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RESOURCE PLANNING PRACTICES AND PERFORMANCE OF TELECOMMUNICATION COMPANIES' FIBRE OPTIC CONNECTIVITY PROJECTS IN KENYA

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ABSTRACT

In Kenya, telecommunication companies have heavily invested in fibre optic connectivity projects. However, these projects only cover 17% of the country. Because of this, a study has been carried out to focus on the impact of resource planning on project performance. The research objectives were to assess the effects of resource budgeting and material planning on project performance. The performance of the project was measured through cost performance, timely delivery, productivity of workers and quality of the network. The study drew on the Resource-Based View (RBV), Systems Theory, Human Capital Theory (HCT) and Theory of Constraints (TOC). Further, the study adopted a pragmatic philosophy, cross-sectional descriptive survey design, and quantitative approach. Researchers gathered data from 117 project managers from 166 telecommunication companies involved in deploying fibre optic using structured questionnaires with a response rate of 79.5 per cent and analysed the data through descriptive and inferential statistics (SPSS v30.0). In this study, it was found that material planning influenced project performance the most since it had the highest coefficient ($\beta = .676$, $p = .008$), followed by resource budgeting ($\beta = .284$, $p = .001$). The study concludes that robust resource planning enhances cost, time, and quality outcomes, though external and internal limitations persist. Recommendations include adopting advanced budgeting tools, centralized scheduling systems, enhanced workforce training, and optimized material management, alongside policy support to mitigate financial and regulatory barriers.

Key Words: Resource Planning Practices, Telecommunication Companies, Fibre Optic Connectivity, Resource Budgeting, Material Planning, Project Performance

Background of the Study

Fibre optic is now considered one of the most important areas to focus on in regards to telecommunications organizations and internet service providers (ISP). Technology has advanced to the extent that communication systems today rely on fibre optic networks to facilitate the provision of broadband services to homes and businesses (Olwal et al., 2016). Cook (2019) stated that the actualization of fibre optic networks requires tremendous efforts in properly addressing the issues of resources and project management. Nyarko-Boateng et al. (2020) highlighted one of the areas that have a huge impact on the establishment of fibre optic infrastructure, which include lack of adequate planning for resources. This presents a challenge for the telecommunication companies and internet providers in the different parts of the world as it hinders project running.

Statement of the Problem

The fast development of fibre optic infrastructure is an issue for many parts of the African continent, but currently, Kenya only has 17% fibre coverage in the country (Ministry of Information, Communications and The Digital Economy, 2023). Despite such investment, the coverage remains limited (CAK, 2018). Sub-optimal resource planning and allocation hinder the execution of fibre expansion projects in Kenya. With this approach, there has beena problem of delay, increased costs, and low benefits (Nyarko-Boateng et al., 2020). These challenges suggest inefficiencies in resource planning practices, which are essential for aligning human, financial, and material resources with project objectives (Lemlem & Moronge, 2017). Poor project performance not only strains organizational resources but also limits access to reliable connectivity, particularly in underserved regions, perpetuating economic and social disparities (Kiminza & Were, 2016).

Evidence indicates that there is a dearth of literature on how specific resource planning approaches couldenhance fibre optic deployment performance in the telecommunications sector of Kenya (Ngugi, 2023; Rukumba, 2021). Most studies have attempted to relate resource planning practice and project performance (Saade & Nijher, 2016; Park & Yi, 2021), but have not addressed the issues telecommunication firms face in the Kenyan situation. Moreover, most studies have been conducted in developed countries or different sectors (Lemlem & Moronge, 2017), thus showing a contextual gap in literature. As noted by Lemlem and Moronge (2017), this gap calls for research focused on resource planning within Kenyan internet infrastructure. Therefore, this study sought to bridge this gap in scientific knowledge by assessing the influence of resource planning practices on the performance of telecommunication companies' fibre optic connectivity projects in Kenya.

Objectives of the Study

The general objective of this study is to determine the influence of Resource Planning Practices on the Performance of Telecommunication Companies' Fibre Optic Connectivity Projects in Kenya.

Specific Objectives

i. To assess the influence of Resource Budgeting on the Performance of Telecommunication Companies' Fibre Optic Connectivity Projects in Kenya.
ii. To assess the influence of Material Resource planning on the Performance of Telecommunication Companies' Fibre Optic Connectivity Projects in Kenya.

Theoretical Background

Resource-based view (RBV)

RBV was first introduced by Wernerfelt (1984) and later developed by Barney (1991) as a strategic management concept. The RBV aims to explain how a firm's internal resources and core competencies can be a source of sustainable competitive advantage and superior performance (Wernerfelt, 1984; Jugdev & Mathur, 2013). Under this theory, firms are clearly differentiated entities having a special array of resources, which not only includes tangible assets, for example financial resources, physical infrastructure but also intangible assets like brand reputation, intellectual property and capabilities like organizational processes, skills,and knowledge. The RBV stresses that not all resources contribute equally to competitive advantage generation and requisite stability. In his work, Porter (1991) says that suchresources must be valuable, rare, impossible to imitate, and non-substitutable to bring a firmlong-term competitive advantage. While these strategic resources may not be easily replaceable, there are other resources that could give the same benefits.

Nevertheless, the RBV has been criticized, despite its many contributions to project management. However, some researchers claim that the focus of RBV on internal resources sidelines the significance of external factors and industry dynamics (Porter, 1991). Further critics have accused it for being static and not talking much about how resources can be obtained, developed and deployed over time (Priem & Butler, 2001). Furthermore, the theory

suffers from issues in operationalization and measurement of critical constructs such as resource value, rareness, and inimitability (Kraaijenbrink et al., 2010).

In the context of this study, the RBV theory emphasizes the importance of a firm's internal resources and capabilities in achieving a competitive advantage. Resource budgeting, which involves allocating financial resources effectively based on project requirements, is a critical internal process that can directly impact project performance. In short, RBV is significant asit provides a theoretical paradigm to understand how resource planning practice contribute towards successful fibre optic deployment projects among telecommunication companies. The initial research objective aims at investigating resource planning practice and processesused in fibre network connectivity projects. According to RBV effective resource planning practice i.e., resource allocation; scheduling; cross-functional coordination; and optimizationtechniques are valuable, rare, inimitable (VRIN) resources that improve project performanceresulting into sustainable competitive advantage for telecommunication firms (Killen et al., 2012; Park & Yi 2021). Moreover, these investments made by telecommunications organizations right away bring about specific operational capabilities set through which theyspecialize their resources. These capabilities can thus serve to ensure efficient utilization of resources and help the companies change according to new project and help them coordinatewell (Doloi, 2013). Hence, organizations with better resource planning techniques surpass atmaximum efficiency, finish in time, quality, cost, risk mitigation, and other factors (Park & Yi, 2021).

Moreover, the RBV can determine the role of resource planning in telecommunication as a source of the industry's competitive advantage. As fibre optic deployment projects are becoming more sophisticated and complicated over time, companies that consistently prove their proficiency in low-resource setting operationally certainly clinchs a larger share of the market (Killen et al., 2012).

Theory of Constraints (TOC)

The Theory of Constraints (TOC) was coined by Dr. Eliyahu M. Goldratt in 1984 (Goldratt & Cox, 2016). The main goal of this theory is to help organizations in recognizing and addressing constraints/limiting factor that act as a barrier to organizational performance and efficiency. TOC identifies the constraints of the system or the process that often hinder the quality and capacity of the system (Stelson et al., 2017). The theory includes three interrelated concepts: performance evaluation procedures, transportation coverage, and formal reasoning (Gupta & Andersen, 2018). It lays down a five-step improvement cycle where the first step is the identification of system constraints, the second is to exploit the constraint found, the third is to use the constraint to make everything else subservient, fourth is to raise the level of the constraint, and the fifth is to find a new constraint after the previous one has been taken to the highest possible level. According to Watson et al. (2007), TOC simplifies the systems in which it is used, and does not provide a good way of handling the dynamic nature of constraints for which it is applied. However, some scholars say that TOC has not been verified empirically beyond any doubt and is not applicable to all conditions and contexts (Gupta & Andersen, 2018).

In the context of the objective of determining the influence of material resource planning on the Performance of telecommunication companies' fibre optic connectivity projects in Kenya,the TOC provides a relevant framework for understanding how material resource constraintscan impact project performance. Material resource management entails the procurement, distribution, and use of essential materials and equipment that are required in the practice of fibre optic connectivity (Pritchard & Pritchard 2019). Applying TOC principles in telecommunication companies, fibre optic connectivity projects can learn about the material constraint that become bottlenecks in delivery. Such key constraining factors may include the availability of particular materials, the capacity of certain equipment, or even the effectiveness of the supply chain motion. The constraints that are once identified, organizations can then manage to fully utilize them by optimizing their usage, give priority and subordinate other usages to ensure that the constraint is not fully utilized to the maximum (Stelson et al., 2017).

Furthermore, TOC dictates a systematic elevation of the material constraints which have been identified. These may involve buying more of the items, improving the purchasing, or coming up with ways of finding better substitutes for the materials or equipment (Pritchard & Pritchard, 2019). Thus, telecommunication companies can still regularly look for and address material constrains in order to improve on the fibre optic connectivity projects in terms of costs, quality and time for the project's completion. In fact, the TOC has a broader concept as a useful structure for comprehending and directing MRP of fibre optic connectivity projects. Overcoming the challenges surrounding material constraints can be a best practice that enhances the operation of a telecommunication company and the actualization of its strategic goals to the greatest possible degree.

Conceptual Framework

The conceptual framework for this study illustrates the relationship between resource planning practices and the performance of fibre optic connectivity projects. The independent variable in this study is resource planning practices. The dependent variable, project performance.

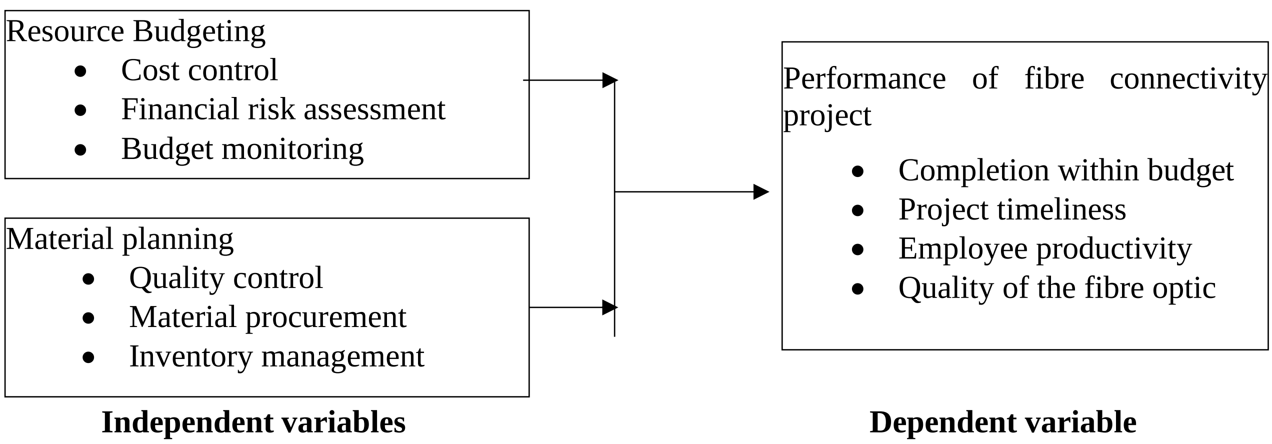

Figure 1: Conceptual Framework: Source: (Author, 2024).

Empirical Literature

Resource Planning Practice and Performance of Fibre Network ConnectivityProjects

Resource planning is an important aspect of fibre network connectivity project because it involves the systematic identification of available resources; the procurement of resources; the distribution of resources; and the consumption of resources by the project (cited by Saade & Nijher, 2016). In this regard, Nangithia (2010) pointed out that resource planning principles were, in this regard, considered crucial in managing a project by ensuring that the right skilled people were provided with the right tools and resources. It helps an organization not to waste resources, time and other important factors by eliminating the need for specific services to be produced while making the process more effective and efficient (Olwal et al., 2016). It can be seen in several major categories: Human resource planning, financial resource management, material resource planning and technology resource planning (Ochieng, 2014; Lemlem & Moronge, 2017; Olwal et al., 2016). Altogether, these practices form a coherent framework for effective resource management and immediately affect outcomes of fibre optic infrastructure initiatives.

Performance on the other hand is a broad concept that covers elements like effectiveness, efficiency, quality, and timeliness (Lemlem & Moronge, 2017). In relation to the fibre optic infrastructure projects, performance tries to get into the depth to which projects achieve theirset objectives in terms of connecting people, providing high-speed connectivity, and reliability while operating within the set resources and deadlines. Mueni et al. (2011), arguethat it is through performance that the organization can realize success and a competitive advantage in the market. Measuring performance is an important tool for evaluating the success of fibre optic infrastructure projects. Several metrics and Key Performance Indicators(KPIs) may be used to measure performance based on the specific project goals andobjectives (Cheruiyot, Omwenga, & Mwalili, 2023). Among the conventional metrics in theassessment of the performance of fibre network projects is network coverage and reach, datatransmission speed and capacity, reliability and uptime of the network, among others, and financial measures such as return on investment (ROI) and cost efficiency (Kiminza & Were, 2016). Regular monitoring and analyses of performance indicators can help organizations gauge the effectiveness of resource planning practices and make informed decisions to optimize project results.

Resource planning practices are pivotal in determining the success of fibre optic connectivity projects in Kenya, as they ensure optimal allocation and utilization of critical resources. Lemlem and Moronge (2017) pointed out that where there is good resource planning that is budgeting, scheduling, and human capital, the project would turn out better. According to Nyarko-Boateng et al. (2020), their study investigated Liquid Telecom Kenya and revealed that systematic allocation of resources reduces cost overruns and improves adherence to timelines. This has important implications for Kenya’s telecommunication sector, where only 17% of the country is covered by fibre networks. Also, Ochieng (2014) found that having strong resource planning in the telecommunication companies in Kenya made the project efficient by reducing wasting of the resource and coordinating with stakeholders. However, Ngugi (2023) notes that regulatory delays and poor technology systems adoption remain challenges for Kenya’s telecoms players which need to be addressed through integrated resource planning to mitigate external constraints like vandalism and power dips. Implementing sophisticated tools such as ERP systems, recommended by Saade and Nijher (2016), can assist telecommunication companies in monitoring their resources in real-time, boosting ROI and network reliability. The findings also confirm the Resource-Based View, which states that resource planning helps gain competitive advantage in Kenya’s telecommunication environment. The various studies presented indicate that resource planning practices have much influence on the success of fibre network connectivity projects.

Budgeting Processes and Performance of Fibre Network Connectivity Projects

The implementation of effective and efficient budgeting strategies is vital for effective delivery of fibre network connectivity projects in the telecommunications industry. Lemlem and Moronge (2017) in their study sought to determine factors that enhance the effectiveness of fibre optic projects in Kenya with special reference to Liquid Telecom Kenya. This is in line with their study that found that governmental support, technological advancement, and resource planning practices influenced the probability of successful project completion significantly. Nevertheless, they failed to consider how the above budgeting processes can help in improving project outcomes.

Nyarkó-Boateng et al. (2020) examined the challenges of fibre optic in developing countries taken specifically in Ghana. They highlighted such factors as infrastructure, regulation and skills as some of the challenges likely to frustrate the deployment of fibre optics. While they noted that the resource planning which involves budgeting was essential to overcoming these challenges, they failed to present information on the various budgeting practices that telecommunication can apply to combating these hitches. Besides that, Saade and Nijher (2016) looked at critical success factors for the utilization of enterprise resource planning, which may be employed for the processes of budgeting in the field of fibre optic projects. It emphasized that top management support, clear goal setting, communication, training, and education are necessary for successful ERP implementation. However, this is completely different from the fibre optic deployment context, and thus, the application of their findings to the telecommunication industry is limited.

In summary, the budgeting process is the most vital component in the financial success of fibre optic connectivity project in Kenya because of the high infrastructure costs, which affect the viability of the project (Nyarko-Boateng et al., 2020). Kiminza and Were (2016) found that accurate cost estimation and financial tracking in fibre projects in Nairobi prevent budget overruns, improving cost performance. Lemlem and Moronge (2017) further observe that the budgeting process which takes the form of structured financial planning along with policy incentives enables firms including Liquid Telecom Kenya to fund the projects within limits. According to Saade and Nijher (2016), applying ERP systems will enable the firm to track its budgets in real-time just as supported the Resource-Based View focusing on the internal abilities (Barney, 1991). According to Ngugi (2023) however, financial constraints and regulatory delays remain a nightmare that requires risk assessments. Oteri et al. (2015) states that firms can enhance resource allocation as well as network coverage and cost efficiency by prioritizing investments based on ROI. In Kenya, designing detailed budgets to balance quality and affordability of fibre connectivity is critical for enhancing project performance and meeting the needs of stakeholders with low-cost solutions.

Material Planning and Performance of Fibre Network Connectivity Projects

Evaluating material planning and management is an essential aspect of effective implementation and performance of the fibre network connectivity project that telecommunication companies undertake. Kiminza and Were (2016) sought to establish the factors that affect implementation of fibre optic cable projects in Nairobi City County-Kenya. On this front, they pointed at financial investment as one of the most crucial areas. Though the study did not offer a direct coverage on material planning, financial investment cannot be separated from procurement and acquisition of materials that are crucial in laying fibre optic cables. The authors stated that infrastructure for fibre optic cable entail financial for employees' remuneration and raw materials, tools and processes needed for the implementation of the fibre optic cable projects. This, therefore, suggests that the accessibility and handling of materials, like the fibre optic cables, networks parts and construction materials can affect how these projects are embarked on and their effectiveness. Besides that, Ngugi (2023) studied the critical success factors and performance of fibre optic infrastructureprojects by the Information and Communication Technology Authority, Kenya, did not focuson material planning practices, it highlighted the contribution of project financing to projectperformance. Good project financing strategies can indirectly enhance the acquisition and management of materials required in the fibre optic infrastructure project.

According to the studies, material planning is critical to the success of project execution of fibre optic connectivity in Kenya. According to Ngugi (2023), Kenya's ICT Authority undertakes strategic procurement and inventory management in order to mitigate supply chain disruptions. This is in line with the Theory of Constraints that stresses on resolving material bottlenecks (Goldratt & Cox, 2016). Choosing the right supplier plays an important role in ensuring proper supply and reliability of materials for the network. Kiminza and Were (2016) note how this is especially the case for Nairobi's fibre projects. Nyarko-Boateng et al. (2020) state that the high prices of materials and logistics difficulties can hinder planning and this requires strong techniques such as MRP as Pritchard and Pritchard (2019) proposed. By implementing tight quality control as noted by Stelson et al. (2017), the firm will maintain high standard material which helps in network durability. In essence, telecommunication companies can ensure that their projects adhere to quality, cost, and timing by optimizing logistics and supplier partnerships, which helps in the execution of Kenya's digital inclusion and economic development goals.

RESEARCH METHODOLOGY

In this research, the cross-sectionaldescriptive survey was used as a research design. This enabled the researcher to derive knowledge from data collected at one point in time. According to Wang and Cheng(2020), cross-sectional survey is an observer's approach of collecting data and making conclusions about a specific population at one moment. the target population in this study are the project managers in telecommunication companies across Kenya as they are directly responsible for the planning, execution, and monitoring of fibre optic projects. Specifically, the study focuses on 166 telecommunication companies that have undertaken fibre optic network deployment projects. This represents the entire sector in performance and operational conditions. In this study, the unit of observation was the individual respondent, specifically project managers, network engineers, financial officers, and technical staff involved in fibre optic connectivity projects across the sampled companies (Safaricom, Liquid Telecom Kenya, Telkom Kenya, ICT Authority). A total of 117 respondents were surveyed and interviewed, as determined by the Yamane (1967) formula. The unit of analysis, however, was the fibre optic connectivity project within each telecommunication company.

The study employed a two-stage stratified random sampling strategy to gather data. The first stage involved stratifying the telecommunication companies based on their geographical regions to ensure proportional representation of each region in Kenya. In the second stage, random assignment of project managers involved in fibre optic deployment projects was done within each stratum. Sample size was calculated using Yamane formula for finite populations. Primary data collection for this study was mainly conducted through the use of a self-administered structured questionnaire. The Statistical Package for the Social Sciences version 30.0.0 and Excel spreadsheets facilitated data entry. The data was analyzed first using descriptive statistics, followed by inferential statistics. Descriptive statistics tools help in measuring the central tendency. The tests used are the ones that are based on the inferential statistics methods, such as regression analysis.

RESEARCH FINDINGS AND DISCUSSIONS

A total of 117 project managers from telecommunication companies in Kenya were sampled for the study. The respondents that were selected were given questionnaires and those that were returned were checked for accuracy and completeness. 93 questionnaires out of the 117 that were sent were found valid and reliable that could be used for further analysis and reporting. This means that 79.5% of people responded. A response rate of 50% and above is adequate for statistical reporting (Mugenda & Mugenda, 2003). Thus, sufficient for the study.

Descriptive Analysis

The findings regarding the Likert scale questions related to the deployment of fibre optic projects that the participants were asked are presented in this section. The scale used is as follows; 1-strongly disagree, 2-disagree, 3-neutral, 4-agree and 5-strongly agree. The results were analyzed using descriptive statistics to determine the average and the standard deviation. The findings provide empirical insights into how these practices shape project success in Kenya's telecommunications sector.

Resource Budgeting

Effective resource budgeting is critical for managing financial resources in fibre optic projects, ensuring cost efficiency and alignment with strategic goals.

Table 1: Descriptive statistics on resource budgeting

	Mean	Std. Deviation
The company has a well-defined budgeting process for fibre optic connectivity projects.	4.247	0.8927
The company conducts thorough cost estimation and analysis for each project.	4.247	0.9167
The company allocates financial resources effectively based on project requirements.	4.333	0.7421
The company uses specialized software tools for budgeting and financial management.	3.86	1.1189
The company regularly monitors and controls project costs to ensure adherence to the budget.	4.226	0.768
The company conducts financial risk assessments to identify and mitigate potential budgetary issues.	4.097	0.9448
The company prioritizes investments based on their potential return on investment (ROI) and alignment with strategic objectives.	4.088	0.9024

Table 1 lists seven statements on resource budgeting, with sample sizes of 91–93 respondents. Mean scores range from 3.86 to 4.333, and standard deviations vary from 0.7421 to 1.1189. The highest mean (4.333) is for effective allocation, while the lowest (3.86) is for software tool usage.

The results in Table 1 demonstrate a robust perception of resource budgeting practices among respondents, with the highest mean score of 4.333 (SD = 0.7421) for effective allocation of financial resources indicating a strong capability to align budgets with project needs, a key tenet of the Resource-Based View (RBV) theory which emphasizes resource allocation as a source of competitive advantage (Barney, 1991). High scores for a well-defined budgeting process and cost estimation (both M = 4.247) suggest structured financial planning, crucial for preventing cost overruns in fibre optic projects (Saade & Nijher, 2016), while regular monitoring (M = 4.226, SD = 0.768) and risk assessments (M = 4.097, SD = 0.9448) reflect proactive cost management, enhancing budget adherence in Kenya's resource-constrained context (Nyarko-Boateng et al., 2020). Prioritizing investments based on ROI (M = 4.088, SD = 0.9024) aligns resources with strategic goals, supporting long-term project success (Lemlem & Moronge, 2017). However, the lower mean of 3.86 (SD = 1.1189) for software tools highlights inconsistent adoption, possibly due to cost or skill barriers (Olwal et al., 2016), indicating a gap that could affect budgeting precision. Overall, these findings confirm that resource budgeting significantly influences project performance by optimizing cost efficiency, aligning with Objective 1 and offering insights for improving technological integration in Kenyan telecom firms (Park & Yi, 2021).

Material Planning

Material planning manages physical resources like cables and equipment for project success.

Table 2: Descriptive statistics on material planning

	Mean	Std. Deviation
The company employs effective material requirements planning (MRP) techniques to determine the quantity and timing of material needs.	3.871	1.0553
The company has a well-established inventory management system to ensure the availability of materials while minimizing holding costs.	3.871	1.0025
The company adopts strategic procurement and sourcing strategies to secure materials at the best price and quality.	4.075	1.0134
The company conducts thorough supplier selection and evaluation processes to ensure reliable and capable material suppliers	3.957	1.0206
The company implements strict material quality control and inspection procedures to maintain high standards.	3.989	0.955
The company effectively manages lead times to ensure timely arrival of materials and prevent project delays.	3.978	0.9543
The company has proper material storage and handling practices in place to protect material quality and minimize waste.	4.097	0.9676
The company develops comprehensive logistics and transportation plans to ensure efficient material movement to project sites.	3.88	1.0571

Table 2 includes eight statements on material planning, with sample sizes of 91–93. Means range from 3.871 to 4.097, with standard deviations between 0.9543 and 1.0571. Storage and handling scores highest (4.097), while MRP and inventory tie for lowest (3.871).

Table 2 shows positive views on material planning, with the highest mean of 4.097 (SD = 0.9676) for storage and handling reflecting practices that protect quality, aligning with the Theory of Constraints (TOC) focus on constraint management (Goldratt & Cox, 2016). Strategic procurement (M = 4.075, SD = 1.0134) balances cost and quality, enhancing cost efficiency (Kiminza & Were, 2016), while quality control (M = 3.989, SD = 0.955) and lead time management (M = 3.978, SD = 0.9543) support network reliability and timeliness (Ngugi, 2023). Supplier selection (M = 3.957, SD = 1.0206) mitigates supply risks (Nyarko-Boateng et al., 2020), but lower MRP and inventory scores (M = 3.871, SD = 1.0553 and 1.0025) indicate planning weaknesses, potentially delaying projects (Olwal et al., 2016). Logistics (M = 3.88, SD = 1.0571) shows variability due to infrastructure issues (Pritchard & Pritchard, 2019). For Objective 4, material planning bolsters quality and cost, with MRP as a key improvement area (Park & Yi, 2021).

Completion within Budget

Completion within budget measures cost performance success.

Table 3: Descriptive statistics on completion within budget

	Mean	Std. Deviation
Projects are completed within the planned schedule	3.57	1.0774
Milestones are achieved as per the project timeline.	3.681	1.0422
Critical path activities are managed effectively to avoid delays.	3.772	1.0175
Resource availability is ensured to maintain the project timeline.	3.946	0.9182
Potential risks to the project timeline are proactively identified and mitigated.	3.685	0.9937
Changes to the project scope are managed to minimize impact on the timeline.	3.839	1.0559
Regular progress reviews are conducted to keep the project on track.	3.892	0.9941

Table 3 lists seven statements on budget completion, with sample sizes of 91–93. Means range from 3.72 to 3.914, with standard deviations from 0.9351 to 1.0771. Cost monitoring scores highest (3.914), while completion scores lowest (3.72).

Table 3 indicates moderate success in budget adherence, with the highest mean of 3.914 (SD = 0.9516) for cost monitoring reflecting proactive financial control, a strength tied to budgeting practices (Saade & Nijher, 2016). Risk management (M = 3.871, SD = 0.9351) and optimized procurement (M = 3.839, SD = 0.9923) support cost efficiency (Lemlem & Moronge, 2017), while cost estimation (M = 3.796, SD = 1.0168) and overrun identification (M = 3.736, SD = 0.9642) suggest reasonable planning (Park & Yi, 2021). Cost-saving efforts (M = 3.753, SD = 0.9742) show initiative, but the lowest mean of 3.72 (SD = 1.0771) for completion within budget highlights challenges, possibly due to external financial constraints in Kenya (Nyarko-Boateng et al., 2020). This ties to Objective 1, showing budgeting's critical role in cost performance, with room to address completion gaps (Kiminza & Were, 2016).

Project Timeliness

Project timeliness assesses adherence to schedules, a key performance metric.

Table 4: Descriptive statistics on project timeliness

	Mean	Std. Deviation
Projects are completed within the approved budget	3.72	1.0771
Accurate cost estimation techniques are used to develop project budgets.	3.796	1.0168
Cost performance is regularly monitored and controlled.	3.914	0.9516
Potential cost overruns are proactively identified and addressed.	3.736	0.9642
Cost-saving opportunities are explored and implemented where feasible.	3.753	0.9742
Procurement processes are optimized to ensure cost-effectiveness.	3.839	0.9923
Financial risks are assessed and managed throughout the project lifecycle.	3.871	0.9351

Table 4 includes seven statements on timeliness, with sample sizes of 91–93. Means range from 3.57 to 3.946, with standard deviations from 0.9182 to 1.0774. Resource availability scores highest (3.946), while completion scores lowest (3.57).

Table 4 shows varied success in timeliness, with the highest mean of 3.946 (SD = 0.9182) for resource availability highlighting its role in meeting schedules, consistent with Systems Theory's resource interdependencies (Von Bertalanffy, 1968). Progress reviews (M = 3.892, SD = 0.9941) and scope management (M = 3.839, SD = 1.0559) support timely execution (Ballesteros-Pérez et al., 2019), while critical path management (M = 3.772, SD = 1.0175) and risk mitigation (M = 3.685, SD = 0.9937) show moderate effectiveness (Jafari & Rodchua, 2014). Milestone achievement (M = 3.681, SD = 1.0422) and the lowest completion score (M = 3.57, SD = 1.0774) indicate delays, possibly due to external factors like permits (Kiminza & Were, 2016). This relates to Objective 2, affirming coordination's impact on timeliness, with delays suggesting external challenges (Olwal et al., 2016).

Employee Productivity

Employee productivity measures workforce efficiency and contribution to project goals.

Table 5: Descriptive statistics on employee productivity

	Mean	Std. Deviation
Employees demonstrate high levels of productivity and efficiency in their project roles.	4.054	0.9182
Project team members consistently meet or exceed their performance targets and objectives.	4.022	0.9205
Employees actively contribute ideas and suggestions for process improvements and innovation.	4.022	0.9086
Team members collaborate effectively and support each other to achieve project goals.	4.108	0.9379
Employees maintain a positive attitude and high morale throughout the project lifecycle.	4.12	0.8751
The company provides a conducive work environment that promotes employee productivity and well-being.	4.054	0.8517
Regular training and development opportunities are provided to enhance employee skills and productivity.	4.022	0.9323
The company recognizes and rewards employees for their exceptional productivity and contributions to the project's success.	3.817	1.1028

Table 5 lists eight statements on productivity, with sample sizes of 92–93. Means range from 3.817 to 4.12, with standard deviations from 0.8517 to 1.1028. Morale scores highest (4.12), while recognition scores lowest (3.817).

Table 5 reflects high productivity, with the top mean of 4.12 (SD = 0.8751) for morale indicating a motivated workforce, aligning with HCT's view that human capital drives performance (Becker, 2009). Collaboration (M = 4.108, SD = 0.9379), productivity (M = 4.054, SD = 0.9182), and work environment (M = 4.054, SD = 0.8517) enhance efficiency (Rukumba, 2021), while training (M = 4.022, SD = 0.9323), target achievement (M = 4.022, SD = 0.9205), and innovation (M = 4.022, SD = 0.9086) support quality (Ayentimi et al., 2018). The lowest mean of 3.817 (SD = 1.1028) for recognition suggests a gap in motivation, potentially affecting retention (Mueni et al., 2021).

Quality of the Fibre Optic

Quality of fibre optic networks assesses technical performance and reliability.

Table 6: Descriptive statistics on quality of fibre optic

	Mean	Std. Deviation
Fibre optic networks meet performance standards.	4.075	1.0346
Quality assurance processes are implemented to ensure conformance to specifications.	4.054	0.9368
Quality control measures are applied to identify and rectify defects.	4.065	0.9302
Strict quality criteria are adhered to during installation and commissioning.	4.129	0.8499
Network performance is regularly monitored and optimized.	4.152	0.8508
Preventive maintenance is conducted to ensure network reliability.	4.161	0.9474
Continuous improvement initiatives are implemented to enhance network quality.	4.065	0.9759

Table 6 includes seven statements on quality, with sample sizes of 92–93. Means range from 4.054 to 4.161, with standard deviations from 0.8499 to 1.0346. Maintenance scores highest (4.161), while assurance scores lowest (4.054).

Table 6 shows strong quality perceptions, with the highest mean of 4.161 (SD = 0.9474) for preventive maintenance emphasizing reliability, aligning with TOC's focus on elevating constraints like material quality (Goldratt & Cox, 2016). Monitoring (M = 4.152, SD = 0.8508) and installation criteria (M = 4.129, SD = 0.8499) ensure performance standards (Ngugi, 2023), while quality control (M = 4.065, SD = 0.9302) and improvement (M = 4.065, SD = 0.9759) maintain consistency (Pritchard & Pritchard, 2019). Standards (M = 4.075, SD = 1.0346) and assurance (M = 4.054, SD = 0.9368) reinforce network uptime, vital for customer satisfaction (Lemlem & Moronge, 2017). Tied to Objective 4, material planning drives quality, ensuring fibre optic reliability in Kenya (Kiminza & Were, 2016).

Regression Analysis

The beta coefficients reveal the individual contributions and significance of each predictor to project performance, providing detailed insights into their relative impacts.

Table 7: Beta coefficients

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	.693	.355		1.953	.000
	Resource Budgeting	.335	.129	.284	2.592	.001
	Material Planning	.605	.079	.676	7.656	.008

a. Dependent Variable: Performance of Fibre Connectivity Projects

From the results on Table 7, the regression model was fitted as follows;

$$Y = 0.693 + 0.335(\text{Resource Budgeting}) + 0.605(\text{Material Planning}) + \varepsilon.$$

Table 7 provides a nuanced view of how each resource planning practice influences fibre optic project performance, with all predictors showing statistical significance, reinforcing their individual and collective roles in achieving the study's objectives. Material planning's unstandardized coefficient of .605 (SE = .079, t = 7.656, p = .008) and standardized Beta of .676 indicate it has the strongest impact, suggesting that a one-unit increase in material planning effectiveness raises project performance by .605 units, a finding tied to Objective 4 and the Theory of Constraints (TOC), where managing material constraints like availability and quality is pivotal (Goldratt & Cox, 2016). This aligns with Ngugi (2023), who emphasized material reliability for network quality, and explains its high Beta (.676), reflecting its critical role in cost and quality outcomes (Pritchard & Pritchard, 2019). Resource budgeting's coefficient of .335 (SE = .129, t = 2.592, p = .001, Beta = .284) supports Objective 1, showing a significant effect on cost efficiency per RBV theory (Barney, 1991), consistent with Lemlem and Moronge (2017), who linked budgeting to project success in Kenya.

Discussion of Findings

The findings suggest that structured budgeting processes enhance cost performance, which explains an additional R^2 of .605. Accurate budgeting helps in averting cost overruns which is significant in the high-cost telecommunication sector of Kenya (Kiminza & Were, 2016). According to Lemlem and Moronge (2017), budgeting supported by policy ensures that fibre projects are financially viable. This shows that firms like Safaricom benefit from estimating and monitoring costs. Financial resources are a competitive advantage a company may have (Barney, 1991). Even though Ngugi (2023) found financial constraints, companies which use ERP systems to account for budgets (Saade & Nijher, 2016) are likely to achieve higher ROI. This implies that sound budgeting can provide telecommunication companies with the funds to realise quality but at an affordable price since only 17% of Kenyans have fibre connection (Nyarko-Boateng et al., 2020). This ensures that projects are completed on time and stakeholders are satisfied, thus facilitating the digital disruption in Kenya.

The significant role of material planning in project performance of a project means that the effectiveness of procurement and inventory is such that project performance is enhanced. Ngugi (2023) established that Kenya's ICT Authority undertakes strategic planning for material procurement to minimize disruption to the supply chain in accordance with the Theory of Constraints (Goldratt & Cox, 2016). Kiminza and Were (2016) says choosing a reliable supplier will result in quality materials used in the network hence their durability. Thus, it can be inferred that strong MRP techniques (Pritchard & Pritchard, 2019) and quality control (Stelson et al., 2017) tend to help in reducing delays and costs which are critical in Kenya's resource-constrained environment (Nyarko-Boateng et al., 2020) Companies that prioritize partnering with suppliers and optimizing logistics are likely to use delivery time on projects and increase coverage and connectivity of fibres. This approach contributes to Kenya's digital inclusion goals through proper infrastructure deployment.

Conclusion

The study concludes that resource planning practices—resource budgeting and material planning—collectively and individually enhance the performance of fibre optic connectivity projects in Kenya's telecommunication sector. Material planning exerts the most substantial influence, underscoring the critical role of physical resource management in achieving quality and cost efficiency, as per TOC. Resource budgeting drives cost performance, aligning with RBV.

Recommendations

Telecommunication companies should invest in specialized budgeting software to improve precision and real-time cost monitoring, addressing the technological gap (M = 3.86). Training staff on tools like ERP systems, as suggested by Saade and Nijher (2016), can enhance budgeting efficiency, reducing cost overruns and aligning with RBV's focus on capability development (Barney, 1991).

Firms should enhance MRP and inventory management (M = 3.871) through strategic supplier partnerships and quality control investments, mitigating supply risks (Pritchard & Pritchard, 2019). Leveraging TOC, companies can prioritize bottleneck resolution, ensuring material availability and network reliability (Goldratt & Cox, 2016; Ngugi, 2023).

Policymakers should provide incentives like tax breaks or subsidies to alleviate budget constraints, while companies explore public-private partnerships to secure funding, as suggested by Oteri et al. (2015). Robust contingency planning can mitigate external risks like weather or vandalism (Ngugi, 2023).

Implications for Further Study

In the future, researchers could examine how government policies or stakeholder involvement might have influenced resource planning performance. Longitudinal studies could also look at the long-term effect resource planning practices have on network sustainability as the current study was a cross-sectional study. Examining similar comparative study across other developing countries. For example, Nyarko-Boateng et al. (2020) done in Ghana will confirm generalizability of findings beyond fibre coverage of 17% in Kenya. In addition, qualitative studies could explore context-specific issues such as skills shortage or funding constraints to complement the quantitative outcomes of this study.

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