Int Journal of Social Sciences Management and Entrepreneurship 9(2): 40-55 2025

ISSN 2411-7323

www.sagepublishers.com

PROJECT MANAGEMENT PRACTICES AND IMPLEMENTATION OF SOLAR ENERGY PROJECTS IN THE TELECOMMUNICATION INDUSTRY IN KENYA

[1] Musili Japheth Maingi, [2] Dr. Musembi Annastacia PhD, PMP

[1] Master of Science in Project Management of Jomo Kenyatta University of Agriculture and Technology

[2] Lecturer, Jomo Kenyatta University of Agriculture and Technology

ABSTRACT

For any endeavor or project to be implemented fully, it means that its objectives have to be achieved. It's not guaranteed that project management practices will result to effective implementation of solar energy projects in the telecommunication industry but implementation of projects to a good percentage depends on the way it is managed and controlled. The challenges met during the application of project management practices has been during project planning, exceeding the set budget and going beyond its set schedule and poor quality. This study seeks to examine the influence of project management practices on the implementation of solar energy projects in the telecommunication industry, Kenya. Specifically, the study sought to determine the influence of project planning practices and assess the influence of risk management practices on the implementation of solar energy projects in the telecommunication industry in Kenya. The study was underpinned by the theory of scheduling, and enterprise risk management theory. The target population was 180 key implementers and decision makers. These are the key implementers of the 60 solar energy projects implemented in telecommunication sites for (Safaricom, Airtel and Telkom Kenya) and 4 telco infrastructure companies (Atlas Towers, American Towers Corporation-Kenya, AlanDick and Seal Towers) from the telecommunication industry in Kenya. The unit of observation was the Project Directors, Project managers and two team members from each of the project. The unit of analysis was the 60 solar energy projects. A sample size of 124 was drawn using Yamane formula. Questionnaires were the main data collection instrument that was tested for validity and reliability in a pilot test and study. The study conducted correlation, descriptive and inferential analysis of the data collected. The study aims to establish the relationship between project management practices and implementation of solar energy projects in Kenya. The findings were presented in table and figures and discussed. The findings were useful to project managers, scholars and project practitioners.

Key Words: Project Management Practices, Project Planning Practices, Risk Management Practices, Implementation of Solar Energy Projects, Telecommunication Industry

Background of the Study

A practice is a technique, process, activity, or method that is deemed to be more effective in delivering outcome in a project as compared to other approaches that provide the desired outcome with fewer complications and unseen problems (Kerzner, 2018). Project management practices are methods used to plan, organize and execute a project to achieve its goal within set timelines and budget. As project management evolved, the best practices for project management also changed over the years. People learned from both the failures and successes of projects in contrast to early years when the best practices were from success. Lack of application of project management practices during project implementation leads to significant negative effects which include missed deadlines, budget overruns, poor quality deliverables, stakeholder dissatisfaction, scope creep, inefficient resource allocation, decreased team morale, and ultimately, project failure due to poor planning, cost management, communication breakdowns, and inadequate risk management. This, therefore, brings the need to competent and trained team that fully understands, has the skills and can very well apply the project management practices in order to ensure that all the stakeholders' goals and objectives of an undertaking are achieved in harmony.

Statement of the Problem

Implementation of solar Energy in the Telecommunication industry face several challenges that affect their outcomes. One of these key challenges is lack of project management practices knowledge and application. The problem is lack of project management practices knowledge and its application during the implementation of solar energy in the telecommunication industry in Kenya. This is a problem because solar energy projects are inherently complex and dynamic. They require meticulous planning, coordination, and management to deliver their intended benefits such as reducing operational costs, enhancing energy security, and contributing to climate action.

The implementation of solar energy projects in Kenya's telecommunication industry faces significant challenges, particularly due to inadequate project management practices, undermining the sector's ability to achieve cost efficiency, sustainability, and national climate goals. For instance, the Kenya's telecom sector, which contributes 7.2% to GDP and serves over 65 million mobile subscribers relies heavily on diesel generators and grid electricity, with energy costs consuming 40% of operational expenses (Communications Authority of Kenya, 2023).

The problem is significant because solar energy projects are complex and dynamic, requiring careful planning and risk management to achieve the desired outcomes and impacts. The core issue is the persistent lack of structured project management practices such as planning, stakeholder engagement during the implementation of solar energy projects in Kenya's telecom sector. For instance, Safaricom's 2022 initiative to convert 5,300 base stations to solar power achieved only 27% completion (1,432 sites) by 2023, with 34% budget overruns and stakeholder conflicts halting progress (Safaricom Sustainability Report, 2023). Similarly, American Tower Corporation's-Kenya 2019 solar project suffered 18-month delays and 42% cost escalations due to poor technical planning (Business Daily, 2023). These failures reflect broader trends: 52% of Kenyan projects exceed budgets, while 89% miss deadlines (Project Management Institute Kenya, 2023), directly linked to weak PM frameworks.

Similarly, American Towers Corporation - Kenya leading Telco company that deals with only construction of telecommunication infrastructure for the Telecom service providers initiated solar energy projects to its GSM sites in 2019 with the purpose of ensuring continuous power supply and low electricity bills to their tenants but the project faced delays, cost overruns, technical glitches, and low adoption rates, which all point to poor project management practices. Nonetheless, the literature lacks insight into how project management practices influence implementation of solar energy projects in telecommunication industry in Kenya.

There is also lack of empirical evidence on the challenges and best practices of implementation of solar energy in telecoms industry in Kenya. Without improved PM, the sector risks failing to deploy the 4,000 solar-powered sites needed by 2025 to meet universal connectivity targets (CAK, 2023), further straining operational costs and delaying climate action. Therefore, there is a need to investigate how Project Management practices influence the implementation of Solar energy projects in telecommunication industry in Kenya and how they can be improved to ensure better outcomes and benefits for all stakeholders. Thus, this study seeks to fill the gap by examining the influence of project management practices and implementation of solar energy projects in the telecommunication industry in Kenya.

Research Objectives

General Objective

This study sought to examine the relationship between project management practices and the implementation of solar energy projects in the telecommunication industry in Kenya.

Specific Objectives

The study specifically sought:

i. To determine the relationship between project planning practices and implementation of solar energy projects in the telecommunication industry in Kenya.
ii. To assess the relationship between risk management practices and implementation of solar energy projects in the telecommunication industry in Kenya.

LITERATURE REVIEW

Theoretical Review

Theory of scheduling

Theory of scheduling originated from Putnam-Norden-Rayleigh Model which was developed by Putnam in 1978 (Moore, 1999). Putnam proposed an analytical formula for scheduling labour cost rates over time for software development projects (Boehm, 1981). Project scheduling theory encompasses the scheduling of project tasks and activities based on the preference or resource limitations (Herroelen, 2005). This theory is based on three concepts: planning, the dispatching model and the thermostat model (Koskela & Howell, 2002). The dispatching model adopts that planned tasks and activities can be implemented by a notification of the start of the task to the project leader.

This theory provides insights into how well-structured scheduling and task sequencing influence timely delivery of project outcomes. In solar energy implementation, especially for telecom infrastructure, precise scheduling of activities such as site acquisition, equipment delivery, installation, and testing is critical. Delays often arise from poor time allocation, misaligned resources, and lack of coordination, which the theory effectively addresses. The dispatching and thermostat models within the theory offer a logical framework to analyze planning inefficiencies and their effects on deliverables. This theory is therefore important to the study since it demonstrates a strong causal relationship between scheduling and the project deliverables (Koskela & Howell, 2002). This theory will link project planning practice and how it affects the implementation of solar energy projects in the telecommunication industry.

Enterprise Risk Management Theory

The theory was created by Daniel Bernoulli in 1738. Effective and efficient risk management aims at improving the performance of a project by creating value to the project through best service delivery, effectively manage of change, efficient use of resources, better project management, minimizing fraud, minimizing waste and supporting innovation. Tabish and Jha

(2012) defines enterprise risk management (ERM) as a discipline that supports achievement of projects objectives by addressing the full chain of risks and managing the combined impact of those risks as an interrelated portfolio.

Enterprise Risk Management Theory is highly appropriate for the Risk Management variable. The theory addresses the comprehensive identification, evaluation, and mitigation of risks throughout a project's lifecycle. In the solar energy implementation space, risks such as regulatory changes, equipment failure, supply chain disruptions, and environmental opposition are prevalent. The theory's holistic view allows the study to assess how interrelated risks when unmanaged can compound and derail project outcomes. ERM's emphasis on proactivity and integration aligns well with project management needs in the volatile energy and telecom sectors. The historical underperformance of solar initiatives in Kenya's telecom industry, marked by delays and system inefficiencies, underscores the importance of formal risk management frameworks. Therefore, the theory provides a solid lens through which the study can evaluate risk identification, analysis, response planning, and monitoring.

Conceptual Framework

This study's conceptual framework sought to demonstrate the relationship between project management practices and implementation of solar energy projects in the telecommunication industry in Kenya.

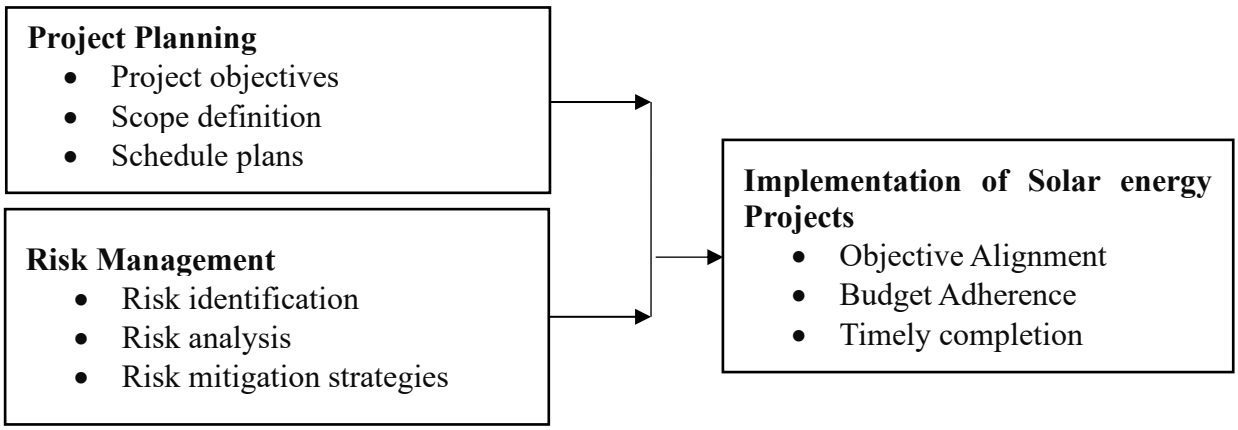

Figure 2.1: Conceptual Framework

Project Planning

Project planning is a complex and iterative task which typically involves; Identification of all of the tasks to be performed given the scope of the project and the technical and business constraints, estimating the effort and cost of completing each task and project scheduling (Kerzner, 2017). Planning is the management function that involves setting goals, prioritizing these goals and deciding how to achieve them (PMI, 2017). In project planning phase the project plans are documented, requirements defined, the project schedule is created, and the project deliverables are defined. The plans help the project team during implementation and completion of project. The plans are important for management of time, cost, risk, quality and changes to scope. The plans also help to control other stakeholders such as external suppliers to ensure delivery of project within budget, on time, and within the schedule. Planning is challenging for the project manager since he/she has to make a very educated guess on the resources, equipment, and staff needed to ensure completion of the project. The basic process of project planning includes scope planning where the requirements for the project are specified; the project schedule is developed; specify the cost to complete the project; plan for

the possible risks and mitigation strategies; design the communication strategy with the project stakeholders (Watts, 2018).

Planning for the project objectives guides the project's direction and defines its success (PMI, 2017). This includes outlining the project's objective and scope, as well as its deliverables, limitations, and boundaries. The project objectives should also be in line with the overall organisational strategy or business goals (Kerzner, 2017). The process of project planning requires that clients' expectations and available resources be defined first, matched to set project objectives, so that available options are identified and evaluated and the most appropriate frameworks, strategies and tactics to achieve the objectives are selected. It ends with communicating the objectives and the frameworks, methods, strategies, targets/deadlines to achieve them to people, parties and organizations concerned with their implementation, monitoring and control. The end products of project planning are numerous project plans that represent defined strategies to achieve defined project objectives (PMI, 2017).

The PMI (2017) defines project scope as the total project deliverables that are also necessary in project. The Work Breakdown Structure (WBS) and the Statement of scope (SOS) also called scope statement, are some of the tools used in managing the project scope. The SOS is an agreement of the key stakeholders before project initiation and it outlines the justification of the project, its scope, deliverables, the criteria for meeting the deliverables, and constraints or assumption to be made. The SOS provides the basis for future negotiations on the changes in scope. The WBS describes the SOS in a chart form. It displays the work done and depicts the deliverables of the project but not the activities and task needed for that. A WBS is helpful in allocating resources and also counter checks for omission and overlapping of deliverables (Johansson, 2023). The project scope statement helps the project team to remain focused and be on task. It provides the guidelines for making decisions related to change requests. For an effective scope management, good communication is inevitable as it ensures the project team understands the project's extent and what has been agreed upon in meeting the project's goal (Hanna, Lutkevich, & Pratt, 2023).

Project scheduling is defined as the process of determining when project activities will take place depending upon defined durations and precedent activities. Schedule constraints specify when an activity should start or end, based on duration, predecessors, external predecessor relationships, resource availability, target dates or other time constraints (PMI, 2017). Oburu(2020) views project scheduling as the art of planning and designing all project activities to enable project to achieve its anticipated goals and priorities within the constrain of time and cost. A schedule often includes a specified start and finish date, duration, and resource allocation for each activity. Several techniques are used for project scheduling which include Gantt chart, Critical Path Method (CPM) and the program evaluation and review technique (PERT). CPM schedules the number of tasks in a project and also in order on how they must be completed. PERT uses a visual mapping tools to plan for the project and more suited for initial project timeline planning.

Risk Management

Projects are faced with many risks owing to the environment they have to act. It is important for projects to build a good awareness for both internal and external factor that have an influence on the project environment that create risk to projects. The factors include but not limited to; poor local infrastructure, unclear project objectives, stakeholders' interests, poorly defined scope, social, political and economic environment and many more (Pm4dev, 2019).

Risk identification is the process of identifying the possible risks, characteristics and details of the risks. The aim is to identify the risks and take the necessary corrective and preventive measures to ensure they have minimal impact on the project and the project outcomes (Ayudhya & Kunishima, 2019). The PMI (2017) mentions various tools and techniques used for risk identification in projects. They include but not limited to checklist analysis, assumption analysis, information gathering techniques, document reviews, and diagramming techniques.

Brain storming is the most common technique used for risk identification and uses a risk breakdown structure (RBS) as a checklist. The RBS provides a reflection of the stakeholders' perspectives that is structured to enable distinguish the risks in the various stages including inception, implementation, and closure. The RBS is useful in checking whether the risks coverage is adequate as well identify any gaps in order to identify the areas where the risks are widely and less detailed (Altran, 2018).

Risk analysis which is a multi-step process that aims at finding and evaluating every possible risk and problem that could endanger the project (Association for Project Management, 2018). Risk assessment is integrated in project management in various phases including project planning, project implementation, project monitoring, and project closure (Hyseni, 2024). The project team is given the chance to determine the underlying cause of issues in projects through the use of root cause analysis, a risk assessment and problem-solving methodology. It involves more than just figuring out a problem's primary cause; it also includes assisting the project team in determining the problem's contributors, planning corrective measures, and continuously improving the procedures (Landau, 2023).

A Risk Mitigation strategy entails several components that are important and they include a plan for identifying and analyzing risk as well as the process to determine the likelihood of the risk occurrence. The risk mitigation aspects such as risk mitigation meetings, use of contingency plans, availability of safety systems, and quality assurance (Otieno & Mutiso, 2021).

Risk mitigation is a critical pillar of project Implementation. Risk Response is the reflection on whether the risks are accepted on their basis of level of exposure and the mitigating controls that are in place, or reduction of the risks through addition mitigations in order to bring it in line with the tolerance levels. It is the development of options and actions for enhancing opportunities and reduction of the threats to project objectives (Doval, 2019).

Project Implementation

Generally, implementation dimensions have several indicators and could be influenced by various project characteristics (Kerzner, 2017). Project implementation consists of undertaking activities with the purpose of delivering outputs and monitoring progress compared to the work plan. Durdyev *et al.,* 2018) found that project delivery time get influenced by project characteristics, procurement system, project team performance, client representation's characteristics, contractor characteristics, design team characteristics, and external conditions. Nunes and Abreu (2020) indicated that implementation of projects means carrying out activities proposed in the project plan with the aim of achieving project objectives and delivering results and outputs.

Each project has specific objectives which must be achieved to meet the stakeholder expectation. For the expectations to be well achieved, there should be continuous communication with all the project stakeholders in order to understand their need as expectations and ensure that issues are addressed as they occur, conflicts are managed and appropriate stakeholder engagement for project decisions. Since each project is unique, the project manager should tailor the way project stakeholder management process is applied based on stakeholder diversity, the complexity of the relationships, and the adoption of communication technology (PMI, 2017).

Gupta and Miller (2024) opine that based on reports on the internet, about 37% of projects fail due to undefined milestones and project objectives, and this is due to a lack of effective communication. Delays are common in almost all projects and their effect is felt by everyone involved in the projects. A fully completed project is defined by the extent of success of high-quality products or outputs that pertain to the prescribed goals and dreams forming venture parameters (Hupe & Hill, 2021). In project delivery, project objectives are the focal point of every effort and activity. Project objectives are important in planning because project plans are derived from them. In project planning, project objectives are first defined; thereafter the

strategies to achieve them are formulated and presented as project plans and these are used in evaluating the achievement of the objectives. Project planning can therefore be regarded as the process of defining project objectives, determining the framework, methods, strategies, tactics, targets and deadlines to achieve the objectives and the techniques of communicating them to project stakeholders (Kerzner, 2017).

Cost planning aims at project completion within the approved budget. As for budgets in projects they are important as they influence both planning and execution. Cost planning practices which entail cost budgeting and cost estimating, affect project implementation. The practices in cost planning are essential to ensure completion of a project within the budget (PMI, 2017). Implementation of projects is fairly dependent on the finishing time based on the start to the final delivery of results and this has a proper way of referring to management selections which include budgets, goals and standards (Jackson, 2020). According to Salome (2018), project completion enables the evaluation of seven undertaking performance signs specifically cost, creation time, value predictability, time predictability, defects, client satisfaction with the product and patron preference for the service; and enterprise performance indicators, particularly protection, profitability and productivity.

Empirical Review

Project Planning and Project Implementation

Ocharo and Kimutai (2018) examined the 'project management practices and implementation of power projects in Kenya.' The study specific objectives include to determine the effect of stakeholders'' participation, project planning, project monitoring, and project evaluation. A census of 380 respondents comprising of individuals in the construction projects in the power sector were targeted. The study also adopted an explanatory survey design. The study was guided by stakeholders' theory, resource-based theory, and institutional based theory. The study found that there is a strong correlation between project management practices and implementation of the power projects in Kenya. The study also established 86.8% of changes in implementation of power projects was explained by the project management practices. The study also found that project planning had a direct relationship with project implementation (β = .955, sig = .000). Project planning was also the most influential practice influencing implementation by 81.1% (Ocharo & Kimutai, 2018).

Ronoh (2020) examined the project management practices and performance of construction projects in Nairobi County in Kenya. The study focused on resource scheduling, planning, communication, and M&E as the project management practices. The study was also underpinned by the resource-based view theory, cybernetic theory, realistic evaluation theory, and construction management theory. The study employed a descriptive research design and targeted 79 gated community construction projects in Nairobi County under Knight and Frank as the realtor that were active between 2015-2018. The unit of observation included project managers, contractors, and project supervisors where in total were 237 respondents. The study found a strong correlation between project management practices and performance of construction projects in Nairobi County. The study also established that the project management practices explained 82.6% variation in project performance. Project planning had a significant relationship with performance of construction projects in Nairobi County (β = .263, sig = .000) and also highly influenced performance by 53.4% (Ronoh, 2020).

Similarly, a study by Mavuti et al (2019) on the effects of project management practices on implementation of KPA funded projects found a strong significant correlation (r = .564, sig = .000) between project planning practices and implementation of KPA funded projects. Project planning practices had a direct significant correlation with project implementation (β = .344, sig = .001) though it only influenced implementation by 11.8%. It had the second least influence on project implementation. In another study by Ocharo and Kimutai (2018) project planning practices were found to have direct significant relationship with implementation of

power projects in Kenya (β = .955, sig = .000). It had the highest influence on project implementation at 81.1%. Makutano (2018) found a strong significant correlation (r = .805, sig = .000) between project planning practices and performance of NGOs projects in Nairobi County. Project planning practices had direct relationship with project performance (β = .394, sig = .000) though on 9.5% of performance is influenced by project planning practices.

Risk Management and Project Implementation

Njuguna (2019) in a study on risk management practices and project performance in Nairobi County on 135 project managers. The study found that there is a positive influence or risk control on project performance in Nairobi City County. This was mostly because the organization was found not to identify the risks that were associated with the projects, even if the organization slightly separated the risks from their sources and adequately responded to the defined risks as indicated in the risk management plan. Organizations used risk control mechanisms such as risk response, risk identification, risk segregation and the use of a risk management plan (Njuguna, 2019).

Maghanga and Lewa (2019) examined the 'effects of project risk management practices and performance of cement manufacturing firms; projects in Kenya.' The study adopted a cross-section survey and primary data was collected using a questionnaire. The study targeted 6 cement companies where a total of 162 formed the target population and a sample of 62 individuals involved in the cement manufacturing companies in Kenya. The study established that the risk management practices of risk retention, risk transfer, risk avoidance and risk control were common practices by the cement companies in Kenya. The study also found a significant relationship between risk management practices and performance of cement manufacturing companies in Kenya (Maghanga & Lewa, 2019).

In another study by Mavuti et al (2019) on the effects of project management practices on implementation of KPA funded projects found a strong significant correlation (r = .607, sig = .000) between risk management practices and implementation of KPA funded projects. Risk management practices had a direct significant correlation with project implementation (β = .378, sig = .000) though it only influenced implementation by 10%. It had the least influence on project implementation. Ochenge (2018) investigated project management practices and performance of road infrastructure project in the Lake basin region in Kenya. The study was guided by theory of constraints, project management competency theory, and the resource-based view theory. The project management practices included project risk management, project M&E, group dynamics management, and resource mobilization. A descriptive and explanatory design was adopted. The study found project risk management that included technical risks, organizational risks, and political risks were significantly and positively associated with performance of infrastructure projects (β = .217, sig = .036) even though it only influenced 23.5% of the performance (Ochenge, 2018).

RESEARCH METHODOLOGY

Research design refers to how data collection and analysis are structured to meet the research objectives through empirical evidence economically (Bloomfield & Fisher, 2019). This study will adopt a correlational research design. Correlational research studies are designed to investigate the relationship between variables without the researcher controlling or manipulating any of the variables to obtain the strength or the direction of the relationship between the variables, the direction can be either positive or negative. The target population is defined as all members of a real or hypothetical set of people, events, or objects from which a research study wishes to generalize the results (Bryman & Bell, 2011). The target population for this study was 180 key implementers of the 60 selected solar energy projects implemented in telecommunication sites for Safaricom, Airtel, Telkom Kenya, Atlas Towers, American towers, AlanDick and Seal towers from the telecommunication industry in Kenya. The unit of

observation was the Project Directors, Project Managers and two team members from the selected 60 projects. The unit of analysis was the implemented solar energy projects in the telecommunication industry.

Table 1: Target population

Respondents	Target Population
Project Directors	7
Project Managers	53
Project Team Members	120
Total	180

The sample size, was derived from the target population of 180 key implementers using the Yamane's formula (1967) for estimating sample size of 124 respondents. The sampling technique employed in this study is proportionate Stratified Sampling, a method that ensures equitable representation of all predefined subgroups within the population while maintaining statistical precision and minimizing bias. Proportionate stratified sampling involves dividing the population into distinct, homogeneous strata based on shared characteristics, such as job roles or responsibilities, and then allocating the total sample size to each stratum in proportion to its representation in the overall population (Creswell, 2014). In this case, the population of 180 respondents was stratified into three key subgroups; project directors, project managers, and project team members. This stratification acknowledges the unique roles and perspectives of each subgroup, ensuring that their voices are proportionally reflected in the final sample. Data collection procedure refers to the process of gathering and measuring information on variables of interest in an established systematic function that enables one to answer stated research questions, test hypotheses, and evaluate outcomes (Mazhar, 2021). Questionnaires were developed and prepared to address different targeted respondents to collect primary data from the Project directors, project managers and team members from the telecommunication industry.

The data was analyzed using IBM SPSS Version 27 to carry out descriptive statistics such as means, percentages, and standard deviation. The analysis of variance (ANOVA) will also be conducted to determine the overall model's significance by comparing the calculated f statistic with the tabulated f statistic. A critical p-value of 0.05 will be used to assess the model's significance. The regression model was used to examine and quantify the relationship between a dependent variable and one or more independent variables.

RESEARCH FINDINGS AND DISCUSION

The researcher administered 124 questionnaires out of which only 95 were returned while fully filled. This translated to a response rate of 76.61%. According to Suanders (2011), a response rate of 50% and above is considered adequate for data analysis hence the data can be used to generalize the opinion of the entire population.

Study Variables

The study aim was to determine the relationship of scope management and performance of digitization projects in state agencies in Kenya. The study constituted the independent and dependent variables. The independent variable of the study included; scope definition, scope decomposition, scope control and scope verification. The dependent variable was performance of digitization projects in state agencies in Kenya.

Project Planning

The respondents indicated their level of agreement on various statements relating to the relationship between project planning and implementation of solar energy projects in the telecommunication industry in Kenya. A Likert scale of 1-5 was used, where 1 represented

strongly disagree, 2 represented disagree, 3 represented neutral, 4 represented agree, and 5 represented strongly agree. The descriptive statistics of the analysed data was represented using percentages as shown in the table below.

Table 2: Project Planning

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Descriptive Statistics	
						Mean	SD
Project planning aids in communicating the objectives for the solar energy projects	0.0%	0.0%	0.0%	18.9%	81.1%	4.81	.39
Planning for the solar energy projects leads to achievement of the goals of timely completion and within budget.	0.0%	0.0%	0.0%	17.9%	82.1%	4.82	.39
The scope definition should be shared to the project team member to ensure the project is implemented based on the scope.	0.0%	0.0%	0.0%	36.8%	63.2%	4.63	.48
The schedule plans should be regularly updated to ensure the project timeline is realistic and in real time.	0.0%	0.0%	9.5%	37.9%	52.6%	4.43	.66
The schedule plans should be made available to the project team to ensure team members understand the deliverables.	0.0%	0.0%	0.0%	27.4%	72.6%	4.73	.45

According to the results, 81.1% of the respondents strongly agreed that solar energy projects should have accurate and realistic cost estimates to ensure the project budget isn't affected while 18.9% agreed. The results also indicated that 80% of the respondents strongly agreed that solar energy project should use cost budgeting as tool for estimating the costs based on work packages while 20% of the respondents agreed.

Similarly, the results also found out that 69.5% of the respondents also strongly agreed that modern control techniques should be adapted to track the cost of the solar energy projects while only 30.5% of the respondents agreed that Modern control techniques should be adapted to track the cost of the solar energy projects.

The results also indicated that 57.9% of the respondents strongly agreed that solar energy projects resources should be well allocated to ensure the projects are successfully implemented, 38.9% agreed while 3.2% of the respondents remained neutral. Similarly, 62.1% of the respondents also strongly agreed that the resources for the solar energy project should be well utilized during its implementation as only 37.9% of the respondents agreed that the resources for the solar energy project should be well utilized during its implementation.

Regression Analysis Model for Project Planning and Implementation of Solar Energy Projects in the Telecommunication Industry in Kenya.

Model Summary

Table 3 Model Summary

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.978[a]	.956	.956	.06150

a. Predictors: (Constant), Project Planning

Project planning was found to be a very significant variable in ensuring effective implementation of solar energy projects in the telecommunication industry in Kenya. This is clearly supported by the results found in the table above where the R Square (0.956) which is the coefficient of determination explains 95.6% of the change in the dependent variable which is implementation of solar energy projects in the telecommunication industry in Kenya. This concludes that the relationship is significant hence project planning is a key factor in ensuring effective implementation of solar energy projects in the telecommunication industry in Kenya.

Analysis of Variance

Table 4 Analysis of Variance

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	7.716	1	7.716	2039.974	.000[b]
	Residual	.352	93	.004		
	Total	8.067	94			

a. Dependent Variable: Implementation of Solar Energy Projects

b. Predictors: (Constant), Project Planning

The results indicate that the model was statistically significant. Further, the results imply that the independent variable, project planning was a good predictor of effective implementation of solar energy projects in the telecommunication industry in Kenya. This was supported by an F statistic of 2039.974 which was greater than f critical of 3.95 and the reported p=0.000 which was less than the conventional probability of 0.05 significance level.

Regression Coefficient Analysis

Table 5: Regression Coefficient Analysis

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	1.118	.080		14.010	.000
	Project Planning	.770	.017	.978	45.166	.000

a. Dependent Variable: Implementation of Solar Energy Projects

The study determined the beta coefficient of project planning against the effective implementation of solar energy projects. The beta coefficient of stakeholder involvement was 0.770. The P value of 0.000 was less than the conventional probability of 0.05 significance level. Hence project planning and effective implementation of solar energy projects had a positive and significant relationship. The specific model was as shown below;

$Y = 1.118 + 0.770\ X_1$

Where Y is Effective implementation of solar energy projects

Where X_1 is Project Planning

Risk Management

The respondents indicated their level of agreement on various statements relating to the relationship between risk management and implementation of solar energy projects in the telecommunication industry in Kenya. A Likert scale of 1-5 was used, where 1 represented strongly disagree, 2 represented disagree, 3 represented neutral, 4 represented agree, and 5 represented strongly agree. The descriptive statistics of the analysed data was represented using percentages as shown in the table below.

Table 6: Risk Management

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Descriptive Statistics	
						Mean	SD
Risks for the solar energy projects should be identified during the early stages of the projects.	0.0%	0.0%	0.0%	27.4%	72.6%	4.73	.45
There should be structure frameworks for identifying risk for the solar energy project in the telecommunication industry	0.0%	0.0%	0.0%	26.3%	73.7%	4.74	.44
The financial implication of the solar energy risks should be document to ensure there is preparedness	0.0%	0.0%	17.9%	17.9%	64.2%	4.46	.78
Both internal and external risks for the solar projects should be documented.	0.0%	0.0%	0.0%	45.3%	54.7%	4.55	.50
There should be clear risk mitigation strategies outlined for the solar energy projects to ensure the project implementation isn't affected	0.0%	0.0%	17.9%	37.9%	44.2%	4.26	.75
Risks that have impact on the solar energy projects should be eliminated to ensure the project are effectively implemented	0.0%	0.0%	0.0%	27.4%	72.6%	4.73	.45

According to the results, 72.6% of the respondents strongly agreed that risks for the solar energy projects should be identified during the early stages of the projects while 27.4% agreed. The results also indicated that 73.7% of the respondents strongly agreed that there should be structure frameworks for identifying risk for the solar energy project in the telecommunication industry while 26.3% of the respondents agreed.

Similarly, the results also found out that 64.2% of the respondents strongly agreed that financial implication of the solar energy risks should be document to ensure there is preparedness, 17.9% agreed while 17.9% of the respondents remained neutral. 54.7% of the respondents also strongly agreed that both internal and external risks for the solar projects should be documented while only 45.3% of the respondents agreed that both internal and external risks for the solar projects should be documented.

The results also indicated that 44.2% of the respondents strongly agreed that there should be clear risk mitigation strategies outlined for the solar energy projects to ensure the project

implementation isn't affected, 37.9% agreed while 17.9% of the respondents remained neutral. Similarly, 72.6% of the respondents also strongly agreed that risks that have impact on the solar energy projects should be eliminated to ensure the project are effectively implemented as only 27.4% of the respondents agreed that risks that have impact on the solar energy projects should be eliminated to ensure the project are effectively implemented.

Regression Analysis Model for Risk Management and Implementation of Solar Energy Projects in the Telecommunication Industry in Kenya.

Model Summary

Table 7: Model Summary

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.976[a]	.953	.952	.06409

a. Predictors: (Constant), Risk Management

Risk management was found to be a very significant variable in ensuring effective implementation of solar energy projects in the telecommunication industry in Kenya. This is clearly supported by the results found in the table above where the R Square (0.956) which is the coefficient of determination explains 95.6% of the change in the dependent variable which is implementation of solar energy projects in the telecommunication industry in Kenya. This concludes that the relationship is significant hence risk management is a key factor in ensuring effective implementation of solar energy projects in the telecommunication industry in Kenya.

Analysis of Variance

Table 8: Analysis of Variance

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	7.685	1	7.685	1870.774	.000[b]
	Residual	.382	93	.004		
	Total	8.067	94			

a. Dependent Variable: Implementation of Solar Energy Projects

b. Predictors: (Constant), Risk Management

The results indicate that the model was statistically significant. Further, the results imply that the independent variable, risk management was a good predictor of effective implementation of solar energy projects in the telecommunication industry in Kenya. This was supported by an F statistic of 1870.774 which was greater than f critical of 3.95 and the reported p=0.000 which was less than the conventional probability of 0.05 significance level.

Regression Coefficient Analysis

Table 9 Regression Coefficient Analysis

Coefficients[a]

		Unstandardized Coefficients		Standardized Coefficients		
Model		B	Std. Error	Beta	t	Sig.
1	(Constant)	1.768	.068		25.876	.000
	Risk Management	.643	.015	.976	43.252	.000

a. Dependent Variable: Implementation of Solar Energy Projects

The study determined the beta coefficient of risk management against the effective implementation of solar energy projects. The beta coefficient of stakeholder involvement was

0.643. The P value of 0.000 was less than the conventional probability of 0.05 significance level. Hence risk management and effective implementation of solar energy projects had a positive and significant relationship. The specific model was as shown below;

$Y = 1.768 + 0.643\ X_1$

Where Y is Effective implementation of solar energy projects

Where X_1 is Risk Management

Implementation of Solar Energy Projects in the Telecommunication Industry in Kenya

The respondents indicated their level of agreement on various statements relating to the implementation of solar energy projects in the telecommunication industry in Kenya. A Likert scale of 1-5 was used, where 1 represented strongly disagree, 2 represented disagree, 3 represented neutral, 4 represented agree, and 5 represented strongly agree. The descriptive statistics of the analysed data was represented using percentages as shown in the table below.

Table 10: Implementation of Solar Energy Projects

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Descriptive Statistics	
						Mean	SD
The solar energy projects are meeting their intended objectives	0.0%	0.0%	0.0%	16.8%	83.2%	4.83	.38
The telecommunication industry has witnessed improved signal strength that is consistent as a result of successful implementation of solar energy projects	0.0%	0.0%	0.0%	17.9%	82.1%	4.82	.39
The solar energy projects are implemented within their intended budgets	0.0%	0.0%	0.0%	36.8%	63.2%	4.63	.48
The solar energy projects have minimal cost overruns due to effective project management practices.	0.0%	0.0%	0.0%	27.4%	72.6%	4.73	.45
Project management practices have ensured the projects are completed within their timeline.	0.0%	0.0%	0.0%	37.9%	62.1%	4.62	.49
Effective project management practices have ensured time implementation of the solar energy projects.	0.0%	0.0%	0.0%	36.8%	63.2%	4.63	.48

According to the results, 83.2% of the respondents strongly agreed that solar energy projects should meet their intended objectives while 16.8% agreed. The results also indicated that 82.1% of the respondents strongly agreed that the telecommunication industry can witness improved signal strength that is consistent as a result of successful implementation of solar energy projects while 17.9% of the respondents agreed.

Similarly, the results also found out that 63.2% of the respondents strongly agreed the solar energy projects should be implemented within their intended budgets while 36.8% of the respondents agreed. 72.6% of the respondents also strongly agreed that the solar energy projects can have minimal cost overruns due to effective project management practices while only 27.4% of the respondents agreed that the solar energy projects should have minimal cost overruns due to effective project management practices.

The results also indicated that 62.1% of the respondents strongly agreed that project management practices can help to ensure the projects are completed within their timeline while 37.9% of the respondents remained neutral. Similarly, 63.2% of the respondents also strongly agreed that effective project management practices can ensure timely implementation of the solar energy projects as only 36.8% of the respondents agreed that effective project management practices can ensure timely implementation of the solar energy projects.

Conclusion of the Study

Additionally, the study highlighted the importance of project planning in the implementation of solar energy projects. There is a positive correlation between well-structured planning and project performance. Clearly defining the project scope, communicating project objectives effectively, updating schedule plans regularly, and making schedules accessible to team members were shown to significantly contribute to timely completion and achievement of project goals. Proper planning provides a clear roadmap for the project team, enhances coordination, and minimizes delays.

The study further established that effective risk management is vital for the success of solar energy projects. Early identification of risks, the use of structured frameworks for risk analysis, documentation of financial implications, and the development of clear mitigation strategies were all found to be critical practices. Managing both internal and external risks proactively ensures that potential disruptions are minimized and project objectives are safeguarded.

Recommendations of the Study

Project Planning and Implementation of Solar Energy Projects

Comprehensive project planning is vital for the effective delivery of solar energy projects. Clear definition of the project scope at the early stages must be emphasized to establish well-understood deliverables and boundaries. The scope and project objectives should be consistently communicated to all team members to ensure unified direction during implementation. Project schedule plans should be regularly updated to reflect real-time realities and be made accessible to all relevant stakeholders to enhance coordination and responsibility. The use of detailed, dynamic schedules helps project teams understand key deliverables and milestones, contributing to better time management and timely project completion.

Risk Management and Implementation of Solar Energy Projects

Early identification and documentation of project risks are essential to reduce uncertainties that can derail project implementation. Project teams should adopt structured risk identification frameworks customized for the solar energy and telecommunication sectors. Financial implications of potential risks should be analyzed and documented to prepare contingency plans. It is recommended that both internal and external risks be systematically recorded, with corresponding mitigation strategies clearly outlined. Risk mitigation plans should be proactive rather than reactive, focusing on eliminating or minimizing risks with the greatest potential impact. Regular risk reviews should be incorporated into project monitoring to ensure emerging risks are promptly addressed, safeguarding project success.

Areas for Further Research

Quality management is essential to ensure that solar energy projects meet specified technical standards, regulatory requirements, and performance expectations. In the context of solar installations, poor quality control during procurement, installation, or commissioning phases can lead to significant operational inefficiencies, reduced system lifespan, and increased maintenance costs. Therefore, research focusing on quality planning, quality assurance, and quality control processes could provide valuable insights into how these practices can improve project delivery outcomes.

Specifically, future studies could investigate how the establishment of quality benchmarks, routine inspections, testing protocols, and certification processes impact the overall efficiency, reliability, and cost-effectiveness of solar energy projects. Research could also explore the role of continuous quality improvement mechanisms and how the involvement of qualified technical personnel during different project phases affects implementation success. By focusing on quality management, future studies would contribute to building a body of knowledge that emphasizes not just the completion of solar energy projects, but the delivery of durable, high-performing, and sustainable energy solutions. Understanding the link between robust quality management practices and project performance will be critical for achieving long-term value from solar energy investments.

REFERENCES

Acheampong, E. A. (2019). 'Stakeholder management practices in public infrastructure delivery in Ghana municipal and disrict assemblies in the eastern region of Ghana'. Msc in Project Management, Kwame Nkrumah University of Science and Technology,, Construction Technology and Management, Kumasi.

Alinea, K. M., Gamariel, N., & Placide, M. (2022). "Role of Project Management Practices on Performance of Agriculture Projects: A Case of Price II Project in Musanze District, Rwanda (2019-2020)". *International Journal of Social Sciences: Current and Future Research Trends, 13*(1), 133 - 141.

Cronbach, L. J. (1951). Coefficient alpha and the interval structure of tests. *Psychometrika, 16*, 297–334.

GSMA Intelligence. (2023). *'Going green: Benchmarking the energy efficiency of mobile networks* (2nd ed.). Retrieved from https://data.gsmaintelligence.com/research/research/research-2023/going-green-benchmarking-the-energy-efficiency-of-mobile-networks-second-edition-

Gurhan, I. M., & Nyang'au, P. S. (2020). Effect of project management constraints on implementation of public housing projects in Isiolo County, Kenya. *Int Journal of Social Sciences Management and Entrepreneurship, 4*(1), 247-267.

Haron, N., Devi, P., Hassim, Aloias, A., Tahir, M., & Harun, A. (2018). 'Project management practice and its effects on project success in Malaysian construction industry '. *International Conference on Architecture and Civil Engineering (ICACE 2018).* IOP Publishing.

Kaluai, F. K. (2020). "Proejct manageemtn practices and performance of project under the women and girls economic empowerment program in Kiambu and Nairobi City Counties, Kenya". MBA in project management, Kenyatta University, Nairobi.

Kerzner, H. (2017). Project Management: A systems approach to planning, scheduling, and controlling (10th ed.). New Jersey: John Wiley & Sons, Inc.

Klugiewicz, M. (2024). *'The Importance of Solar Power in Transforming Telecommunication Infrastructure'*. Retrieved from linkedin.com: https://www.linkedin.com/pulse/importance-solar-power-transforming-telecommunication-klugiewicz-ubvjf/

Maghanga, E. M., & Lewa, E. (2019). "Influence of Project Risk Management Practices on the Performance of Cement Manufacturing Firms' Projects in Kenya". *International journals of academics & research, 1*(4), 204 - 208. doi: 10.32898/ibmj.01/1.4article19

Mavuti, B. M., Kising'u, T. M., & Oyoo, J. J. (2019). "Effect of project management practices on implementation of Kenya Ports Authority Funded projects". *Strategic Journal of Business & Change Management, 6*(2), 1110 - 1129.

Mkutano, S. M. (2018). "Project management practices and perormance of Non-goverenemntal organizations proejcts in Naiorbi City County, Kenya". MBA thesis, Kenyatta University, Nairobi.

Mutiso, R., & Nyang'au, S. (2021). Project Cost Management And Successful Implementation of Machakos County Government Funded Water Projects, Kenya. *International Journal of Innovative Development and Policy Studies, 1*(18), 1-18.

Ngwai, F. M., Simba, F., & Oyoo, J. J. (2019). "Influence of project management practices on construction cost control of projects in Mombasa County". *The Strategic Journal of Business & Change Management, 6*(3), 314 - 330.

Nkundumpaye, S., & Dushimimana, J. D. (2022). "Project management practices and performance of agriclutural cooperatives the case of COTUMU cooperative in Gakenke district , Rwanda". *Voice of Research, 11*(1), 109 - 120.

Nsengiyumva, J., & Ogbe, A. (2022). 'assessment of stakeholder engagement practices and the project performance of prime cement ltd , Musanze district , Rwanda'. *Global Scientific Journals, 10*(12), 1477-1494.

Ocharo, R. N., & Kimutai, G. (2018). " Project management practices and implementation of power projects in Kenya". *International Academic Journal of Information Sciences and Project Management,, 3*(1), 28-46. Retrieved from http://www.iajournals.org/articles/iajispm_v3_i1_28_46.pdf

Otieno, F. S., & Mutiso, J. (2021). 'Infleunce of project risk management on performance of agricultural projects in Nakuru County, Kenya'. *International Research Journal Publishers, 2*(2), 371-387.

PMI. (2017). *A Guide to the Project Management Body of Knowledge: PMBOK Guide* (6th ed.). Newtown Square, PA: Project Management Institute, Inc.

PMI. (2017). Guide to the Project Management Body of Knowledge PMBOK Guide 6th Edition. Newtown Square: Project Management Institute, Inc.

Ramadhani, A. C., & Yusuf, M. (2019). Influence of project management practices on implementation oof NG-CDF fundende projects in Nyali constitunecy. *International Journal of Management and Commerce Innovations, 7*(1), 173-182.

Ramadhani, A., & Yusuf, M. (2019). Influence of project management practices on implementation of NGCDF projects in Nyali Constituency. *International Journal of Management and Commerce Innovations, 7*(1), 173-182.

Warsame, A. A. (2023). 'Project management practices and sustainability of donor funded projects: A case of Somali health nutrition programme, Abduwak Galmudug state of Somalia'. MA thesis, University of Nairobi, Nairobi.

Yamane, T. (1967). *Statisitics: An Introduction Analysis* (2nd ed.). New York: Harper and Row.