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PROJECT QUALITY AND PERFORMANCE OF SOLAR ENERGY TECHNOLOGY AMONG GAS AND FUEL RETAIL STATIONS IN NAIROBI CITY, KENYA

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ABSTRACT

The growing demand for sustainable energy solutions, coupled with the challenges posed by the high operational costs and environmental impacts of fossil fuel-based power systems, necessitates the adoption of alternative energy sources like solar technology. In Kenya, the downstream oil sector, particularly the Fuel and Gas Retail Stations, faces increasing energy costs and environmental concerns related to its reliance on fossil fuels. To address these challenges, integrating solar energy technology has become a promising solution. However, the successful implementation of solar projects requires effective management of project quality to ensure optimal performance and long-term sustainability. This study aimed to evaluate the impact of project quality on the performance of solar technology projects at the stations, specifically within the Nairobi region's downstream oil sector. The research focused on key aspects of project quality; quality assurance, and quality control. The primary objectives were to assess how each of these factors influence the performance of solar technology projects at the stations. A descriptive research design was adopted, combining both qualitative and quantitative methods to provide a comprehensive analysis. The target population included 192 participants from various stations' departments, including Gas and Fuel Station Dealers, Station Managers and Projects and Maintenance Engineers, Data was collected through structured questionnaires for quantitative analysis and semi-structured interviews for qualitative insights. Quantitative data was analyzed using SPSS, while qualitative responses was analyzed through content analysis to identify emerging themes.

Key Words: Solar Energy Technology, Gas and Fuel Retail Stations, Project Quality, Quality Assurance, Quality Control

Background to the study

The global adoption of solar energy is increasingly acknowledged for its economic and environmental benefits. In sectors with high energy demands, such as the downstream oil industry which includes refining, distribution, and retail of petroleum products solar power offers a promising alternative to the traditional reliance on fossil fuels. Solar energy provides a more sustainable energy source, leading to both long-term cost reductions and environmental conservation (IEA, 2023).

Global solar power capacity had exceeded 1,000 gigawatts (GW), according to the International Energy Agency, by 2023, with much of this growth attributed to innovations in solar photovoltaic (IEA, 2023). Organizations that have implemented solar energy report significant savings, with energy costs decreasing by as much as 40% (National Renewable Energy Laboratory, 2019).

Environmental wise, the adoption of solar power plays a critical role in lowering carbon emissions and supporting international climate goals. Projections from the Global Carbon Project (GCP) suggest that a broader adoption of renewable energy, including solar, could potentially prevent up to 3.5 billion metric tons of carbon dioxide emissions annually by 2030 (Global Carbon Project, 2023). For the downstream oil industry, which is a considerable source of greenhouse gas emissions, transitioning to solar energy could be essential for reducing its environmental impact. Kenya, positioned along the equator, receives ample sunlight, making solar energy a highly viable yet underutilized resource. The Fuel and Gas Retail Stations, a state-owned enterprise, currently relies on diesel-powered generators for backup power, leading to escalating operational costs. The adoptions of solar technology could offer the stations a sustainable solution to reduce these expenses, improve operational efficiency, and decrease its environmental footprint.

According to the Project Management Institute (2021), effective management of project quality is crucial for the successful execution and performance of solar energy projects, especially within the downstream oil industry. Elements such as quality control and ongoing quality assurance are fundamental in ensuring that solar initiatives achieve their goals while staying within budget and meeting timelines.

The Project Management Institute (2021) notes that organizations focusing on quality in project management tend to experience higher levels of customer satisfaction, decreased project costs, and improved overall results. According to Zhang et al. (2020), establishing strong quality control practices is essential for reducing defects and ensuring the efficient operation of solar energy systems. Additionally, research indicates that a strong focus on project quality can enhance operational performance, which is particularly important in energy-intensive fields like oil and gas.

Statement of the problem

The fuel and gas retail sector in Nairobi City, Kenya, is a significant consumer of energy heavily relying on diesel-powered generators to meet its operational energy needs. This reliance on fossil fuels not only results in high operational costs but also contributes substantially to environmental degradation, with the oil and gas sector accounting for approximately 40% of global CO2 emissions (International Energy Agency, 2023). In Kenya, the sector’s dependence on fossil fuels exacerbates the country’s environmental challenges, making it crucial to explore alternative, sustainable energy sources like solar power.

Solar energy are among the most deliberated on energy topic in Kenya. It has been at the Centre of regional and national energy policy agenda and different actors both state and non-state have taken steps to resolve energy quality and efficiency. Despite Kenya's abundant solar resources

and the country's ambitious renewable energy targets, including a goal of achieving 100% renewable electricity generation by 2030 (Kenya Renewable Energy Association, 2023), solar energy remains underutilized in the fuel and gas retail sector. The growing scale of solar energy projects mandates a need to ensure that all the work product created adheres to the highest quality standard. The country's potential for solar energy is estimated at approximately 15 GW. The installed solar power capacity connected to the national grid is 210.3MW, which is 6.5% of the total installed capacity. (Epra, 2025). As of June 30, 2024, renewable energy accounted for 79.89% of Kenya's electricity generation (KREA, 2024), yet the transition to solar energy within urban energy-intensive sectors, such as fuel and gas retail stations in Nairobi region, has not been widely adopted. One of the concerns of the adoption of solar energy technology in downstream oil sector is the quality of the projects implemented and how it affects the performance of solar energy.

Integrating solar energy in this sector presents a clear opportunity to reduce energy costs, lower dependence on fossil fuels, and mitigate environmental impacts but it is very critical for project quality to be observed in its planning and execution. Many researchers including (Naomi, 2014) have investigated indicators of project success and impact on policy process in Kenya but there has been limited research on how project quality affects the performance of solar energy projects among downstream oil sector. Therefore, the study aims to find out whether indeed Project quality variables namely quality assurance and quality control affects performance of solar energy technology as an alternative source of energy for gas and fuel retail stations in Nairobi city, Kenya

General objective of the study

The general objective of this study is to evaluate the effects of project quality on performance of solar energy technology among gas and fuel retail stations in Nairobi City, Kenya.

Specific objectives of the study

i. To assess the effects of quality assurance on performance of solar technology projects among gas and fuel retail stations in Nairobi City, Kenya.

ii. To determine how quality control influences the performance of solar technology projects among gas and fuel retail stations in Nairobi City, Kenya.

LITERATURE REVIEW

Theoretical Review

Stakeholder Theory

Stakeholder Theory asserts that organizations should account for the interests of all parties that are either affected by or have the ability to influence project outcomes. Initially introduced by Freeman (1984), this theory underscores the need for businesses and projects to address the concerns of various stakeholders, including investors, employees, customers, suppliers, regulatory bodies, and the wider community. Engaging stakeholders effectively is essential for project success, as their expectations and input can shape decision-making and overall performance.

In the context of adopting solar technology in fuel and gas retail stations, this theory emphasizes the necessity of involving key stakeholders such as government agencies, environmental groups, customers, and investors. Their participation can enhance project quality and sustainability by fostering support, minimizing resistance, and encouraging broader acceptance of solar energy solutions. Furthermore, proactive stakeholder involvement aids in

identifying potential risks and opportunities, leading to well-informed decisions and improved project execution (Donaldson & Preston, 1995).

This study adopts Stakeholder Theory to assess how stakeholder engagement influences the effectiveness of solar technology projects. It investigates the collaboration between fuel and gas retailers and regulatory bodies to ensure adherence to energy policies, the role of customer awareness in solar adoption, and the impact of financial contributors on project feasibility. By analyzing these factors, the research aims to illustrate the role of stakeholder management in the successful integration of solar technology within Nairobi County.

Diffusion of Innovation Theory

The Diffusion of Innovation (DOI) Theory, introduced by Rogers (1962), describes how new ideas, technologies, and practices spread within a society. The theory outlines five key factors that influence the adoption of innovations: perceived benefits, compatibility with existing systems, ease of use, trialability, and visibility of results. It also classifies adopters into five categories—innovators, early adopters, early majority, late majority, and laggards—each playing a role in how quickly an innovation gains acceptance.

In the context of solar energy adoption in fuel and gas retail stations, the DOI Theory provides a framework for understanding the pace and extent of implementation. Adoption rates depend on aspects such as the economic advantages of solar technology, its suitability for existing power infrastructure, and the simplicity of integration. Additionally, the willingness of early adopters, such as environmentally conscious businesses, to showcase successful applications can accelerate wider adoption.

This research applies the Diffusion of Innovation Theory to explore the drivers and challenges of integrating solar technology into fuel and gas retail operations in Nairobi County. By examining stakeholders' awareness, attitudes, and experiences, the study aims to determine how different factors shape adoption trends. Gaining insights into these adoption patterns will help businesses enhance implementation strategies, leading to improved project quality and long-term success in renewable energy utilization.

Conceptual Framework

This study's conceptual framework focuses on the interplay between project quality Elements (independent variables) and the performance of solar technology (dependent variable) among the Fuel and Gas Retail Stations. Figure 1 below shows the conceptual framework of the study.

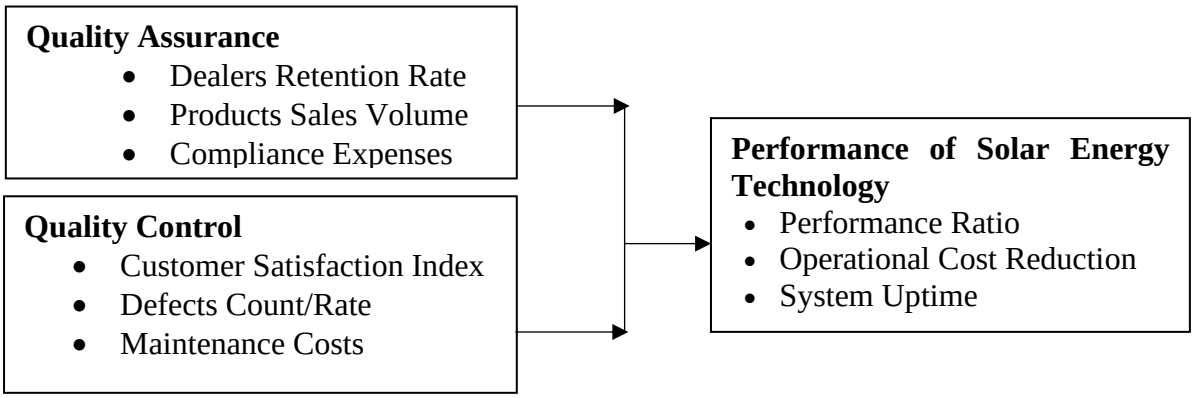

Figure 1: Conceptual framework

Empirical Review

Effects of Quality Assurance on the Performance of Solar Technology Projects

Quality assurance processes are crucial for improving the performance of solar technology projects, as they ensure that all deliverables meet established standards and stakeholder expectations. Research by Othman et al. (2021) found that projects with strong quality assurance protocols experienced fewer defects and less rework, resulting in significant gains in efficiency and cost savings. Their study emphasized that systematic quality assurance practices, including regular audits and compliance with international standards, enhance the reliability of solar technology installations and improve overall project outcomes. These findings suggest that organizations that prioritize quality assurance are more likely to successfully deliver solar projects that meet both performance and regulatory requirements.

In addition, a study by Tran and Le (2022) examined how quality assurance processes impact stakeholder satisfaction in solar energy projects. Their research indicated that effective quality assurance practices, such as transparent reporting and active stakeholder engagement throughout the project lifecycle, significantly increased satisfaction levels among clients and end-users. The study showed that integrating quality assurance into the project management framework fosters trust and confidence in project deliverables. This alignment between quality assurance and stakeholder expectations ultimately enhances the perceived value of solar technology projects, which is essential for success in a competitive market.

Parsa et al. (2020) found that projects employing comprehensive quality assurance frameworks, which include detailed planning, monitoring, and evaluation, achieved superior performance metrics regarding cost control and timely completion. Their findings revealed that routine inspections and adherence to quality standards reduced project delays and budget overruns. This research highlights the benefits of a proactive approach to quality assurance, which not only mitigates risks but also improves operational efficiency, leading to successful project delivery.

Alavi and Mohtashami (2023) explored the relationship between quality assurance practices and project team dynamics in solar energy initiatives. The study found that effective quality assurance processes promote a culture of accountability and collaboration among team members, positively influencing project outcomes. Engaging team members in activities like peer reviews and collaborative problem-solving enhances communication and trust within the team. This collaborative environment contributes to higher quality deliverables and increased overall project success, suggesting that integrating quality assurance into project management can improve both technical aspects and team performance.

Fadhl et al. (2022) discovered that projects with clearly defined quality assurance protocols encountered fewer quality-related issues, leading to improved timelines and cost efficiency. Their research emphasized that rigorous quality assurance practices, such as systematic testing and validation of solar components, not only ensure compliance with industry standards but also enhance the reliability and durability of solar installations. The results indicate that investing in quality assurance minimizes the likelihood of failures and supports the long-term sustainability of solar projects.

Furthermore, Yang and Zhou (2021) investigated how quality assurance processes facilitate stakeholder engagement in solar energy projects. The study revealed that effective quality assurance practices enhance communication with stakeholders, resulting in greater transparency and trust throughout the project lifecycle. By involving stakeholders in quality assurance activities, such as feedback loops and quality reviews, projects can better align with stakeholder expectations. This engagement not only boosts stakeholder satisfaction but also contributes to smoother project execution, highlighting the importance of integrating quality

assurance into project management for optimizing both technical performance and stakeholder relationships.

Influence of Quality Control on the Performance of Solar Technology Projects

Quality control measures are essential for the success of solar technology projects, as they ensure that all components and processes adhere to established quality standards. Research by Chen et al. (2021) found that projects with strict quality control protocols, such as regular inspections and testing of solar panels and installations, achieved significantly higher performance metrics, including lower defect rates and enhanced operational efficiency. Their study indicated that effective quality control minimizes the risk of failures throughout the project lifecycle and bolsters the overall reliability of solar systems. By implementing robust quality control measures, organizations can ensure optimal performance of their solar projects, leading to increased customer satisfaction and long-term sustainability.

Memon et al. (2022) examined the connection between quality control measures and project outcomes in the solar energy sector. Their findings revealed that projects employing comprehensive quality control strategies—such as process monitoring and thorough documentation—experienced fewer delays and cost overruns. The research underscored that effective quality control promotes a culture of accountability among project teams, fostering better communication and collaboration. This alignment with quality objectives ultimately enhances project performance. The study concluded that emphasizing quality control is vital for optimizing project execution and achieving strategic goals within solar technology initiatives.

Alkhazaleh and Ameen (2021) investigated the impact of quality control practices on solar project outcomes, demonstrating that rigorous quality checks lead to significant improvements in both efficiency and reliability. Their research highlighted that systematic quality control processes, including pre-installation inspections and ongoing monitoring during operation, resulted in a notable decrease in system failures and maintenance costs. This suggests that effective quality control not only contributes to immediate project success but also ensures the long-term operational viability of solar technologies.

Additionally, Patel et al. (2023) explored the relationship between quality control measures and stakeholder trust in solar energy projects. Their findings indicated that projects with well-defined quality control protocols enhanced transparency and accountability, which in turn boosted stakeholder confidence. By upholding high-quality standards and providing regular updates on quality metrics, project teams were able to cultivate strong relationships with clients and regulatory bodies. This trust is critical for securing future investments and support for solar initiatives. The study concluded that prioritizing quality control not only enhances technical performance but also positively impacts stakeholder engagement, ultimately leading to greater project success.

RESEARCH METHODOLOGY

The research design encompasses the strategies and procedures for collecting and analyzing data, establishing a structured framework for the study (Mugenda & Mugenda, 2012). This study adopted a descriptive research design using both qualitative and quantitative methods. This is a scientific method of investigation in which data is collected, processed, analyzed and presented in order to describe the current conditions, terms or relationships concerning a certain field (Mugenda, 2018). The case study approach was utilized to provide an in-depth analysis of Fuel and Gas Retail Stations Operations. This study was conducted in Fuel and Gas Retail Stations in Nairobi City. Nairobi City has three hundred and seventy (370) Stations from various independent and ten main gas and fuel service providers which include, Rubis Energy Kenya, Ola Energy Kenya, Astrol Petroleum Kenya, National Oil Corporation of Kenya, Shell

Energy Kenya, Luqman Petroleum Ltd, Oryx Energies Kenya, Total Energies Kenya, Lexo Energies Kenya, Hass Petroleum Ltd. These ten gas and fuel service providers constitute 82.4% of stations in Nairobi City. The target for this study population wasStation Managers of each fuel and gas service providers. The target population of the study was therefore 370 respondents from each station.

Table 1: Solarized Fuel Stations within Nairobi City

No.	Gas and Fuel Provider	Population	Solarized Stations	Percentage (%)
1	Rubis Energy Kenya	62	20	32.2
2	Ola Energy Kenya	45	1	2.2
3	Astrol Petroleum Kenya	13	1	7.7
4	National Oil Corporation of Kenya	15	0	0
5	Shell Energy Kenya	56	38	67.8
6	Luqman Petroleum Ltd	12	0	0
7	Oryx Energies Kenya	16	0	0
8	Total Energies Kenya	54	46	85
9	Lexo Energies Kenya	18	0	0
10	Hass Petroleum Ltd	14	0	0
11	Independent stations	65	0	0
	Totals	**370**	**106**	**28.6%**

Source: EPRA (2024)

A purposive sampling technique was employed to select key personnel who is knowledgeable about the stations' energy usage, daily operations. Station manager who is involved in daily operations of the fuel stations and conversant with monthly Power utility bills and stations products sales volumes were engaged in this study. In determining the sample size for study research, Yamane Formula [n =N/ (1+N(e)^2 was used. A sample size of 192 stations was involved in the study with one respondents from each station of independent and other main gas and fuel service providers in Nairobi City. Participants were Station managers for each service station who was selected for interviews and surveys. Therefore, the sample size population for carrying out the research was 192 respondents.

Quantitative data on energy consumption patterns, costs, and potential savings was collected through structured questionnaires distributed to relevant staff and departments at the stations together with Gas and fuel stations management team. To gain a comprehensive understanding of Fuel and Gas Retail Stations' energy strategies, semi-structured interviews was conducted with key management personnel within the organization and at gas and fuel stations. These interviews involved open-ended questions designed to elicit detailed qualitative insights into the company's current energy practices, challenges, and perspectives on the adoption of solar energy. The goal is to uncover nuanced information about decision-making processes, strategic objectives, and perceived benefits and drawbacks of integrating solar power. The interviews were recorded and transcribed for thorough analysis, allowing for an in-depth exploration of management's views and experiences related to energy strategies.

A thorough review of Fuel and Gas Retail Stations' and Fuel stations operational reports and energy-related documents was undertaken to gather secondary data on the company's energy usage, products sales volumes and financial performance. This involved examining internal reports, monthly products sales volumes, energy audits, financial statements, Fuel stations power utility bills and other relevant documents to assess historical energy consumption, cost structures, and previous energy efficiency initiatives. The document review provided contextual background and corroborative evidence to support findings from interviews and

questionnaires, offering a comprehensive view of Fuel and Gas Retail Stations' energy practices and the potential impact of solar energy adoption on their operations at gas and fuel stations.

Quantitative data was coded and analyzed using Statistical Software Package for Social Science (SPSS) while data from interview schedules was coded, and the responses to each item were categorized into specific main themes. The quantitative data obtained from these research instruments was analyzed using frequencies and inferential statistics. Descriptive statistics, including frequencies, means, and standard deviations, was employed to analyze data from observation schedules. Qualitative analysis involved content analysis and the identification of common themes emerging from the interview responses. Quantitative data collected was analysed using descriptive and inferential statistical tools. Pearson R correlation was used to measure the strength and direction of linear relationship between variables. Multiple regression models was fitted to the data in order to determine how the independent variables influence the dependent variable.

RESEARCH FINDINGS AND DISCUSSIONS

One hundred and ninety-two (192) questionnaires in total were administered but the researcher managed to obtain one hundred and thirty (130) completed questionnaires representing a 67.7% response rate. The questionnaire contained questions that addressed the objective of the study.

Quality Assurance

The respondents were asked to indicate their level of agreement with various statements regarding the influence of quality assurance on the performance of solar technology projects. Table 2 presents the distribution of responses on the influence of quality assurance on the performance of solar technology projects.

Table 2: Responses on the Influence of Quality Assurance on the Performance of Solar Technology Projects.

Statement	SA		A		UD		D		SD	
	F	%	F	%	F	%	F	%	F	%
Undertaking quality Assurance in solar energy projects leads to increased fuel products sales volume.	55	42.3	70	53.8	-	-	5	3.8	-	-
Adherence to quality Assurance standards results in fewer defects and higher project success rate.	61	46.9	65	50.0	-	-	4	3.1	-	-
Implementing quality assurance during the planning and execution phases increases the reliability of solar energy projects.	54	41.5	74	56.9	2	1.5	-	-	-	-
High Dealers retention rate in ownership of gas and fuel retail stations is an indication of high quality assurance on solar projects.	55	42.3	70	53.8	5	3.8	-	-	-	-
Good quality assurance on solar energy projects leads to low compliance expenses.	34	26.2	87	66.9	-	-	9	6.9	-	-

As shown in Table 2 above, slightly more than half (53.8%) of the respondents agreed that undertaking quality assurance in solar energy projects leads to increased fuel product sales

volume, supported by 42.3% who strongly agreed with the statement, while only 3.8% disagreed. A majority (50.0%) of the respondents agreed that Adherence to quality assurance standards results in fewer defects and higher project success rate. This was strongly supported by 46.9% of them who strongly agreed with the statement, while a small percentage (3.1%) disagreed. Regarding whether implementing quality assurance during the planning and execution phases increases the reliability of solar technology projects, more than half (56.9%) of the respondents agreed with the statement. This was supported by 41.5% who strongly agreed, while only 1.5% were undecided.

Slightly more than half (53.8%) of the respondents agreed that high dealers retention rate in ownership of gas and fuel retail stations is an indication of high quality assurance on solar projects. This was strongly supported by 42.3% of them who strongly agreed, and only 3.8% were undecided. On whether good quality assurance on solar energy projects leads to low compliance expenses, a majority 66.9% agreed with the statement. This was supported by 26.2% who strongly agreed, while 6.9% disagreed. From these findings, it can be concluded that quality assurance significantly influences the performance of solar technology projects by ensuring increased products sales volumes, minimizing defects, improving Performance of solar technology projects rates, enhancing dealer retention rate, and reducing compliance expenses.

This finding aligns with the study by Alghamdi et al. (2020), which established that effective quality assurance practices in renewable energy projects reduce operational risks and promote sustainability. Similarly, Al-Sabek (2022) emphasized that integrating strong quality assurance frameworks enhances the performance and reliability of solar energy systems in critical sectors like gas and oil stations.

The respondents were further asked to indicate the extent to which quality assurance affects the performance of solar technology projects. Figure 1 below shows the distribution of responses on the extent to which quality assurance affects the performance of solar technology projects.

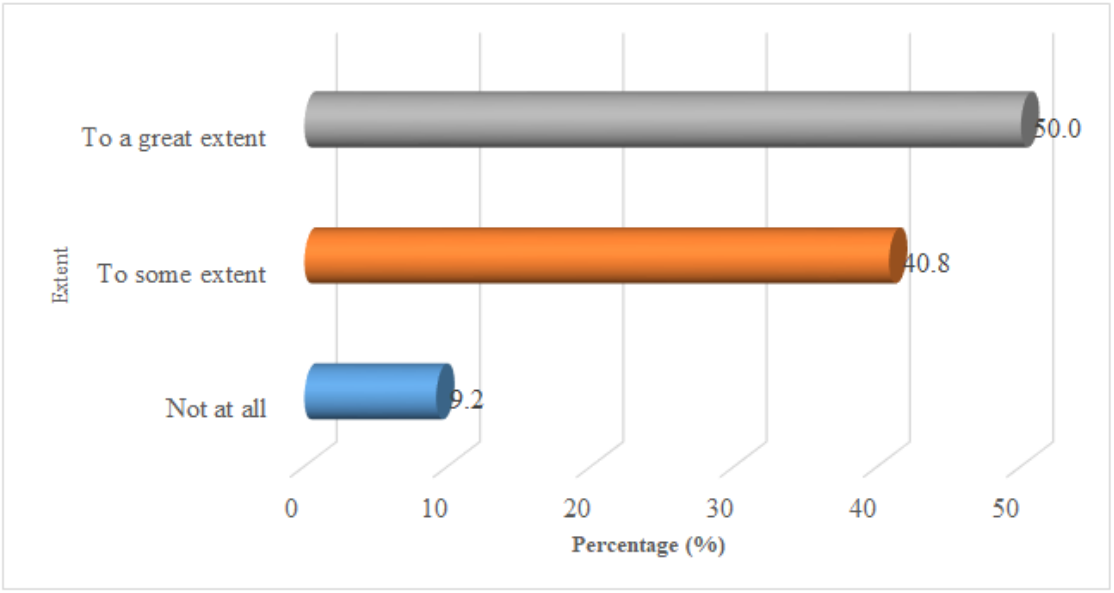

Figure 1: The Extent to which Quality Assurance Affects the performance of Solar Technology Projects

As shown in Figure 1, half (50.0%) of the respondents indicated that quality assurance affects the performance of solar technology projects to a great extent while 40.8% of them stated that

quality assurance affects the performance of solar technology projects to some extent. Only 9.2% of them reported that it does not affect the performance of solar technology projects

Quality Control

The respondents were asked to indicate their level of agreement with the following statements on the influence of quality control on the performance of solar technology projects. Table 3 below shows the distribution of responses on the issue.

Table 3 Responses on the Quality Control on the Performance of Solar Technology Projects.

Statement	SA		A		UD		D		SD	
	F	%	F	%	F	%	F	%	F	%
Implementing quality control significantly improves the overall performance of solar technology projects.	37	28.5	68	52.3	-	-	25	19.2	-	-
Improved Customer satisfaction index is an indication of a good quality control measures in solar energy projects.	37	28.5	54	41.5	-	-	39	30	-	-
Carrying out Quality control measures ensures that solar technology projects meet all planned technical and safety standards.	55	42.3	70	53.8	-	-	5	3.9	-	-
Performing quality control measures results in low maintenance costs in running of solar energy projects.	34	26.2	87	66.9	-	-	9	6.9	-	-
Proper execution of quality control measures leads to low defects counts in solar energy projects.	39	30.0	75	57.7	-	-	12	9.2	4	3.1

As shown in Table 3 above, slightly more than a quarter (28.5%) of the respondents strongly agreed that implementing quality control significantly improves the overall performance of solar technology projects. This was supported by 52.3% of them who agreed with the statement, while 19.2% disagreed. Regarding whether improved customer satisfaction index is an indication of good quality control measures in solar energy projects, 28.5% of the respondents strongly agreed with the statement, and 41.5% agreed. However, 30% disagreed, suggesting a strong perception among respondents. On whether carrying out quality control measures ensures that solar technology projects meet all planned technical and safety standards, an overwhelming majority (42.3%) of the respondents strongly agreed with the statement, supported by 53.8% who agreed. Only 3.9% disagreed indicating a strong consensus.

Most respondents (66.9%) agreed that performing quality control measures results in low maintenance costs in running solar energy projects. This was supported by 26.2% who strongly agreed, while only 6.9% disagreed. On whether proper execution of quality control measures leads to low defect counts in solar energy projects, 30.0% of the respondents strongly agreed with the statement, and 57.7% agreed. Only a small percentage (9.2%) disagreed and 3.1% strongly disagreed.

These findings imply that quality control practices are critical for enhancing the performance, minimum maintenance costs, low project defects counts, improved customer satisfaction index and cost-efficiency of solar technology projects. Similar conclusions were drawn by Agyekum et al. (2020), who found that effective quality control mechanisms contribute significantly to Performance of solar technology projects, defect reduction, and operational sustainability in

renewable energy projects. Furthermore, Arditi and Gunaydin (1997) emphasized that systematic quality control in construction and energy projects ensures technical compliance, minimizes risks, and improves stakeholder satisfaction.

The study further sought to examine the extent to which quality control affects the performance of solar technology projects. Figure 4.4 below shows the distribution of responses on the extent to which quality control affects the performance of solar technology projects.

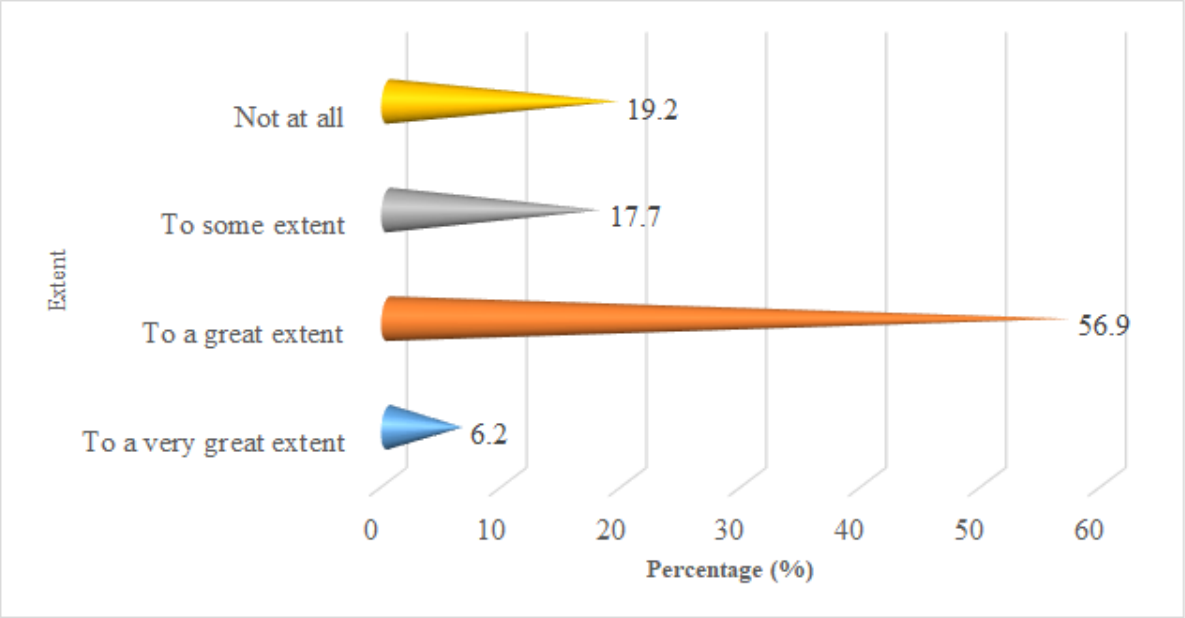

Figure 2: The Extent to which Quality Control Affects the performance of Solar Technology Projects

As shown in Figure 2, slightly more than half (56.9%) of the respondents indicated that quality control affects the performance of solar technology projects to a great extent. This was followed by 19.2% of the respondents who stated that quality control does not affect performance at all, and 17.7% who felt that quality control affects performance to some extent. Only 6.2% of the respondents reported that it affects the performance to a very great extent. These results suggest that while a majority recognize the importance of quality control in influencing the performance of solar technology projects, the degree of perceived impact varies among respondents.

Regression Results

The results for the regression analysis are presented in the sections below. The regression coefficients are presented in table 4 below.

Table 4.6: Coefficients table

Coefficients[a] Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.878	.586		4.914	.000
	Quality assurance	.36	.076	-.030	-.475	.088
	Quality control	.253	.075	-.213	-3.382	.093
a. Dependent Variable: Performance of solar energy technology						

The B values and the p-value to check for significance are depicted in table 4.6 above. We reject Ho if p< .05. This means the relationship is reliable and can be used to make predictions. The findings also show the contribution of each variable in explaining the influence of Project Quality on Performance of solar technology projects in Nairobi City, Kenya as depicted by unstandardized beta values which assess the contribution of each variable towards the prediction of the dependent variable. The overall equation as suggested in the conceptual framework can be represented by use of unstandardized coefficients as follows:

Therefore, the regression model was as follows;

Y = 2.878 + (0.36 X1) + (0. 253 X2).

A unit change in Quality assurance would result in 0.364 change in Performance of solar technology projects and a unit change in Quality control would result in 0.253 change in Performance of solar technology projects. Findings in the table also show that quality assurance (p=0.088) and Quality control (p=0. 093) were all statistically significant.

CONCLUSIONS

It is also concluded that quality assurance significantly enhances the performance of solar technology projects. Implementing quality assurance measures during the planning and execution phase's increases products sales volumes, reliability, reduces defects, and improves overall project outcomes, increases dealer retention rate and lower compliance costs.

The findings further reveal that quality control plays a critical role in the performance of solar technology projects. Proper execution of quality control measures ensures that solar projects meet technical and safety standards, enhances customer satisfaction, and leads to lower maintenance costs and defect counts.

RECOMMENDATIONS OF THE STUDY

Quality Assurance

i. Strict adherence to quality assurance standards should be maintained during all phases of solar technology projects to ensure reliability and minimize defects.
ii. Stakeholder engagement should be strengthened by applying quality assurance principles that promote relationship building and communication.
iii. Project managers should continuously monitor and assess compliance expenses as a metric for effective quality assurance.

Quality Control

i. Quality control practices should be enforced throughout project execution to guarantee technical and safety compliance.
ii. Customer satisfaction indices should be used as a measure of quality control effectiveness, aiming to enhance service delivery in solar projects.
iii. Continuous quality checks should be implemented to reduce maintenance costs and defect rates over the lifespan of solar technology installations.

Suggestions for Further Studies

Based on the findings and scope of this study, the following suggestions are made for future research:

i. Future studies could be conducted in different counties or at a national level to provide a broader understanding of how quality assurance and quality control influence the performance of solar technology projects across diverse contexts.

ii. Additionally, research could also investigate how digital technologies, such as real-time monitoring systems and AI-based quality management tools, impact the quality control and assurance processes in solar technology projects.

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