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PROJECT MANAGEMENT PROCESSES AND THE IMPLEMENTATION OF GEOTHERMAL POWER PROJECTS IN NAKURU COUNTY KENYA

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ABSTRACT

This study sought to investigate the influence of project management processes on the implementation of Geothermal Power projects in Kenya. The study applied a descriptive research design since it was focussed on describing the characteristics of the participants involved in the study. The study used self-administered questionnaires on a sample of 100 members from the target population. The respondents were given a period of 14 days to complete the questionnaires before collection and there was a drop and pick arrangement of the same. This study coded the data in the form that was more easily understood by applying a Likert Scale. It then used SPSS (version 20) to conduct regression analysis and descriptive data analysis using measures of central tendency such as standard deviation and mean. The presentation of the results was then done using a combination of graphs and tables. The results from the descriptive statistics indicated that the majority of respondents felt that their organisations had effectively applied the various aspects of project management practices. Nonetheless, the most influential processes of project management in the geothermal energy sector were Project Planning and Project Closing processes, followed by Project Execution and Project Initiation, respectively. Additionally, the respondents agreed that the implementation of geothermal projects had been conducted appropriately. According to the Pearson Correlation Coefficients, three of the independent variables, Project Planning, Project Execution and Project Closing influenced the dependent variable positively, while Project Initiation influenced the dependent variable negatively. The study recommended the introduction of best practices from global industrial leaders within the geothermal energy sector particularly for wind, biomass, and small hydro sources; the improvement of communication and timely payment of contractors in complex energy projects; and improvements in the integration of defect management systems and processes.

Key Words: *Project Initiation, Project Planning, Project Execution, Project Closing, Geothermal Power Projects*

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INTRODUCTION

The implementation of projects continues to be a painstakingly involving endeavour for many concerned stakeholders particularly in an increasingly competitive and resource constrained environment. There have been a wide range of attempted solutions to this situation given the disparate nature of organisations and even projects. One of the more obvious ones is the optimization of project management processes. According to the Project Management Institute (PMI) (2013), project management processes which include initiation, planning, execution, monitoring and control, and closing, can be influenced by competing project constraints including scope, quality, schedule, budget, resources, and risks. The initiation processes are the processes performed during the definition of a new project or a new phase of an existing project so as to obtain the authorization to start the project (PMI, 2013). The planning processes refer to the processes needed to develop the scope of the project, refine the objectives, and ascertain the appropriate course of action needed for attainment of project objectives (PMI, 2013). Executing processes are aimed at the completion of the work as defined by the project management team so as to satisfy the project specifications; monitoring and controlling processes are needed to track, review and regulate the progress and performance of the project; determine and initiate changes to the plan if necessary; and closing processes ensure the finalization of all activities in order to formally close the project (PMI, 2013).

Nyakundi (2015), while investigating the link between project management processes and project outcome for public sector infrastructural projects at Telkom Kenya, determined that public sector projects that have a high end user level of satisfaction require effective and efficient project processes as exemplified by: planning and initiation processes which ensure that deliverables and milestones are reasonable and attainable by identifying and committing needed resources; execution processes ascertain the establishment of roles and responsibilities for each task, the monitoring of project progress, the provision of the required tools for project implementation, and timely completion on budget; monitoring and control processes ensure the involvement of stakeholders at every stage, outlining change control procedures, risk and impact analysis, and the procedural documentation of all decisions; finally, closure processes establish client satisfaction through effective closeout. Ocharo and Kimutai (2018) found that power projects in Kenya had strategic plans, mission statements, visions and core values to guide their project activities which are critical components of project planning and implementation processes; further, most of them had a monitoring plan and tools to facilitate project monitoring, schedule, budget and scope management while those that didn't experienced project cost overruns and rescheduling; they also used participatory evaluation methods that ensured compliance and stakeholder confidence in facilitating projects; however, they lacked adequate stakeholder participation which led to poor project implementation.

Statement of the Problem

The geothermal energy sector in Kenya is estimated to have a potential of 7,000 MW, however, some 30 years since geothermal exploration started, the country is only able to exploit 1350 MW as the installed capacity from plants located in Olkaria, Naivasha, thereby necessitating a change of strategy (GDC, 2010). Indeed, with hydropower generational capacity deteriorating to the extent that only 75 MW can be added to the national grid, it is clear that alternative sources of power are needed. Geothermal power contributes 22% of all electricity consumed but in order for Kenya to become a middle income economy it needs to produce 10,000 MW in the next 20 years. According to Mangi (2018), the demand for electricity in Kenya was expected to grow by 23% to a

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minimum of 3,000 MW by the end of 2018, a fact that pushed the Government to scale up renewable energy resources, particularly geothermal sources given the untapped high temperature geothermal resources. However, many organisations involved in the geothermal energy sector are struggling to apply appropriate project management practices in the pursuit of effective project implementation which has made it difficult for the scaling up process to be actualised (Njogu & Gakobo, 2017).

Kloppenborg, Manolis, and Tesch (2009) posit that one of the critical challenges during project initiation is identification of and acceptance by a sponsor given that such an individual(s) will be a provider of funds, will drive the project undertaking, will be the primary risk-taker, and the person to whom the project manager reports. Thus, the lack of a project sponsor can jeopardise the implementation of complex geothermal projects particularly during the project initiation phase.

Effective project management calls on the application of best practices during the project execution phase, which in turn is dependent upon the deployment of project managers who are able to meet sponsor requirements and business values; adapt to changing situations; and coordinate the efforts of all other project team members (Menon, 2015). However, increasing project requirements tend to compel organisations to deploy project managers who may lack the aforementioned capabilities while finding and grooming of the same may prove to be a difficult task for the organization. Additionally, projects may suffer from undefined communication processes which result in miscommunication and drain the essence of the intended communication, and may cause poor escalation procedures (Sankar & Jubi, 2015). This indicates that project managers need to establish appropriate communication processes in order to ensure the implementation of proper escalation procedures.

According to Zohrehvandia, Khalilzadeha, Hajizadehb, and Cheraghia (2017) large projects encounter a number of problems during project closure phase including lack of budget, shortage of required resources, disputes and claims, and poor project termination quality. Consequently, such projects need adequate allocation of budget along with other resources, a properly established means of dispute resolution, and the conformity to good project quality termination. In a different study, Shakir and Nørbjerg (2015) found that smaller organisations experience challenges in closure of projects since the clients tend to dictate most of the closure processes and demand more negotiation skills on the part of the project managers to convince the clients to accept the project, and the involvement of many intermediaries undermines the effectiveness of closure since multiple business layers cause more misunderstandings and ambiguities between end clients and project managers.

This study sought to investigate the influence of project management processes on the implementation of projects in Kenya by focusing on energy power projects. It was able to shed new light into how the different management processes affect successful implementation of projects.

Research Objectives

To general objective of this study was to investigate the influence of project management process on the implementation of Geothermal Power projects in Kenya. The specific objectives were;

- To establish the influence of project initiation process on the implementation of Geothermal Power projects in Kenya
- To ascertain the influence of project planning process on the implementation of Geothermal Power projects in Kenya
- To determine the influence of project execution process on the implementation of Geothermal Power projects in Kenya

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- To establish the influence of project closing process on the implementation of Geothermal Power projects in Kenya

LITERATURE REVIEW

Theory of Transformation

According to Daszko and Sheinberg (2005), the theory of transformation postulates that leaders engender a vision for change and a system that continually questions and challenges beliefs, assumptions, patterns, habits and paradigms so as to continually develop and systematically apply management theory towards the acquisition of knowledge. Kollmorgen (2010) adds that dimension of the transformation theory is societal transformation which relates to a radical, systematically controlled and staged social change that encompasses all spheres of the social whose goal is accelerated modernisation so as to facilitate the catching up by lower nations with leading nations in the world society.

Value Creation Theory

Kraaijenbrink (2011) posits that the value creation theory enable the production of new products or services through the facilitation of economic mechanisms so as to change people's notion of what is desirable and important. Galvagno and Dalli (2014) stretches value creation theory to become value co-creation theory which alludes to the joint, collaborative concurrent and peer-like process of material and symbolic production of new value, as customers and suppliers interact in the market by extending their collaboration beyond the conventional mediation of the pricing mechanism. Gummerus (2013) explains that the value creation concept is two-fold: the value creation processes which involve the continuous interaction of parties, activities and resources; and the value outcomes which involve the type of value outcomes customers perceive that are more static since they are bound to a specific point in time.

Chaos Theory of Management

According to Thietart and Forgues (2002), the chaos theory of management holds that organisations are dynamic systems governed by nonlinear relationships where there are counteracting forces at play with some forces pushing the organisation towards stability and order (these include planning, structuring and control), while others push the system towards instability and disorder such as innovation, initiative and experimentation. Another proponent of the Chaos theory, Levy (1994), maintains that small disruptions multiply over time due to nonlinear relationships and the dynamic, repetitive nature of chaotic systems; consequently long-term planning is difficult which in turn affects the ability to formulate effective strategies for organisations.

Systems Theory of Management

According to Chikere and Nwoka (2015), proponents of the systems theory management, the theory focuses on the arrangement and relationships between constituent parts and how work together as a whole and this determines the properties of the system. Organisational management systems comprise a number of internal subsystems which need to be constantly aligned with each other, and as the organisation grows, they develop more complex subsystems which must coordinate with each other as part of the transformation process from inputs to outputs. Mele, Pels and Polese (2010) add that systems theory revolves around interactions and they sustain the behaviour of a single autonomous unit, and can be either open – exchanges of energy, matter, people and information with the external environment, closed – no exchanges of information and matter, only exchanges of energy or isolated – no exchange of elements.

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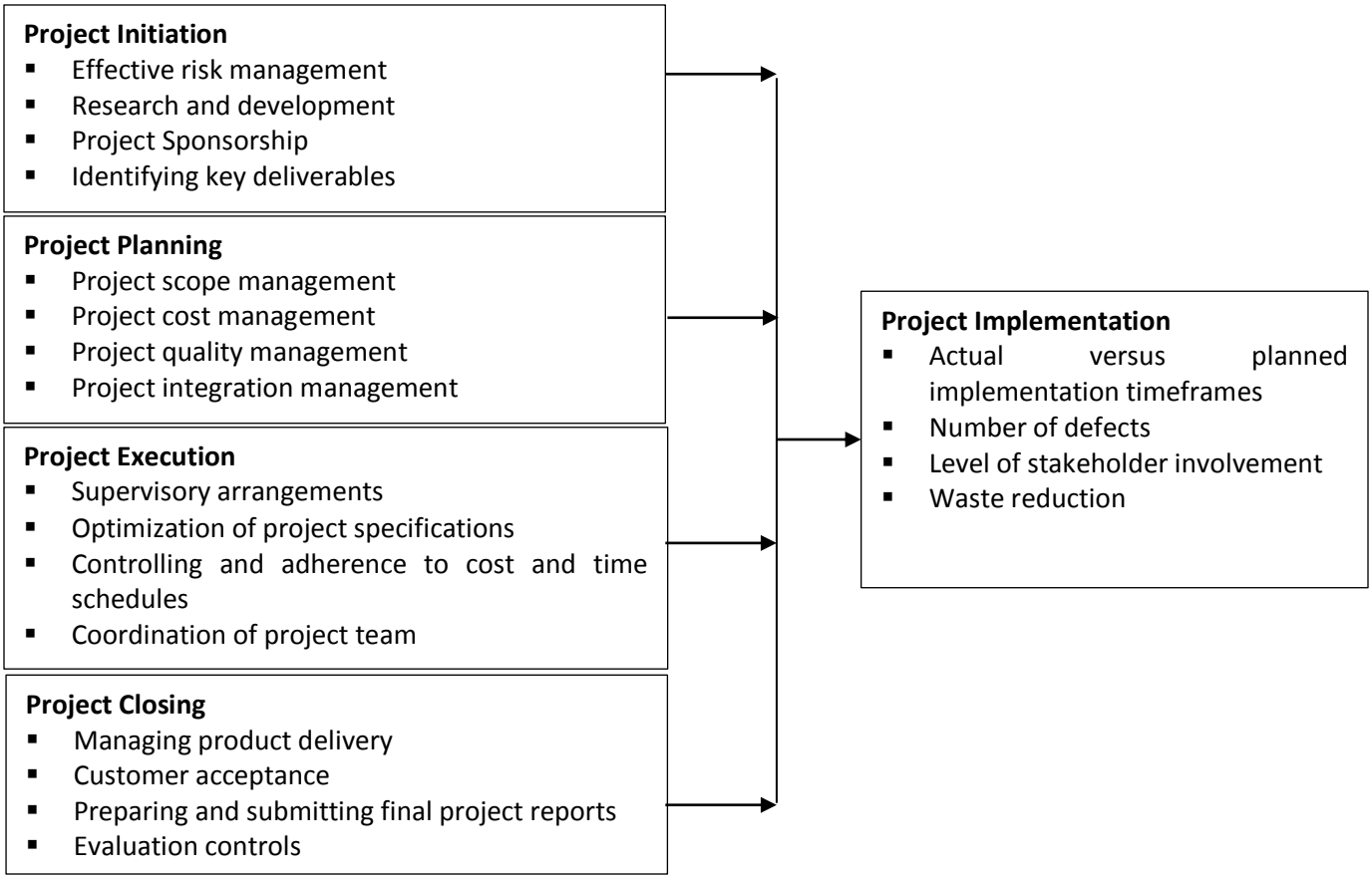

Figure 1: Conceptual Framework

According to Ouma and Nyonje (2016), the management of known and unknown project risks in energy projects at KPLC is founded on the triple constraint paradigm – scope, schedule and cost, and is aimed at enhancing the likelihood and impact of positive events and lowering the likelihood and impact of negative events. However, KPLC remains vulnerable to technological risk owing to the fact that a number of their key personnel lack the requisite innovative capabilities which hamper the integration of information technology into the project management process; fortunately, the management of technical planning and design processes for distribution projects has assured effective completion of projects, thereby mitigating the occurrence of completion risk. A study conducted by Nzioka (2015) confirmed that KenGen is exposed to a number of risks in the performance of its projects including: hydrological risks occasioned by unfavourable hydrological conditions such as shortage of rainfall in the energy generation areas; regulatory risks which occur due to vulnerability to changes in the laws and regulations by the Energy Regulatory Commission (ERC) which can expose the organisation to litigation liability; and geothermal steam supply risk which emanates from an exposure to the depletion of steam in the geothermal power generation wells due to harsh geological conditions.

Ochari and Kimutai (2018) posited that complex power projects in Kenya require a proper and approved plan which should comprise a purpose definition, scope definition, defined user needs, task identification, proper time and cost allocation, and responsibility allocation. Indeed, as a consequence of

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effective scope management, the project managers are able to achieve project goals, have a workable communication matrix, facilitate project reporting, and feedback mechanism. Lugusa and Moronge (2016) opined that project scope management should mirror end-user adoption so as to ensure that the project delivers the business results in accordance with customer requirements. This will only be achieved through appropriately precise and clear scope definition so as not to overlook any critical project risks, or have unrealistic schedules and budgets. Nibiyiza (2015) added that when the scope definition does not result in the achievement of project goals, it may be necessary for change in scope in response to unmet beneficiary needs or the recognition of a need to add value to project product quality. Scope changes tend to lead to alterations of project activities so as to provide an improved way of satisfying beneficiary needs and produce the intended outcomes.

The Economic Consulting Associates (2014) proposed a new policy framework for communities or municipalities owning and operating mini-grids in Kenya through either electric cooperatives (regulated by the Cooperative Societies Act) or a Village Trust (regulated by the Companies Act). The envisioned implementation procedures were: the ERC to still handle the regulation and licensing of power generation and distribution activities; KPLC to remain as the off-taker in the short-term; while licensing and supervision of cooperatives would be undertaken by the National Electrification and Renewable Energy Authority (NERA). Energy projects can also be supervised by a supervision consultant selected by the implementing organisation to oversee the intricate aspects of design and construction such as the supervisory arrangement that was formulated by the Kenya Pipeline Company which selected an Engineering Design and Construction Supervisory Consultant for the extension of a 352 km oil pipeline from Eldoret to Kampala (Institute of Economic Affairs, 2015).

There are a number of factors which influence the successful delivery of projects including: procurement processes that are free of malpractices; communication tools such as drawing designs, bill of quantities, contract specifications, works programme and site instructions; mitigation of risk occurrence and ensure adequate project financing (Ogutu & Muturi, 2017). The delivery of projects in Kenya is also dependent on the skilful coordination and management of the efforts of all the participants so as not to overrun the budget, fail to meet the schedule, or be deficient in functional or technical quality (Ochwoto & Ogolla, 2017). Additionally, project managers should be adequately trained in strategic management of the project, there must also be a competent project team and effective stakeholder management.

The implementation of projects involves a review of the overall project progress by comparing the actual performance against implementation timetables and indicators, it also involves an assessment of risk exposure in accordance with the impact of particular project implementation parameters on the project and their probability of occurring and this usually founded on the established assumptions and educated estimates and measured in relation to the budget and time lost or indicators that have not been achieved (Brown, 2014). The process of project implementation is incumbent upon the efforts of the project sponsor, who is also known as the senior responsible owner, who draw upon their skills and experiences of other organisational members, its partners and suppliers to ensure timely completion of main components of the project lifecycle and incorporating a level of flexibility into the process which eases the incorporation of changes along the way in response to dynamic aspects of implementation. This is facilitated by the accuracy of estimated timescales allied to the estimated resource

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availability when measured against the actual implementation. (Department of Business Innovation & Skills, 2010).

METHODOLOGY

This study applied a descriptive research design since it was focussed on describing the characteristics of the participants involved in the study. The study targeted a population of 160 members of staff from five organisations carrying out geothermal energy projects including KenGen, GDC, Ketraco, KNEB and KPLC in their head office premises. The study applied the questionnaire method of data collection due to the benefit of inclusion of more extensive enquiries and the convenience of getting responses from individuals who were not easily accessible due to hectic working schedules. The study used self-administered questionnaires on 160 members from the target population. This study coded the data in the form that is more easily understood by applying a Likert Scale. It then used SPSS (version 20) to conduct regression analysis, descriptive data analysis using measures of central tendency such as standard deviation and mean. The presentation of the results was then done using a combination of graphs and tables.

The analysis used a multiple regression model to capture the variables of the study.

FINDINGS AND DISCUSSION

Project Initiation

The descriptive statistics relating to project initiation are illustrated in table 1. According to the results, 60% of the respondents disagreed with the assertion that their organisation was exposed to technological risk since a number of staff lacked the needed innovation capabilities. This contradicted Ouma and Nyonje (2016) who found that KPLC remains vulnerable to technological risk owing to the fact that a number of their key personnel lack the requisite innovative capabilities which hamper the integration of information technology into the project management process. Further the results indicated that 51% of the respondents disagreed while 20% were uncertain about shortage of rainfall in energy generation areas also exposing their organisation to hydrological risks. This was inconsistent with Nzioka (2015) who confirmed that KenGen is exposed to a number of risks in the performance of its projects including: hydrological risks occasioned by unfavourable hydrological conditions such as shortage of rainfall in the energy generation areas.

According to the results, 69% of the respondents disagreed that their organisation has had difficulties researching on customer's needs and expectations which was at odds with Njenga and Olweny (2016) who found that many parastatals in the energy sector in Kenya have not been able to actively and regularly seek customer inputs in the identification of their needs and expectations as well as measure customer satisfaction through surveys. Further 79% of the respondents agreed that their organisation has been able to maintain an acceptable response rate to customer complaints and they ultimately delivered quality services. This was consistent with Njenga and Olweny (2016) who established that parastatals in the Kenyan energy sector have been able to maintain an acceptable response rate to customer complaints and they ultimately delivered quality services.

The results also showed that 83% of the respondents agreed that the organisation has been able to select sponsors who can develop bankable project proposals by identifying appropriate project development opportunities. This resonated with CTF (2010) who determined that the likelihood of success for the projects is also dependent on the ability of the project managers to choose a sponsor who is able to develop bankable project proposals, by identifying appropriate project development opportunities, which will lead to qualification for project financing.

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The results further indicated that 70% of the respondents disagreed that lack of experience and familiarity with renewable energy technologies has prevented sponsors from confidently assessing the variability of such projects. This was inconsistent with Hussain (2013) who submitted that lack of experience and familiarity with Renewable Energy Technologies (RETs) inhibits project sponsors from confidently assessing the feasibility, viability, and risks of projects and, as such, makes them reluctant to carry on with the development of such projects. Additionally, 62% of the respondents agreed that the organisation has been able to make preparatory arrangements for the implementation of the feed-in-tariffs which was corroborated by Economic Consulting Associates (2012) who determined that as part of the preparatory arrangements for the implementation of the feed-in tariffs (FiT) model, the project management team along with all critical stakeholders settled a number of key deliverables.

Lastly 81% of the respondents agreed that the organisation has been participating in consultative meetings in order to address key implementation issues which was consistent with African Development Bank (2014) who explained that aid consultation, alignment and harmonisation mechanisms within the energy sector in Kenya feature various groups which meet twice a year to discuss key policy issues and agree on the appropriate set of deliverables. Given the high frequencies of affirmative responses to questions relating to positive aspects of project initiation and the high frequencies of non-affirmative responses to questions relating to negative aspects of project initiation, it is clear that project initiation has been prioritised by organisations in the geothermal energy sector as a determinant of successful project implementation.

Table 1: Descriptive Statistics of Project Initiation

	Strongly Disagree	Disagree	Uncertain	Agree	Strongly Agree
The organisation is exposed to technological risk since a number of staff lack the needed innovation capabilities	26.0%	34.0%	17.0%	18.0%	5.0%
Shortage of rainfall in energy generation areas had also exposed the organisation to hydrological risks	22.0%	29.0%	20.0%	22.0%	7.0%
The organisation has had difficulties researching on customer's needs and expectations	19.0%	50.0%	14.0%	11.0%	6.0%
The organisation has been able to maintain an acceptable response rate to customer complaints and they ultimately delivered quality services	8.0%	5.0%	8.0%	58.0%	21.0%
The organisation has been able to select sponsors who can develop bankable project proposals by identifying appropriate project development opportunities	2.0%	6.0%	9.0%	45.0%	38.0%
Lack of experience and familiarity with renewable energy technologies has prevented sponsors from confidently assessing the variability of such projects	23.0%	47.0%	14.0%	13.0%	3.0%
The organisation has been able to make preparatory arrangements for the implementation of the feed-in-tariffs	3.0%	3.0%	32.0%	42.0%	20.0%
The organisation has been participating in consultative meetings in order to address key implementation issues	5.0%	6.0%	8.0%	38.0%	43.0%

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Project Planning

Table 2 presented the descriptive statistics of project planning. According to the results, "the organisation has ensured a proper and approved plan which includes a purpose definition, scope definition, defined user needs, task identification, proper time and cost allocation, and responsibility allocation" had a mean of 4.03 reflecting a very strong level of agreement (approximately 81%) amongst the respondents. This was in agreement with Ochari and Kimutai (2018) posited that complex power projects in Kenya require a proper and approved plan which should comprise a purpose definition, scope definition, defined user needs, task identification, proper time and cost allocation, and responsibility allocation.

The results also indicated that "the organisation's project scope management has included end-user adoption so as to ensure that the projects deliver the business results in accordance with customer requirements" had a mean of 3.9 also reflecting a strong positive endorsement of 78% amongst the respondents. This was consistent with Lugusa and Moronge (2016) who opined that project scope management should mirror end-user adoption so as to ensure that the project delivers the business results in accordance with customer requirements. Further, "the organisation has been able to effectively control the operational costs of its projects" had a mean of 4.11 indicating that the vast majority of respondents (82%) were in agreement with this. This was corroborated by Ocharo and Kimutai (2018) who determined that a key cost management initiative undertaken by Ministry of Energy (MoE) and KPLC was the Updated Least Cost Power Development Plan (ULCPDP) 2008/2028 which sought to increase the success rate of power projects by controlling the high operational costs due to long implementation timeframes through the enhancement of efficiency and effectiveness of the energy development process at all levels.

The results further showed that "the organisation has benefited from foreign partnerships in the form of financing, grants, technical assistance and investment promotion" had a mean of 4.63 also indicating a very strong affirmative response (93%) from the respondents. This was consistent with Herscowitz (2015) who found that the GoK partnered with Power Africa, a U.S. Government initiative, to support the development of the energy sector through financing, grants, technical assistance, and investment promotion so as to enable the realisation of the stated goal of increasing power generation capacity. "The organisation has adopted effective quality management practices such as quality control, quality assurance, and continual improvement" had a mean of 4.02 reflecting a strong positive endorsement (80%) from the respondents. This agreed with Ngina (2014) who established in a study of the implementation of quality management in the Kenya's geothermal energy sector revealed that the most popular quality management practices adopted by the GDC include: quality control, quality assurance, and continual improvement.

According to the results, "quality management at the organisation has been influenced by top management support, continuous improvement, employee involvement and customer focus" had a mean of 4.02 also illustrating that most of the respondents (80%) were in agreement with this statement. This was consistent with Njenga and Olweny (2016) who determined that quality management in parastatals in the energy sector of Kenya is influenced by a number of factors including: top management support, continuous improvement, employee involvement, and customer focus. Additionally, "the organisation has understood all its organisational processes as well as the impact of integration and communicated the same to all relevant stakeholders" had a mean of 4.03. This indicated that 81% of the respondents were in agreement with this and echoed the findings of Sang (2015) that the process of integration of project

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management requires a comprehensive understanding of the existing functionality of organisational processes and an accurate portrayal of the impact of the integration so that the anticipated synergies can be communicated properly to all concerned stakeholders.

Finally, "the organisation's culture provides an enabling environment for learning and adapting to project integration" had a mean of 4.01 indicating that the majority of respondents (80%) were in agreement with this. This was consistent with Kahungura (2018) who surmised that organisations must undergo cultural adjustments in order to facilitate the embedding of a formal mechanism for learning and adapting to project management ideals including mechanisms for assessing, following-up, evaluating and providing feedback on the performance of the project within the triple constraint paradigm of time, schedule and cost. Given that all the standard deviations were so low, it is clear that all the responses were concentrated tightly around the average responses indicating a low variation in the responses. Further, given the high mean scores for all the indicators of project planning, it is clear that project planning plays a very significant role in the implementation of projects in the geothermal power sector.

Table 2: Descriptive Statistics of Project Planning

	Mean	Std. Deviation
The organisation has ensured a proper and approved plan which includes a purpose definition, scope definition, defined user needs, task identification, proper time and cost allocation, and responsibility allocation.	4.0300	.85818
The organisation's project scope management has included end-user adoption so as to ensure that the projects deliver the business results in accordance with customer requirements	3.9000	.96922
The organisation has been able to effectively control the operational costs of its projects.	4.1100	1.11821
The organisation has benefited from foreign partnerships in the form of financing, grants, technical assistance and investment promotion	4.6300	.59722
The organisation has adopted effective quality management practices such as quality control, quality assurance, and continual improvement	4.0200	.86433
Quality management at the organisation has been influenced by top management support, continuous improvement, employee involvement and customer focus	4.0200	.82853
The organisation has understood all its organisational processes as well as the impact of integration and communicated the same to all relevant stakeholders	4.0300	.85818
The organisation's culture provides an enabling environment for learning and adapting to project integration	4.0100	1.02981

Project Execution

The descriptive statistics of project execution were shown in Table 3. The results indicated that 64% of the respondents agreed that their organisation was involved in community-based energy projects which are supervised by National Electrification and Renewable Energy Authority. This was corroborated by the Economic Consulting Associates (2014) who proposed a new policy framework for communities whose envisioned implementation procedures were: the ERC to still handle the regulation and licensing of power generation and distribution activities; KPLC to remain as the off-taker in the short-term; while licensing and supervision of cooperatives would be

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undertaken by the National Electrification and Renewable Energy Authority (NERA).

Additionally, 96% of the respondents were in agreement that their organisation hires supervision consultants to oversee the execution of complex energy projects. This echoed the Institute of Economic Affairs (2015) who determined that energy projects can also be supervised by a supervision consultant selected by the implementing organisation to oversee the intricate aspects of design and construction such as the supervisory arrangement. Further, the results indicated that 91% of the respondents affirmed that their organisation has embraced renewable energy sources as a means of lowering its emission levels. This was consistent with Kinyanjui (2010) who found that in order for the Kenya national power system to minimise current and future environmental emissions and energy production costs it had to develop a mechanism for optimal generation dispatch and capacity extension by focusing on replacement of existing fossil energy sources with renewable energy sources and imposing punitive emission penalties on power plants.

76% of the respondents agreed that their organisation has exploited an integrated approach that provides opportunities for optimization for scaling both on- and off-grid which was corroborated by Power Africa (2016) who argued that remote rural populations in sub-Saharan Africa require a diverse set of electrification solutions and calls for an integrated approach that provides opportunities for optimization for scaling both on- and off-grid. Additionally, 80% of the respondents agreed that their organisation has put in place a monitoring plan and tools which facilitates monitoring, scheduling, budgeting and scope management and ensures that the project managers have workable communication matrices and prevents the occurrence of cost overruns. This was consistent with Ocharo and Kimutai (2018) who determined that in order for power projects in Kenya to achieve effective scheduling of costs and time they require a monitoring plan and tools which facilitate monitoring, scheduling, budgeting and scope management and ensures that the project managers have workable communication matrixes and prevents the occurrence of cost overruns and re-scheduling of power projects.

54% of the respondents agreed that the organisation's complex projects have been hampered by poor communication systems, inadequate specifications in the contract, delayed payments to contractors, inadequate specifications in the contract, delayed payment to contractors, increase in scope. This was echoed by Gituro and Mwawasi (2017) who found that complex projects tend to be affected by poor organisational communication systems, poor or inadequate specifications in the contract, delayed payments to contractors, employer cash flow problems, increase in scope of work, inaccuracy of bill of quantities, underestimation of project durations, delay of access to the site, poor resource planning by contractor, and poor cost control mechanisms which lead to time and cost overruns.

The results also showed that 85% of the respondents agreed that their organisation's project managers assume coordination responsibilities by motivating the contractors to work better by delegation, communication and by adopting a management style which facilitates this process. This was echoed by Gakure (2012) who established that electrical contractors tend to lack coordination skills so require the intervention of the project manager to assume coordination responsibilities by motivating the contractors to work better by delegation, communication and by adopting a management style which facilitates this process.

Lastly, 89% of the respondents affirmed that their organisation has been able to maintain an acceptable level of collaboration among multidisciplinary teams to ensure successful project development. This was consistent with Karani (2013) who found that the key

factors that influence the level of collaboration among multidisciplinary teams to ensure successful project development include: continued commitment, effective coordination, dedicated team members, evaluation of team performance, and level of teamwork.

The results indicated that apart from two indicators which only received moderately positive endorsements of 54% and 64% by the respondents, the rest received highly positive endorsements. Thus, project execution is a critical determinant of project implementation in geothermal power organisations in Nakuru County as evidenced by the considerable investment by the organisations under study in the various aspects of project execution.

Table 3: Descriptive Statistics of Project Execution

	Strongly Disagree	Disagree	Uncertain	Agree	Strongly Agree
The organisation is involved in community-based energy projects which are supervised by National Electrification and Renewable Energy Authority.	5.0%	7.0%	24.0%	41.0%	23.0%
The organisation hires supervision consultants to oversee the execution of complex energy projects		3.0%	3.0%	48.0%	46.0%
The organisation has embraced renewable energy sources as a means of lowering its emission levels		2.0%	7.0%	44.0%	47.0%
The organisation has exploited an integrated approach that provides opportunities for optimization for scaling both on- and off-grid		2.0%	22.0%	52.0%	24.0%
The organisation has put in place a monitoring plan and tools which facilitates monitoring, scheduling, budgeting and scope management and ensures that the project managers have workable communication matrices and prevents the occurrence of cost overruns	1.0%	7.0%	12.0%	49.0%	31.0%
The organisation's complex projects have been hampered by poor communication systems, inadequate specifications in the contract, delayed payments to contractors, inadequate specifications in the contract, delayed payment to contractors, increase in scope	12.0%	27.0%	7.0%	26.0%	28.0%
The organisation's project managers assume coordination responsibilities by motivating the contractors to work better by delegation, communication and by adopting a management style which facilitates this process	2.0%	2.0%	11.0%	39.0%	46.0%
The organisation has been able to maintain an acceptable level of collaboration among multidisciplinary teams to ensure successful project development.	2.0%		9.0%	47.0%	42.0%

Project Closing

The descriptive statistics of project closing are illustrated in table 4. The results indicated that "the organisation has been able to influence the successful delivery of projects" had a mean of 4.44 which is a strong positive response equivalent to 89%. This corroborates Ogutu and Muturi (2017) who established that there are a number of factors which influence the successful delivery of projects including: procurement processes that are free of malpractices;

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communication tools such as drawing designs, bill of quantities, contract specifications, works programme and site instructions; mitigation of risk occurrence and ensure adequate project financing.

Additionally, "The delivery of projects in the organisation is dependent on the skilful coordination and management of the efforts of the participants so as not to overrun the budget, fail to meet the schedule, or be deficient in functional or technical quality" had a mean of 4.25 also reflecting a strong positive affirmation (equivalent to 85%) by the majority of respondents. This was confirmed by Ochwoto and Ogolla (2017) when they established that the delivery of projects in Kenya is also dependent on the skilful coordination and management of the efforts of all the participants so as not to overrun the budget, fail to meet the schedule, or be deficient in functional or technical quality.

"The organisation has been able to ensure that projects meet project objectives, meet the agreed budget, deliver the project in a timely manner, add value to the client's organisation, achieve the clients' quality requirements, and ensure an acceptable level" had a mean of 4.03 reflecting that the majority of respondents were in agreement with this. This was consistent with Mwangi and Mwangangi (2015) who opined that effective closure of projects is dependent on the acceptance of the project by clients which requires the satisfaction of a number of factors including meeting project objectives, meeting the agreed budget, timely delivery of the project, adding value to the client's organisation, achieving the client's quality requirements, and ensuring an acceptable level of professional satisfaction for the project team.

According to the results, "organisational projects receive adequate management support through the allocation of adequate finances, and high level of confidence by managers in the projects" had a mean of 4.14 indicating that most of the respondents agreed with this. This echoed Thairu (2014) who found that the extent of client acceptance of projects is a derivative of the degree of management support offered to the project as evidenced by the sufficiency of allocated finances or the level of confidence by managers in the project.

Further, "the organisation prepares close-out reports so as to finalize the project as per the requirements of the stakeholders and serve as a point of reference for future development" had a mean of 3.94 which reflect a strong endorsement from the majority of respondents. This agreed with Ollows (2012) who found that organisations running projects need to consider the scope which details the predetermined set of activities and tasks needed to complete the project successfully, a close-out report will eventually be presented so as to finalize the project as per the requirements of the stakeholders and serve as a point of reference for future development.

The results further indicated that "the organisation's completion reports include provisions for business-related considerations such as human resource component; the technology applied during the implementation of the project; funding; the applicable political environment; economic and social" had a mean of 3.85 showing that most of the respondents were in agreement with this. This was corroborated by Wanjau (2015) who established that the completion report should also include provisions for business-related considerations such as human resource component.

"The organisation employs the use of evaluation software which provides a dashboard view of the project implementation and provides a means of gauging project performance against set project objective" had a mean of 3.67 also indicating a strong positive affirmation from the majority of the respondents. This was consistent with Gyawali and Tao (2009) who found that one of the most effective

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evaluation controls for organisational projects is evaluation software which provides a dashboard view of the project implementation and provides a means of gauging project performance against set project objectives by focusing on the product or service specifications, programming, testing, and built-in self-control mechanisms which eventually ensure project completion.

Additionally, "the organisation's steering committee provides a means of reviewing the implementation challenges and successes of the projects and consider changes to be made for the future based on their findings" had a mean of 4.03 reflecting a strong positive endorsement from the respondents and agreeing with Dahlgren and Söderlund (2010) who affirmed that evaluation controls which are established by the steering committees of multi-project organisations provide a means of reviewing the implementation challenges and successes of the projects and consider changes to be made for the future based on their findings. Thus, it is apparent that project closing plays a very prominent role in determining success project implementation given the strong mean scores (between 3.67 and 4.44) of the aspects of project closing. Ultimately, that all the standard deviations were so low, it is clear that all the responses were concentrated tightly around the average responses indicating a low variation in the responses.

Table 4: Descriptive Statistics of Project Closing

	Mean	Std. Deviation
The organisation has been able to influence the successful delivery of projects.	4.4400	.75639
The delivery of projects in the organisation is dependent on the skilful coordination and management of the efforts of the participants so as not to overrun the budget, fail to meet the schedule, or be deficient in functional or technical quality.	4.2500	.83333
The organisation has been able to ensure that projects meet project objectives, meet the agreed budget, deliver the project in a timely manner, add value to the client's organisation, achieve the clients quality requirements, and ensure an acceptable level	4.0200	.71038
Organisational projects receive adequate management support through the allocation of adequate finances, and high level of confidence by managers in the projects.	4.1400	.80428
The organisation prepares close-out reports so as to finalize the project as per the requirements of the stakeholders and serve as a point of reference for future development.	3.9400	.82658
The organisation's completion reports include provisions for business-related considerations such as human resource component; the technology applied during the implementation of the project; funding; the applicable political environment; economic and social	3.8500	.85723
The organisation employs the use of evaluation software which provides a dashboard view of the project implementation and provides a means of gauging project performance against set project objective.	3.6700	1.04500
The organisation's steering committee provides a means of reviewing the implementation challenges and successes of the projects and consider changes to be made for the future based on their findings.	4.0300	.95827

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Project Implementation

The distribution of responses for the descriptive statistics of project implementation are shown in table 5. According to the results, 94% of the respondents agreed that their organisation reviews overall project progress by comparing the actual performance against implementation timetables and indicators which starts with an assessment of risk exposure. This was consistent with Brown (2014) who found that the implementation of projects involves a review of the overall project progress by comparing the actual performance against implementation timetables and indicators, it also involves an assessment of risk exposure in accordance with the impact of particular project implementation parameters on the project and their probability of occurring. Further, 89% of the respondent felt that their organisation's project sponsors draw upon their skills and experiences of other organisational members, its partners and suppliers to ensure timely completion of main components of the project lifecycle. This echoed the Department of Business Innovation and Skills (2010) who determined that the process of project implementation is incumbent upon the efforts of the project sponsor, who is also known as the senior responsible owner, who draw upon their skills and experiences of other organisational members, its partners and suppliers to ensure timely completion of main components of the project lifecycle.

59% of the respondents agreed that the implementation of projects is boosted by the use of defect management systems and processes which resonated with Mittal, *et al.* (2011) who posited that the implementation of projects is boosted by the use of defect management systems and processes which seek to improve the product or service development process by discovering the severity, number and causes of defects.

The results also indicated that 59% of the respondents affirmed that defect management in their organisation is aided by the application of site models and web technologies to share and communicate defect information effectively. This was in agreement with Lin *et al*. (2016) who found that defect management systems process can be aided by the application of site models and web technologies. 68% of the respondents felt that their organisation has established appropriate stakeholder involvement platform that can lead to community buy-in which was consistent with Ramnarine (2016) who determined that the implementation of renewable energy projects is dependent upon the establishment of appropriate stakeholder involvement platforms such as community outreach activities aimed at educating residents on renewable energy conservation.

Additionally, 81% of the respondents agreed that their organisation meets regularly with stakeholders in order to determine drivers of increased production and use of renewable energy sources. This was corroborated by Bremere, *et al.* (2018) when they found that project team members for energy projects need to meet with stakeholders so as to identify and discuss drivers for increased production and use of renewable energy sources.

The results also indicated that 69% of the respondents agreed with the statement that their organisation minimises material wastes generated as a consequence of implementation activities. This was confirmed by Al-Haji and Hamani (2011) who found that projects can also benefit from the minimisation of material wastes generated as a consequence of implementation activities. Lastly, 63% of the respondents affirmed that their organisation has been minimising wastes by adopting the 3R principles of reduce, reuse and recycle throughout all the stages of project implementation which was in agreement with Esa *et al*. (2017) who determined that there is an increasing awareness of the need to minimise wastes by organisations all over the world especially for environmental protection purposes through the

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adoption of the 3R principles of reduce, reuse and recycle throughout all the stages of project implementation. It is apparent that as far as the above analysis is concerned, the organisations have implemented all the various aspects of project implementation quite effectively, particularly the review of overall project progress, the use of project sponsors' skills and experiences of other organisational members to ensure timely completion, and meeting regularly with stakeholders to determine drivers of increased production.

Table 5: Descriptive Statistics of Project Implementation

	Strongly Disagree	Disagree	Uncertain	Agree	Strongly Agree
The organisation reviews overall project progress by comparing the actual performance against implementation timetables and indicators which starts with an assessment of risk exposure.	2.0%		4.0%	71.0%	23.0%
The organisation's project sponsors draw upon their skills and experiences of other organisational members, its partners and suppliers to ensure timely completion of main components of the project lifecycle.		3.0%	8.0%	56.0%	33.0%
The implementation of projects is boosted by the use of defect management systems and processes	1.0%	19.0%	21.0%	39.0%	20.0%
Defect management in the organisation is aided by the application of site models and web technologies to share and communicate defect information effectively.		19.0%	26.0%	32.0%	23.0%
The organisation has established appropriate stakeholder involvement platform that can lead to community buy-in.	3.0%	7.0%	22.0%	44.0%	24.0%
The organisation meets regularly with stakeholders in order to determine drivers of increased production and use of renewable energy sources.	3.0%	2.0%	14.0%	51.0%	30.0%
The organisation minimises material wastes generated as a consequence of implementation activities.		8.0%	23.0%	48.0%	21.0%
The organisation has been minimising wastes by adopting the 3R principles of reduce, reuse and recycle throughout all the stages of project implementation.	4.0%	5.0%	28.0%	23.0%	40.0%

Inferential Statistics

The Pearson Correlation coefficients for the variables of the study were presented in Table 6. The results showed that three of the independent variables, Project Planning, Project Execution and Project Closing, had positive correlations of r = 0.797, r = 0.900, and r = 0.895, respectively, with the dependent variable, Implementation of Geothermal Projects while the remaining independent variable, Project Initiation had a negative correlation of r = -0.699 with the dependent variable. Accordingly, a change of Project Initiation by a value of 1 leads to a corresponding -0.699 change in Implementation of Geothermal Projects. Further, a change of Project Planning by a value of 1 leads to a corresponding 0.797 change in Implementation of Geothermal Projects. A change in Project Execution by a value of 1 leads to a corresponding 0.900 change in Implementation of Geothermal Projects. Lastly, a change in Project Closing by a value of 1 leads to a corresponding 0.895 change in Implementation of Geothermal Projects.

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Further, the p-values for all the independent variables at 0.000 were all below 0.05 indicating a statistically significant relationship between each independent variable and the dependent variable. This is in keeping with Dahiru (2008) who found that given intervals of 95%, p-values of less than 0.05 indicate that observed differences between groups are unlikely to be due to chance and, as such, are statistically significant. This reflected the relevance of the p-value as an acceptable test of statistical significance.

Table 6: Pearson Correlation Coefficients

		Project Initiation Process	Project Planning Process	Project execution process	Project closing process	Implementation of geothermal projects
Project Initiation Process	Pearson Correlation	1				
	Sig. (2-tailed)					
Project Planning Process	Pearson Correlation	-.084	1			
	Sig. (2-tailed)	.015				
Project execution process	Pearson Correlation	-.796	.691**	1		
	Sig. (2-tailed)	.040	.000			
Project closing process	Pearson Correlation	-.529	.668**	.414**	1	
	Sig. (2-tailed)	.001	.000	.000		
Implementation of geothermal projects	Pearson Correlation	-.699	.797**	.900**	.895**	1
	Sig. (2-tailed)	.005	.000	.000	.000	

**. Correlation is significant at the 0.01 level (2-tailed).

Multiple Regression Analysis

The multiple regression statistics for the study were demonstrated in table 7. According to the table, the R Square value for all the variables was 0.715 indicating that the results explained 71.5% of the variation in the Implementation of Geothermal Projects whenever there was a one percent change in the four independent variables which is consistent with Hamilton, Ghert and Simpson (2015) who found that in order for R square values to be significant they should be higher than 0.7.

Table 7: Multiple Regression Analysis

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.852[a]	.715	.571	.95244

a. Predictors: (Constant), Project closing process, Project Initiation Process, Project execution process, Project Planning Process

ANOVA Statistics

Table 8 presented the results of the ANOVA statistics for the study. The results indicated that the ANOVA F-test score, calculated value F_{cal} at 5% level of significance was equivalent to 6.113 which ws greater than the F critical value (F_{crit}) of 2.53 implying that there is a significant relationship between all the independent variables and the dependent variable;

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while the p-value of 0.000 was less than 0.05 implying that there was a statistically significant relationship between all the independent variables and Implementation of Geothermal Projects. This demonstrated the goodness of fit of the model.

Table 8: ANOVA Statistics

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	22.181	4	5.545	6.113	.000[b]
	Residual	86.179	95	.907		
	Total	108.360	99			

a. Dependent Variable: The implementation of projects is boosted by the use of defect management systems and processes

b. Predictors: (Constant), Project closing process, Project Initiation Process, Project execution process, Project Planning Process

Beta Coefficients

The beta coefficients of the study were illustrated in table 9. The values of the constant and coefficients enabled the generation of the multiple regression model as follows:

$$Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \varepsilon$$

$$= -0.242 + 0.090X_1 + 0.089X_2 + 0.411X_3 + 0.514X_4 + 0.980$$

Where, Y refers to the dependent variable (Implementation of Geothermal projects), X_1 refers to the Project Initiation variable, X_2 refers to the Project Planning variable, X_3 refers to Project Execution variable, and X_4 refers to the Project Closing variable.

According to the equation, taking all the independent variables to be zero (Project Initiation, Project Planning, Project Execution and Project Closing), Implementation of Geothermal Projects will be a constant equivalent to -0.242. A review of the findings also shows that a unit increase in Project Initiation will lead to a 0.090 increase in Implementation of Geothermal Project when all other independent variables are held constant; a unit increase in Project Planning will lead to a 0.089 increase in Implementation of Geothermal Projects when all other independent variables are held constant; a unit increase in Project Execution will lead to a 0.411 increase in Implementation of Geothermal Projects when all other independent variables are held constant; finally, a unit increase in Project Closing will lead to a 0.514 increase in Implementation of Geothermal Projects when all other independent variables are held constant. Lastly, the p-values for all the variables are all below 0.05 which indicates that they are all statistically significant.

Table 9: Beta Coefficients

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	-.242	.980		-.246	.006
	Project Initiation Process	.090	.160	.052	.560	.008
	Project Planning Process	.089	.163	.061	.549	.004
	Project Execution Process	.411	.181	.246	2.269	.006
	Project Closing Process	.514	.166	.332	3.107	.002

a. Dependent Variable: The implementation of projects is boosted by the use of defect management systems and processes

According to the above Beta Coefficients, Project Closing processes are the most significance determinants of project implementation in the geothermal sector in Nakuru County, followed by Project Execution processes, project initiation processes, and project planning processes, respectively. Additionally, given that all the coefficients were positive, it is clear that they all make positive contributions towards the attainment of successful project implementation in geothermal projects.

CONCLUSIONS AND RECOMMENDATIONS

The organisations in the geothermal energy sector had been able to minimise the exposure to technological as well as hydrological risks. Additionally, they had been able to ensure appropriate project initiation by researching on customers' needs and expectations as well as maintaining an acceptable response rate to customer complaints. The organisations had also benefited from the selection of project sponsors who were able to develop bankable project proposals and leverage on their experience and familiarity with renewable energy technologies to confidently assess the variability of projects. Ultimately, the organisations had been able to make preparatory arrangements for the implementation of feed-in tariffs and participate in consultative meetings that seek to address key implementation issues.

Organisations in the geothermal energy sector had established appropriate project planning by focusing on: the establishment of a proper and approved plan; the inclusion of end-user adoption within the project scope management procedures that ensure project delivery of the business results in accordance of customer requirements; achieving effective control of operational costs; the use of foreign partnerships to get financing, grants, technical assistance, and investment promotion; the adoption of effective quality management practices such as quality control, quality assurance, and continual development; understanding all organisational processes; and the use of culture to provide of an enabling environment for learning and adopting to project integration.

Organisations in the Kenyan geothermal energy sector had been able to establish appropriate measures for project execution including: the hiring of supervision consultants to oversee the execution of complex energy projects; embracing renewable energy sources as a means of lowering emission levels; maintaining acceptable levels of collaboration among multidisciplinary teams; utilizing project managers as a means of coordinating the efforts of contractors through delegation and communication; incorporating a monitoring plan and tools for facilitating monitoring, scheduling, budgeting and scope management; and exploiting an integrated approach for providing opportunities for optimization. However, these organisations were only to moderate success in management of complex projects which were hampered by poor communication systems, inadequate specifications in the contract, delayed payments to contractors, and increase in scope.

The organisations had also ensured effective project closing by influencing the successful delivery of projects by utilizing the skillful coordination and management of the efforts of the participants so as not to overrun the project budgets; they had also ensured that the projects meet their objectives and agreed budget; they have provided adequate management support through the allocation of finances and a high level of confidence by managers in the projects. They have also facilitated proper closing by preparing close-out reports and completion reports; used evaluation software and a steering committee to review the implementation challenges and successes.

The implementation of geothermal energy projects had been conducted very competently by

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organisations in Kenya as exemplified by: appropriate reviews of project progress by comparing actual performance against implementation timetables; utilizing project sponsors who were able to draw upon the skills and experiences of other organisational members; the establishment of appropriate stakeholder involvement platforms that can lead to community buy-in; carrying out regular meetings with stakeholders; and minimizing material wastes. This notwithstanding, these organisations have struggled to integrate the use of defect management systems and processes as part of project implementation.

The study recommended that the organisations in the geothermal sector should maintain their current efforts of project initiation since they have yielded evident benefits. They should also pay particular attention to the preparatory arrangements needed for the implementation of feed-in tariffs since it was evident that quite a number of respondents were uncertain about this. This can be done through the introduction of best practices from global industrial leaders within the geothermal energy sector particularly for wind, biomass, and small hydro sources.

The organisations should also focus project execution efforts on the management of complex projects by ensuring better communication amongst the project team members and other stakeholders so as to highlight probable causes of project delays from an early enough stage; improving contract terms of engagement to ensure thorough capture of details pertaining to project specifications; making concerted efforts to pay contractors on time by ensuring the submission of all supporting documentation for any progress updates; understanding the terms or clauses of payment; the contractor should make frequent follow-ups on any outstanding payments; and the establishment of clauses within the relevant legislation to cover delayed payments.

The organisations should consider making improvements in the integration of defect management systems and processes by providing budget allocations for the acquisition of such systems and processes including the application of site models and web technologies so as to ensure the timely dissemination of defect information to all concerned stakeholders. Additionally, workshops should be conducted to appraise organisational members of the importance and applications of defect management systems and processes so as to raise the level of awareness and ensure buy-in by all members.

Areas of Further Research

The study established that more research needed to be conducted on the implementation of geothermal energy projects rather than other forms of energy since the vast majority of research has been done on other energy sources. Additionally, more research needed to be centred on the impact of project management practices on the implementation of geothermal projects given that this had been neglected by other scholars and researchers.

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