Journal of
Entreprenuership and Project Management
(JEPM)

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CARI Journals

Journal of Entrepreneurship and Project Management
ISSN: 2520-9116 (Online)
Vol.10, Issue No.1, pp 52 – 70, 2025
www.carijournals.org

Project Management Approaches and Sustainability of Infrastructure Projects in Embu County

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Accepted: 6th Apr 2025 Received in Revised Form: 20th Apr 2025 Published: 27th Apr 2025

ABSTRACT

Purpose: This study focused on the following specific objectives; to establish the role of traditional, agile, waterfall and systems approaches on sustainability of infrastructure projects in Embu County. This study was guided by stakeholder theory, social learning theory, Technology Acceptance Model, the theory of change, and the 3 overlapping circles theory of sustainability.

Methodology: A descriptive study design was employed. The targeted population of the study were the 188 project managers. The census method was used in identifying a sample of 158 respondents since the target population was small. A self-administered closed questionnaire was used to obtain primary data. A pilot study was conducted with 10% of the sample prior to the main study and through Cronbach alpha, reliability of the research instrument indicated a co-efficient of 0.7 indicating a relatively high reliability. The raw data was coded, validated, and entered into a statistical package for social sciences (SPSS version 28) for analysis by use of linear regression to establish the relationship between variables. The results are presented in form of graphs, tables and figures.

Findings: The findings of this study showed strong relationships between the variables with the traditional approach at 64.7 per cent, agile approach at 73.2 per cent, the waterfall approach at 66.7 per cent, and the systems approach at 56.2 per cent. All the four formulated null hypotheses were rejected. The study concluded that all project management approaches under this study are key factors for sustainability of the projects.

Unique Contribution to Theory, Policy and Practice: The study thus recommends that a hybrid approach involving some or all the methodologies should be adopted in order to bring about project success. Other factors such as financial analysis, risk analysis, communication and network determination, operational plan, training, human resource development and capacity building, environmental and community analysis all help to determine the sustainability of projects.

Keywords: *Stakeholder Involvement, Stakeholder engagement, Market linkages, Monitoring, Participation, Project Implementation*

INTRODUCTION

Background of the Study

Sustainable infrastructure development has increasingly gained global recognition as a crucial element for fostering economic growth, social inclusion, and environmental protection. Infrastructure projects such as roads, bridges, water supply systems, and public facilities form the backbone of socio-economic development, particularly in emerging economies (World Bank, 2020). However, the sustainability of these projects often hinges on the effectiveness of project management approaches employed during their planning, implementation, and closure phases. As such, understanding the link between project management practices and the long-term sustainability of infrastructure projects has become a key area of interest in development studies (Silvius & Schipper, 2014).

The term "sustainable infrastructure" is defined by various stakeholders as a set of objectives, principles and criteria applicable to infrastructure projects for enhancing their utility in promoting sustainable development (World Bank, 2008). Omondi (2022) lamented that despite the contribution of infrastructure projects to the growth of the economy, they continue to encounter sustainability issues as a result of a lack of openness on how to mitigate and monitor project environmental impacts.

According to the Asian Development Bank (ADB, 2009), the basic principles underpinning sustainable infrastructure are: a) promoting low-carbon development and minimizing local impacts (e.g. on energy), b) developing solutions to help communities cope with the inevitable impacts of climate change (e.g. on water, health, and basic social protection); c) enhancing access to markets and productive assets; d) promoting gender equality and empowerment; and f) improving transparency and efficiency in public finance management (e.g. on corruption (ADB, p5). Sustainability of projects cannot take place if participatory approaches are left out (Ali & Gitonga, 2019). To ensure sustainability of projects, the implementing team should link the beneficiaries with input and service providers who should be approached and engaged from project inception (Larsson & Larsson 2020).

In the Kenyan context, and more specifically in Embu County, infrastructure development is a major agenda item as the county seeks to boost local economic activities, improve accessibility, and enhance the quality of life for its residents (County Government of Embu, 2022). Despite considerable investments, many projects in the region face challenges related to poor planning, cost overruns, stakeholder conflicts, environmental degradation, and premature deterioration. These challenges raise concerns about the sustainability and resilience of infrastructure projects. There is, therefore, an urgent need to interrogate how various project management approaches—such as traditional (waterfall), agile, hybrid, and sustainable project management frameworks—impact the durability, environmental friendliness, and socio-economic benefits of infrastructure projects (Martens & Carvalho, 2017).

Project management approaches determine how project objectives are set, how risks are managed, and how stakeholders are engaged. Traditional approaches often emphasize time, cost, and scope as the primary success factors, sometimes at the expense of broader sustainability goals (PMI, 2021). Conversely, newer approaches integrate sustainability dimensions into project life cycles, promoting practices that minimize ecological footprints, optimize resource use, and ensure long-term social acceptance (Silvius & Tharp, 2013). Understanding which approaches contribute most effectively to sustainable outcomes is crucial for policymakers, project managers, and local authorities in Embu County as they strive to improve infrastructure resilience and community impact.

Previous studies have explored project sustainability at the national level, but there is a paucity of empirical research focusing specifically on county-level contexts such as Embu. Local peculiarities including governance structures, financial constraints, community engagement levels, and environmental factors may uniquely influence project outcomes (Kariuki & Kihoro, 2020). Therefore, investigating project management approaches within Embu County provides an opportunity to generate context-specific insights that could inform better project planning, execution, and evaluation practices.

In sum, this study seeks to examine the relationship between project management approaches and the sustainability of infrastructure projects in Embu County. By identifying effective practices and potential pitfalls, the research aims to contribute toward enhancing the overall success and sustainability of infrastructure initiatives in the region.

Statement of the Problem

Infrastructure is an indivisible part of our modern life experience. Infrastructure projects are the

cornerstone of states' economic growth, development and wellbeing. Butkovic *et al* (2019) observed that although many studies have been done in the field of infrastructure and sustainability research, there is no found clear relationship between infrastructure project types and sustainability concepts. Mas *et al* (2023) studied sustainability assessment in infrastructure projects. Arshad *et al* (2021) did an evaluation of road infrastructure projects through a life cycle sustainability-based Decision-making approach. They noted that economic growth, social wellbeing, and infrastructure are strongly interrelated and jointly contribute to national development.

Ferrarez *et al* (2020) looked at sustainability indicators to assess infrastructure projects; sector disclosure to interlock with the global reporting initiative. Infrastructure projects have great potential to impact the sustainability of cities due to typically being large-sized projects and having a high level of intervention. Elsewhere, Hinge *et al* (2020) presented some of the mitigation approaches and opportunities that can alleviate environmental issues in infrastructure projects. Butkoic *et al* (2019) studied infrastructure projects classification. They noted that infrastructure is

one of the most recognized terms in project management in general. Many researchers elaborated infrastructure projects success as a critical element in achieving a desirable quality of life.

Locally, Omondi (2022) looked at environmental impact assessment and sustainability of infrastructure projects in Kenya, with an assessment of the Standard Gauge railway. Chepchirchir (2018) studied factors influencing sustainability of donor funded projects in Kenya. Njigua and Ndungu (2024) focused on institutional factors influencing sustainability of road construction projects in Kenya, with results showing that human resource efficiency and resource availability played a key role. Amolo (2024) studied green financing for sustainable development in infrastructure projects in Kenya. The foregoing studies present a literatue gap that needs to be filled. It is this gap that this study attempted to address.

General Objective

The general objective was to assess project management approaches on sustainability of infrastructure projects in Embu County, Kenya

Specific Objectives

The following specific objectives guided the study:

i. To establish the influence of the traditional approach on sustainability of infrastructure projects in Embu County.

ii. To explore the influence of the agile approach on sustainability of infrastructure projects in Embu County.

iii. To assess how the waterfall approach influence sustainability of infrastructure projects in Embu County.

iv. To evaluate the influence of the systems approach on the sustainability of infrastructure projects in Embu County.

LITERATURE REVIEW

Theoretical Framework

Stakeholder Theory

Stakeholder theory derives from the documentation on management topics. Preston, (1990) finds the concept of stakeholders being popular during the United States' Great Depression (1929-1941) when the General Electric Company grouped stakeholders in these quorums: investors, workers, clients, and the wider community. As stated by Freeman, (1984) its origins can be traced back to a study carried by the Stanford researchers in 1963, which described it as the category of people who determine the existence of an organization. Freeman, (1984) proposed from a managerial point of view that identifies key stakeholders as investors, clients, workers, and vendors.

Freeman, (1984) as a physical representation in which the company is the rim of a wheel and ends of spokes around the rim represents the stakeholders (Freeman, 1999), first presented the stakeholder model. It had the main circle which stands for the organization, while around it small other circles arrows were pointing toward and from the central section each standing for a different institution. As per to this theory, Gilbris (2010) notes that stakeholders key roles in an organization includes ensuring that resources are allocated appropriately and, operations runs smoothly for benefits (Gilbris 2010). The stakeholder trustee principle states that managers must act as the stakeholders' agents in the interest of the company to ensure the firm's sustainability (Ozturk, 2012).

The main stakeholders of infrastructure projects are the local communities, county governments, project teams among others. This study pays attention to such stakeholders as their contribution results to the success of the projects.

Technology Acceptance Model (TAM)

Fred Davis and Richard Bagozzi proposed TAM theory in in 1989 (Davis, 1989). As modified from the Theory of Reasoned Action (TRA), TAM is an information system theory that defines how individuals adopt and use technology. According to Kondo *et al*., (2013), among the well-developed theories, TAM gained considerable empirical documentation on the method of its power to predict performance.

As per TAM, perceived usefulness combined with perceived ease of use can predict a person‟s intention to use technology to make normal duties easier (Surendran, 2012). It identifies worth and simplicity of use beliefs as primary determinants of innovations adoption for many organizations (Li, 2010). The system should add value to a worker‟s job performance (Li, 2010; Kondo, Ishida, & Ghyas, 2013).

The documented studies term perceived usefulness and ease as the level to which workers have confidence that a particular system would enable them to attain results faster (Li, 2010; Kondo, Ishida, & Ghyas, 2013). Besides, an assumption on ease of use is a thought by individuals that specific innovation will be quick and effortless. Personal actual behavior is then based on these two thoughts, how useful and easy to use technology will be. As noted by Ventkatesh, *et al*., (2003) the thought of usefulness is also subjective to the assumption that technology is user-friendly.

Also several factors, for example, biased perceived behavioral control, and belief on what someone is capable of have been added to the model (Taylor &Todd, 1995; Mathieson, *et al*., 2001; Hartwick & Barki, 1994;). In Kenya, as noted by Ngugi and Wanyoni, (2018) the rate of adoption of any technology is dependent of the knowledge and skills of the user. This is where the concept of stakeholder influence would be beneficiary in that they can help in changing beneficiary’s attitudes and perception regarding a technology.

TAM theory provides a ground this study's specific objective trying to answer the investigation on what level does the adoption of advanced technologies determine the sustainability of projects. This theory addressed the systems approach.

Social Learning Theory

Social learning theory proposed by Albert Bandura in the late 1970‟ is regarded as one of the key theories of learning and development where the learners gained experience through observation, demonstrations, and trying to copy behaviors, emotional reactions and attitudes as portrayed by others. Miller and Dollard, (1941) further states that this is linked to admiration to specific persons viewed as models who possess qualities that are seen as rewarding. This theory is anchored on four key principles; attention, retention, reproduction, and motivation. Attention aspect emphasizes that human learn if they have a focus on the specific assignment. Retention outlook supports the assumption that humans learn by internalizing whatever information they get in their brains. Reproduction principle explains that humans duplicate information they have accessed in previous time.

The last principle, motivation supports the view that humans must be motivated to carry out any task. This theory is in favor of the specific objective trying to investigate how engaging the agile approach determine the sustainability of infrastructure projects in Embu, Kenya. The theory supports the assumption of the study that helping managers adopt the best practices requires physical observation, group learning and reflection, as well as feedback. As Folke *et al.,* (2005) argues, the flexible approach needs a clear facilitation process in order to enable the project beneficiaries to participate actively and take time to reflect on knowledge and skills gained. Social learning theory is used to explain the agile approach in this study.

Theory of Change

Though it's not clear when the theory of change concept came into use, a hint on its origin points to Carol Weiss during the 90s as an advancement in evaluation theory as explained by Stein and Valters, (2012). Its objective in those decades was to help scholars understand some of the challenges they came across during evaluation of complex programs. Many organizations have adopted a theory of change approach to monitoring and evaluation processes. Theories of Change are very diversified but there are frequently common factors; poorly reasoned assumptions, confusion about how change processes occurred, and an insufficient focus on the steps required to accomplish a purpose (O'Flynn, 2012).

Since then, Theory of Change reasoning has advanced fast and is accepted globally. Theories of change can be applied at the organizational, program, or project levels in a program. They are capable of being developed and used in a variety of ways for various objectives. They are, however, possibly the most beneficial for international institutions and projects working with different collaborators because everyone's feedback is incorporated to come up with a common

understanding on how change occurs, as well as how the institution quickly responds to the change.

Theory of change adds value to this study by supporting the objective trying to answer the question on how the waterfall approach influences sustainability of infrastructure projects in Embu County. The theory of change supports the waterfall approach in this study.

Overlapping-circles Theory of Sustainability

The 3-overlapping-circles theory of sustainability can be traced in the 1980s as proposed by Babier but a literature survey conducted in 2001 to track the origin of this model describes it as a „common view" (Caradonna, 2014; Grober, 2012; Waas, *et al*. 2011; Giddings *et al*. 2002). The theory supports the balance between economic, environmental, and social elements if an outcome is to be regarded as sustainable. These three factors are demonstrated as three circles which are overlapping and sustainability is viewed as the elusive center (Stenberg, 2001. The economic dimension is measured as a result of improved standards of livings which include stable source of income, stable food source while the environmental aspects is concerned with conservation or restoration of the natural capital such as soil resulting into stable food productivity.

The social dimension describes as a scope to which social organizations can support expansion of project approaches in the future especially in new regions (Black, 2004). According to this theory, social and economic success can felt if the environment has promoted availability of necessary resources. The theory further argues that sustainability is dependent on new synergies which are part of the systems thinking to achieve success at the economy, society, and environment level with reduced trade-offs (Purvis, Mao, & Robinson 2018). A number of researchers have critiqued this model on the assumption that they are dependent on each other (Thatcher, 2014).

Another controversy is the approach of this model that specific outcomes from these pillars should consummate (Mieg, Hansmann, & Frischknecht, 2010). Gibson, (2001) argues that there is need to include cultural as well as political aspect to make the theory make it more acceptable since it's focusing on people. During sustainable development discussions either the environment or the economy is viewed as the superior of the three pillars (Giddings et al., 2002). Literature on the development sector measure of sustainability points more to the UN"s set of sustainable development goals (SDGs), which are embedded on the three pillars of economic, environmental, and social (UN, 2012a). Outputs integrating the three pillars is necessary if infrastructure projects have to be viewed as sustainable. This study will help in discovering how cooperation between the community members can be a foundation for sustainability

Conceptual Framework

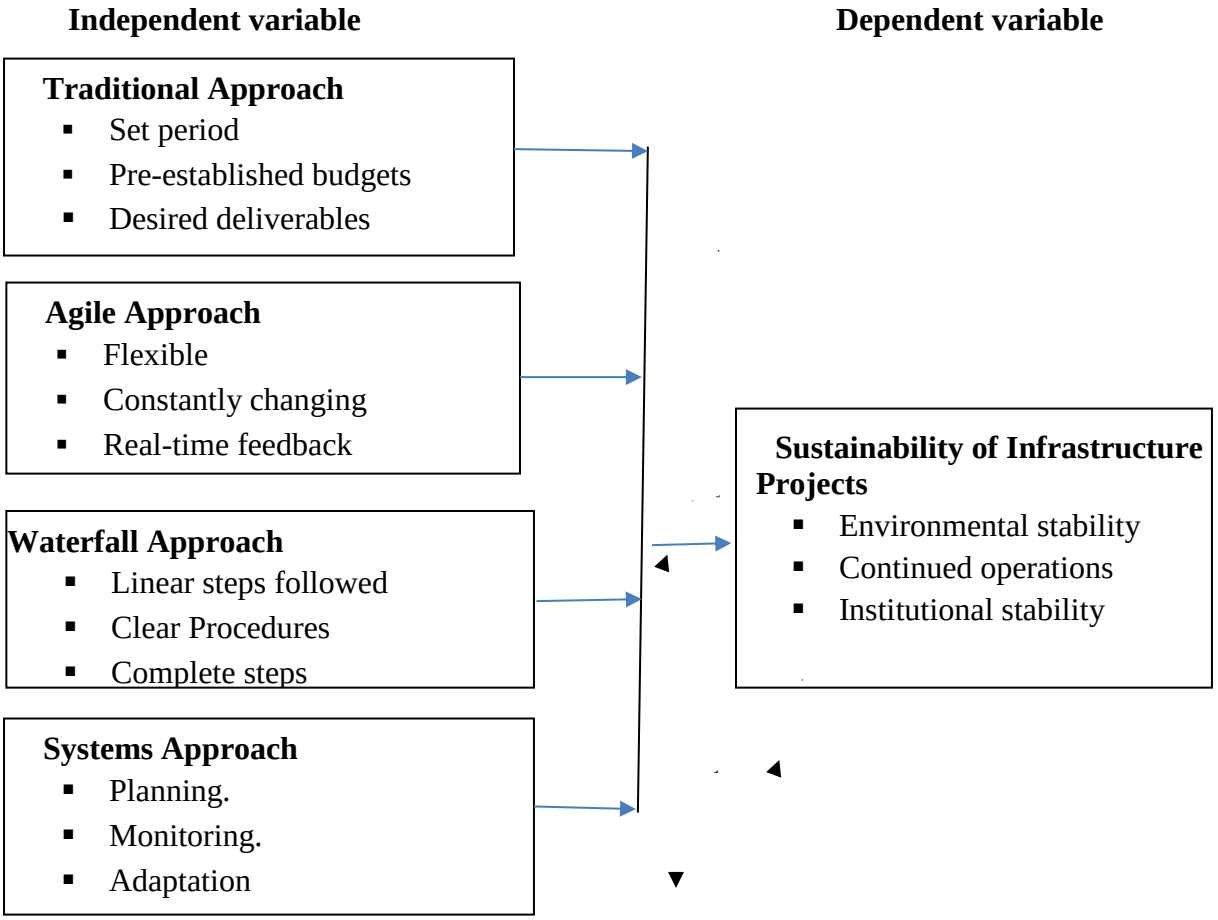

Figure 2.1 Conceptual framework

Empirical Review

Ndombi *et al.,* (2021) examined implementing specific project exit strategies such as linking the community to service providers' influences sustainability of donor-funded livelihood projects in Kilifi county. The study used pragmatic paradigm and descriptive correlational research design where a population of 295 provided a sample size of 170 using Slovin's formula. The data collection tools included focus group discussions, interviews and questionnaires. The findings indicated that involvement of stakeholders for support service linkages is one of the practices that significantly influence donor funded agriculture project sustainability.

Mutegi, Gathungu, and Sande (2019) investigated the factors which enable the sustainability of agriculture projects supported by donors in the Tharaka South sub-county. An exploratory methodology in combination with a descriptive study was used. The study sought for feedback from 400 project beneficiaries using a combined methodology of simple random and purposive

sampling. 90% of the target group took part in the study. Questionnaires, with open and closed responses formed part of the primary data collection tools. The raw data was coded and analyzed by using a descriptive method. Stakeholder engagement and the sustainability of donor-supported agriculture projects were found to be positively and significantly correlated.

Ochunga, (2016) study focused on how engaging stakeholder's influences sustainability of community based development in Homa Bay Town Sub-County as implemented by Plan International. Three respondents were targeted from each organization to represent the 51 partner organizations totaling to a 153 people who through Simple random sampling were narrowed to 113 respondents. Questioners provided the basis for data collection. From the findings, there was an evidence of weak stakeholder engagements thus lack of assurance on project sustainability. This provides a ground that Stakeholder involvement could be considered as one approach to address the issue of problem of project sustainability.

The study by Ngatia, (2018) on factors influencing sustainability of projects supported by donors in Garissa County used a descriptive methodology. The targeted respondents included funded project leads, implementing partners, and project beneficiaries. The study used stratified sampling to define the number of respondents from forming each category. Primary data was gathered through a semi-structured survey form and secondary data was obtained using desk search approaches from previous scholarly articles found on the website. Quantitative data was scrutinized using a multivariate regression analysis methodology and to comprehend the qualitative data the content analysis methodology was used. Indications from inferential results pointed towards stakeholder participation being one of the supporting factors for sustainability of community projects supported by the donors.

Mutindi and Muthoni, (2020) investigation in Kajiado county was focused on finding out the role played by technology in promoting impact of donor supported projects. A survey approach was used and 100 participants who of which 20 represented a sub county form the sample. A semi structured questionnaire which used Likert scale was the data collection tool. Results from the analysis indicated a positive relationship technology and effectiveness of donor supported projects.

RESEARCH METHODOLOGY

The researcher used a descriptive study approach. This study targeted 188 project managers and supervisors engaged in both national and county infrastructure projects within Embu County. For the study, sampling frame included one senior or middle level manager from each of the projects in Embu County. The study targeted these managers due to their interaction with the project management approaches. A census of all the 188 managers will be selected for the study. For this study, the primary data collection instrument was a self-administered questionnaire. A pilot study was carried out using 18 managers from the two sub counties in Embu County. The data collected was analyzed with the Statistical Package for Social Sciences software version 25. Quantitative data was analyzed and visualized using descriptive statistics such as mean, standard deviation,

frequency, and percentages. Pearson Correlation Coefficient and multiple linear regression was used for inferential data analysis.

DATA ANALYSIS PRESENTATION, DISCUSION AND INTERPRETATION

Response rate

Out of 188 questionnaires distributed, 154 were completed and returned, resulting in a response rate of 81.9%. This rate aligns with Thornhill's (2012) benchmark for statistical analysis, which sets a minimum acceptable response rate at 50%. Consequently, the data collected in this study is deemed suitable for analysis, allowing for valid conclusions and recommendations regarding the topic at hand. The findings related to the response rate are presented in the table below.

Table 1: Response Rate

Population	Returned Questionnaire	Response Rate
Response	154	81.9%
Non-Response	34	18.1%
Total	188	100%

Descriptive Analysis of the Study Variables

Traditional Approach and Sustainability of Projects

The first objective of the study sought to investigate the relation between traditional approach and sustainability of infrastructure projects. The respondents were supposed to indicate their level of agreement or disagreement with the statements. The results are as shown in Table 2 below:

Table 2: Descriptive results for traditional approach

	SD	D	N	A	SA	M	SD
The project engages in thorough record keeping of all project activities and events.	0.0%	25.9%	8.9%	54.1%	11.1%	3.50	0.21
There is improved responsibility for all those involved in the project	0.0%	0.7%	1.5%	35.6%	62.2%	4.59	0.28
The managers have complete control of the project	0.0%	0.7%	0.7%	44.4%	54.1%	4.51	0.26
The project has very clearly defined and stated goals	1.5%	0.7%	2.2%	51.9%	43.7%	4.35	0.25
Management of the project is very well established	0.0%	0.0%	4.4%	28.1%	67.4%	4.62	0.29
Aggregate Score						**4.384**	**0.261**

Based on the findings in table 2 above, a significant proportion of respondents, specifically 67.4%, expressed strong agreement regarding statement that the project engages in thorough record keeping of all project activities and events (M= 3.50, SD= 0.21). Similarly, a substantial percentage of participants, namely 62.2%, strongly concurred that there is improved responsibility for all those involved in the project (M= 4.59, SD= 0.28). Furthermore, a notable majority of 54.1% strongly agreed that the managers have complete control of the project while 51.9% the project has very clearly defined and stated goals (M= 4.35, SD= 0.29).

The findings of the study revealed that a significant proportion of the participants, specifically 67.4%, expressed agreement with the notion that the management of the project is very well established (M= 4.489, SD= 0.261).

Regression Model on Traditional Approach on Sustainability of Projects

A linear regression model was used to establish the relationship between the traditional approach and sustainability of infrastructure projects in Embu County. The results of the regression are as shown in table 3 below:

Table 3: Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.647[a]	.419	.213	1.149	.218	38.796	1	139	.000

a. Predictors: (Constant), Traditional approach
b. Dependent Variable: Sustainability of infrastructure projects

From the results of table 3 above, R= 64.7%, implying that independent variable, traditional approaches can predict the dependent variable, sustainability of projects at 64.7%. Also the variation between dependent and independent variable is explained by 64.7%, study with a significance level of 0.001<0.05. The study, therefore, rejected the null hypothesis that the traditional approach has no significant influence on sustainability of projects. This shows a variation of 64.7%, of sustainability of infrastructure projects in Embu County is largely contributed by the traditional approach while 35.3% were contributed by other factors. This study corresponds with the study findings done by Spalek (2016) who observed that the TPM methods have been developed since the sixties and are suitable for application in large, long-term projects in a stable environment. The prerequisite for their application is the ability to plan, in detail, the project ex-ante, while MPM methods seem to more accurately match the client's needs, especially if the requirements have the tendency to change frequently over time.

Descriptive Statistics on Agile Approach

The second objective sought to explore the relation between agile approach and sustainability of projects in Embu, Kenya. The respondents were supposed to indicate their level of agreement or disagreement as presented on the 5-point Likert scale as 5= strongly agree 4= Agree 3= neither agree/disagree 2= Disagree 1= strongly Disagree as shown in table 4 below.

Table 4: Descriptive results for agile approach

	SD	D	N	A	SA	M	SD
The project is built over small steps	0.0%	25.9%	8.9%	54.1%	11.1%	3.504	0.212
We emphasize flexibility in the way the project activities are carried out	0.0%	0.7%	1.5%	35.6%	62.2%	4.593	0.280
The project allows for customer contribution towards the attainment of its goals.	0.0%	0.7%	0.7%	44.4%	54.1%	4.516	0.269
The project team actively collaborates with its stakeholders	1.5%	0 .7%	2.2%	51.9%	43.7%	4.356	0.255
The project follows an incremental approach that emphasizes the importance of delivering services quickly.	0.0%	0.0%	4.4%	28.1%	67.4%	4.626	0.290
Aggregate Score						**4.384**	**0.261**

The statistical measures as displayed in Table 4 above shows that a significant proportion of respondents, specifically 67.4%, expressed agreement regarding statement that the project is built over small steps (M= 3.50, SD= 0.212). Similarly, a substantial percentage of participants, namely 62.2%, strongly concurred that the project managers emphasized flexibility in the way the project activities are carried out (M= 4.593, SD= 0.280). Furthermore, a notable majority of 54.1% strongly agreed that the project allows for customer contribution towards the attainment of its goals while 51.9% expressed strong agreement with the notion that the project team actively collaborates with its stakeholders (M= 4.356, SD= 0.255).

The findings of the study revealed that a significant proportion of the participants, specifically 41.5%, expressed agreement with the notion that the project follows an incremental approach that emphasizes the importance of delivering services quickly (M= 4.489, SD= 0.261).

Regression Model on Agile Approach

Regression model results for agile approach on sustainability of infrastructure projects in Embu, Kenya. The results of the regression are as shown in table 5 below:

Table 5: Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics R Square Change	F Change	df1	df2	Sig. F Change
1	.732[a]	.536	.010	1.288	.017	2.471	1	139	.008

a. Predictors: (Constant), Agile approach
b. Dependent Variable: Sustainability of infrastructure projects

From the results of table 5 above, R= 73.2%, implying that independent variable, agile approach can predict the dependent variable, sustainability of projects at 73.2%, Also the variation between dependent and independent variable is explained by 73.2%, study with a significance level of 0.008<0.05, therefore this study rejected the null hypothesis that agile approach has no significant influence on sustainability of projects in Embu, Kenya. This shows a variation of 73.2%, of sustainability of projects is largely contributed by adoption of agile approach while 26.8% were contributed by other factors which may not have formed part of the study. The findings of this study is in agreement with a study done by Ciric *et al* (2022) which evidenced that the agile approach has a more significant positive impact concerning the two out of five dimensions of project success, under analysis in this research (impact on the team and preparing for the future), over the traditional approach.

Descriptive Statistic on Waterfall Approach

The third objective sought to assess the extent to which the waterfall approach influenced sustainability of projects. The respondents were supposed to indicate their level of agreement or disagreement as presented on the 5-point Likert scale as 5= strongly agree 4= Agree 3= neither agree/disagree 2= Disagree 1= strongly Disagree as shown in table 6 below.

Table 6: Descriptive results for waterfall approach

	SD	D	N	A	SA	M	SD
Stakeholder and customer requirements are gathered at the beginning of the project	0.7%	3.0%	1.5%	17.0%	77.8%	4.682	0.330
A sequential project plan has been developed to accommodate requirements	0.0%	2.2%	3.0%	27.4%	67.4%	4.600	0.288
Each phase of the project is completed before moving to the next one	0.0%	3.0%	6.7%	43.7%	46.7%	4.344	0.231
Managers emphasize thorough documentation and pre-determined timelines.	0.0%	4.4%	8.1%	36.3%	51.1%	4.338	0.225
Project teams design and use technology to implement requirements through collecting of data	0.0%	2.2%	3.7%	39.3%	54.8%	4.467	0.253
Project is maintained by designing strategies for updating and upgrading them.	0.7%	3.7	6.7%	39.3%	49.6%	4.334	0.227
Aggregate Score						**4.459**	**0.257**

From the results, 77.8% of the respondents strongly agreed that stakeholder and customer requirements are gathered at the beginning of the project (M= 4.682, SD= 0.330) and 67.4% strongly agreed that a sequential project plan has been developed to accommodate requirements (M= 4.600, SD= 0.288).

The study further showed that a total of 90.4% of the respondents agreed that each phase of the project is completed before moving to the next one (M= 4.344, SD= 0.231), 51.1% agreed that managers emphasize thorough documentation and pre-determined timelines (M= 4.338, SD= 0.225), 54.8% agreed that project teams design and use technology to implement requirements through collecting of data (SD= 4.467, SD= 0.253), 36.3% of the respondents agreed that project is maintained by designing strategies for updating and upgrading them (M= 4.338, SD= 0.225).

Regression Model on Waterfall Approach

The study explored the relation between waterfall approach and sustainability of infrastructure projects in Embu, Kenya. The results of the regression are as shown in table 7 below:

Table 7: Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.667[a]	.445	.441	.968	.445	111.584	1	139	.000

a. Predictors: (Constant), Waterfall approach
b. Dependent Variable: Sustainability of Infrastructure projects

From the results of table 7 above, R= 66.7%, implying that independent variable, waterfall approach can predict the dependent variable, sustainability of projects at 66.7%, Also the variation between dependent and independent variable is explained by 66.7%, study with a significance level of 0.001<0.05. This study therefore rejected the null hypothesis waterfall approach has no significant influence on sustainability of projects. This shows a variation of 66.7%, of sustainability of projects is largely contributed by waterfall approach while 33.3% were influenced by other factors not forming part of the study. Van de Merwe (2017) showed that the waterfall project management methodologies are still very relevant in today's modern project environment.

Descriptive statistic on Systems Approach

The forth objective sought to investigate the systems approach on the sustainability of infrastructure project in Embu County, Kenya. The respondents were supposed to indicate their level of agreement or disagreement with statements on the sub-construct of variable. The responses were indicated as guided on the 5-point Likert scale as 5= strongly agree 4= Agree 3= neither agree/disagree 2= Disagree 1= strongly Disagree as shown in table 8 below.

Table 8: Descriptive statistic on Systems Approach

	SD	D	N	A	SA	M	SD
Project activities are organized and managed in a systematic manner.	0.7%	6.7%	5.9%	23.7%	63.0%	4.416	0.255
Projects are broken into smaller and manageable components.	0.0%	6.7%	5.2%	38.5%	49.6%	4.310	0.224
Managers use a set of standardized processes to plan, execute and control the project.	0.0%	8.1%	8.9%	36.3%	46.7%	4.216	0.203
All project elements depend on each other.	0.0%	6.7%	3.7%	43.7%	45.9%	4.288	0.228
We have adopted holistic and analytical approaches to solving complex problems.	0.0%	5.2%	5.2%	43.7%	45.9%	4.303	0.228
Aggregate Score						**4.303**	**0.228**

Project activities are organized and managed in a systematic manner represented by 63% of those who agreed (M= 4.416, SD= 0.255), 38.5% agreed that projects are broken into smaller and manageable components. Managers use a set of standardized processes to plan, execute and control the project (M= 4.216, SD= 0.203), 43.7% agreed that all project elements depend on each other. The managers also agreed that they have adopted holistic and analytical approaches to solving complex problems (M= 4.303, SD= 0.228).

These results conform to Gregory (2018) who noted that project management still suffers from limitations, and many projects are not successful for various reasons. One of these reasons is insufficient understanding and attention to system analysis principles and techniques. Project management is now ready to evolve to the next level through the integration of system analysis

techniques into the fundamental project management principles and process.

Regression model on Systems Approach

Regression model on extent to which the systems approach influences sustainability of infrastructure projects in Embu, Kenya. The results of the regression are as shown in table 9 below:

Table 9: Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.562[a]	.316	.311	1.075	.316	64.095	1	139	.000

a. Predictors: (Constant), Systems approach
b. Dependent Variable: Sustainability of infrastructure projects

From the results of table 9 above, R= 56.2%, implying that independent variable, systems approach can predict the dependent variable, sustainability of projects at 56.2%, Also the variation between dependent and independent variable is explained by 56.2%, study with a significance level of 0.001<0.05. This study therefore rejected the null hypothesis which had been stated as systems approach has no significant influence on sustainability of project in Embu, Kenya. This shows a variation of 56.2%, of sustainability of project is largely contributed by the systems approach while 43.8% were other factors influencing sustainability of projects in Embu, Kenya that were not covered in this study.

Barbier and Burgess (2017) showed that there was a link between the systems approach, sustainability and the 17 Sustainable Development Goals (SDGs), which were formally adopted by the UN in 2015. The systems approach depicts sustainable development as the intersection of the goals attributed to three interlinked systems: environmental (or ecological), economic and social.

Multiple Regression analysis

The study tested the relationship using multiple linear regression model, that is, performance regressed on the independent variables; traditional, agile, waterfall and systems approach.

The results are presented below. As indicated in Table 10, R square equal 0.596. This meant that 59.6% of the variation in sustainability of infrastructure projects was explained by changes in traditional, agile, waterfall and systems approach leaving 40.4% unexplained (error term).

Table 10: Overall Regression Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change
1	.772[a]	.596	.589	.64029822	.596	100.721	4	273	.000

a. Predictors: (Constant), traditional, agile, waterfall and systems approaches.

CONCLUISONS AND RECOMMENDATIONS.

Conclusions

From the findings, the study concludes that, despite the presence of modern project management approaches, the traditional approach still remains an important approach that can be employed as it continues to influences sustainability of projects in Kenya. This may be in its deployment as a supportive structures that ensure continuity of projects in the counties.

The agile approach is equally an important aspect in any project and its sustainability. The approach emphasizes flexibility, collaboration and customer centricity. The Agile methodology benefits teams by enabling adaptive planning, rapid execution, and ongoing evaluation, leading to more responsive and successful outcomes. This study concluded that the project managers and team members need to be sensitized on the need to remain flexible as a means of creating environments in which projects. Organizations are dynamic systems influenced by their environment, requiring management to monitor and adapt to external changes.

The study further concludes that the waterfall approach for projects is a requirement in order to have the desired outcomes especially in the aspect of sustainability of infrastructure projects. In Waterfall, each stage of the workflow needs to be completed before moving on to the next step. While there are various types of project management methodologies, Waterfall is well suited for projects where the objectives are clearly outlined from the beginning.

The study also concluded that the systems approach plays a crucial role in sustainability of projects. It emphasizes that a system is not merely a collection of individual parts but an organized whole where the interdependence of its parts contributes to the unique characteristics of the entire system. An organization is like a puzzle made up of smaller pieces (sub-systems) that interact and depend on each other for the organization to function properly.

Recommendations

Based on the finding of the study and the conclusion, the following are the key recommendations:

i. This study recommends that contracting firms should embrace the traditional approach as it provides a structured framework for planning, executing, and managing projects to achieve specific goals and deliverables.

ii. The study recommends that the agile approach should be encouraged as it calls for collaborative cross-functional teams. Open communication, collaboration, adaptation, and trust amongst team members are at the heart of the agile approach.

iii. This study recommends that the waterfall approach can be adopted as an alternative to other project approaches. It is vital that managers complete each project phase before moving to the next.

iv. The study also recommends that project contractors should engage in constant monitoring and prompt corrective action since these are crucial to enhancing the project as a complete systems that supports inputs, processes and therefore, outcomes.

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