staff with valuable opportunities to experience its benefits firsthand.

- Pilot project successes: Participants acknowledged the effectiveness of ICT in pilot projects, which highlighted considerable time and cost savings.
Participant 4 remarked, *“We’ve used drones on certain projects, and the results were impressive in terms of time and cost savings.”*
- Limited scope of trials: Despite these successes, the limited visibility of pilot project outcomes restricted their influence on broader adoption.
Participant 3 explained, *“We decide to use GIS or drones only when the project absolutely requires them.”*

Expanding the scope and communication of pilot project results is critical for accelerating progress through the persuasion and decision stages.

4.3.2.5 Observability

Observability refers to the extent to which the benefits of an innovation are visible to others. The findings revealed that the benefits of ICT adoption were often confined to specific projects, limiting their broader influence within the organisation.

- Internal observability challenges: While some stakeholders observed the advantages of ICT tools, these successes were not widely communicated across the department.
Participant 7 remarked, *“Seeing how ICT works in the private sector motivates us to explore it more.”*
- External observability: Exposure to private sector benchmarks and global success stories helped reinforce ICT’s value but highlighted the NW DPW’s lag in adopting similar tools.
Participant 7 added, *“When we see how ICT is applied internationally or in the private sector, it’s clear we’re missing out on big opportunities.”*

Enhancing observability through better communication of internal successes and lessons from external benchmarks is essential for progressing through the confirmation stage.

4.3.2.6 Adoption Stages: Mapping the Findings

1. Knowledge (awareness): Awareness of ICT tools such as drones, GIS, and SharePoint is widespread among NW DPW staff, driven by internal pilot projects and external workshops.

Participant 7 noted, *“Private sector workshops help us understand what ICT tools are available and how they can be used.”*

2. Persuasion: Stakeholders vary in their attitudes toward ICT adoption. Younger staff generally express enthusiasm, while older staff exhibit resistance, influenced by perceptions of complexity and a preference for traditional methods.

Participant 6 stated, *“The younger staff are eager to learn new tools, but older colleagues find it harder to adapt.”*

3. Decision: Decisions to adopt ICT tools are often reactive, driven by immediate project needs rather than strategic planning.

Participant 4 explained, *“We decide to use GIS or drones only when the project absolutely requires them.”*

4. Implementation: Basic tools like Microsoft Teams and SharePoint have been widely implemented, but advanced systems remain underutilised due to training gaps and infrastructural constraints.

Participant 5 observed, *“Advanced tools like GIS require specialised skills, and not everyone feels confident using them.”*

5. Confirmation: Positive outcomes from pilot projects reinforce ICT’s value but have yet to translate into a cohesive adoption strategy.

Participant 2 noted, *“Drones save time and improve safety, so we are planning to use them more often.”*

The DOI framework provides a comprehensive lens to understand ICT adoption within the NW DPW. While the relative advantage and trialability of ICT tools are evident, challenges related to compatibility, complexity, and observability hinder progress through adoption stages. Addressing these barriers requires expanding pilot projects, enhancing training programmes, and improving the visibility of ICT successes. These efforts will accelerate adoption and foster a culture of innovation within the department.

4.4 SUMMARY OF FINDINGS

The adoption of Information and Communication Technology (ICT) in public sector organisations, such as the North West Department of Public Works (NW DPW), is pivotal for improving efficiency, governance, and service delivery. This study investigates the extent of ICT adoption in the NW DPW, exploring the barriers and opportunities for digital transformation. By employing the Technology Acceptance Model (TAM) and the Diffusion of Innovations (DOI) framework, the study identifies key factors influencing ICT integration. This chapter synthesises the findings into themes derived through a rigorous coding process, aligning them with the study's objectives and research questions.

4.4.1 Themes and Codes

Thematic analysis was employed to systematically derive codes and themes from the data, following Braun and Clarke's (2006) methodology. The process involved initial coding to identify patterns, followed by categorisation into overarching themes. These themes provide a nuanced understanding of ICT adoption within the NW DPW.

4.4.1.1 Fragmented ICT Adoption

Codes: Drone use, GIS adoption, SharePoint, Virtual meetings, Manual workflows

Description: ICT adoption within the NW DPW is fragmented and project specific. While tools like SharePoint and Microsoft Teams facilitate communication and collaboration, advanced technologies such as Geographic Information Systems (GIS) and drones remain underutilised. Reliance on manual processes hinders comprehensive digital integration.

4.4.1.2 Efficiency and Governance Benefits

Codes: Time savings, Accuracy improvement, Cost savings, Collaboration, Goal alignment

Description: Existing ICT tools demonstrate clear benefits, including enhanced operational efficiency, improved decision-making, cost reductions, and better collaboration. These advantages underline the transformative potential of broader ICT adoption in project management and service delivery.

4.4.1.3 Usability barriers and training needs

Codes: Basic tools easy, Advanced tools complex, Age divide, Training gaps, Confidence lacking

Description: Basic tools are perceived as user-friendly, while advanced systems like GIS and drones are seen as complex, especially by older staff. Insufficient training exacerbates this challenge, leading to a lack of confidence in adopting advanced technologies.

4.4.1.4 Structural and cultural resistance

Codes: Manual reliance, Infrastructure issues, Budget limits, Leadership indifference, Cultural inertia

Description: Deep-rooted reliance on manual processes, infrastructural challenges (e.g., unreliable networks, power outages), budget constraints, and leadership's lack of prioritisation impede ICT adoption. Cultural inertia further amplifies resistance to change.

4.4.1.5 Momentum for transformation

Codes: Pilot successes, Consultant influence, Benchmarking, Young staff advocates, Observed benefits

Description: Successful pilot projects, insights from consultants, benchmarking against global best practices, and advocacy from younger staff provide a foundation for transformation. These factors highlight the benefits of ICT and create opportunities for scaling up adoption.

4.4.1.6 Stakeholder dynamics and culture

Codes: Generational divide, Consultant insights, Limited leadership, Hierarchical culture, Poor communication

Description: Stakeholder attitudes significantly influence ICT adoption. While younger staff are more open to technology, hierarchical structures, poor communication, and limited leadership engagement hinder progress.

4.4.1.7 Adoption process gaps

Codes: Awareness, Persuasion resistance, Reactive decisions, Limited implementation, Weak confirmation

Description: ICT adoption often stagnates at the persuasion and decision stages. Limited proactive decision-making and weak reinforcement of successful outcomes prevent full integration of ICT tools into operations.

4.4.1.8 Contextual challenges

Codes: Load shedding, Training deficits, Cultural barriers, Pilot validation, Budget challenges

Description: South Africa-specific issues, such as load shedding, exacerbate barriers to ICT adoption. Training deficits, cultural barriers, and budget constraints further limit the department's ability to implement and sustain ICT initiatives.

4.4.2 Key Interconnections between themes

- **Fragmented Adoption & Resistance:** Cultural resistance leads to limited ICT adoption.
- **Usability Barriers & Resistance:** Lack of training exacerbates perceived complexity, reinforcing resistance.
- **Efficiency Benefits & Transformation Momentum:** Pilot successes demonstrate benefits, motivating broader adoption.
- **Stakeholder Dynamics & Transformation Momentum:** Leadership support is vital for sustaining momentum and overcoming resistance.
- **Adoption Process Gaps & Training Needs:** Addressing training can help progress through adoption stages.
- **Contextual Challenges & Resistance:** External factors like load shedding intensify resistance, highlighting the need for infrastructural improvements.

4.4.3 Alignment with research objectives and questions

The thematic findings align with the study's research objectives and questions, providing targeted insights:

Objective 1 / Question 1: Assess the current extent of ICT adoption and its integration into project management.

- Theme: Fragmented ICT Adoption
- Interpretation: ICT tools are inconsistently adopted. Advanced technologies remain underutilised, limiting their impact on project management and decision-making.

Objective 2 / Question 2: Identify barriers to ICT adoption, including organizational, technical, financial, and cultural challenges.

- Theme: Structural and Cultural Resistance
- Interpretation: Organisational culture and technical deficiencies hinder adoption. Budget constraints and leadership indifference exacerbate resistance.

Objective 3 / Question 3: Evaluate the impact of limited ICT adoption on project timelines, costs, and service delivery.

- Theme: Efficiency and Governance Benefits
- Interpretation: Limited ICT adoption negatively impacts timelines and costs, preventing the department from realising potential efficiencies.

Objective 4 / Question 4: Propose strategic recommendations for improving ICT adoption, aligning with global best practices and socio-economic goals.

- Theme: Momentum for Transformation
- Interpretation: Building on pilot successes and leveraging younger staff's enthusiasm can drive ICT adoption. Strategies should prioritise scaling pilots and leadership advocacy.

4.4.4 Interpreting themes using TAM and DOI frameworks.

- Perceived Usefulness (TAM): Basic tools are seen as useful for communication and collaboration. Advanced tools' usefulness is acknowledged but not fully leveraged due to complexity and resistance.
- Perceived Ease of Use (TAM): Basic tools are user-friendly, facilitating adoption. Advanced tools are perceived as complex, requiring training and support.

- Relative Advantage (DOI): ICT tools offer clear benefits over traditional methods, but advantages are not fully recognized due to limited adoption and compatibility issues.
- Compatibility (DOI): Advanced tools face challenges integrating with current practices reliant on manual processes.
- Complexity (DOI): The perceived difficulty of advanced tools creates resistance, particularly among older staff.

4.4.5 Contextualizing themes with literature insights

- Fragmented ICT Adoption: Mirrors global trends of slow, uneven adoption due to budget and cultural resistance (Heeks, 2002).
- Efficiency and Governance Benefits: Underutilization of ICT prevents realizing improvements noted in global studies (Bhatnagar, 2004).
- Usability Barriers and Training Needs: Training deficits are significant barriers, consistent with findings by Dlodlo and Dhurup (2013).
- Structural and Cultural Resistance: Organizational culture and leadership indifference hinder adoption, as observed by Nkohkwo and Islam (2013).
- Momentum for Transformation: Pilot projects and external influences can drive adoption, aligning with Chircu and Kauffman (2000).
- Stakeholder Dynamics and Culture: Leadership engagement is crucial for progress, reflecting Venkatesh et al. (2003).

By grounding the findings in theoretical frameworks and literature, this chapter highlights the multifaceted challenges and opportunities of ICT adoption within the NW DPW.

4.5 DISCUSSION

The study's findings reveal a complex interplay of factors influencing ICT adoption within the North West Department of Public Works (NW DPW). These factors, framed through the Technology Acceptance Model (TAM) and Diffusion of Innovations (DOI) framework, illuminate the barriers, opportunities, and dynamics shaping the department's digital transformation efforts.

4.5.1 Fragmented ICT adoption

The partial and project-specific adoption of ICT highlights a cautious approach within the department. While tools like Microsoft Teams and SharePoint are widely used due to their immediate utility, advanced technologies such as Geographic Information Systems (GIS) and drones remain underutilised. This selective adoption reflects both organisational inertia and barriers to scaling ICT integration.

The perceived complexity of advanced tools and scepticism about their applicability further fragment adoption. Employees accustomed to manual processes often perceive these technologies as unnecessary complications, especially when the tools' advantages in specific contexts are not clearly demonstrated. These findings underscore the importance of targeted training and demonstrable use cases to build confidence in the value of advanced technologies.

4.5.2 Barriers to ICT adoption

Cultural and structural resistance

Organisational culture within the NW DPW remains anchored in traditional workflows, with manual processes deeply embedded in operations. This resistance to change is exacerbated by leadership indifference, which fails to prioritise ICT adoption as a strategic imperative. Without strong advocacy from senior management, cultural inertia becomes a significant impediment to transformation.

Usability barriers and training needs

The generational divide in ICT literacy further hampers adoption. Older staff members often lack confidence in using advanced tools, perceiving them as overly complex. Conversely, younger employees are more adaptable but lack the influence to drive widespread change. Insufficient training exacerbates these usability challenges, creating a persistent skills gap that undermines the potential for broader adoption.

Contextual challenges

External factors, such as load shedding and budget constraints, intensify barriers to ICT integration. Frequent power outages disrupt the consistent use of ICT tools, while

financial limitations restrict investments in infrastructure and comprehensive training programmes. These challenges highlight the need for systemic reforms and resource allocation to create a conducive environment for digital transformation.

4.5.3 Opportunities for digital transformation

Despite these barriers, the study identifies clear opportunities for advancing ICT adoption within the NW DPW.

- **Pilot Projects:** Successful pilot initiatives demonstrate the tangible benefits of advanced ICT tools, such as improved efficiency and cost management. These projects provide compelling evidence of ICT's value, fostering momentum for broader implementation.
- **Advocacy from Younger Staff:** Younger employees, familiar with digital tools and motivated by observed benefits, can act as internal champions for ICT adoption, helping to bridge the generational divide.
- **External Influences:** Insights from consultants and benchmarking against global best practices highlight successful ICT integration strategies that the NW DPW can emulate.

4.5.4 Stakeholder dynamics and organisational culture

Stakeholder engagement emerges as a critical factor in overcoming resistance to ICT adoption. Leadership plays a pivotal role in this process, with active advocacy signalling a commitment to digital transformation. By prioritising ICT initiatives and fostering open communication, leadership can create a culture more receptive to change.

Improving communication across hierarchical structures is equally important. Sharing success stories from pilot projects and encouraging collaboration can disseminate positive experiences, building collective support for ICT initiatives. These efforts must include structured feedback mechanisms to ensure that all stakeholders are engaged in the transformation process.

4.5.5 Adoption process gaps

The study finds that ICT adoption often stalls at the persuasion and decision stages of the DOI framework. Awareness alone is insufficient to drive implementation; addressing underlying resistance and providing tangible support are essential to move forward.

Tailored training programmes designed to address specific skill gaps and build confidence can help advance the adoption process. Demonstrating practical benefits through pilot projects and disseminating success stories can also aid in overcoming resistance and progressing to full-scale implementation.

4.5.6 Synthesis of key insights

The findings converge on several critical insights:

1. Fragmented adoption and resistance: Cultural resistance and a lack of leadership commitment result in selective and inconsistent ict adoption.
2. Multi-dimensional barriers: Internal factors (e.g., cultural inertia, training gaps) intersect with external constraints (e.g., load shedding, budget limitations) to create a challenging environment for ict adoption.
3. Momentum from pilots and external influence: Successful pilot projects and benchmarking against global best practices build momentum for ict adoption.
4. Critical role of stakeholder engagement: Leadership advocacy and the evolution of organisational culture are essential for overcoming resistance.
5. Need to strengthen the adoption process: A strategic, coordinated effort is required to address resistance and progress through the stages of adoption, from awareness to implementation and confirmation.

4.5.7 Conclusion

The NW DPW's journey toward ICT adoption reflects challenges that are both global and context specific. However, the department has significant opportunities to enhance its digital transformation.

Strategic Recommendations

1. Leadership engagement: Leaders must actively endorse ICT adoption, setting an unobstructed vision for digital transformation.
2. Training and development: Comprehensive training programmes are necessary to reduce perceived complexity and build staff confidence.
3. Scaling pilot projects: Expanding successful pilot initiatives can provide practical demonstrations of ICT benefits, persuading resistant stakeholders.
4. Infrastructure improvement: Addressing infrastructural challenges, such as load shedding, is critical for ensuring ICT tools' reliability.
5. Fostering collaboration: Breaking down hierarchical barriers and improving communication can create a supportive environment for innovation.

By implementing these strategies, the NW DPW can align its operations with global best practices, leveraging digital transformation to achieve improved governance, efficiency, and socio-economic development.

4.6 CHAPTER SUMMARY

This chapter has provided an in-depth analysis of the findings from the study on ICT adoption within the North West Department of Public Works (NW DPW), offering a comprehensive exploration of the barriers and opportunities shaping the department's digital transformation efforts. The findings were thematically organised and interpreted through the theoretical lenses of the Technology Acceptance Model (TAM) and Diffusion of Innovations (DOI) framework, providing a nuanced understanding of the factors influencing ICT integration.

Key insights highlighted the fragmented and selective adoption of ICT tools within the department, the pervasive barriers such as cultural resistance, usability challenges, and contextual limitations, as well as the momentum created by pilot successes and younger staff advocates. Stakeholder dynamics and the critical role of leadership were also emphasised as pivotal in driving organisational change. The analysis further synthesised the findings with the research objectives, linking them to broader socio-economic goals and global best practices.

The next chapter will synthesise the findings presented here to draw conclusions on the current state of ICT adoption at the NW DPW. It will also provide actionable recommendations aimed at addressing the identified barriers and capitalising on the

opportunities for digital transformation. These recommendations will be framed within the context of TAM and DOI frameworks and will align with the strategic imperatives of the South African public sector, contributing to both academic discourse and practical solutions.

CHAPTER 5: CONCLUSIONS AND RECOMMENDATIONS

The concluding chapter synthesises the findings of this study on ICT adoption within the North West Department of Public Works (NW DPW) and offers actionable recommendations for overcoming identified barriers and leveraging opportunities for digital transformation. This chapter also reflects on the study's contributions to knowledge, its limitations, and areas for future research.

The research aimed to evaluate the current extent of ICT adoption at the NW DPW, identify key barriers and opportunities, and propose strategies for improvement, using the Technology Acceptance Model (TAM) and the Diffusion of Innovations (DOI) frameworks as guiding theoretical lenses. These frameworks provided a structured approach to understanding the department's ICT adoption dynamics, from perceived usefulness and ease of use (TAM) to innovation attributes such as relative advantage and complexity (DOI).

This chapter is structured as follows: the findings are synthesised and conclusions drawn in relation to the research objectives; recommendations are made to address barriers and enhance adoption efforts; the study's contributions and limitations are discussed; and suggestions for future research are presented. The chapter concludes with a summary of the study's significance for the NW DPW and the broader public sector.

5.1 SYNTHESIS OF FINDINGS AND CONCLUSIONS

This section synthesises the key findings of the study on ICT adoption within the NW DPW, aligning them with the research objectives and theoretical frameworks. The conclusions drawn from these findings provide a comprehensive understanding of the barriers, opportunities, and strategic directions for enhancing ICT adoption in the department.

5.1.1 Current extent of ICT adoption

The study revealed that ICT adoption within the NW DPW is fragmented and largely project specific. Basic tools such as Microsoft Teams and SharePoint are employed for communication and collaboration, while advanced technologies like Geographic Information Systems (GIS) and drones are underutilised. This selective approach to ICT

adoption limits the department's ability to leverage digital tools for comprehensive project management and decision-making.

Aligned with TAM, this finding underscores the department's recognition of the perceived usefulness of basic tools, but the perceived complexity and lack of support for advanced systems hinder broader integration. Similarly, the DOI framework highlights limited trialability and compatibility of advanced technologies with the department's existing workflows as key barriers to full-scale adoption.

5.1.2 Barriers to ICT adoption

The findings identified significant barriers to ICT adoption, which were categorised into cultural, structural, and contextual challenges:

- Cultural and structural resistance: A reliance on manual workflows, coupled with leadership indifference and hierarchical organisational culture, creates resistance to change. These barriers align with TAM's focus on perceived ease of use and DOI's complexity attribute, as staff view advanced technologies as cumbersome and disruptive to established practices.
- Usability barriers and training gaps: Insufficient training and a generational divide exacerbate the perceived complexity of advanced ICT tools. Older staff lack confidence in adopting modern technologies, highlighting a need for capacity-building initiatives.
- Contextual challenges: External factors such as load shedding and budget constraints further hinder ICT adoption. These challenges reflect DOI's environmental compatibility attribute, as infrastructural limitations impede the practical implementation of digital solutions.

5.1.3 Opportunities for digital transformation

Despite these barriers, the study identified clear opportunities for ICT adoption within the NW DPW:

- Pilot projects: Successful pilots demonstrate the tangible benefits of advanced ICT tools, building momentum for broader adoption.

- Advocacy from younger staff: Younger employees exhibit a higher level of digital literacy and enthusiasm for ICT adoption, creating a foundation for cultural change within the department.
- External benchmarking: Insights from consultants and global best practices provide evidence of ICT's transformative potential in similar contexts, reinforcing the perceived relative advantage of digital tools.

These opportunities align with DOI's attributes of observability and trialability, which can be leveraged to address resistance and scepticism.

5.1.4 Strategic implications

The findings have significant implications for the NW DPW's approach to ICT adoption. A strategic, coordinated effort is required to address cultural resistance, enhance training, and improve infrastructure. Leadership engagement and advocacy are critical to overcoming structural inertia and fostering a culture of innovation. Furthermore, scaling pilot projects and leveraging external influences can demonstrate the practical benefits of ICT adoption, shifting perceptions and building momentum for change.

5.2 RECOMMENDATIONS

Based on the synthesis of findings, this section provides actionable recommendations to address barriers and leverage opportunities for ICT adoption within the NW DPW. These recommendations are informed by the theoretical frameworks of TAM and DOI, as well as global best practices, and are tailored to the contextual realities of South Africa's public sector.

5.2.1 Leadership engagement and strategic vision

Leadership plays a pivotal role in driving digital transformation. To overcome cultural inertia and structural resistance, the NW DPW must:

- Establish a Clear Digital Transformation Vision: The department's leadership should articulate a strategic vision for ICT adoption, emphasising its alignment with organisational goals and socio-economic development objectives.

- Demonstrate visible advocacy: Leaders must actively promote ICT initiatives, participate in pilot project evaluations, and communicate successes to foster trust and enthusiasm among staff.
- Create a digital transformation task force: A dedicated team comprising senior leaders, ICT experts, and younger staff advocates can coordinate efforts, identify opportunities, and address challenges collaboratively.

5.2.2 Capacity building and training

Addressing training gaps is critical for reducing the perceived complexity of advanced ICT tools and building user confidence. Recommended actions include:

- Develop tailored training programmes: Training should focus on both basic digital literacy and advanced ICT applications, such as GIS and drones, tailored to staff roles and responsibilities.
- Leverage external expertise: Partnerships with academic institutions, technology providers, and industry consultants can enhance training quality and introduce staff to global best practices.
- Implement mentorship initiatives: Younger, digitally savvy staff can mentor older colleagues, fostering peer learning and bridging generational divides.

5.2.3 Scaling pilot projects

Pilot projects offer an opportunity to demonstrate the tangible benefits of ICT adoption, reducing resistance and highlighting practical applications. The NW DPW should:

- Expand successful pilots: Build on the outcomes of existing projects by scaling them across different programmes within the department.
- Document and share success stories: Create case studies that illustrate cost savings, time efficiencies, and improved service delivery from pilot projects to build organisational support.
- Integrate feedback loops: Use pilot projects to gather user feedback, refine processes, and address potential barriers before broader implementation.

5.2.4 Infrastructure and resource investment

Robust infrastructure is essential for supporting ICT tools and ensuring their reliability. To address contextual challenges, the department should:

- Invest in ICT infrastructure: Allocate resources for high-speed internet, reliable power backups, and modern hardware to reduce disruptions caused by load shedding and outdated equipment.
- Secure funding for ICT projects: Explore public-private partnerships, donor funding, and government grants to finance infrastructure upgrades and training programmes.
- Adopt scalable and sustainable technologies: Prioritise cloud-based systems and energy-efficient solutions that align with sustainability goals and reduce operational costs.

5.2.5 Organisational culture and stakeholder dynamics

Building an organisational culture that supports innovation, and collaboration is essential for successful ICT adoption. Recommended steps include:

- Promote open communication: Facilitate regular meetings and workshops to discuss ICT adoption challenges and successes, fostering a culture of transparency and inclusivity.
- Align organisational policies with ICT goals: Update departmental policies to encourage the use of digital tools and discourage reliance on manual workflows.
- Engage external stakeholders: Collaborate with local communities, contractors, and other public entities to align ICT initiatives with broader socio-economic objectives.

5.2.6 Monitoring and evaluation

Continuous monitoring and evaluation are necessary to assess progress, identify barriers, and refine strategies. The NW DPW should:

- Establish Key Performance Indicators (KPIs): Define measurable objectives for ICT adoption, such as the percentage of digitalised workflows or reductions in project timelines.

- Conduct periodic reviews: Regularly evaluate the effectiveness of ICT tools and initiatives, ensuring alignment with strategic goals.
- Incorporate feedback mechanisms: Encourage staff and stakeholders to provide feedback on ICT systems, ensuring ongoing improvements.

5.2.7 Alignment with global best practices

To ensure sustainability and scalability, the NW DPW should:

- Benchmark against similar contexts: Learn from ICT adoption successes in countries with similar socio-economic challenges, such as Kenya and India.
- Adopt international standards: Align ICT projects with global frameworks, such as ISO standards for digital governance, to enhance quality and interoperability.
- Leverage external expertise: Engage with international consultants and technology providers to gain insights into best practices and emerging trends.

5.3 CONTRIBUTIONS OF THE STUDY

This section outlines the theoretical, practical, and policy-related contributions of the study, highlighting how it advances knowledge on ICT adoption in public sector construction projects, particularly within the South African context.

5.3.1 Theoretical contributions

The study contributes to the academic discourse by applying the Technology Acceptance Model (TAM) and the Diffusion of Innovations (DOI) framework to explore ICT adoption in a complex, resource-constrained public sector environment. Key contributions include:

- Integration of TAM and DOI in the public sector: By synthesising these frameworks, the study provides a nuanced understanding of how perceived usefulness, ease of use, and innovation attributes such as complexity and trialability interact to influence ICT adoption.
- Contextual application: The study extends TAM and DOI by situating them in the unique socio-economic and infrastructural challenges of the South African public sector, highlighting the role of contextual factors such as load shedding and budget constraints.

- Insights into stakeholder dynamics: The research sheds light on the generational divide, leadership influence, and cultural resistance, adding to the theoretical understanding of stakeholder dynamics in ICT adoption.

5.3.2 Practical contributions

The study offers actionable insights that can directly inform strategies for enhancing ICT adoption in the NW DPW and similar organisations:

- Identification of barriers and enablers: The research identifies specific organisational, cultural, and technical barriers to ICT adoption, providing a foundation for targeted interventions.
- Evidence-based recommendations: Practical strategies such as scaling pilot projects, investing in training, and improving infrastructure are grounded in the empirical findings and aligned with global best practices.
- Framework for organisational change: By outlining a roadmap for digital transformation, the study equips public sector managers with tools to navigate resistance, foster collaboration, and drive innovation.

5.3.3 Contribution to the NW DPW

Specifically, for the NW DPW, this research provides a tailored analysis of its current ICT adoption practices, challenges, and opportunities. The insights gained from the study can support the department in:

- Strategic planning: Informing the development of a comprehensive ICT strategy aligned with organisational goals.
- Enhanced project management: Offering practical solutions to improve efficiency, reduce costs, and enhance service delivery through ICT.
- Stakeholder engagement: Encouraging leadership advocacy and fostering a culture that supports innovation and collaboration.

5.4 LIMITATIONS OF THE STUDY

This study acknowledges several limitations inherent to its research design and methodological approach:

- The research focuses exclusively on the North West Department of Public Works (NW DPW) as a particular case study. While this approach allows for in-depth exploration and context-specific insights, it limits the generalisability of the findings to other public sector organisations or geographical locations.
- Primary data were collected through semi-structured interviews, which depend on participants' self-reported perceptions and experiences. This reliance introduces the potential for biases such as:
 - Social desirability bias, where participants may provide responses, they believe are more favourable or acceptable.
 - Recall bias, particularly for participants discussing historical challenges or successes related to ICT adoption.
- While secondary data, such as organisational reports and policy documents, were used to supplement primary data, the availability and comprehensiveness of these documents varied. Some relevant reports may not have been accessible, potentially restricting the scope of triangulation.
- External factors unique to South Africa, such as load shedding, limited ICT infrastructure, and budgetary constraints, significantly shaped the study's findings. These factors may not be directly applicable to regions with different socio-economic conditions.

5.4.1 Implications for generalisability

The findings are deeply rooted in the specific operational, cultural, and infrastructural realities of the NW DPW. While the study offers transferable insights, particularly for public sector entities in similar resource-constrained settings, its direct applicability to other organisations or regions is limited.

The reliance on participants' accounts may lead to an incomplete or overly subjective understanding of ICT adoption challenges and successes. This limitation affects the robustness of the conclusions drawn and their generalisability to other contexts.

By focusing on a single sector (public construction management), the study does not account for potential variations in ICT adoption dynamics across other public sectors, such as healthcare or education, further limiting the generalisability of findings.

5.5 AREAS FOR FUTURE RESEARCH

This study has laid the groundwork for understanding ICT adoption within the NW DPW, but there are opportunities to extend the research:

5.5.1 Comparative studies

Future research could examine ICT adoption across multiple public sector organisations to:

- Understand sector-specific dynamics.
- Identify transferable strategies for ICT adoption.

5.5.2 Longitudinal analysis

Research tracking ICT adoption over time would:

- Assess the long-term sustainability of digital transformation initiatives.
- Monitor evolving stakeholder attitudes and organisational readiness.

5.5.3 Emerging technologies

Exploring the adoption of advanced technologies such as AI, IoT, and Blockchain could:

- Highlight their potential benefits and challenges in public sector construction projects.
- Inform policies to support their integration.

5.5.4 Cultural change management

Future studies could investigate:

- Effective strategies to overcome cultural resistance.
- Leadership's role in driving organisational change and ICT adoption.

5.6 CONCLUSION

This study has provided a comprehensive exploration of ICT adoption within the North West Department of Public Works (NW DPW), highlighting both the barriers and opportunities that influence the department's digital transformation journey. Despite the challenges of cultural resistance, limited infrastructure, and budgetary constraints, the findings underscore the significant potential of ICT to improve governance, efficiency, and service delivery in public sector construction management.

Looking forward, the digital transformation of public sector construction holds immense promise. By leveraging advanced technologies such as AI, BIM, and IoT, and fostering a culture of innovation and adaptability, organisations like the NW DPW can drive sustainable infrastructure development, enhance transparency, and contribute to socio-economic growth. With strategic leadership, robust policy frameworks, and targeted investment in capacity-building, the public sector in South Africa can not only overcome existing barriers but also set benchmarks for effective digital integration in developing economies.

The potential for digital transformation is not merely a theoretical possibility; it is a practical necessity. As global best practices demonstrate, embracing ICT can position public sector entities as leaders in innovation, equipping them to meet the evolving demands of a rapidly digitalising world. Through collaborative efforts and a commitment to continuous improvement, public sector construction management in South Africa can achieve a future defined by efficiency, sustainability, and impactful service delivery.

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5.8 APPENDIX A

Goodwill permission: a study conducted at the north west department of public works.

I herewith wish to request your permission for the North-West department of public works to participate in this research, which involves interviewing relevant stakeholders within the department regarding the extent of ICT adoption in implementing construction projects in the department. Prior to granting permission, please acquaint yourself with the information below.

TITLE OF THE PROJECT:

Exploring ICT adoption for project implementation in the North West Department of Public Works.

PROJECT SUPERVISOR: Prof Leenta Grobler

ADDRESS: 110 Thabo Mbeki Way, Potchefstroom, 2520

CONTACT NUMBER: 0828785894

MEMBER OF PROJECT TEAM

MBA-STUDENT: Aobakwe Mogamisi

ADDRESS: 1392 Mokale Str, Unit 7 Mmabatho 2735

CONTACT NUMBER: 072 3005 908

Ethics Committee of the Faculty of Economic and Management Sciences (EMS-REC)

Chairperson: Prof. Mark Rathbone

Committee administrative coordinator: Ms. Dalene Vorster (018 299 1529)

This study has been approved by the Research Ethics Committee of the Faculty of Economic & Management Sciences of the North-West University and will be conducted according to the ethical guidelines of this committee.

ETHICS APPLICATION NUMBER: NWU - 01764 – 24 - A4

What is this research about?

The purpose of this research study is to investigate the extent of ICT adoption in construction projects conducted by the North-West Department of Public Works. The study aims to gain a comprehensive understanding of how ICT is currently utilised, explore the factors influencing its adoption, assess its impact on project management practices, and identify challenges and opportunities associated with its implementation. By conducting interviews with relevant stakeholders, this study seeks to gather valuable insights and perspectives to inform recommendations for enhancing ICT adoption in the construction sector.

Participants

Participants who will be selected will fall into one of the following categories:

Operational staff, management personnel, construction project managers, contractors, consultants, and other stakeholders directly involved in construction projects within the NW DPW.

Individuals with experience or knowledge of ICT adoption in the construction industry.

Participants willing to share their perspectives and experiences related to ICT adoption in construction projects.

What is expected of the participants?

Participants will be expected to:

Participate in a 1-hour semi-structured interview with the researcher at a suitable time and restricted area without interruptions that is convenient for both parties via an online platform. This will be scheduled by the researcher once approved by the NWU ethics committee.

Respond to the questions in an open and honest manner.

Inform the supervisor should you feel or experience any form of discomfort or distress during the research process and inform the supervisor if you at times feel the need to terminate your involvement in the research process.

Benefits to the participants

This research study intends to give participants a voice to reveal, explain and reflect on the use of ICT in projects within the department. No monetary reward shall be made available for participation in the study. They will however be furnished with a two-page

communicate on the outcomes of the study that they can utilize to plan and implement technology in future projects within the department.

Risks involved for participants.

Participation in this study does not create any physical risk to participants as the study does not involve any physical activities or experiments. We, however, have identified certain ethical principles that shall be always maintained to prevent any damage to participants. The focus of these principles will be to protect the dignity of participants and keep all records provided private and confidential.

Confidentiality and protection of identity

Participants will be assigned a unique participant ID. The interview will be recorded and saved with reference to the ID, but data collected shall be regarded as confidential and will not be shared with any 3rd party that is not directly involved in the research process. Personal details of participants and their direct input to the research study shall not be made public. All records of the research shall be kept for a retention period and destroyed by an appropriate means. The findings of the study will be made public however will not contain any raw data that might incriminate certain individuals.

Dissemination of findings

The findings concluded in the study will be for academic purposes and will only be utilized to add to the current body of available knowledge.

If you have any further questions or inquiries regarding participation in this research, please contact the researchers for more information.

DECLARATION BY THE RELEVANT RESPONSIBLE PERSON:

By signing below, I _____ agree to give permission for the research to take place with the identified participants in the study entitled:

Exploring the extent of ICT adoption in implementing construction projects in the North-West Department of Public Works

I declare that:

I have read this information and consent form and understand what is expected of the participants in the research.

I have had a chance to ask questions to the researcher and all my questions have been adequately answered.

I understand that taking part in this study is voluntary and participants will not be pressurised to take part.

Participants may choose to leave the study at any time and will not be penalised or prejudiced in any way.

Participants may be asked to leave the research process before it is completed, if the researcher feels it is in their best interests, or if they do not follow the research procedures, as agreed to.

Signed at (place)_____on (date) ____/____/20____

Signature of Relevant responsible person



public works & roads

Department:
Public Works and Roads
North West Provincial Government
REPUBLIC OF SOUTH AFRICA

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Private Bag X 2080, Mmabatho, 2735

HEAD OF DEPARTMENT

Tel.: +27 (18) 388 1435
Email: Kmabe@nwpg.gov.za

882426

D.B Jini

Prof Leenta Grobler
North West University
Private Bag x6001
Potchefstroom
2520

Dear Prof Leenta Grobler

REQUEST FOR PERMISSION TO CONDUCT RESEARCH STUDY: EXPLORING THE EXTENT OF ICT ADOPTION IN IMPLEMENTING CONSTRUCTION PROJECTS IN THE NORTH WEST DEPARTMENT OF PUBLIC WORKS AND ROADS

The above noted request has reference.

Permission has been granted for Mr Aobakwe Mogamisi to conduct research and distribute questionnaire to our personnel.

You are kindly requested to share a copy of your approved thesis/ dissertation to glean from the findings of your study.

All of the best with your research studies.

MR M.I KGANTSI

HEAD OF DEPARTMENT

16/05/23

DATE

5.9 APPENDIX B

Consent Form

DEAR PARTICIPANT

INFORMED CONSENT LETTER TO INTERVIEW PARTICIPANTS

You are invited to participate in a research study that forms part of a Master of Business Administration (MBA) degree. Please take some time to read the information presented here, which will explain the details of this study. Please ask the researcher or person clarifying the research to you any questions about any part of this study you do not fully understand. It is essential that you are delighted that you clearly understand what this research is about and how you might be involved. Also, your participation is entirely voluntary, and you are free to say no to participating. If you say no, this will not affect you negatively in any way whatsoever. You are also free to withdraw from the study at any point, even if you agree to participate now.

The study complies with the requirements of the Protection of Personal Information Act (Act 4 of 2013) (POPIA) and your non-identifiable responses will be stored in a password-protected file on a cloud drive.

This study has been approved by the NWU Economic and Management Sciences Research Ethics Committee (EMS-REC). It will be conducted according to the ethical guidelines and principles of the North-West University and other international ethical guidelines applicable to this study.

Title of the project: *Exploring ICT adoption for project implementation in the North West Department of Public Works.*

Institution: NWU Business School

Ethics Reference Number: NWU - 01764 – 24 - A4

What is this research study all about?

This research study aims to explore the extent of ICT adoption in construction projects conducted by the North-West Department of Public Works. The study seeks to gain a comprehensive understanding of how ICT is currently utilized, explore the factors influencing its adoption, assess its impact on project management practices, and identify challenges and opportunities associated with its implementation. This study seeks to gather valuable insights and perspectives to inform recommendations for enhancing ICT adoption in the construction sector by conducting interviews with relevant stakeholders.

Why have you been invited to participate?

You have been invited to participate in this research study because you fall into at least one of the following categories:

- Operational staff, management personnel, construction project managers, contractors, consultants, and other stakeholders directly involved in construction projects within the NW DPW.
- Individuals with experience or knowledge of ICT adoption in the construction industry.
- Participants willing to share their perspectives and experiences on ICT adoption in construction projects.

What will be expected of you?

You will be expected to:

- Participate in an approximately 1Hour min semi-structured interview with the researcher at a suitable time and restricted area without interruptions that is convenient for both parties and via an online platform. This will be scheduled by the researcher once approved by the NWU ethics committee.
- Respond to the questions openly and honestly.
- Inform the supervisor should you feel or experience any discomfort or distress during the research process and inform the supervisor if you sometimes feel the need to terminate your involvement in the research process.

Will you gain anything from taking part in this research?

This research study aims to allow you to share your perspectives, experiences, and insights regarding the adoption of ICT in construction projects within the North West Department of Public Works and Roads (NW DPW). By participating in the study, you will have a platform to express your thoughts and contribute to understanding ICT adoption in the construction sector.

Although no monetary reward will be provided for participation in the study, your input will be highly valued and appreciated. As a participant, you will be satisfied knowing that your insights will contribute to the body of knowledge in managerial sciences. You may inform recommendations for enhancing ICT adoption in construction projects within the NW DPW.

After the study, you will receive a two-page summary of the research outcomes. This communicate will serve as a summary of the essential findings and insights from the study. You can utilise this document to gain a deeper understanding of the research outcomes and potentially apply the findings in your own professional context, such as informing decision-making processes or improving practices related to ICT adoption in construction projects.

We value your contribution to this research study and aim to ensure that your involvement is meaningful and beneficial.

Are there risks involved in participating in this research, and what will be done to prevent them?

Participation in this study does not create any physical risk to you as the study does not involve any physical activities or experiments. We, however, have identified certain ethical principles that shall be consistently maintained to prevent any damage to you. These principles will focus on protecting your dignity and keeping all records provided private and confidential.

How will we protect your confidentiality, and who will see your findings?

You will be assigned a unique participant ID. Our interview will be recorded and saved with reference to the ID, but the data collected shall be regarded as confidential. It will not be shared with any 3rd party not directly involved in the research process. Personal details of participants and their direct input to the research study shall not be made public.

All research records shall be kept for a retention period and destroyed by an appropriate means. The study's findings will be made public but contain no raw data that might incriminate specific individuals.

What will the demographic information be used for?

Demographic information will be used to compare ICT adoption across different age groups, with younger professionals adopting technology more readily than older workers. Themes such as resistance to change or enthusiasm for innovation may also vary by education level and years of experience. By using these demographics to explain participants' views, researchers can gain a deeper understanding of the factors influencing ICT adoption, enabling more nuanced conclusions and tailored recommendations for implementing.

What will happen with the findings or samples?

The findings concluded in the study will be for academic purposes and will only be utilised to add to the current body of available knowledge. The results may also be published in the form of an article or presented at a conference to offer tailored recommendations for implementing technology across different sectors of the industry.

How will you know about the results of this research?

Participants in the study, should they require, will be made aware of the research results through a two-page communique using electronic mail. The electronic last version of the dissertation will also be made available if requested.

Will you be paid to participate in this study, and are there any costs for you?

Participation in this study will not yield monetary value to you. There is no cost envisaged to you except the time you spend participating in this study. The researcher himself will fund this study.

Is there anything else that you should know or do?

You may contact the supervisor, Prof Leenta Grobler, on 0828785894 if you have further questions or problems. You will receive a copy of this information and consent form for your purposes.

DECLARATION

Declaration by participant

By signing below, I () agree to take part in the research study titled: Exploring the extent of ICT adoption in implementing construction projects in the North-West Department of Public Works.

I declare that:

I have read this information/it was explained to me by a trusted person in a language with which I am fluent and comfortable in. The research was clearly explained to me. I have had a chance to ask questions to both the person getting the consent from me, as well as the researcher and all my questions have been answered. I understand that taking part in this study is voluntary and I have not been pressured to take part. I may choose to leave the study at any time and will not be handled in a negative way if I do so. I may be asked to leave the study before it has finished if the researcher feels it is in the best interest, or if I do not follow the study plan, as agreed to.

Signed at: _____

on: _____

Signature of participant

Signature of witness

Declaration by researcher

I, Aobakwe Mogamisi declare that:

- I explained the information in this document to (PARTICIPANT ID)
- I did/did not use an interpreter.
- I encouraged them to ask questions and took adequate time to answer them, or I was available should they want to ask any further questions.
- I am satisfied that they adequately understand all aspects of the research, as described above.

- I am satisfied that they had time to discuss it with others if they wished to do so.

Signed at: _____ on: _____

Signature of researcher

Signature of supervisor

5.10 APPENDIX C

Interview Guide

The interview will last 1Hour to 1Hour 15 minutes, and your responses will remain confidential.

Before we begin, please note the following:

- Confidentiality: all information you provide during the interview will be strictly confidential. Your responses will be anonymised, and only the research team will have access to the collected data.
- Open and honest responses: we encourage you to answer the questions openly and honestly, sharing your insights and experiences related to ICT adoption in construction projects.
- Discomfort or distress: if, at any point during the research process, you feel uncomfortable or experience distress, please inform the researcher immediately. Your well-being is of utmost importance, and you have the right to terminate your involvement in the research if needed.

Demographic Questions

- What is your age range:
 - 18-25 years
 - 26-35 years
 - 36-45 years
 - 46-55 years
 - 56 years or older
- Education level:
 - High school diploma or equivalent
 - Associate's degree or equivalent

- Bachelor's degree
- Master's degree
- Doctorate or professional degree.

- Years of experience in the construction industry:
 - Less than 1 year
 - 1-3 years
 - 4-6 years
 - 7-10 years
 - 11-15 years
 - 16-20 years
 - Over 20 years

- Job title/position:

- Role in construction projects within the NWD PW:

- Are you directly involved in the decision-making process related to ICT adoption in construction projects?
 - Yes
 - No
- **CURRENT ICT ADOPTION:**
 - What ICT tools or technologies are currently used in NW DPW construction projects?
 - Can you provide examples of specific ICT applications or software utilised in different construction project phases?

- How frequently are these ICT tools used in your day-to-day work?

- **ICT INTEGRATION:**
 - To what extent is ICT integrated into the overall project management processes within the NW DPW?
 - How are ICT tools integrated with other project management tools and systems?
 - Are there any specific areas or stages of construction projects where ICT plays a more prominent role?

- **LEVEL OF ICT PROFICIENCY:**
 - How would you rate the overall proficiency of construction professionals in using ICT tools and technologies within the NW DPW?
 - Are any training or upskilling programmes provided to enhance ICT skills in the construction industry?
 - Do you believe that there is a need for additional training or support to improve ICT proficiency in the construction sector?

- **EXTENT OF DATA MANAGEMENT:**
 - How is data managed and shared within construction projects? Is there a centralised system or platform for data storage and access?
 - Are specific ICT tools used for data management, collaboration, or document sharing among project stakeholders?
 - What are the challenges or benefits of using ICT for data management in construction projects?

- **COMMUNICATION AND COLLABORATION:**
 - How does ICT facilitate communication and collaboration among project stakeholders (e.g., project managers, contractors, consultants)?

- Are there specific ICT tools or platforms used for real-time communication, virtual meetings, or sharing project updates?
- Do you believe that ICT has improved the effectiveness and efficiency of communication and collaboration in construction projects?

- **PERCEIVED USEFULNESS:**
- How do you perceive the usefulness of ICT in construction projects within the NW DPW?
- In what ways do you believe ICT can enhance project management in the construction industry?
- Can you provide examples of how ICT tools or technologies have improved efficiency or effectiveness in construction projects?

- **PERCEIVED EASE OF USE:**
- How would you describe the ease of use of ICT tools and technologies in construction projects?
- Have you encountered any challenges or difficulties using ICT in your construction work? If so, what were they, and how were they addressed?
- How do you think the usability of ICT can be improved to facilitate its adoption in the construction sector?

- **ATTITUDES TOWARDS ICT:**
- What is your overall attitude towards adopting ICT in construction projects?
- How do you perceive the benefits and advantages of integrating ICT in construction processes?
- Are there any concerns or reservations you have regarding the implementation of ICT in the construction industry?

- **SOCIAL INFLUENCE:**

- To what extent do you believe the opinions and recommendations of others influence the adoption of ICT in construction projects?
- How do interactions with colleagues, superiors, or industry peers impact your decision to adopt or utilise ICT in construction work?
- Have you observed any social pressures or norms that influence the adoption of ICT in the construction sector?

- **FACILITATING CONDITIONS:**

- What resources, support, or infrastructure do you believe are necessary to facilitate the effective use of ICT in construction projects?
- Are there any barriers or constraints that hinder the implementation and utilization of ICT in the construction industry? How can they be overcome?
- What improvements or investments do you think are required to create a conducive environment for ICT adoption in construction projects?