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COST AND TIME SCHEDULING ON PERFORMANCE OF GEOTHERMAL DRILLING PROJECTS IN OLKARIA, NAKURU COUNTY, KENYA

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ABSTRACT

Purpose: The objectives of the study was to determine the influence of cost and time scheduling as practices of schedule management on performance of geothermal drilling projects in Olkaria, Nakuru County in Kenya.

Methodology: The study adopted descriptive survey design. The study targeted geothermal drilling projects in Olkaria, Nakuru County, Kenya. A sample of 146 respondents consisting of project managers, engineers, technicians and rig workers involved in geothermal drilling projects was identified for the purpose of this research.

Findings: The study found Cost scheduling and Time Scheduling have significant influence on performance of geothermal drilling projects. The study established that cost scheduling had a positive (β = .221), significant (sig s= .000<.05) and direct relationship with performance of geothermal drilling projects in Olkaria, Nakuru County, Kenya. Cost scheduling also influenced performance of geothermal projects to an extent of .271 (27.1%). The study found time scheduling had a positive (β = .196), significant (sig = .003<.05) and direct relationship with performance of geothermal drilling projects in Olkaria, Nakuru County, Kenya. Time scheduling also influence performance of geothermal projects to an extent of .266 (26.6%). There is a significant relationship between Time scheduling and Performance of geothermal projects in Olkaria, Nakuru County, Kenya.

Recommendations: The study recommended for adoption of effective schedule management practices in projects to ensure there is improved performance

Keywords: Cost scheduling, time schedule, performance of geothermal projects

Background of the study

Geothermal energy refers to heat energy contained in the earth. This is a renewable, reliable and clean form of energy since it does not result in emission of harmful green-house gases. Through development of geothermal technologies, it is possible to harness the energy from beneath the earth's surface and hence use it either for electricity generation or direct-use of the heat (Archer, 2020). The first process of making geothermal energy usable for humans is drilling so as to access the resource. The heat energy can be accessed from depths as deep as 10 kilometres which is the maximum depth reached by human drilling thus far (Manzella, 2017). Geothermal well drilling on a new field can be done in four stages: Exploration, appraisal, production, and make-up. Exploration stage refers to the initial well or wells drilled in a prospective geothermal field to provide the proof of exploitable steam and data (IRENA, 2018).

The global capacity of electricity generation through geothermal technology is estimated at 70-80 GW (World Bank, 2017). This implies that the current utilization is at 21-23% of the potential. Various countries have embraced the challenge to add to their geothermal electricity with Indonesia setting a target of adding 5.8 GW by the year 2026 (World Bank, 2017). This will account for 23% of their electricity generation. With the current trends advocating for exploration and utilization of geothermal resources, there is a high chance for increase in the number of countries exploiting their geothermal energy. As a result of the many advantages, the future of clean power generation lies upon geothermal technologies. As population and industries keep on rising, there is need to provide sufficient electricity to march demand. There is an emphasis for governments and the public to be educated about the benefits of geothermal as well as energy policies tailored to ensure that geothermal energy is successfully integrated into the future energy mix (Vargas, Caracciolo, & Ball, 2022).

According to a publication by the World Energy Council (WEC), it is considered possible to produce up to 8.3% of the total world electricity with geothermal resources, supplying 17% of the world population. Globally, the top 10 countries in terms of geothermal electricity generation have an installed capacity of 16.127 Giga-Watts (GW) as at the end of 2022 (Richter, 2023) with an increase of 286.4 Mega-Watts (MW) in the installed capacity of geothermal power plants in the year 2022. This growth occurred despite the post-COVID challenges. Prior to 2021, the electricity generated via geothermal energy grew at a modest rate of 3.5% while direct-use heating applications grew at a rate of 9% annually (IRENA & IGA, 2023).

Project schedule management is a procedure that necessitates the development of policies and documentation for maintaining, developing, managing, and controlling the time and resource schedules required for project completion (Kerzner, 2017). The process of project scheduling entails creating a document that details the project timeline as well as the organizational resources needed to complete each task. Every team member must have access to the project schedule. Its purpose is to communicate critical information to the team, so it must be thorough and simple to comprehend. The schedule management process has the strategic advantage of continuously monitoring and managing the project's schedule. The project schedule provides a detailed plan for presenting how and when the project will deliver results as defined in the scope. It a tool for communication as well the management of the stakeholders' expectations and also is the basis for performance reporting (PMI, 2017).

Geothermal Energy in Kenya

Kenya is the leading country in Africa when it comes to geothermal and the eighth-highest electricity producer in the world (EIA, 2023). The total installed capacity for geothermal-sourced electricity in Kenya is at 944MW (IRENA & IGA, 2023). Of this, Kenya Electricity Generating Company Limited (KenGen) leads the way with 799MW installed capacity at Olkaria. There are plans underway to revamp the existing power plants at Olkaria as well as to build Olkaria VII power plant in a bid to take Kenya to the 1GW club in the world (Kamau, 2023).

KenGen has been vocal in its quest to not only increase its production via geothermal sources but to also empower the region in tapping into their resources. This has been seen with Ethiopia embarking into projects in Tulu Moye, Aluto and Corbetti. KenGen has been a key player in the Tulu Moye and Aluto projects aimed at drilling geothermal wells to supply steam which will be used in electricity production (Payton, 2023). Initially, KenGen offered consultancy services in the field of geo-scientific studies, but at the moment, the company has moved a step forward to also provide drilling services as is the case in Ethiopia and Djibouti (Payton, 2023). It is clear that the future of harnessing geothermal energy goes hand-in-hand with drilling of geothermal wells, hence the willingness for investors to partner with the African countries along the rift to explore the resource through drilling of geothermal wells.

Statement of the problem

Economic growth in Kenya is greatly dependent on meeting the electricity demand for both household and commercial use. Kenya's electricity demand has always been on the rise and it hit a record peak demand of 2132.29 MW in January 2023 (Muiruri, 2023). Electricity generated from geothermal sources has recently surpassed hydropower and accounts for 30.87 percent of the market share. It is estimated that Kenya has the potential to generate up to 5 GW of electricity from geothermal sources by 2030 (Ngugi & Chepkemoi, 2022). Kenya's economic growth has put pressure on the country's electricity supply with demand rise by 18.9% annually since 2013. The Least Cost Power Development (LCPD) focuses on development of hydroelectric and geothermal plants. Kenya's electricity 39% comes from hydropower and the gaps are compensated by thermal generation (Mokveld & Eije, 2018).

Geothermal energy development is a highly capital-intensive technology that requires 5-7 years to be operational and also requires effective project management to attain the desired results. A geothermal energy development project goes through five phases namely resource exploration, resource assessment, power plant construction, operations and decommissioning and the cost of development of geothermal is the most expensive venture with cost up to USD 6 million and cost is influenced by many factors related to drilling, energy factor. Drilling time which has been a challenge worldwide (Muriga, 2019). Since serious exploration began more than 40 years ago, geothermal has become a major contributor to the electricity mix in Kenya providing almost a half of the Kenya's power. However, after more than decade of establishment of GDC there has been no accelerated growth that had been estimated in LCPD plan of over 1869 MW by 2030 as compared to targeted capacity of 5530MW in 2031 (GOK, 2018). Some of the challenges include high exploration costs, bureaucratic procedures, and uneven distribution of risks, shortage of technical capacities (Johnson & Ogeya, 2018; GOK, 2018; IRENA, 2018; Kincer & Ngaryo, 2021)

Objectives of the study

The study specifically sought;

i. To determine the influence of cost scheduling on performance of geothermal drilling projects in Olkaria, Nakuru County, Kenya.
ii. To assess the influence of time scheduling on performance of geothermal drilling projects in Olkaria, Nakuru County, Kenya.

LITERATURE REVIEW

Theoretical review

The study was underpinned by the resource-based view theory and control theory. Resource based theory was first developed by E. Penrose as a model for management of organizations resources (Penrose, 2009). It was latter proposed by Barney as a framework for highlighting and predicting the fundamentals of organizations performance and competitive advantage (Barney, 1991). The RBV theory acknowledges that organizational resources are of essential impact on the execution of firms' roles. RBT theoretically predicts intangible resources as important factors for success of a project. Intangible resources are financial, physical, human, intellectual, organizational reputational and technological resources. For the success of a project,

all the resources should be incorporated together. Human beings as a resource must have intelligence and required technology to manage the material and financial resource properly. A superior performance is usually based on developing a competitively distinct set of resources, heterogeneous and strategic development and a capable workforce in a well-conceived strategy to sustain superior returns (Fahey, 2005; Collis & Montgomery, 2008). In geothermal drilling projects, resource scheduling is crucial in allocating the resources to the projects. The resource recognized by the resource-based theory ought to be sorted out through undertaking assets intending to guarantee accomplishment of the project.

The control theory, developed by Henry Gantt played a pivotal role in the development of modern scheduling techniques. In contemporary project management, scheduling theory incorporates a variety of tools and techniques to address different project requirements and complexities. Gantt charts remain widely used due to their simplicity and effectiveness in visualizing project timelines. Network diagrams, used in both CPM and PERT, illustrate task dependencies and help in identifying potential bottlenecks. Additionally, resource leveling and smoothing techniques are employed to optimize resource allocation and ensure a balanced workload throughout the project (Kerzner, 2017). Effective scheduling is crucial for various aspects of project management, including planning, resource management, progress tracking, risk mitigation, stakeholder communication, and quality assurance. During the planning phase, scheduling helps define the project scope, allocate resources, and estimate timelines, providing a roadmap for execution. Resource management is enhanced by ensuring optimal use of resources, reducing wastage, and avoiding bottlenecks. Schedules also serve as benchmarks for tracking progress, identifying delays, and assessing performance (PMI, 2017). By providing a structured approach to planning, resource allocation, and risk management, scheduling theory helps ensure that geothermal drilling projects are completed on time, within budget, and to the required quality standards.

Conceptual framework

The independent variables are Cost scheduling and Time Scheduling while the dependent variable is the performance of geothermal drilling projects in Olkaria, Nakuru County, Kenya. The conceptual framework is illustrated in Figure 1 below.

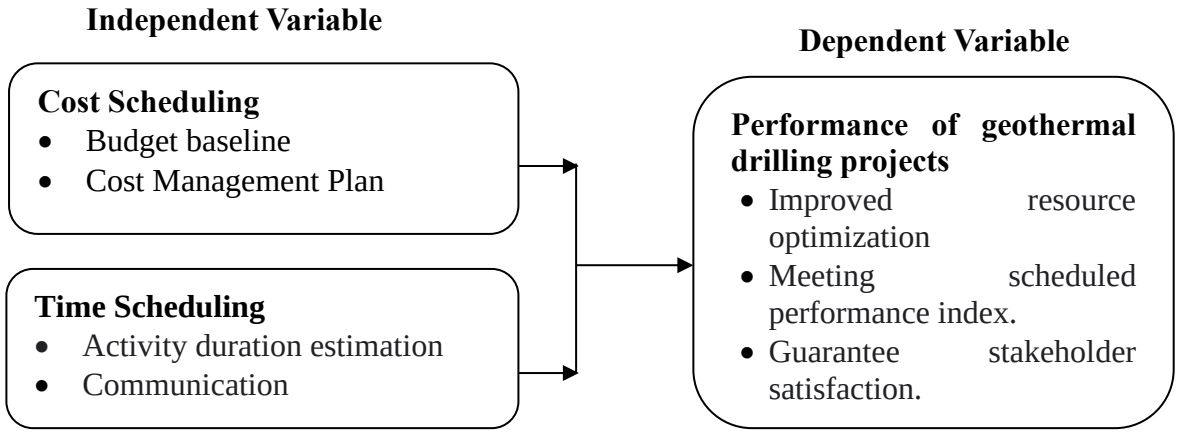

Figure 1: Conceptual Framework

Cost Scheduling

Cost Scheduling is the process of analyzing and forecasting the project costs to help the project manager to determine how to allocate the project budget. It helps the project manager to keep track of the actual costs against the planned costs in order to identify the variances (Kerzner, 2017). Successful delivery of a project is defined by the overall cost performance and ability to meet deadlines. Project managers need to be to allocate time and resources efficiently to manage costs and keep track of the project. These project management skills are crucial in

organizing and communicating with team members, especially in complex projects. Project scheduling is as important just as cost budgeting since they both determine the resources and timeline for the delivery of the project (Scott, 2020). Budget baseline refers to the anticipated project costs and it is used for reference purposes at the initial stages of the project. It acts as basis for comparison the actual performance (Bohra, 2023).

The project baseline is an approved plan for project alterations and is used to equate the actual performance to the planned performance in order to determine the project performance is within the acceptable guidelines (PMI, 2017). In project management the project baseline includes budget baseline, schedule baseline, quality baseline and scope baselines. The schedule and cost basslines are important in the project constraint polygon and without them it is impossible to understand where the project stands in relative to the planned budget performance or the planned schedule progress. Cost management plan is a component of project plan that describes the planning, structuring and controlling of costs in the project (PMI, 2017). The importance of cost control in project management includes budget optimization, enhanced profitability, risk mitigation, and efficient use of resources.

Time Scheduling

The APM (2018) defined time scheduling as a collection of techniques used to develop and present schedules that show when work will be done. The results of all these techniques of time scheduling are usually presented in pictorial views as activities or bars on a timeline. This is known as a Gantt chart. Scheduling is a key aspect of project planning and conventionally, this is done in two ways: critical path and critical chain. The focus of the critical path approach is on the activities in the project with consideration to the shortest time to complete all the activities in a logical order. The succession of activities follows a precedence network from start to finish in defining the duration of the entire project. Critical path analysis is an activity-based planning technique that determines the total duration of tasks based on estimates and logical dependencies. In essence, it is a method used to determine the critical path. Critical path analysis can be simplified by doing it using planning software, but it is a key skill for project professionals to understand how it is done, to validate that the project plan is based on comprehensive and defensible logic (Kerzner, 2017). The purpose of the project manager's understanding of the project's critical path is to focus his efforts on managing the tasks he is working on, knowing that they will all be completed on time and will not interfere with other activities and if it exceeds the floating total, the entire project will be completed during the run (PMI, 2017).

The activity duration varies according to the type of activity (Brown, 2023). The advantage of this procedure is that there is projection of the amount of time that every task will take to complete and thus provides a significant input for development of the schedule process. Estimating activity durations is a lengthy process that needs involvement of the project team. In doing so it ensures the project objectives are achieved based on the agreed dates and delivery schedules by the key stakeholders and project management team. Project success is often related to project duration. The time taken for the different phases is the parameter to determine whether the project is successful or not. By estimating the duration of the project, the first step to accuracy increases the challenge of building a reliable project schedule (Sebastian, 2023).

Good communication should also be integrated in the organizational culture and ensure all project stakeholders are involved to reduce conflicts. Once the changes and been approved and the schedule has been updated, the project manager needs to communicate the new schedule, this can be done during the regular reporting periods or if the change is significant, to communicate the change to all stakeholders impacted by it. It is on no use if the project makes modification to the schedule and this change is not communicated to the stakeholders who can still be working on the original schedule dates. The project schedule posted on the project office is also replaced so that all project staff is aware of the modifications and can act accordingly (PM4DEV, 2021).

Project Performance

Project schedule is critical for achieving results in project management. A well-controlled project schedule is critical for project success especial in the global market that is highly competitive. Schedule overrun is considered to be the second most important factor that affects project success after cost overrun. Various studies have defined project management through an operational and conceptual perspectives (Urbanski et al, 2019; Carvalho & Rabechini, 2017; Wu, et al, 2017). According to Carvalho & Rabechini (2017) project performance can be viewed under three aspects: the impact on the organisation clients and project team, project efficiency, and preparation for the future.

Empirical review

Cost scheduling and project performance

Widowati and Rachmawati (2020) identified the factors affecting schedule and cost performance in building project in Indonesia. The factors were grouped in 3 namely: management, environmental and resource factors. The study focused on the influence of project cost and time performance in relation to the physical progress and the actual cost. The study found that the factors under resources have an influence on the direct and indirect cost of the project. As for the environment factors they influence the indirect cost. Soltan and Ashrafi (2020) predicted the project duration and cost using statistical methods for EVM. The study used the EVM to control the project status as well predict the future status of the project the study used control charts with EVM to increase the accuracy of prediction of the cost and time of the projects. The method can be applied in every phase of the project.

Time scheduling and project performance

Tuyishime (2020) investigated the factors affecting time and cost performance of construction projects in Rwanda for high-rise building project in Kigali. The study aimed to identified the causes of delays, cost overrun, and the strategy to minimize the delays and cost of overruns in high-rise building projects in Kigali. The findings revealed that late payment to contractors, design variations, decision making delays, clearance delays and contractor financial difficulties was the main cause of time overrun in high-rise buildings while material cost, poor contract management, inaccurate cost estimations, and frequent changes in design were the main causes of cost overrun. The study recommended adequate funding of projects by the clients, and thorough planning during initial stages of the projects

Omulupi and Yusuf (2022) examined the influence of project time scheduling on successful implementation of healthcare projects in Nairobi County. The study targeted 219 healthcare projects where a sample 140 projects was drawn. The study found that project time scheduling had a positive significant influence on the implementation of healthcare projects. Oburu (2020) reviewed effective project time management. The study reviewed literature from qualitative information related to effective time management. The study concluded that Project time management is inevitable in any project life cycle as it determines the required project duration and scope.

RESEARCH METHODOLOGY

This study was based on the descriptive design which serves the purpose of providing a picture of a situation as it naturally occurs by defining the topic at hand. This study therefore provided the researcher with correct information on performance of geothermal drilling projects in Olkaria, Nakuru County, Kenya. The study focused on geothermal drilling projects at Olkaria, Nakuru County, Kenya that are undertaken by KenGen. The respondents included individuals involved in various aspects of geothermal projects and to be specific, 232 personnel of the drilling and logistics department of KenGen in Olkaria. A sample of 146 was drawn from the population using Yamane formula. The study collected primary data using a structured questionnaire. Both simple and purposive sampling were used.

RESEARCH FINDINGS

The questionnaires were administered to the sample size of 146 respondents from KenGen in Olkaria, Nakuru County, Kenya. A total of 120 questionnaires were dully filled and returned giving a response rate of 82.2%.

Descriptive statistics

The 5-point liker scale was used where the responses were coded as 1= Strongly Disagree, 2= Disagree, 3= Neutral, 4= Agree, 5 = Strongly Agree. The results were presented in tables and analysed and discussed. The descriptive statistics for the study variables are as follows:

Cost Scheduling

The first objective of the study was to determine the influence of cost scheduling on performance of geothermal drilling projects in Olkaria, Nakuru County, Kenya. This section provides descriptive findings on various questions relating t**o** Cost Scheduling in the Project Schedule Management process in geothermal drilling projects in Olkaria, Nakuru County, Kenya. Respondents gave their level of agreement or disagreements with various statements and the findings were as presented in Table 4.8. Based on the findings in Table 1, on average, the respondents slightly agreed with the statements as shown by an aggregate mean value of 3.41 and standard deviation of .423.

On whether the overall cost performance of project determined the delivery of a project, the study found that 44.2% agreed while 47.5% disagreed. Thus, majority of the respondents disagreed with the statement. The mean of 2.71 and standard deviation of 1.542 also implied that disagreement. Cost performance was found to have an effect on the ability to meet project deadlines as agreed by 68.3% of the respondents. This was also supported by mean of 3.98 and standard deviation of 1.159. The respondents also agreed (70%) the schedule and cost baselines are important in the project to enable understand the status of the project in relative to the planned budget performance. The statement was also supported by the mean of 3.96 and standard deviation of 1.305. On the statement that Cost/budget baseline being the time-phased project budget that formed the basis for comparison to actual results changeable through formal change control procedures, only 47.5% agreed against 35.5% who disagreed. The mean of 3.01 and standard deviation of 1.319 also could clearly support the statement.

Whether the geothermal drilling project use WBS to determine the task and variables of the project, 45.8% agreed against 39.2% who disagreed. The mean of 2.89 and standard deviation of 1.407 could clearly support the statement. However, respondents (57.5%) opined that the WBS used in geothermal projects helped in avoiding common project management issues such as missed deadlines, scope creep and cost overrun, among others. The mean of 3.24 and standard deviation of 1.432 could clearly support the statement. On whether the geothermal drilling projects used cost controlling techniques to estimating future costs and also identify areas of the project that can save money, 43.3% agreed against while a majority of 45.8% disagreed. The mean of 2.76 and standard deviation of 1.467 also show a disagreement on the statement. Finally, the geothermal drilling projects used modern cost control techniques that embrace technology to help the project manager track their budget in real-time as agreed by 76.7% of the respondents. This was also supported by the mean of 4.08 and standard deviation of 1.217.

Table 1: Cost Scheduling

Cost Scheduling	Mean	Stdv
The overall cost performance of project determines the delivery of a project.	2.71	1.542
Cost performance has an effect on the ability to meet project deadlines.	3.98	1.159
The schedule and cost baselines are important in the project to enable understand the status of the project in relative to the planned budget performance.	3.96	1.305
Cost/budget baseline is the time-phased project budget that is the basis for comparison to actual results changeable through formal change control procedures.	3.01	1.319
The geothermal drilling project use WBS to determine the task and variables of the project.	2.89	1.407
The WBS used in geothermal projects helps avoid common project management issues such as missed deadlines, scope creep and cost overrun, among others.	3.24	1.432
The geothermal drilling projects use Cost control techniques to estimating future costs and also identify areas of the project that can save money	2.76	1.467
The geothermal drilling projects use modern cost control techniques that embrace technology to help the project manager track their budget in real-time.	4.08	1.217
Mean Cost Scheduling	**3.41**	**.423**

a) In your opinion how does Cost Schedule influence performance of geothermal drilling projects in Olkaria, Nakuru County, Kenya?

In response to the above question, those who agreed that Cost Scheduling influence on performance opined that Successful delivery of a project is defined by the overall cost performance and ability to meet deadlines. Without schedule and cost baselines, it is impossible to understand where the project stands in relative to the planned budget performance or the planned schedule progress. The schedule also forms of the project plans and determine the activities to be completed, the milestones and the time for completion of the project. Those, who had contrary opinion argued that though it is true that cost scheduling is essential to the project manager in determining the allocation of project budget and keeping track of variances, most project managers assumed the activities or even lack the skills to develop the cost schedules.

b) How many projects have been affected by cost overrun?

On the number of projects affected by cost overruns, the respondents differed in their opinion however, there was a consensus that few of the completed geothermal projects have faced cost overruns. It was cited that the cost overruns were mainly linked to delay in completion days. Delay in completion schedule dates means additional cost of drilling. The opinions are also supported by Muriga (2019) that the cost of development of geothermal is the most expensive venture with cost up to USD 6 million and cost is influenced by many factors related to drilling days and energy factor.

Time Scheduling

The second objective to establish the influence of time scheduling on performance of geothermal drilling projects in Olkaria, Nakuru County, Kenya. This section provides descriptive findings on various questions relating to Time Scheduling in the Project Schedule Management process in the geothermal drilling projects in Olkaria, Nakuru County, Kenya. Respondents gave their level of agreement or disagreements with various statements and the findings were as presented in Table 2. Based on the findings in Table 2, on average, the respondents were neutral on the statements as shown by an aggregate mean value of 3.25 and standard deviation of .458.

It was agreed by majority (64.1%) during project planning that the time scheduling produced the project timeline. The mean of 3.27 and standard deviation however couldn't clearly support the findings. Majority of the respondents (45.8%) agreed that the critical path approach focused on the activities in the project as well as understanding the shortest time to complete all the activities in a logical order. About 37.5% had contrary opinion. The mean of 2.98 and standard deviation of 1.501 couldn't clearly support the findings. The Critical chain was used as a resource-based approach to planning whenever project time was of the essence. This was affirmed by 64.2% of the respondents. It was further supported by the mean of 3.77 and standard deviation of 1.268. The geothermal drilling project used activity duration Estimation in estimating the work periods needed for the completion of individual activities. This was affirmed by a majority of the respondents (73.4%) and also supported by the mean on 4.03 and standard deviation of 1.250. On whether the Gantt chart was the main tool used for the development of the project schedule, 54.2% affirmed the statement though the mean of 3.24 and standard deviation indicated otherwise.

It was only agreed by 52.5% of the respondents that through project time management the schedule management plan was developed as a subsidiary of the project management plan. The mean of 3.13 and standard deviation of 1.388 couldn't further support the findings. It also agreed by 53.4% of the respondents that the project team organized their schedule by noting down important dates of the project activities on a calendar as a reminder. The mean of 3.19 and standard deviation however could support that. Finally, it was agreed by 52.5% of the respondents that the project stakeholders were involved in time scheduling of the project to reduce conflicts. However, the mean of 3.03 and standard deviation 1.1481 couldn't further support that.

Table 2: Time Scheduling

Time Scheduling	**Mean**	**Stdv**
During project planning the time scheduling produces the project timeline.	3.27	1.494
The critical path approach focuses on the activities in the project as well as understanding the shortest time to complete all the activities in a logical order.	2.98	1.501
The Critical chain is used as a resource-based approach to planning whenever project time is of the essence.	3.77	1.268
The geothermal drilling project use activity duration Estimation in estimating the work periods needed for the completion of individual activities.	4.03	1.250
The Gantt chart is the main tool used for the development of the project schedule.	3.24	1.396
Through project time management the schedule management plan is developed as a subsidiary of the project management plan	3.13	1.388
The project team organize their schedule by noting down important dates of the project activities on a calendar as a reminder	3.19	1.279
The project stakeholders are involved in time scheduling of the project to reduce conflicts.	3.03	1.481
Mean Time Scheduling	**3.25**	**.458**

a) In ways does Time Scheduling influence performance of geothermal drilling projects in Olkaria, Nakuru County, Kenya?

Respondents generally agreed that time is an important factor in relation to performance of geothermal drilling projects. Time management was mentioned to have a ripple effect on other performance measures such as cost, quality, and stakeholder satisfaction. The respondents cited drilling projects which are done in phases and the way each phase is allocated specific timelines for completion. This implies that the projects are split into tasks for easier implementation and

tracking. Time scheduling was done based on resources available and the activity duration estimation was subject to analysis of previously drilled wells.

b) In your opinion, what the percentage of timely completed projects have your witnessed?

The respondents with the support of the secondary data mentioned about 50%. The secondary data indicated about 58.3% of the project have been completed on time. As from the secondary data the project duration was compared to the estimated completion time of 55 – 65 days. From the secondary data, though all the 12 wells were successfully completed, 58.3% (7) were completed on time.

Performance of Geothermal Drilling Projects

The study's general objective is to determine the influence of project schedule management on the performance of geothermal drilling projects in Olkaria, Nakuru County, Kenya. Respondents gave their level of agreement or disagreements with various statements and the findings were as presented in Table 3. Based on the findings on average, the respondents were neutral on the statements as shown by an aggregate mean value of 3.33 and standard deviation of .625. It was agreed by only 45.8% of the respondents that due to schedule managing practices the geothermal drilling projects schedule was critical for project success. The mean of 3.38 and standard deviation of 1.094 couldn't support the findings. On whether the geothermal project have witnessed schedule overruns., only 47.5% affirmed the statement while 36.3% were contrary. The mean of 3.03 and standard deviation of 1.306 couldn't further support the statement.

Stakeholders believed that project resources were well utilized as per scope and schedule. This was affirmed by 60% of the respondents and further supported by the mean of 3.58 and standard deviation of 1.255. The project records couldn't clearly show whether the project was implemented according to budget. Only 48.3% agreed while 41.7% disagreed. The statement was further supported by the mean of 2.85 and standard deviation of 1.532. It was agreed by majority of the respondents (69.2%) that the concluded projects normally met the required quality/standard. It was further supported by the mean of 4.03 and standard deviation of 1.306. Respondents agreed (71.6%) that adherence to schedule was the overall criteria for the success of a project. This was further supported by the mean of 3.88 and standard deviation of 1.306. Finally, it was agreed by 50% that the geothermal projects have been completed within their timelines. However, the mean of 3.11 and standard deviation of 1.249 couldn't support that.

Table 3: Performance of Geothermal Projects

Performance of Geothermal Projects	Mean	Stdv
The geothermal drilling projects schedule is critical for project success.	3.38	1.094
The geothermal project has not witnessed schedule overruns	3.03	1.306
Stakeholders believe that project resources were well utilized as per scope and schedule	3.58	1.255
The project records show that the project was according to budget	2.85	1.532
Concluded projects normally meet the required quality/standard	4.03	1.028
Adherence to schedule is the overall criteria for the success of a project.	3.88	1.306
Geothermal projects have been completed within their timelines	3.11	1.249
Mean Project Performance	**3.33**	**.625**

Regression analysis

Regression analysis was conducted to established the relationship between the independent variable with the depend variable. Simple linear regression was done for the study variables. The study used model, summary, analysis of variance and regression coefficients to explain the relationship between the independent variables and dependent variables.

Regression analysis for Cost scheduling and performance of geothermal drilling projects

The model summary shows the correlation coefficient (r) and the coefficient of determination (r-squared). From Table 4 below, cost scheduling has a weak correlation (r = .271) with

performance of geothermal drilling projects in Olkaria, Nakuru County. Cost scheduling also explains 7.3% (r-squared = .069) variation in performance of geothermal drilling projects in Olkaria, Nakuru County Kenya.

Table 4: Model Summary for Cost Scheduling

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.271[a]	.073	.069	.53255

a. Predictors: (Constant), Cost Scheduling

The ANOVA was used to determine the fitness of model in explaining the relationship between Cost scheduling and performance of geothermal drilling projects in Nakuru County. From table 5 below, F (1, 118) was 9.293 and sig .000<0.5 indicating Cost scheduling is significant in explaining the change in performance of geothermal drilling projects. Thus, Cost scheduling is fit for the model.

Table 5: ANOVA Results for Cost scheduling

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	2.624	1	2.624	9.293	.000[b]
	Residual	33.466	118	.284		
	Total	36.090	119			

a. Dependent Variable: Performance of Geothermal Projects

b. Predictors: (Constant), Cost Scheduling

Regression analysis for Time Scheduling and performance of geothermal drilling projects

The model summary shows the correlation coefficient (r) and the coefficient of determination (r-squared). From Table 6 below, Time scheduling has a weak correlation (r = .266) with performance of geothermal drilling projects in Olkaria, Nakuru County. Time scheduling also explains 7.1% (r-squared = .071) variation in performance of geothermal drilling projects in Olkaria, Nakuru County Kenya.

Table 6: Model Summary for Time Scheduling

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.266[a]	.071	.063	.53211

a. Predictors: (Constant), Time Scheduling

The ANOVA was used to determine the fitness of model in explaining the relationship between time scheduling and performance of geothermal drilling projects in Nakuru County. From table 5 below, F (1, 118) was 8.989 and sig .003<0.5 indicating time scheduling is significant in explaining the change in performance of geothermal drilling projects. Thus, time scheduling is fit for the model.

Table 5: ANOVA Results for Time Scheduling

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	2.545	1	2.545	9.293	.003[b]
	Residual	33.411	118	.283		
	Total	35.956	119			

a. Dependent Variable: Performance of Geothermal Projects

b. Predictors: (Constant), Time Scheduling

Multiple linear regression

This study applied a multiple regression model to identify the relationship between Cost Scheduling, Time Scheduling and their influence on Performance of geothermal drilling projects in Olkaria in Nakuru County, Kenya. The study checked for the direction of the relation, significance of the relationship and the extent of influence.

Table 8: Regression Coefficients for Cost scheduling, Time Scheduling

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.476	.901		1.639	.104
	Cost Scheduling	.221	.059	.271	3.762	.000
	Time Scheduling	.196	.065	.266	2.998	.003

a. Dependent Variable: Performance of Geothermal Project

From Table 8 above, Cost Scheduling had a positive (β = .221), significant (sig s= .000<.05) and direct relationship with performance of geothermal drilling projects in Olkaria, Nakuru County, Kenya. The study significance of the Cost Scheduling in influencing performance of geothermal drilling projects in Olkaria, Nakuru County, Kenya is further supported by the t - calculated (3.762)> t-critical (±1.980). One unit change of cost scheduling while holding all other variables at zero results in .221 increase in performance of geothermal drilling projects. Cost scheduling also influence performance of geothermal projects to an extent of .271 (27.1%). There is a significant relationship between Cost Scheduling and Performance of geothermal projects in Olkaria, Nakuru County, Kenya. The findings are supported by Belay et al (2021) cost overruns in infrastructure projects lead to schedule delays. Thus, infrastructure projects should ensure they have effective cost schedules to minimize schedule delays. Similarly, Trisanto and Wardhan (2021) also found cost scheduling to significantly influence the implementation of road projects in Indonesia.

Finally, Time Scheduling had a positive (β = .196), significant (sig = .003>.05) and direct relationship with performance of geothermal drilling projects in Olkaria, Nakuru County, Kenya. The study found Time Scheduling to be significant in influencing performance of geothermal drilling projects in Olkaria, Nakuru County, Kenya further supported by the t-calculated (2.998) < t-critical (±1.980). One unit change of Time Scheduling while holding all other variables at zero results in .196 increase in performance of geothermal drilling projects. Time scheduling also significantly influences performance of geothermal projects to an extent of .117 (11.7%). There is a significant relationship between Time Scheduling and Performance of geothermal projects in Olkaria, Nakuru County, Kenya. The findings concur with the study by Makoria and Mundia (2019) on the influence of scheduling techniques on project performance of registered building works contractors in Nakuru County, Kenya which found a positive significant relationship between critical path, Gantt chart methods and project performance. The study by Oburu (2020) found that Project time management is inevitability in any project life cycle as it determines the required project duration and scope. Omulupi and Yusuf (2022) also found project time scheduling had a positive significant influence on the implementation of healthcare projects.

Model fitting

The following regression model was used;

$$\gamma = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \varepsilon, \text{ `} \ldots\ldots\ldots\ldots\ldots\ldots\text{(i)}$$

Y = Performance of geothermal drilling projects

X_1 = Cost Scheduling (CS), X_2 = Time Scheduling (TS)

Performance of Geothermal Projects = 1.476 + .221CS + .196TS ..... (ii)

CONCLUSION

The first objective was to determine the influence of cost scheduling on performance of geothermal drilling projects in Olkaria, Nakuru County, Kenya. The study found a significant relationship between Cost scheduling and Performance of geothermal projects in Olkaria, Nakuru County, Kenya. This study therefore concludes that Cost scheduling as a project schedule management practice influences performance of geothermal drilling projects in Olkaria, Nakuru County, Kenya. The second objective was determining the influence of Time scheduling on performance of geothermal drilling projects in Olkaria, Nakuru County, Kenya. The study found a significant relationship between time scheduling and Performance of geothermal projects in Olkaria, Nakuru County, Kenya. This study therefore concludes that time scheduling as a project schedule management practice significantly influences performance of geothermal drilling projects in Olkaria, Nakuru County, Kenya.

RECOMMENDATION

Cost scheduling was found to have a significant influence on performance of geothermal drilling projects in Olkaria, Nakuru County, Kenya. Project managers need to be to allocate time and resources efficiently to manage costs and keep track of the project. The project budget baseline should also be used to determine the performance of projects to ensure they are within the acceptable guidelines. A WBS helps avoid common project management issues such as missed deadlines, scope creep and cost overrun, among others. Thus, project managers should effectively use the WBS for the development of cost schedules. Time scheduling was also found to have a significant influence on performance of geothermal drilling projects in Olkaria, Nakuru County, Kenya. The study recommended the use of Gantt charts and Critical paths by project managers to ensure accurately determination of timelines as well as timely tracking of project outcomes.

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