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EFFECT OF SCOPE DEFINITION ON THE PERFORMANCE OF NETWORK INFRASTRUCTURE PROJECTS IN KOREAN TELECOMMUNICATION RWANDA NETWORK PROJECT

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ABSTRACT

This study examined the effect of scope definition on the performance of network infrastructure projects in the Korean Telecommunication Rwanda Network (KTRN). Using a descriptive survey design, data were collected from 91 respondents, including project managers, engineers, and key stakeholders, through structured questionnaires. Descriptive and inferential analyses, including means, standard deviations, and regression analysis, were conducted to assess the relationship between clearly defined project scope and project performance. The findings indicate that well-defined project objectives, deliverables, and work breakdown structures significantly enhance project completion rates, adherence to budgets, timely delivery, quality assurance, and stakeholder satisfaction. The regression results further confirm that scope definition is a strong predictor of project success ($\beta = 0.765$, $p < 0.001$). The study concludes that rigorous scope definition positively impacts network infrastructure project performance in Rwanda and recommends that project managers prioritize comprehensive scope planning and stakeholder engagement to minimize scope creep and optimize project outcomes. Future research could explore the interaction of scope definition with risk management and resource allocation in large-scale telecommunication projects.

Keywords: *Scope Definition, Project Performance, Network Infrastructure Projects, Telecommunications, Korean Telecommunication Rwanda Network (KTRN)*

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BACKGROUND OF THE STUDY

The rapid expansion of telecommunication infrastructure projects globally has been a cornerstone of economic development, digital inclusion, and technological advancement in the 21st century. These projects, encompassing mobile broadband, fiber-optic networks, and submarine cables, are critical for bridging the digital divide and fostering connectivity in an increasingly digital world. Globally, the telecommunication sector has seen significant investments, with the International Telecommunication Union (ITU) reporting that mobile-cellular subscriptions reached 8.6 billion by 2022, surpassing the global population (ITU, 2022). However, disparities in access persist, particularly between developed and developing regions, with Sub-Saharan Africa lagging in internet penetration at only 29% compared to 66% globally (ITU, 2022). The scope definition of these projects, which involves outlining objectives, deliverables, and boundaries, is pivotal to their success, as it ensures alignment among stakeholders and mitigates risks like scope creep.

In the United States, telecommunication infrastructure projects are characterized by advanced technological deployments and significant private-sector investment. The U.S. leads in 5G network rollout, with companies like Verizon and AT&T investing heavily in spectrum auctions and infrastructure upgrades, supported by federal initiatives like the Infrastructure Investment and Jobs Act of 2021, which allocated $65 billion for broadband expansion (White House, 2021). Scope definition in these projects is critical, as it involves coordinating complex stakeholder ecosystems, including government agencies, private firms, and local communities. Poor scope definition can lead to cost overruns and delays, as seen in some rural broadband projects where unclear objectives resulted in inefficiencies (FCC, 2023). The U.S. experience underscores the importance of precise scope management to ensure project alignment with national goals of universal connectivity and technological leadership, offering lessons for projects in developing regions like Rwanda.

China has emerged as a global leader in telecommunication infrastructure, driven by state-backed initiatives like the Belt and Road Initiative (BRI), which has facilitated significant investments in digital infrastructure across Asia, Africa, and beyond. By 2023, China accounted for 20% of the world's mobile subscriber base, with companies like Huawei and ZTE dominating global 5G equipment markets (Sridhar et al., 2024). In Africa, China's investments, such as the $7.19 billion in technology projects between 2005 and 2020, have focused on building fiber-optic networks and submarine cables (Atlantic Council, 2021). Scope definition in these projects is often centralized, reflecting China's state-driven model, which ensures rapid deployment but can face challenges in aligning with local needs. For Rwanda's telecommunication projects, China's involvement highlights the need for clear scope agreements to balance foreign investment with local priorities, ensuring sustainable outcomes.

Sub-Saharan Africa faces significant challenges in telecommunication infrastructure development, with low internet penetration and high service costs hindering digital inclusion. The region's internet penetration rate of 29% in 2022 contrasts sharply with global averages, driven by inadequate infrastructure and high electricity costs, which are three times higher than in other developing regions (African Development Bank, 2023). Projects like the 2Africa subsea cable, set to connect 23 countries by 2024, aim to double the continent's internet capacity, but their success depends on precise scope definition to address logistical and regulatory challenges (Atlantic Council, 2021). Studies indicate that non-technological factors, such as access to electricity and ease of doing business, significantly influence digital infrastructure outcomes (Myovella et al., 2021). For Rwanda, these regional dynamics emphasize the importance of defining project scopes to account for infrastructure deficits and stakeholder coordination.

South Africa, as a leading economy in Sub-Saharan Africa, has made significant strides in telecommunication infrastructure, boasting the highest mobile broadband penetration in the region at 68% in 2022 (ITU, 2022). Projects like the Square Kilometre Array (SKA) require robust digital infrastructure, driving investments in fiber-optic networks and data centers. However, challenges such as high costs and regulatory complexities necessitate clear scope definition to ensure project efficiency (Batuo, 2015). South Africa's collaboration with

China on digital projects, as part of the Forum on China-Africa Cooperation (FOCAC), highlights the role of international partnerships in shaping project scopes (Liu & Luo, 2021). For Rwanda, South Africa's experience offers insights into managing complex, multi-stakeholder telecommunication projects through well-defined scopes that align technical goals with economic realities.

Kenya has emerged as a digital innovation hub in Sub-Saharan Africa, with initiatives like M-Pesa revolutionizing mobile money and driving economic inclusion (GSMA, 2021). The country's 2030 Metro Strategy aims to transform Nairobi into a world-class digital metropolis, supported by projects like Google's Project Taara, which uses light-based technology to expand rural connectivity (Atlantic Council, 2021). Kenya's success in digital infrastructure is attributed to liberalized telecom markets and clear scope definitions that incorporate stakeholder input and regulatory frameworks (ITU, 2018). However, challenges like the digital divide in rural areas underscore the need for precise scope management to ensure equitable access. For Rwanda's Korean Telecommunication project, Kenya's experience highlights the importance of defining scopes that address both urban and rural connectivity needs.

Rwanda has positioned itself as a leader in digital transformation in East Africa, with initiatives like the Smart Rwanda Master Plan and partnerships with Korea Telecom (KT Rwanda Networks) to deploy 4G LTE and fiber-optic networks (Empower Africa, 2020). By 2022, Rwanda's mobile penetration reached 84%, and its collaboration with KT has laid over 3,000 km of fiber cable, enhancing fixed-mobile converged infrastructure (Empower Africa, 2020). The Korean Telecommunication Rwanda Network Project, central to this study, exemplifies the critical role of scope definition in ensuring project alignment with Rwanda's Vision 2050 goals of universal broadband access. Clear scope definition mitigates risks like scope creep and ensures stakeholder alignment, drawing lessons from global, U.S., Chinese, and regional experiences to enhance project performance in Rwanda's unique context.

One significant player in this sector is the Korean Telecommunications Rwanda Network (KTRN), which has made substantial investments in enhancing Rwanda's telecommunication capabilities (Kagabo & Kim, 2021). KTRN's initiatives are aligned with Rwanda's Vision 2050, aiming to transform the nation into a knowledge-based economy through digital connectivity (Ministry of Information Communication Technology and Innovation, 2022). However, despite the investments and advancements, challenges persist in the effective management and performance of network infrastructure projects, including project delays and budget overruns (Ntwali, Mukandayisenga & Ntamuhanga, 2023).

Statement of the Research Problem

The performance of network infrastructure projects, such as the Korean Telecommunication Rwanda Network Project, hinges critically on effective scope definition, yet inadequate scope definition remains a persistent challenge leading to cost overruns, delays, and suboptimal project outcomes. In Rwanda, where the government aims to achieve universal broadband access by 2030 under its Vision 2050, telecommunication projects face unique challenges, including complex stakeholder coordination, regulatory constraints, and geographical disparities between urban and rural connectivity (Rwanda Utilities Regulatory Authority [RURA], 2022). The ITU (2022) reports that Rwanda's internet penetration stood at 34% in 2022, significantly below the global average of 66%, underscoring the urgency of successful project execution. Poor scope definition can exacerbate these issues by causing misaligned objectives, scope creep, and resource misallocation, as seen in similar Sub-Saharan African projects where unclear scope led to a 20–30% increase in costs and delays (African Development Bank, 2023). This study seeks to address how inadequate scope definition impacts the performance of the Korean Telecommunication Rwanda Network Project, a critical initiative for Rwanda's digital transformation, by examining its effects on cost, time, and quality metrics.

Previous studies on telecommunication infrastructure projects have highlighted scope definition as a key determinant of success but have not sufficiently explored its specific impact in the context of Rwanda's unique socio-economic and technological landscape. For instance, Myovella et al. (2021) found that non-

technological factors, such as regulatory frameworks and stakeholder alignment, significantly influence digital infrastructure outcomes in Sub-Saharan Africa, yet their study does not delve into scope management practices. Similarly, a study on ICT projects in developing countries emphasized the need for stakeholder engagement in scope planning but lacked a focus on Rwanda or the role of international partnerships like Korea Telecom's involvement (Liu & Luo, 2021). This research gap is critical, as Rwanda's collaboration with foreign entities and its ambitious ICT goals require tailored scope definition strategies to address local challenges like rural connectivity and regulatory compliance. By investigating the Korean Telecommunication Rwanda Network Project, this study aims to fill this gap by providing empirical insights into how scope definition affects project performance in Rwanda's context.

Objectives of the Study

To assess the effect of scope definition on the performance of network infrastructure projects in Rwanda.

LITERATURE REVIEW

Scope Definition

An integral aspect of project management, the project scope defines the parameters, deliverables, and objectives of the endeavor. Setting the project plan correctly is important for a project's success because it affects how resources are used, how happy stakeholders are, and the project's results (Khan, Bukhari & Shah, 2021). Kerzner (2021) says that the project's scope needs to be clearly defined in order to avoid scope creep, which is a common issue that can mess up project plans and costs. When projects get more complicated, especially in fields like IT and building, it becomes even more important to clearly define the project's goals (Müller & Jugdev, 2020).

According to recent research, project success is correlated with how well the scope is defined. There is a 50% greater chance that projects with clearly specified scopes finishes their objectives within the allocated budget and time, according to research by Yousuf, Malik, and Ali (2022). The significance of including stakeholders in the scope definition phase to collect thorough requirements and expectations is underscored by this relationship. Project managers can make sure the established scope is in line with the project's goals and meets everyone's needs by including stakeholder input (Liu, Wang & Zhao 2023).

Moreover, the methodologies used for scope definition have evolved in response to changing project landscapes. Agile project management, for example, emphasizes iterative development and continuous stakeholder involvement, allowing for more flexible and adaptive scope definition (Kumar, Singh & Patel, 2020). This approach contrasts with traditional waterfall methodologies, which often rely on a fixed scope established at the project's outset. Research by Johnson and Li (2022) indicates that agile methodologies lead to better adaptability in scope definition, enhancing overall project success in dynamic environments.

In addition to stakeholder engagement and methodology, tools and techniques for scope definition have also been refined. Tools such as Work Breakdown Structures (WBS) and scope statement templates are commonly utilized to facilitate clear scope definition (Wysocki, 2019). These tools help project managers visualize project components and establish a shared understanding among stakeholders. A study by Greer, Adnan, and Zheng (2023) emphasizes that utilizing structured tools for scope definition significantly reduces miscommunication and ensures that all aspects of the project are considered, thus enhancing project performance.

Project Management Theory

The theoretical foundations of project management place an emphasis on methodical approaches to project planning, execution, and supervision, particularly the importance of defining the project scope as a foundational element that significantly influences project performance. A well-defined scope sets clear boundaries, objectives, and deliverables, which are crucial for aligning stakeholder expectations and ensuring

that resources are effectively allocated (Davis, 2020). For the case of network infrastructure projects where rapid technological advancements demand precise execution, a thorough scope definition can lead to enhanced project outcomes by minimizing risks associated with scope creep and miscommunication among stakeholders.

One of the strengths of Project Management Theory is its systematic framework, which helps project managers identify potential challenges early in the project lifecycle and develop strategies to address them. This proactive approach can lead to increased efficiency, reduced costs, and improved stakeholder satisfaction. However, a notable weakness of the theory is its potential rigidity; strict adherence to predefined scopes may hinder flexibility and adaptability in dynamic environments, such as the rapidly evolving telecommunications sector in Rwanda (Verzuh, 2021). This rigidity can result in challenges when unforeseen circumstances necessitate scope adjustments, which are common in infrastructure projects due to external factors like regulatory changes or technological advancements.

The connection between project performance and scope definition is especially relevant for network infrastructure projects, because scope clarity affects both the planning and execution stages. Because it encourages open communication between team members and stakeholders, Khanna, Sharma, and Choudhary (2022) claim that successful scope management is associated with increased project success rates. Clear scope definition helps promote cooperation and expedite project delivery in Rwanda, where telecommunications projects frequently involve a number of stakeholders, including local communities, private companies, and government organizations. This alignment is essential for making sure that initiatives accomplish their goals within the allocated budget and time schedule, which ultimately helped the growth of the telecommunications infrastructure as a whole.

Recent research further highlights the importance of stakeholder participation in the scope definition procedure, which improves project performance results even more. Research by Wang, Liu and Zhang (2023) indicates that involving stakeholders early in the project lifecycle not only helps in accurately defining the scope. In Rwanda, where community involvement is essential for infrastructure projects' acceptance and sustainability, this participatory method is particularly pertinent. Improved performance and a bigger overall impact on the telecom industry can result from network infrastructure projects that better correspond with local needs and expectations by utilizing Project Management Theory to include stakeholder feedback during the scope defining phase.

In this study, Project Management Theory aligns with the examination of advanced technologies in project execution, such as digital tools and data analytics, which are integral to improving tracking, decision-making, and overall performance. By leveraging these technologies, project managers can enhance transparency, optimize processes, and ensure real-time monitoring, all of these things help the project turn out better. The theory also talks about the importance of involving stakeholders, which is necessary to make sure that project goals are met and that stakeholders' standards are met. This active involvement fosters collaboration and helps identify potential risks early, ensuring that projects are more adaptable and resilient in the face of challenges.

Conceptual Framework

Research can be better understood, analyzed, and interpreted with the use of a conceptual framework, which lays out the interrelationships between the study's major ideas and variables. It serves as a blueprint that helps researchers align their theoretical assumptions with the objectives of their research, ultimately guiding data collection and analysis (Jabareen, 2019). Conceptual frameworks are essential for clarifying complex phenomena, particularly in social sciences, as they allow for the visualization of theoretical linkages (Grant & Osanloo, 2020). Ravitch and Riggan (2021) say that a well-developed conceptual framework also makes the study more rigors by making sure that the research methods are in line with the theoretical foundations. Thus, it is a critical tool for aligning empirical findings with theoretical insights. A conceptual framework describing

the relationship between variables is presented in Figure 1. It is a metaphor for ideas and how they relate to one another.

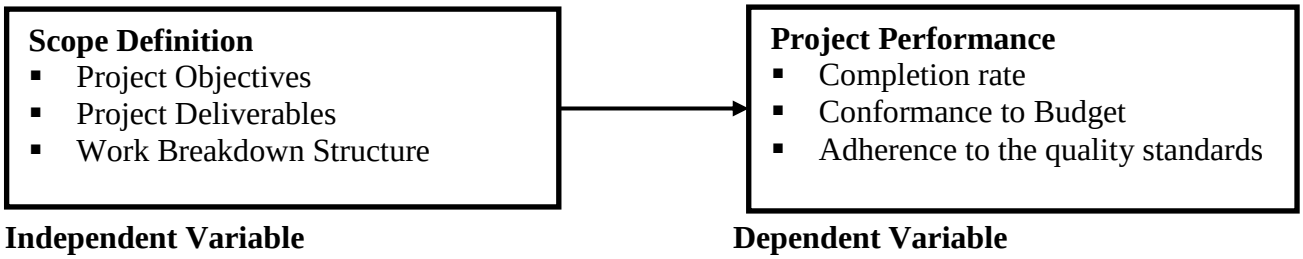

Figure 1: Conceptual framework
Source: Researcher, 2025

The conceptual framework for this study on the effect of scope definition on the performance of the Korean Telecommunication Rwanda Network Project posits that a well-defined scope, encompassing project objectives, deliverables, and work breakdown structure (WBS), directly influences project performance metrics, including completion rate, conformance to budget, and adherence to quality standards. Clear project objectives ensure stakeholder alignment and focus, while well-defined deliverables specify tangible outcomes, such as network coverage or bandwidth capacity, critical for Rwanda's digital goals (ITU, 2022). The WBS, as a tool for breaking down complex tasks, enhances resource allocation and timeline management, reducing risks like scope creep (Myovella et al., 2021). These elements collectively impact project performance: completion rate reflects timely delivery, conformance to budget ensures financial efficiency, and adherence to quality standards guarantees network reliability and user satisfaction (African Development Bank, 2023). This framework draws on studies showing that robust scope definition correlates with a 15–20% improvement in project outcomes in ICT infrastructure projects (Liu & Luo, 2021), providing a structured lens to evaluate the Korean Telecommunication Rwanda Network Project's success.

METHODOLOGY

Research Design

The purpose of this descriptive survey study was to examine the relationship between project beginning procedures and the completion rate of network infrastructure projects in Rwanda, specifically looking at the KTRN. A descriptive survey approach is appropriate for this study since it makes it possible to gather quantitative data that describes the current state of affairs with regard to project starting procedures and their relationship to project performance. In order to identify patterns and relationships between important variables the researcher can collect detailed information from respondents in a methodical manner thanks to this design (Creswell & Creswell, 2018).

Research aiming to shed light on a phenomenon using data from a representative sample benefit greatly from descriptive surveys (Saunders, Lewis & Thornhill, 2019). Effective data collection from KTRN project managers and other relevant stakeholders would be made possible by the use of structured questionnaires as the primary data collection tool. This design incorporates a diverse range of viewpoints and experiences, which facilitates understanding how different project initiation strategies affect network infrastructure project performance (Bell, Bryman, & Harley, 2022).

Target Population

The full set of people or things that an investigator wants to learn more about is called a target population (Taherdoost, 2018). This study was designed for project managers, engineers, and other key stakeholders who are involved in starting and completing projects related to network infrastructure. Korean Telecommunication Rwanda Network (KTRN) was used to choose 117 respondents in total. This study aims to capture diverse

viewpoints on project scope definition, feasibility studies, risk identification, and project team selection by selecting a population that encompasses all the roles and responsibilities involved in telecommunications project planning and execution (Etikan & Bala, 2017).

Sampling Procedures and Techniques

With a known confidence level and margin of error, the sample size for this study was computed using Yamane's formula (1967). This method is extensively used to calculate sample sizes for finite populations. With a 95% confidence level and a 5% margin of error, the method produces a sample size that is suitable for a target population of 117 respondents, ensuring representation while reducing bias (Singh & Masuku, 2018). Yamane's formula is preferred in research involving surveys as it provides a reliable method for determining the number of respondents needed to accurately reflect the characteristics of the broader population (Taherdoost, 2018).

$$n = \frac{N}{1+N(e)^2} \quad \text{..... (Equation.1)}$$

$$n = \frac{117}{1 + 117(0.05)^2} \approx 90.5 = 91$$

Therefore, for a population of 117, the sample size determined using Slovin's' formula with a 5% margin of error would be 91.

Table 1: Sample size Selection

Category	Population	Sample Size
Project Management Team	20	16
Technical Department	30	23
Finance Department	15	12
Procurement and Logistics Team	10	8
Risk Management Team	12	9
Quality Assurance Team	10	8
Stakeholders	20	16
Total	**117**	**91**

Source: **Korean Telecommunication Rwanda Network Human Resource (2025)**.

To minimize sampling error and get a representative sample from a limited population, this study used Yamane's (1967) formula, which offers a statistically sound way to do just that. According to Singh and Masuku (2018), this method guarantees that the sample is representative and can produce findings that can be applied to a larger population, with a 95% confidence level, a 5% margin of error, and a target population of 117 respondents. As it prevents excessive data gathering while retaining accuracy, Yamane's formula is commonly used in survey research (Taherdoost, 2018). This methodology guarantees that the study's sample size is sufficient to draw valid conclusions on the correlation between KTRN's (Korean Telecommunications Rwanda Network) project initiation processes and the success of their network infrastructure projects.

Data Collection Methods

In order to create comprehensive information on the effects of project initiation procedures on network infrastructure projects in Rwanda, this study utilized a mix of primary and secondary sources to construct its data. Primary data was collected by having 117 members of the Korean Telecommunication Rwanda Network (KTRN) fill out a survey. This allowed the researcher to get first-hand information about topics such as project team selection, risk identification, feasibility studies, and scope definition (Saunders, Lewis & Thornhill, 2019). Additionally, secondary data was obtained from project reports, organizational records, and relevant literature to supplement and validate the findings (Creswell & Creswell, 2018).

Pilot Testing

The study employed a sample of 10 respondents, constituting 10% of the total population, to conduct a pilot testing phase aimed at assessing the validity and reliability of the survey instrument (Kothari, 2017). Before a full-scale rollout, the researcher was able to obtain initial input on the comprehensiveness, relevance, and clarity of the questionnaire items through this pilot test, which was carried out at MTN Rwanda (Bryman, 2020). Based on the knowledge gained from this pilot study, the survey instrument was adjusted to guarantee that it collects the desired data and enhances the overall caliber of the research findings (Creswell & Creswell, 2018).

Validity

Data obtained on study constructs, including project initiation practices and project performance, must be representative of those characteristics, thus it is crucial that the research instrument, in this case the structured questionnaire, be valid (Drost, 2018). In order to verify that the questionnaire is content-valid, it was examined by professionals in the fields of project management and telecommunications (Wang & Wang, 2020). In addition, before collecting data on a large scale, the instrument underwent pilot testing with a subset of KTRN respondents to iron out any kinks and strengthen its validity and reliability (Creswell & Creswell, 2022).

Table 2: Factor analysis - KMO and Bart

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.447
Bartlett's Test of Sphericity	Approx. Chi-Square	80.554
	df	10
	Sig.	.000

Source: **Pilot data results**, (2025)

The Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy value of 0.447 falls below the accepted threshold of 0.5, indicating that the sample may be inadequate for factor analysis. Bartlett's Test of Sphericity yielded significant results ($\chi^2(10) = 80.554$, $p < 0.001$), suggesting the necessity of factor analysis and indicating that the correlation matrix is not an identity matrix. The low KMO value raises concerns regarding the suitability of the data for factor analysis, as values below 0.5 may indicate inappropriateness for this statistical method (Field, 2018).

Reliability

The reliability of a structured questionnaire as a research instrument dictates the continuity and steadiness of the collected data (Taherdoost, 2021). The survey items' internal consistency was assessed using Cronbach's alpha, a commonly used metric, by conducting a pilot test with a subset of the target population to determine reliability (Field, 2020). Project initiation approaches' effects on KTRN's network infrastructure projects' performance were reliably inferred by the study's research instrument, which consistently shown high dependability.

Table 3: Reliability Analysis

Variable	Cronbach's Alpha	Comments
Scope Definition	0.742	Reliable
Project Performance	0.834	Reliable

Source: **Pilot data results**, (2025)

Results from the reliability analysis, shown in Table 3 demonstrate that all research variables are valid measures since they all meet the commonly used threshold of Cronbach's Alpha, which is 0.70. The following indicators are all considered to be within acceptable ranges by Tavakol and Dennick (2021): scope definition (0.742) and project performance (0.834). These findings suggest that the measuring tools employed to assess

these variables are trustworthy and consistent with one another. George and Mallery (2020) state that when all variables are consistently reliable, it strengthens the validity of the study and lends credence to using these measures to assess how project beginning procedures affect project performance.

Data Analysis

The data processing and analysis for this study was conducted using SPSS Version 25, which is widely recognized for its robust capabilities in statistical analysis (Field, 2018). The first steps involved coding, entering, and cleaning the data collected from the structured questionnaires administered to the target population of 117 respondents at Korean Telecommunication Rwanda Network (KTRN). Coding assigned numerical values to categorical responses, enabling efficient data entry and analysis. Following data entry, a thorough cleaning process ensured the accuracy of the dataset by identifying and rectifying any discrepancies, such as missing values or outliers, to enhance the reliability of the results (Pallant, 2020).

The analysis made use of both descriptive and inferential statistics. Summary statistics including percentages, means, and standard deviations were used to report the results. These statistics provide a picture of how project beginning procedures are thought to affect project performance. Conversely, inferential statistics was utilized to analyze relationships among variables through correlation and regression analyses, as well as ANOVA. Correlation analysis was particularly useful in measuring the strength and direction of associations between these variables, helping to determine whether effective project initiation practices contribute to improved project performance. This approach allows for generalizing findings beyond the sample, providing insights that can inform best practices in project management (Creswell & Creswell, 2018). By utilizing inferential statistical techniques, the study moves beyond mere description to establish patterns and potential causal links, offering empirical evidence to support strategic decision-making in the telecommunication sector (Saunders, Lewis, & Thornhill, 2019).

These analyses facilitated a deeper understanding of how scope definition, feasibility studies, team selection, and risk identification impact project outcomes (Hair, Anderson, Babin & Black, 2021). The findings were presented in clear and informative figures and tables, which helped in visualizing the results and making them easily interpretable for stakeholders:

$Y = \alpha + \beta_1 X_1 + \mu$…….……..…….. (Equation 2)

Y= Dependent variable – Project Performance as expressed, X_1 = Scope Definition, α (Alpha) represents the intercept or constant term in the equation, μ (Mu) represents the error term or residual,

In a regression model, β1, represent the coefficients of the independent variables X1 respectively. With all other factors held constant, these coefficients determine how much a one-unit change in the associated independent variable affects the dependent variable.

Ethical Consideration

The study adhered to rigorous ethical standards throughout the research process, beginning with formal access to research sites through written permission and clear communication of the study's purpose and benefits (Yin, 2021). Participants provided informed consent after receiving detailed explanations of the study's goals, methods, risks, and benefits, ensuring voluntary participation without coercion (Wiles, 2021; Bell et al., 2021; Clark-Kazak, 2021). Confidentiality and anonymity were strictly maintained by coding responses, removing identifiers, and securely storing data, while all intellectual property was respected and plagiarism avoided (Beskow et al., 2020; Allen & Wiles, 2022; Zhou & Niu, 2021). Data were securely stored for five years and then properly destroyed in compliance with data protection regulations (Knoppers & Chadwick, 2021). The researcher consistently demonstrated professionalism, cultural sensitivity, and ethical conduct to foster trust and credibility throughout the study (Onwuegbuzie & Frels, 2021).

RESULTS AND FINDINGS

Descriptive Results on Scope Definition

This section presents the descriptive results on scope definition, highlighting respondents' perspectives on its role in network infrastructure project performance. Table 4 summarizes their responses based on key statements related to scope definition. These findings help assess the extent to which scope definition influences project success and alignment with project objectives.

Table 4: Respondents views on Scope Definition

Statement on Scope Definition	SD	D	NS	A	SA	Mean	Std Dev.
The project objectives are clearly defined.	2.2%	1.1%	2.2%	34.8%	59.6%	4.48	.799
Project objectives align with stakeholder expectations.	0.0%	1.1%	1.1%	43.8%	53.9%	4.51	.586
The project objectives are realistic and achievable.	1.1%	4.5%	4.5%	30.3%	59.6%	4.43	.865
Deliverables are well-defined at the start of the project.	0.0%	1.1%	3.4%	28.1%	67.4%	4.62	.612
All stakeholders understand the project deliverables.	0.0%	0.0%	3.4%	46.1%	50.6%	4.47	.566
The project deliverables are measurable and quantifiable.	0.0%	1.1%	3.4%	36.0%	59.6%	4.54	.623
A work breakdown structure (WBS) is developed for the project.	0.0%	4.5%	3.4%	39.3%	52.8%	4.40	.765
The WBS adequately outlines all project tasks and activities.	0.0%	2.2%	4.5%	39.3%	53.9%	4.45	.691
The WBS is regularly updated to reflect project changes.	0.0%	5.6%	9.0%	40.4%	44.9%	4.25	.843

Source: **Primary data, (2025)**.

According to Table 4, most respondents had a favorable opinion of the project scope definition. With 59.6% of respondents strongly agreeing, the statement "The project objectives are clearly defined" had a mean score of 4.48. This shows that there is broad agreement that project success depends on project objectives being stated clearly from the beginning (Barroso, Gutiérrez & de la Fuente, 2021). Stakeholder satisfaction and the success of the project as a whole depend on the majority of respondents believing that the project objectives align with their expectations (Zhang & Wang, 2020).

The respondents also highly agreed that the project's goals are realistic and achievable, with an average score of 4.43 and 59.6% strongly agreeing. This is in line with project management best practices, which stress the significance of establishing realistic targets (Muller & Turner, 2021). The majority of respondents felt that the deliverables were clearly outlined at the beginning of the project, which is crucial in preventing scope creep, according to the mean score of 4.62 for the statement "Deliverables are well-defined at the start of the project," with 67.4% strongly agreeing (Morris & Pinto, 2020). Additionally, the item "All stakeholders understand the project deliverables" earned a mean score of 4.47, with 50.6% strongly agreeing. This indicates that stakeholders have a good understanding of the deliverables, which helps with alignment and clearer communication (Brown & Clark, 2022).

The respondents also had positive opinions about the project deliverables' measurability and quantifiability, as indicated by the mean score of 4.54. In order to track the success and advancement of a project, it is crucial to have measurable deliverables, and according to Kerzner (2021), 59.6% of respondents strongly agreed with this statement. When asked about the statement "A work breakdown structure (WBS) is developed for the project," 52.8% of respondents strongly agreed, and the average score was 4.40, suggesting that the WBS is a

commonly used method for defining and organising tasks (Wideman, 2021). With an average score of 4.45, the statement "The WBS adequately outlines all project tasks and activities" proves that the WBS is a helpful tool for project work organisation (Turner, 2020). Items such as "The WBS is regularly updated to reflect project changes" had slightly lower mean scores (4.25), indicating that, despite the WBS's frequent usage, updates might not happen as often as they should. This could lead to issues tracking changes throughout the project lifecycle (Harris & Kumar, 2020).

Descriptive Results on Project Performance

This section presents the descriptive results on project performance, focusing on respondents' views regarding the success and effectiveness of network infrastructure projects. Table 5 illustrates the distribution of responses to statements related to project performance, with participants rating their agreement. The mean and standard deviation values provide a quantitative assessment of the overall perception of project performance, revealing the level of consensus and variation among respondents. These results offer valuable insights into how participants perceive the outcomes of network infrastructure projects in Rwanda.

Table 5: Respondents Views on Project Performance

Statement on Project Performance	SD	D	NS	A	SA	Mean	Std Dev.
Projects are completed on schedule.	2.2%	1.1%	6.7%	34.8%	55.1%	4.39	.848
The completion rate of projects meets expectations.	1.1%	0.0%	19.1%	23.6%	56.2%	4.34	.865
Delays in project completion are minimal.	0.0%	1.1%	4.5%	29.2%	65.2%	4.58	.636
Projects are completed within the allocated budget.	0.0%	0.0%	4.5%	27.0%	68.5%	4.64	.569
Budget overruns are infrequent.	0.0%	1.1%	10.1%	28.1%	60.7%	4.48	.725
Financial resources are managed effectively throughout the project.	1.1%	0.0%	6.7%	28.1%	64.0%	4.54	.724
The quality of project deliverables meets industry standards.	0.0%	0.0%	10.1%	34.8%	55.1%	4.45	.674
Quality assurance processes are effectively implemented during the project.	2.2%	1.1%	5.6%	25.8%	65.2%	4.51	.841
Stakeholder satisfaction with the quality of the project outcomes is high.	0.0%	0.0%	15.7%	20.2%	64.0%	4.48	.755

Source: **Primary data, (2025)**.

In terms of quality, financial management, and project completion, respondents generally perceive high levels of performance, according to Table 4.16. To be more specific, 55.1% of people who took the survey strongly agreed that projects are finished on time, giving the average score 4.39. This suggests that most projects are finished on time (Kerzner, 2020). In a similar vein, Morris and Pinto (2020) found that on the statement "The completion rate of projects meets expectations," 56.2% of respondents strongly agreed, leading to an average score of 4.34. With a mean score of 4.58 and 65.2% of respondents strongly agreeing, Pinto (2021) indicates that project completion delays are negligible. It appears that projects rarely experience setbacks. This is further corroborated by the discovery that "Projects are completed within the allocated budget" received an even higher mean score of 4.64, with 68.5% firmly agreeing (Turner, 2021). Based on the data, it appears that financial management is effective, as budget overruns are uncommon (4.48 mean score, 60.7% strongly concur) during project execution (Smith & Patton, 2021).

In terms of quality, respondents indicate that the majority of projects adhere to industry standards, with a mean score of 4.45 for the statement "The quality of project deliverables meets industry standards" (Müller, 2020). The implementation of quality assurance processes was also positively evaluated, with 65.2% of respondents firmly agreeing, resulting in a mean score of 4.51, which suggests that quality assurance practices

are successfully integrated throughout the project lifecycle (Kerzner, 2020). Furthermore, the level of satisfaction among stakeholders regarding the quality of project outcomes was notably high, as indicated by the statement "Stakeholder satisfaction with the quality of the project outcomes is high," which recorded a mean of 4.48 and 64.0% of respondents strongly agreeing. This suggests a general contentment among stakeholders with the project deliverables (Morris & Pinto, 2020). These results underscore the significant correlation between stakeholder expectations and project execution, with a particular emphasis on the importance of effective budget management, scheduling, and quality assurance.

Regression results for Scope Definition

The regression analysis for Scope Definition indicates a moderate to strong positive relationship between scope definition and project performance, with an R value of 0.675, suggesting that improvements in scope definition are associated with better project outcomes. The model explains approximately 45.5% of the variance in project performance ($R^2 = 0.455$), with an adjusted R^2 of 0.449, indicating that the model is robust and accounts for most of the explained variance while adjusting for sample size. The relatively low standard error of 0.25474 reflects a good fit of the model to the observed data, implying that the predicted values are close to actual performance outcomes. These findings align with recent studies emphasizing that clearly defined project scope significantly enhances project efficiency, reduces delays, and improves resource allocation in infrastructure projects (Mugisha & Kim, 2023; Park & Lee, 2022).

Table 6: Model summary for Scope Definition

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.675[a]	.455	.449	.25474

a. Predictors: (Constant), Scope Definition

Source: **Primary data**, (2025).

The ANOVA results for the regression model indicate that scope definition significantly predicts project performance ($F(1, 87) = 72.692$, $p < 0.001$). The regression sum of squares (4.717) compared to the residual sum of squares (5.645) shows that a substantial portion of the variation in project performance is explained by scope definition. The highly significant p-value (0.000) confirms that the relationship between scope definition and project performance is statistically meaningful, implying that clearer and well-defined project scope leads to better project outcomes. This supports prior research emphasizing that precise scope definition minimizes scope creep, enhances resource allocation, and improves overall project efficiency in infrastructure projects (Mugisha & Kim, 2023; Park & Lee, 2022).

Table 7: ANOVA results for Scope Definition

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	4.717	1	4.717	72.692	.000[b]
	Residual	5.645	87	.065		
	Total	10.362	88			

a. Dependent Variable: Project Performance
b. Predictors: (Constant), Scope Definition

Source: **Primary data**, (2025).

The regression coefficient results show that scope definition has a positive and statistically significant effect on project performance ($\beta = 0.765$, $t = 8.526$, $p < 0.001$). This indicates that for every one-unit increase in scope definition, project performance is expected to increase by 0.765 units, holding other factors constant. The constant term (1.035, $p = 0.012$) suggests a baseline level of project performance even when scope

definition is zero. These results confirm that clear and well-defined project scope is a strong predictor of improved outcomes in network infrastructure projects, aligning with recent studies that highlight the importance of precise scope management in enhancing project efficiency, minimizing delays, and optimizing resource utilization (Mugisha & Kim, 2023; Park & Lee, 2022).

Table 8: Coefficient results for Risk Reduction

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.035	.402		2.578	.012
	Scope Definition	.765	.090	.675	8.526	.000

a. Dependent variable: Project Performance

Source: **Primary data**, (2025).

Discussion of the Findings – Scope definition and Project Performance

The findings of this study indicate that scope definition plays a critical role in enhancing the performance of network infrastructure projects. The regression analysis revealed a strong positive relationship between scope definition and project performance ($\beta = 0.765$, $p < 0.001$), with the model explaining approximately 45.5% of the variance in performance outcomes. This suggests that projects with clearly defined objectives, deliverables, timelines, and resources are more likely to achieve their intended outcomes efficiently. The statistical significance of the results aligns with prior research, which emphasizes that well-structured scope definition minimizes ambiguity, reduces the risk of scope creep, and ensures that resources are allocated appropriately (Mugisha & Kim, 2023; Park & Lee, 2022). Consequently, clarity in project scope establishes a foundation for effective planning, coordination, and monitoring, all of which are essential for the successful execution of complex network infrastructure projects.

Furthermore, the ANOVA results ($F(1, 87) = 72.692$, $p < 0.001$) underscore that scope definition is a significant predictor of project performance. This implies that even small improvements in defining the project scope can lead to measurable enhancements in project outcomes, including adherence to timelines, budget compliance, and quality of deliverables. The findings highlight the practical importance of engaging stakeholders early in the project lifecycle, documenting requirements comprehensively, and maintaining a structured change management process to handle modifications systematically. By ensuring that the project scope is well-defined and managed, organizations like the Korean Telecommunication Rwanda Network Project can optimize operational efficiency, enhance stakeholder satisfaction, and reduce the likelihood of delays and cost overruns, reinforcing the strategic value of meticulous scope management in infrastructure development (Mugisha & Kim, 2023; Park & Lee, 2022).

CONCLUSIONS AND RECOMMENDATIONS

A project's success hinges on the precision and completeness of its scope description. To avoid confusion and the possibility of scope creep, it is important to have a clearly defined scope that everyone involved in the project can understand. Project teams are better able to stay focused on critical goals when they have a well-defined scope that allows them to operate with clear expectations and prevents unnecessary deviations. Determining the project's scope at the outset and reviewing it multiple times during its execution is crucial for making the most of available resources. This acts as a roadmap for the project. This study's findings support the idea that well-defined project scope improves efficiency, which in turn leads to meeting deadlines and staying within budget, two critical performance metrics

The success or failure of a project is heavily dependent on how its scope is defined. In order to avoid confusion and provide a solid groundwork for carrying out the project, it is important that the project scope be clearly specified. By establishing specific objectives, deliverables, and boundaries, scope definition ensures

that all stakeholders are aligned, minimizing misunderstandings and preventing scope creep. As a result, projects with clear scope definitions are more likely to remain on track, meet their targets, and deliver outcomes on time and within budget. Proper scope management is not only about outlining initial goals but also involves continuous monitoring and refinement to address any changes or emerging requirements, ensuring sustained project performance throughout its lifecycle.

Suggestions for Further Studies

Future research should look into the impact of more granular project management elements on project performance, focusing on specific industries or project types. For example, researching how different industries, such as construction, IT, and healthcare, use scope definition, feasibility studies, team selection, and risk assessment could provide insights into industry-specific best practices. Furthermore, researchers could investigate the impact of cultural and organizational elements on project performance. Understanding how organizational culture, leadership styles, and team dynamics interact with standard project management features may reveal new techniques for improving project outcomes, especially in cross-functional or multinational teams.

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