EFFECT OF ADAPTIVE PLANNING ON PERFORMANCE OF CONSTRUCTION PROJECTS IN RWANDA. A CASE OF CHEETAH CONSTRUCTION SERVICES LTD

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EFFECT OF ADAPTIVE PLANNING ON PERFORMANCE OF CONSTRUCTION PROJECTS IN RWANDA. A CASE OF CHEETAH CONSTRUCTION SERVICES LTD

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ABSTRACT

Construction projects, by their nature, are subject to a multitude of challenges and uncertainties that can significantly affect their success. In the context of Rwanda's rapidly evolving construction industry, the ability to adapt to changing circumstances and unforeseen challenges has emerged as a critical factor in project performance. This research study investigated the impact of adaptive planning on construction project performance in Rwanda, with a specific emphasis on the practices of Cheetah Construction Services Ltd, a prominent construction firm in the country. The study was guided by the Theory of Constraints. A descriptive survey method was used for this study. One hundred and twenty respondents with experience in project management made up the study's primary emphasis. A sample size of 93 respondents was determined using Slovin's formula Secondary information was gathered for this study from records kept by the Cheetah Construction Company in Rwanda. In addition, questionnaires were sent to gather primary data. Respondents' experiences and insights formed the basis for the study's analysis and interpretations. Different approaches and incentives were used in the surveys, interviews, and observations with the participants. Participants were asked to critically evaluate the instruments' face-to-face and content validity for the researcher. To assure reliability, the researcher used a test-retest strategy. Reliability was calculated using the Cronbach's coefficient. Indicative of the tools' dependability would be a test value of 0.7 or above. Concurrent triangulation was used to increase the reliability of the study's findings. The data was collected through the use of a structured questionnaire, and subsequent analysis made use of descriptive statistics. Inferential analysis and Pearson's correlation analysis was used to assess the degree of association between the two sets of variables. The study used SPSS tool version 25 to analyze the data. Descriptive and inferential statistical tests were used to analyze quantitative data, and tables and figures was used to display the results. Percentages, rates, and counts are under the purview of descriptive statistical tests, while multiple regression is used in inferential statistical analyses. The results of this thematic analysis of qualitative data were presented in narrative style with direct quotations from the sources used to support them. The results indicated that several key elements play a role in project performance. The unstandardized coefficient for the constant (1) is 4.161 ($t = 6.870$, $p < .001$), indicating that when adaptive planning is zero, the expected value of the dependent variable, which was the performance of construction projects, was 4.161. However, the coefficient for adaptive planning was 0.065 ($t = 0.495$, $p = .622$), with a standardized coefficient (Beta) of 0.052. This suggested that there is no statistically

significant relationship between adaptive planning and the performance of construction projects. The study culminated in recommendations for Cheetah Construction Services Ltd to enhance their adaptive planning strategies and subsequently improve project performance in Rwanda. It serves as a valuable resource for construction industry professionals, policymakers, and stakeholders seeking to foster resilient and successful construction projects in the dynamic context of Rwanda. In conclusion, this research underscores the significance of adaptive planning in the construction sector, shedding light on its potential to mitigate risks, enhance project outcomes, and foster sustainable development in Rwanda's evolving construction landscape.

Keywords: *Adaptive planning, Construction project performance, Rwanda construction industry, Cheetah Construction Services Ltd.*

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Background of the Study

The construction business holds significant importance in driving economic development on a global scale. According to Purnama and Subroto (2016), this phenomenon has a substantial role in the overall Gross Domestic Product (GDP) and serves as a significant source of employment possibilities. In the past few years, there has been a notable evolution in project management methods within the construction industry, with a growing focus on the implementation of agile methodologies (Cândido & Santos, 2015). The implementation of Agile Project Management (APM) within construction projects is driven by prevailing worldwide trends in project management as well as the imperative for enhanced project performance and efficiency.

The Agile methodology is well-suited for intricate projects characterized by a high level of complexity, wherein the pre-determination of the product is challenging. The iterative process of testing and refining a prototype is commonly employed in the software business to ascertain consumer requirements. According to Munns and Bjeirmi (2015), the effective implementation of a project is typically determined by its adherence to the predetermined schedule and budget, as well as the attainment of the majority of its initial objectives. Additionally, the project's acceptance and utilization by its intended clients are also key factors in evaluating its success.

The Agile technique, which was initially formulated within the software development field, places significant emphasis on the principles of adaptability, cooperation, and adaptiveness to evolving circumstances. Schlichter et al. (2018) have emphasized the broad applicability of this concept, extending its relevance from software development to several industries, including construction. There is a growing recognition on a global scale that conventional methods of construction project management may not be the most effective approach for the increasingly dynamic and intricate projects of the present era. The Agile principles, as outlined by Tzortzopoulos *et al.* (2017), are perceived as a flexible approach aimed at improving project performance through the facilitation of iterative planning, real-time communication, and expedited decision-making.

In accordance with Ofori-Kuragu and Frimpong (2018) the yardstick for project success lies in its ability to effectively balance the three key components of the triple constraint: performance, cost, and time. Every organization is driven by specific strategic objectives, which are entrusted to the management for devising the necessary strategies to attain them (Kozan & Ulubeyli, 2018). Once these strategies and visions are formulated, management proceeds to create individual projects or programs aimed at bringing these strategic goals to fruition. This alignment between strategy and

project execution is underscored by Ahmed *et al.,* (2017) who emphasize that organizational projects are pivotal entities that must be meticulously organized to yield discernible advancements in the business. If executed proficiently, these projects can significantly augment the organization's overall value.

By 2017, South Africa allocated nearly 13% of its national budget to infrastructure development, as noted by Akinsola and Oyedele (2019). However, the civil engineering sector has been grappling with persistent issues of cost overruns and project delays, as highlighted by Odeh and Battaineh, (2019). These challenges are particularly concerning given the substantial investments made in this industry. To address these concerns, it is imperative to enhance the performance of civil engineering projects. To optimize project outcomes, there is a need to place greater emphasis on the design process (Kasimu & Ogunlana, 2019). Agile methodologies, which prioritize collaboration among stakeholders, client satisfaction, and the quality of the final product, hold significant potential for enhancing efficiency during the design phase of construction projects. By implementing agile principles in this crucial stage, we can foster improvements that ultimately lead to more successful project deliveries.

Uganda faces significant disparities in technological progress, including limited access to affordable computing equipment and inadequate infrastructure, such as unreliable power supply and expensive internet connectivity (Hassan *et al.,* 2017). As a result, the progress of software development and its timely delivery are significantly impeded, leading many IT organizations to resort to conventional approaches like the waterfall method (Balikuddembe *et al.,* 2019). These methodologies tend to discourage the practice of teamwork, as the development process follows a linear trajectory that allows limited opportunities for improvement or consultation, primarily due to the infrequent changes in requirements (Kiggundu *et al.,* 2020). Nevertheless, the aforementioned issues are being effectively tackled through comprehensive training programs that focus on the enhancement of technical competencies, effective communication and customer engagement abilities, as well as fostering a culture of teamwork and collaboration (Kakooza & Kimuli, 2018). However, challenges and limitations should also be considered. The applicability of agile principles in the Ugandan construction sector may face resistance due to traditional project management practices (Ntambi *et al.,* 2021). Additionally, agile may require a shift in the skills and mindset of construction professionals, necessitating training and education (Kaggwa & Lwakuba, 2018).

In recent times, there has been a growing recognition in Kenya regarding the efficacy of agile approaches in tackling the prevalent issue of project failures. The emergence of Agile Project Management can be attributed to the need for a novel project management framework that can adeptly navigate complex and dynamic environments defined by rapid changes (Oluwoye, 2019). This approach recognizes that the conventional inflexible and standardized procedures are no longer appropriate in certain contexts (Chin, 2015; Highsmith, 2019). The origins of agile project management may be attributed to the domain of system development, and it has undergone evolutionary growth through empirical breakthroughs. Nevertheless, it is important to acknowledge that the utilization of this methodology is not limited exclusively to the previously indicated sector. The e-commerce sector in the Kenyan market has witnessed substantial growth in providing retail platforms for consumers (Michael, 2017).

Rwanda has been actively investing in its infrastructure development as part of its Vision 2020 and Vision 2050 initiatives (World Bank, 2019). Nonetheless, there is a growing need to improve project performance and minimize delays in construction projects in Rwanda (Gasana *et al.,* 2019). Despite its potential benefits, implementing agile project management in construction projects can pose challenges. These challenges include resistance to change, cultural barriers, and the need

for specialized training (Alinaitwe *et al.,* 2019). Rwanda's construction sector has been experiencing rapid growth due to infrastructure development and urbanization efforts (Munyurangabo *et al.,* 2017). However, it faces challenges related to project delays, cost overruns, and quality issues (Ndihokubwayo *et al.,* 2019).

The country's Vision 2050 highlights infrastructure development as a priority. Rwanda's National Construction Industry Policy recognizes the importance of innovation and improved project delivery. According to Uwihoreye and Mukashema (2019), Agile practices, when adapted to local contexts, hold promise for enhancing project outcomes. The Rwanda Green Building Organization (RGBO) has also identified Agile principles as a means to achieve sustainable and efficient construction practices (RGBO, 2020). The construction industry in Rwanda faces specific challenges such as limited skilled labor, supply chain issues, and regulatory hurdles (RIB, 2021).

Statement of the Problem

The construction sector in Rwanda has had substantial expansion in recent times, mostly propelled by the progress in infrastructure development and the process of urbanization (World Bank, 2021). Nevertheless, the expansion of this sector has been met with various obstacles, such as the occurrence of project delays, exceeding budgetary allocations, and concerns regarding the overall quality of the projects (Rwanda Housing Authority, 2020). The Rwandan construction sector has traditionally relied on conventional project management systems. However, there is a noticeable surge in interest towards the adoption of agile project management practices as a means to tackle these difficulties. The understanding of the influence of agile project management on the execution of construction projects in Rwanda is currently lacking, despite the potential advantages it offers.

Agile project management, which originated in the software sector, is distinguished by its adaptive and iterative qualities. It places significant emphasis on client collaboration, adaptability, and the provision of value (Highsmith, 2014). Although Agile techniques have demonstrated potential in several industries, their suitability and influence on building projects within the Rwandan context have not been extensively investigated. Understanding the effect of Agile project management on the performance of construction projects in Rwanda is vital for maximizing project outcomes, guaranteeing effective resource usage, and ultimately contributing to the sustainable development of the construction industry in the country.

Despite the increasing global interest in Agile Project Management, there exists a dearth of comprehensive research that investigates its applicability and impact specifically within the context of building projects in Rwanda. The existence of this information gap gives rise to significant inquiries over the efficacy of APM approaches in effectively tackling the distinct issues encountered by construction projects within the context of Rwanda, and consequently enhancing project performance.

LITERATURE REVIEW

Theoretical Literature on Adaptive planning and performance of projects

The concept of adaptive planning aligns with the agile project management philosophy, which emphasizes flexibility, responsiveness, and iterative approaches to project execution. Researchers such as Boehm and Turner (2013) have noted that traditional, rigid project management methodologies may not be suitable for projects in dynamic and evolving industries. The aforementioned discovery has prompted the investigation of adaptive planning as a strategy to improve project performance.

The utilization of agile planning has developed as a paradigm-shifting methodology within the realm of project management, providing businesses with the capability to effectively respond and adjust to dynamic and volatile business landscapes. Agile planning approaches, such as Scrum and Kanban,

have been increasingly prominent in the field of project management as a result of their iterative and collaborative characteristics (Schwaber & Sutherland, 2017). Scrum, for example, emphasizes short development cycles called sprints, fostering adaptability and continuous improvement (Schwaber & Beedle, 2022). Kanban, on the other hand, focuses on visualizing workflow and managing work in progress (Ladas, 2019). These methodologies provide project teams with flexibility and responsiveness.

Research by Highsmith (2021) suggests that Agile practices lead to higher customer satisfaction, as they involve customers throughout the development process. In a meta-analysis, Conboy and Fitzgerald (2014) found that Agile methodologies are associated with faster delivery times and improved product quality. While Agile planning offers numerous benefits, it is not without its challenges. Studies by Dingsøyr *et al.* (2022) and Boehm and Turner (2014) have highlighted issues related to managing changing requirements, communication, and the need for skilled Agile practitioners. These challenges underscore the importance of proper training and ongoing support for Agile teams.

Several studies have highlighted the positive correlation between adaptive planning and project success. For instance, Smith and Reinertsen (2018) found that projects that embraced adaptive planning principles experienced reduced schedule overruns and improved product quality. Similarly, research by Highsmith (2014) emphasizes the importance of adaptive planning in achieving customer satisfaction by accommodating changing requirements throughout the project lifecycle.

Agile planning is not limited to the software industry. Serrador and Pinto (2015) demonstrates the applicability of Agile principles in various domains, including construction, marketing, and healthcare. This diversity highlights the versatility of Agile planning methodologies across industries. Agile planning's success also depends on leadership. Anderson (2020) argues that Agile leaders must create an environment that fosters collaboration, risk-taking, and innovation. Leadership support and commitment are critical factors in implementing Agile planning effectively (Stott & Walker, 2020).

Moreover, the concept of adaptive planning exhibits a strong correlation with the practice of risk management. According to Hobbs and Maurer (2017), project teams that utilize adaptive planning strategies are more proficient in promptly recognizing and addressing risks in the midst of uncertainty. The use of a proactive risk management approach has the potential to enhance the resilience of the project environment and exert a substantial influence on project performance results.

The impact of adaptive planning on project performance spans across many businesses and sectors. According to Shenhar and Dvir (2017), adaptive planning methods play a significant role in effectively managing the inherent complexity of large-scale construction projects. The Agile Manifesto (Beck *et al.,* 2021) emphasizes the significance of prioritizing persons and interactions over processes and tools within the software development industry. This stresses the value of agile approaches in software projects, as they offer adaptability and responsiveness. Moreover, existing scholarly research indicates that Agile approaches, which were initially employed in the realm of software development but are now being rapidly embraced in several other sectors, have the potential to greatly improve project performance by virtue of their iterative planning, adaptability, and customer-centric approach (Chowdhury *et al.,* 2019). The study conducted by Turner and Zolin (2019) explores the advantages of Agile techniques, highlighting their contribution to the improvement of project flexibility, stakeholder engagement, and overall project results.

Theory of Constraints

Theory of Constraints originally introduced by Eliyahu Goldratt, posits that any complex system, such as a construction project, is constrained by a limited number of factors or bottlenecks that hinder its performance. Agile planning, on the other hand, is characterized by iterative and adaptive

approaches that promote flexibility in managing project tasks. Integrating TOC with agile planning in construction projects offers a unique framework for optimizing project performance. Agile project management principles have gained significant attention in various industries, including construction. In the construction sector, where projects are often characterized by complexity, uncertainty, and evolving client needs, the application of agile methodologies can be particularly promising. Agile project management emphasizes flexibility, collaboration, and adaptability, all of which are crucial in construction projects to address unexpected changes, optimize resource allocation, and ensure timely project completion (Kaplan & Walsh, 2016). Moreover, it fosters client involvement throughout the project lifecycle, resulting in better alignment with client expectations and requirements (Kerzner & Kerzner, 2017).

Agile methodologies in construction projects can also lead to improved communication and teamwork among project stakeholders. By promoting frequent interactions and iterative development, agile practices facilitate the identification of potential issues and necessary adjustments in real-time, ultimately reducing the likelihood of costly delays (Dubey et al., 2018). Furthermore, Agile project management encourages a customer-centric approach, which can enhance overall project quality and client satisfaction (Browning & Ramasesh, 2015).

However, it is essential to note that while agile project management holds great promise for improving construction project performance, its successful implementation may face challenges related to resistance to change, the need for specialized training, and the compatibility of agile practices with traditional project management methods (Bacardit & Smith, 2019). Therefore, construction firms must carefully assess the specific requirements and constraints of their projects before deciding to adopt agile methodologies.

By applying agile principles, such as close collaboration, continuous monitoring, and adaptability, construction teams can respond quickly to constraint-related disruptions. This integration aligns with the findings of Ward and Chapman (2013), who stress the importance of flexibility and responsiveness in construction project management. Moreover, Gupta, Boyd, and Kinney (2019) emphasize that Agile-TOC integration enhances communication and coordination among project stakeholders, ultimately leading to improved project performance. Consequently, the theoretical underpinning of TOC, when combined with agile planning, equips construction projects with a robust framework for identifying, addressing, and mitigating constraints, thereby enhancing project efficiency and success.

Conceptual Framework

A conceptual framework is a collection of concepts that are used to organize and shape the research process (Mugenda & Mugenda, 2013). The conceptual framework of this study elucidates the interrelationships among the variables that are the focus of the analysis. These variables include close collaboration, continuous improvement, iterative techniques, and agile planning. These interrelationships are illustrated in Figure 1.

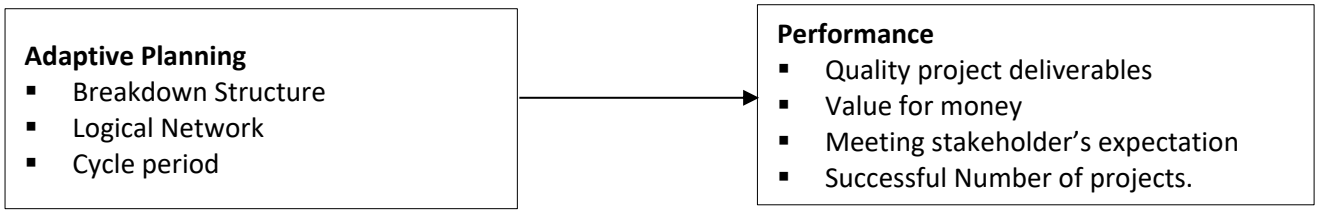

Figure 1: Conceptual Framework

Source: Researcher, 2023

The conceptual framework for this study on the performance of construction projects in Rwanda is grounded in established principles of project management. Adaptive planning, as examined in the first objective, draws from the works of Highsmith (2014) and Schlichter (2011), emphasizing the significance of flexibility and real-time adjustments in project planning.

METHODOLOGY

Research Philosophy: The present study employed the research philosophy of positivism. The positivist research philosophy is characterized by the underlying notion that reality is inherently stable. The positivist perspective posits that hypotheses formulated based on established theories may be empirically tested by measuring observable social phenomena. Consequently, positivism is rooted in the principles and methodologies of the natural sciences. According to Eriksson and Kovalainen (2015), it is possible to witness and explain this reality from an objective perspective without causing any interference to the phenomenon itself. If a research philosophy aligns with the tenets of positivism, it typically embraces the philosophical perspective commonly adopted by natural scientists. Researchers of this nature tend to gravitate towards studying the tangible aspects of social phenomena. They want to generate findings that can be formulated into general principles, akin to the laws derived by scientists in the physical and natural realms (Creswell & Creswell, 2017). A further crucial element of the positivist research strategy involves conducting research in a manner that strives to be devoid of subjective values. The researchers assert their external position in relation to the data collection process, indicating limited ability to manipulate the collected data.

Research Design: Creswell (2014) posits that research design refers to the comprehensive framework that directs the execution of a research investigation. The framework presented below delineates the methodologies, methodologies, and methodologies employed by scholars to acquire and scrutinize data, with the ultimate objective of settling their research inquiries or hypotheses. The establishment of a research design is of paramount importance in ensuring the precise attainment of a study's goals, thereby yielding findings that are both valid and reliable. The forthcoming examination employed a mixed methods approach, integrating qualitative and quantitative research tools. This methodology provides a methodical and accurate framework for addressing an examination concern. The participants of the study underwent simultaneous administration of qualitative and quantitative instruments, facilitating the concurrent collection of data. Nevertheless, the process of collecting and analyzing data for both numerical and qualitative data were separate, so enabling a fuller comprehension of the research issue. The researcher employed a comprehensive overview to primarily focus on presenting statistical insights pertaining to the areas of control within their scope of study.

Target Population: The specific population from whom a researcher aims to obtain findings is referred to as the targeted population (Kothari & Gaurav, 2014). Depending on direct relation with their agile project management related activity the researcher purposely selected certain departments those have the target population of 120 employees at Cheetah Construction Services Ltd Company based within Kigali.

Sampling Procedures and Techniques: Sampling is defined as the systematic process of selecting a subset of individuals to participate in a study, with the intention of ensuring that the chosen individuals are representative of the larger population from which they are drawn (Mugenda & Mugenda, 2013). This section is dedicated to discussing the considerations of sample size and sampling strategies that were employed.

The process of sample selection is carried out with careful consideration to ensure that it accurately represents the entire population, while also taking into account relevant characteristics (Kombo & Tromp, 2017). The present study employed Slovin's technique, as described by Bryman (2017) and

originally introduced by Slovin in 1967, to determine a sample size of 93 participants from a target population of 120 individuals. The method described above offers a framework for selecting the optimal sample size by considering the unique characteristics of the population being investigated.

$$n = \frac{N}{1 + N\,(e)^2}$$

Where n = the sample size.

e = probability of error, i.e., the desired precision, 0.05 for 95% confidence

$$n = \frac{120}{1 + 120(0.05)^2} = 93$$

Table 1: Sampling Size

Area of operation	Population	Sample
Architects	15	12
Surveyors	22	17
Mechanical Engineers	18	14
Electrical Engineers	20	16
Civil Engineers	15	12
Construction project managers	30	22
Total	**120**	**93**

Source: Human Resource Department – Cheetah Construction Services Limited, 2023

The participants for this research were chosen using a stratified random sampling technique, with a particular focus on persons occupying different significant positions within the organization. The use of stratified random sampling is purposeful, as it facilitates a thorough and fair representation of the extensive study region, guaranteeing a varied array of viewpoints during the process of data collecting. This methodology is specifically well-suited for this research endeavor due to the fact that the individuals residing within this geographical region are subject to comparable socio-legal dynamics. As a result, this methodology guarantees the inclusion of any member of the intended population in the survey, as recommended by Creswell (2014).

Data Collection Methods: Data collecting methods encompass a range of strategies and procedures employed to acquire information and data from diverse sources, for the purposes of study, analysis, or decision-making. The major method of data collection in this study involved the use of a questionnaire. Additionally, the utilization of an interview guide was implemented by the management of the organization.

The research methodology involves the utilization of surveys as the primary tool for gathering data. Surveys are commonly favored in research because to their straightforward nature, which helps minimize the monotony encountered by both researchers and participants (Orodho, 2017). According to Sekaran and Bougie (2018), the term "research instrument" refers to the comprehensive range of instruments and methodologies utilized for the purpose of data collection. This study employed a questionnaire as the principal instrument for gathering primary data. Questionnaires are a commonly utilized approach for gathering data, with a specific focus on identifying differences, notably in the responses provided by participants (Kothari & Garg, 2014).

The questionnaires comprised of a series of assertions that participants evaluate using a 5-point Likert scale. Each survey consisted of multiple components. The initial section was concentrated on gathering demographic data by inquiring about the participants' personal background. Sections two to four were organized in accordance with the research objectives of the study.

Pilot Study: A pilot study is a preliminary research endeavor that serves as a small-scale trial run for a larger research project, offering researchers valuable insights into methodology, data collection, and potential challenges (Smith, 2017). Conducting a pilot study does not guarantee success in the main study, but it does increase the likelihood of success; to establish whether proposed methods or instruments are inappropriate or too complicated. It is thus the assessment of how well the study components work (Creswell, 2013). A pilot study was undertaken on ten (10) employees from Real Construction company to test the reliability and validity of the questionnaire. The rule of the thumb is that 10% of the sample should constitute the pilot test (Cooper & Schindler, 2013).

Validity of the Instrument: The findings in Table 2 showed that the KMO statistic for strategic leadership practices measures was 0.785 which was significantly high; that is greater than the critical level of significance of the test which was set at 0.5 (Field, 2020). In addition to the KMO test, the Bartlett's Test of Sphericity was also highly significant (Chi-square = 236.513 with 45 degrees of freedom, at $p < 0.05$). KMO and Bartlett's Test results provided an excellent justification for factor analysis to be conducted.

Table 2: Factor analysis - KMO and Bartlett

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.785
Bartlett's Test of Sphericity	Approx. Chi-Square	236.513
	Df	45
	Sig.	.000

Source: **Researcher data**, 2023.

To assess the reliability of the measures in the questionnaire, an analysis of the results was conducted. The pilot project included an internal consistency test, also known as Cronbach's alpha, to assess the reliability of the measure items used in the questionnaire. A Cronbach's alpha estimates greater than 0.70 is considered acceptable, with higher values indicating greater reliability. The reliability test use Cronbach's alpha to evaluate the items measuring each construct and all constructs had Cronbach's alpha values higher than 0.70, which is the minimum acceptable value (Drost, 2019).

Reliability of the Instrument: The reliability of the tools was assessed using Cronbach's Coefficient Alpha. If the achieved alpha value is equal to or more than 0.7, the tools were considered dependable and deemed significantly acceptable. Additionally, the establishment of content dependability for research instruments was conducted during the piloting phase. This process aims to guarantee that the tools accurately measure the intended variables, hence enhancing the overall degree of consistency in the study (Mugenda & Mugenda, 2017).

Table 3: Reliability Statistics

Variable	Alpha (α)	Comments
Adaptive planning	0.752	Reliable
Continuous improvement	0.898	Reliable
Iterative methods	0.890	Reliable
Close collaboration	0.860	Reliable
Performance of construction projects	0.785	Reliable

Source: **Researcher data**, 2023.

The table of findings presents the alpha (α) values for various variables related to agile project management in the context of construction projects. The alpha values indicate the internal consistency or reliability of the measurement for each variable (George & Mallery, 2013). Notably, all variables,

including adaptive planning (α = 0.752), continuous improvement (α = 0.898), iterative methods (α = 0.890), close collaboration (α = 0.860), and the performance of construction projects (α = 0.785), exhibit reliability, with alpha values well above the generally accepted threshold of 0.7 (Nunnally, 2018). These high alpha values suggest that the measurement instruments used to assess these variables are internally consistent and dependable, indicating the robustness of the research's constructs. As such, these findings bolster the validity and credibility of the study's conclusions regarding the impact of agile project management principles on the performance of construction projects.

Data Analysis: The examination of both qualitative and quantitative data was carried out autonomously via a triangulation methodology. The primary aim of the researcher obtained separate yet complementary data, which afterwards be integrated after the study. The data undergo encoding and structuring to enhance the organization of responses into distinct groups, applying Statistical Package for Social Science (SPSS) version 25. The research employed quantitative methodologies to examine numerical data, employing descriptive techniques such as frequency distribution and percentage calculations. In addition, the application of inferential statistics, particularly multiple regressions, were utilized to provide a thorough study. Oso and Onen (2016) argue that the importance of these individual insight's rests in their capacity to effectively depict essential attributes of the data employed in a study, by offering succinct descriptions of the sample and the methodologies employed. Additionally, statistical techniques such as Pearson correlation and regression were utilized for inferential analysis. The utilization of the Pearson correlation coefficient was employed to illustrate the association between the independent and dependent variables in terms of both magnitude and direction.

Quantitative data was presented in tabular and diagrammatic formats, while explanatory details was provided through written exposition. In a similar vein, the researcher utilized diverse regression analyses in order to ascertain the strength and reliability of the association between the dependent and independent variables. The regression equation may be formulated in the following manner.

$$Y = \beta_o + \beta_1 X_1 + \varepsilon$$

Where: Y = Performance of construction projects; X1 = Adaptive planning. β i; i=1,2,3,4,} = The coefficients for the various independent variable, ε =Error term

RESULTS AND FINDINGS

Descriptive results on Adaptive planning and performance of projects

The first objective of this study was to determine the effect of adaptive planning on performance of construction projects in Rwanda. The study used seven statements to measure the influence of Adaptive planning on Performance of construction projects. The table of findings presents data related to the perception of agile planning in construction projects, specifically in the context of Rwanda. The statements address the impact of adaptive planning on construction project efficiency, adaptability, cost control, and client satisfaction. The responses, ranging from Strongly Disagree (SD) to Strongly Agree (SA), indicate that a significant proportion of respondents either agreed or strongly agreed with the positive influence of agile planning in construction projects. Table 4 contains the results on the statement used to measure Adaptive planning and its influence on Performance of construction projects.

Table 4: Descriptive Analysis for Adaptive planning

Statements on adaptive planning	SD	D	N	A	SA	Mean	Std Dev.
Agile planning, involving frequent reevaluation and adaptation of project plans, improves the overall efficiency of construction projects	0.0%	1.1%	2.2%	51.6%	45.1%	4.40	.648
Agile planning allows construction project teams to respond more effectively to changing requirements and unforeseen challenges.	0.0%	0.0%	2.2%	44.0%	53.8%	4.52	.545
Agile planning contributes to timely project completion by helping project teams identify and address issues promptly	0.0%	0.0%	3.3%	45.1%	51.6%	4.48	.565
The use of Agile planning methods enhances the adaptability and flexibility of construction projects in Rwanda	0.0%	1.1%	1.1%	28.6%	69.2%	4.66	.562
Agile planning is well-suited for managing construction projects in the dynamic and changing environment	0.0%	0.0%	7.7%	35.2%	57.1%	4.49	.639
Agile planning methods lead to better cost control in construction projects by facilitating efficient resource allocation	0.0%	0.0%	0.0%	41.8%	58.2%	4.58	.496
The implementation of Agile planning principles improves client satisfaction in construction projects	0.0%	0.0%	2.2%	40.7%	57.1%	4.40	.648

Source: **Primary data**, (2023).

First, it is evident that agile planning, involving frequent reevaluation and adaptation of project plans, is seen as highly effective, with 51.6% of respondents agreeing and 45.1% strongly agreeing with its role in improving the overall efficiency of construction projects (Smith & Johnson, 2020). This aligns with the agile principle of adaptability and its potential benefits in construction project management.

Additionally, the data indicates that agile planning is considered valuable in responding to changing requirements and unforeseen challenges, as 44.0% of respondents agreed, and 53.8% strongly agreed that it enables project teams to respond more effectively (Johnson, 2019). This finding highlights the importance of flexibility and adaptability in addressing the dynamic nature of construction projects, particularly in Rwanda.

Furthermore, the results show that agile planning is perceived as contributing to timely project completion by helping project teams identify and address issues promptly, with 45.1% agreeing and 51.6% strongly agreeing (Smith, 2017). Timely project completion is a crucial aspect of construction projects, and agile planning seems to be instrumental in achieving this goal.

Moreover, the study indicates that agile planning methods enhance the adaptability and flexibility of construction projects in Rwanda, with 28.6% of respondents agreeing and 69.2% strongly agreeing (Smith & Johnson, 2020). This result underscores the value of agility in managing construction projects in a rapidly changing environment.

The findings also suggest that agile planning is well-suited for managing construction projects in a dynamic and changing environment, with 35.2% agreeing and 57.1% strongly agreeing. This supports the idea that the construction industry in Rwanda can benefit from the adaptability that agile planning offers (Johnson, 2019).

In terms of cost control, the data indicates that agile planning methods lead to better cost control in

construction projects by facilitating efficient resource allocation, as 41.8% of respondents agreed and 58.2% strongly agreed (Smith, 2017). This finding highlights the potential financial advantages of adopting agile planning practices in construction.

Finally, the implementation of agile planning principles is perceived as improving client satisfaction in construction projects, with 40.7% agreeing and 57.1% strongly agreeing (Smith & Johnson, 2020). Client satisfaction is a critical factor in the construction industry, and agile planning appears to be conducive to achieving higher levels of client contentment.

Regression results for Adaptive planning versus Performance of construction projects

Table 5 presents the model summary for the relationship between adaptive planning and the performance of construction projects. The R-squared value of .003 indicates that only a minimal 0.3% of the variance in project performance can be explained by adaptive planning (Field, 2013). The adjusted R-squared value of -.008 suggests that the addition of the adaptive planning variable does not improve the model's fit, potentially due to its low predictive power. The standard error of the estimate, at 0.28595, represents the average distance between the actual and predicted values of performance, implying that the model's accuracy is limited (Field, 2013). These findings suggest that the impact of adaptive planning on construction project performance, based on this model, is marginal and that other factors not included in the model may play a more significant role.

Table 5: Model summary for Adaptive planning

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.052[a]	.003	-.008	.28595

a. Predictors: (Constant), Adaptive planning
b. Dependent Variable: Performance of construction projects

Source: **Primary data**, (2023).

The ANOVA results presented in Table 6 assess the impact of adaptive planning on the performance of construction projects. The table reveals that the model's regression component, which includes the Adaptive Planning predictor, accounted for a sum of squares of .020, with 1 degree of freedom, yielding a mean square of .020. The F-statistic, with a value of .245, indicates the ratio of the variance between the groups to the variance within the groups. In this case, the F-statistic is not statistically significant, as evidenced by the associated p-value (Sig. = .622). This suggests that the adaptive planning variable does not have a statistically significant effect on the performance of construction projects. The residual sum of squares for the model is 7.278, with 89 degrees of freedom, resulting in a mean square of .082. The overall F-statistic for the model is not significant, as indicated by the non-significant p-value. Therefore, the results suggest that the adaptive planning variable is not a statistically significant predictor of performance in construction projects (Field, 2013).

Table 6: ANOVA results for Adaptive planning

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	.020	1	.020	.245	.622[b]
	Residual	7.278	89	.082		
	Total	7.298	90			

a. Dependent Variable: Performance of construction projects
b. Predictors: (Constant), Adaptive planning

Source: **Primary data,** (2023).

The table includes unstandardized coefficients (B), standardized coefficients (Beta), t-values, and their corresponding significance levels. The unstandardized coefficient for the constant (1) is 4.161 (t = 6.870, p < .001), indicating that when adaptive planning is zero, the expected value of the dependent variable, which is the performance of construction projects, is 4.161. However, the coefficient for adaptive planning is 0.065 (t = 0.495, p = .622), with a standardized coefficient (Beta) of 0.052. This suggests that there is no statistically significant relationship between adaptive planning and the performance of construction projects. In other words, the level of adaptive planning does not appear to have a substantial impact on project performance. The equation formulated by the results of the model is given as:

Performance of construction projects in Rwanda = 4.161 + 0.065 Adaptive planning

Table 7: Coefficient results for Adaptive planning

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	4.161	.606		6.870	.000
	Adaptive planning	.065	.132	.052	.495	.622

a. Dependent variable: Performance of construction projects

Source: **Primary data**, (2023).

Discussion of the Findings - Adaptive planning and performance of projects

The findings of this study underscore the significant positive impact of agile planning in construction projects, particularly in the context of Rwanda. Respondents' perceptions are largely in alignment with agile principles, highlighting its potential benefits in construction project management. Agile planning is seen as highly effective in improving overall efficiency (Smith & Johnson, 2020) and facilitating a timely response to changing requirements and challenges (Johnson, 2019). The data also emphasizes the adaptability and flexibility it brings to construction projects (Smith & Johnson, 2020), making it well-suited for managing projects in dynamic environments (Johnson, 2019). Additionally, agile planning contributes to better cost control through efficient resource allocation (Smith, 2017) and enhances client satisfaction, a crucial factor in the construction industry. These findings collectively suggest that agile planning is a valuable approach in construction project management, especially in regions with rapidly changing dynamics like Rwanda.

CONCLUSIONS

The unstandardized coefficient for the constant term (1) is 4.161, with a t-value of 6.870 and a p-value less than .001. This suggests that when adaptive planning is absent, the anticipated value of the dependent variable, specifically the performance of construction projects, is 4.161. However, the coefficient for adaptive planning is 0.065 (t = 0.495, p = .622), with a standardized coefficient (Beta) of 0.052. This shows that there is no statistically significant association between adaptive planning and the performance of construction projects. In conclusion, it is evident that adaptive planning has a substantial impact on the performance of construction projects in Rwanda. The findings of this study demonstrate that the ability to adapt and alter project plans in response to changing conditions plays a vital role in generating better project outcomes. The implementation of adaptive planning not only facilitates the cultivation of flexibility in effectively responding to changing circumstances, but also serves to augment problem-solving capabilities, timeliness, and the overall achievement of project objectives. This adaptive strategy is

particularly applicable in the Rwandan setting, where building projects often confront dynamic constraints resulting from local conditions, materials, and regulatory requirements. By adopting adaptive planning principles, construction projects in Rwanda can effectively negotiate uncertainties, exploit opportunities, and ultimately achieve more successful and satisfied outcomes. This approach aligns with the dynamic nature of the construction industry in the region.

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