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Examining success factors for geothermal power development in Kenya.

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EXAMINING SUCCESS FACTORS FOR GEOTHERMAL POWER DEVELOPMENT IN KENYA

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2024.

DECLARATION

I declare that this work has not been previously submitted and approved for the award of a degree by this or any other University. To the best of my knowledge and belief, the dissertation contains no material previously published or written by another person except where due reference is made in the dissertation itself.

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Date 12/05/2024.

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ABSTRACT

Kenya was the first and still the only Country in Africa to generate significant electricity from geothermal resources. The current output from geothermal is about 983MW, but this output is expected to increase as new power plants are commissioned. Geothermal energy is sustainable, environmentally friendly, reliable, and cost-effective. Kenya has a potential of exceeding 10,000 MWe in geothermal electricity production, but the Country is yet to achieve its full potential. Success factors (SFs) must be attained to produce exceptional results. If not considered, there could be impediments to the overall successful outcome of the project. Few studies have examined the SFs in developing geothermal power in Kenya. Therefore, the goal of this research was to examine the influence of success factors on development of geothermal energy sector in Kenya. Specifically, the study examined success factors including financial, technical, managerial, and regulatory factors. The study was grounded on the theory of production and institutional theory. The target population of the study comprised of senior managers and middle level employees in the six entities of the energy sector in Kenya. A sample size of 142 participants was determined using stratified random sampling technique. Data was then collected using structured questionnaires that consisted of of closed ended questions and divided into six sections. Quantitative data collected using questionnaires were edited, coded in, and categorized then input in the Statistical Packages for the Social Sciences (SPSS) for further analysis. This allowed the researcher to generate descriptive and inferential statistics. The descriptive statistics that were generated included: mean, standard deviation and percentages while the inferential statistics comprised of correlation and regression analysis results. The study findings showed that majority of the respondents and well above 50% in all the questionnaire statements, agreed that financial, technical, managerial, and regulatory factors were success factors that influenced development of geothermal energy sector. The results also found that financial, technical, managerial, and regulatory factors had a positive and significant relationship with development of geothermal energy sector. In addition, regression results also demonstrated that managerial factors had the most positive and significant influence on development of geothermal energy sector, followed by technical factors, regulatory factors, and then lastly financial factors. Therefore, the study concluded that financial, technical, managerial, and regulatory factors were success factors that had a positive and significant influence on the development of geothermal energy sector in Kenya. The study recommended that the management of the sector should foster better collaboration between the government and other key stakeholders to ensure they leverage on each other's strengths and resources and enhance timely and cost-effective execution of geothermal projects. Policymakers should ensure availability of research and development budgets to finance geothermal exploration, data collection as well as geothermal technology development activities.

Keywords: *Geothermal power, success factors, renewable energy, quantitative research*

TABLE OF CONTENT

LIST OF ABBREVIATIONS

ADB	African Development Bank
BLM	Bureau of Land Management
BOT	Build Operate Transfer
CSF	Critical Success Factors
DOE	Department of Energy
EPRA	Energy and Petroleum Regulatory Authority
GDC	Geothermal Development Company
GeTRI	Geothermal Training and Research Institute
GoK	Government of Kenya
GRMF	Geothermal Risk Mitigation Fund
GROS	Geothermal Resource Operational Orders
GTO	Geothermal Technology Office
GWe	Gigawatt energy
IRENA	International Renewable Energy Agency
IPPs	Independent Power Producers
KenGen	Kenya Electricity Generating Company
kWh	Kilowatt per hour
MOE	Ministry of Energy
MOEP	Ministry of Energy and Petroleum
MIT	Massachusetts Institute of Technology
MW	Megawatt
MWe	Megawatt energy
MTP	Medium Term Plan

PPP	Public Private Partnership
PURPA	Public Utility Regulatory Policies Act
RPS	Renewable Portfolio Standard
SOE	State owned enterprise
USA	United States of America
UScts	United States Cents
WB	World Bank
SPSS	Statistical Package for Social Sciences
SF	Success Factors

DEFINITION OF TERMS

Appraisal drilling -Preliminary geothermal steam drilling to confirm existence of resource before rolling out large scale drilling program.

De-risking the field -Upfront geothermal resource exploitation and appraisal activities undertaken to prove existence of geothermal steam.

Geothermal Energy -Derived from two words, Geo meaning earth and thermal referring to heat, it is a form of heat originating from the sub-surface of the earth.

Geothermal Resource - The geothermal steam underneath the earth surface.

Medium Term Plan III -The National Vision 2030 five-year focus areas of development between 2018 to 2023 also known as the Big Four Agenda.

National Vision 2030 -The Government of Kenya's National Development Plan from the years 2008 to 2030.

Production drilling -Comprehensive large scale drilling program once existence of geothermal resource has been proven.

Resource Maps -Details on the location of the geothermal steam underneath the earth surface.

Financial factors -Any aspect of an organization's financial situation that can have an impact on its operations, decisions, and overall performance.

Technical factors -Any aspect related to the technology, equipment, or processes used in a business or industry.

Managerial factors -These are various aspects related to the management and leadership of an organization.

Regulatory factors -The rules, regulations, policies, and laws that govern the operations of businesses and industries.

LIST OF FIGURES

LIST OF TABLES

ACKNOWLEDGEMENT

For all your wonderful blessings and beautiful gifts, thank you Dear God. Thank you, Dr. Elizabeth Muthuma for accepting to be my supervisor and for the guidance and all the invaluable advice during this study.

DEDICATION

To my dear parents and family for love and encouragement; To my fellow Kenyans, in pursuit of affordable and clean electricity.

CHAPTER ONE: INTRODUCTION

1.1 Background Information

Kenya has significant geothermal resource potential estimated at 10,000MW and an additional low and medium enthalpy resource estimated at 50,000MW to 60,000MW (GoK, 2020). Vision 2030, Kenya's National Development Plan formulated in 2007, noted that providing sufficient and competitively priced electricity would be crucial to realizing Vision 2030 growth aspirations (GoK, 2008). Similarly, the Medium-Term Plan (MTP) IV, also known as the Bottom-Up-Economic Transformation Agenda (BETA) notes that realizing the five aspirations comprising of agriculture, housing and settlement, industrialization, health care and micro, small and medium enterprises, creative economy and digital superhighway requires the provision of sufficient and cost-effective electric power (GoK, 2023). In pursuit of this goal, the Government of Kenya has focused on developing electric power, and the current installed capacity stands at 2,990MW (KPLC, 2023)). However, there has been consistent concern about the high cost of electricity in Kenya. The government of Kenya (GoK, 2003), under a Presidential directive, in the Economic Recovery Strategy Paper, directed the Ministries of Energy and Finance to review levies and taxes on electricity to reduce the cost of electricity, a critical factor derailing economic growth.

GoK (2016) noted that expensive power owing to at least 40% of the total installed capacity investment in Heavy Fuel Oil and High-Speed Diesel plants with a tariff range of between 26UScts/kWh-36 UScts/kWh, represents one of the problems facing the energy sector. In a similar observation, Carvallo, Shaw, Avila & Kammen (2018) argued that Kenya has one of the most expensive electric energy in the region owing to investment in fuel oil electric power capacity. On the other hand, GoK (2020) observed that geothermal energy offers reliable base energy with the lowest levelized energy cost at the current Feed In-Tariff of UScts/kWh 6.5. This fact, coupled with the fact that it is a naturally occurring resource in the country, makes it a critical focus area for affordable and reliable power generation (Merem et al., 2019). However, compared with the other geothermal producers, Kenya's utilization is only a tiny percentage of its full potential at 9.83 % (Volgapkina & Sharkova, 2022). Thus, this research sought to assess the components for the successful development of geothermal energy. Various elements are explored when examining geothermal development aspects, including energy mix and market, basic situation (development history, geothermal system, geological setting), institutions, policies, technologies, and finance (Volgapkina & Sharkova, 2022).

The installed capacity for producing electricity from geothermal sources around the globe is about 12.6 GWe as of 2020 (Lund & Toth, 2020). This sum is distributed among nine leading countries, including US, Philippines, Indonesia, Mexico, New Zealand, Kenya, Japan, and Turkey, among others (Chomać-Pierzecka et al., 2022). The US is in the first place, with an installed geothermal capacity of 3,722 MW. Indonesia is

in second place with 2,276 MW, while the Philippines is in third place with 1,918 MW of installed capacity (Wahyudi, 2017). Kenya's installed capacity stands at 983MW. Figure 1.1 demonstrates a significant gap between Kenya and the leading countries globally in the rate of geothermal development and motivates this study to investigate success factors for developing geothermal energy.

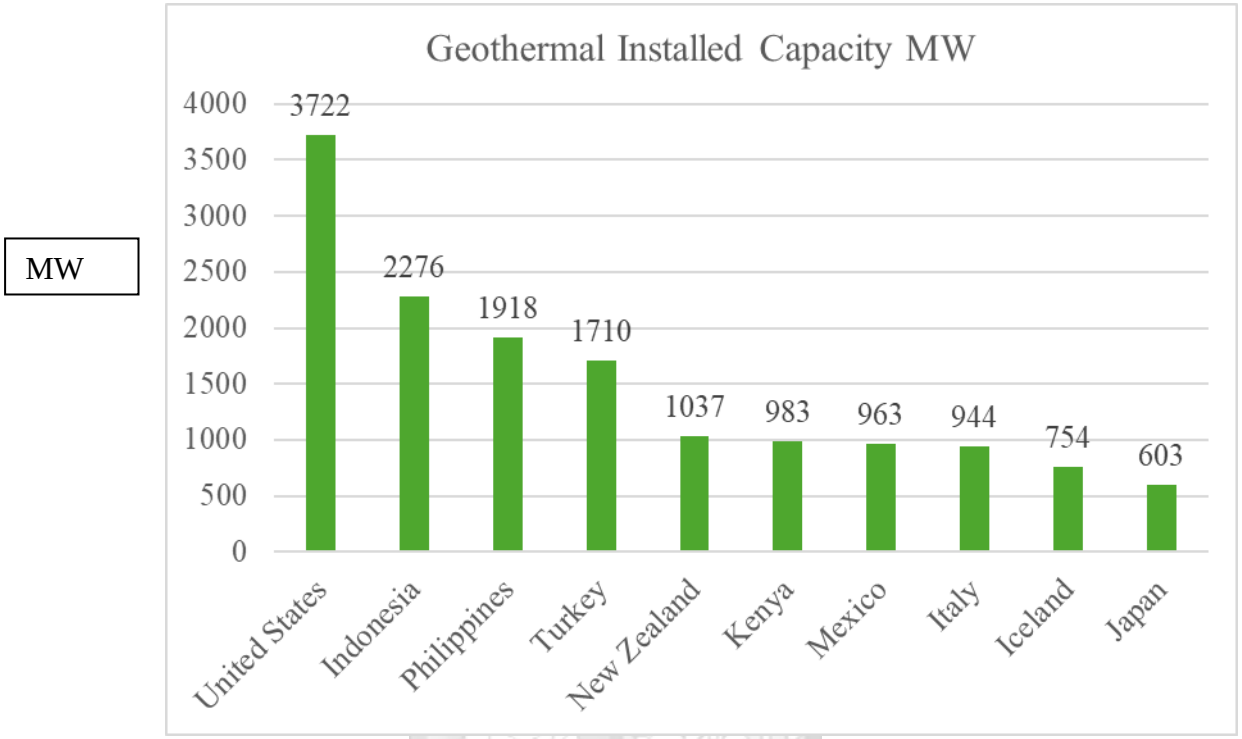


Figure 1.1: Country Ranking- Geothermal Installed Capacity (2023)

Source: Think GeoEnergy

1.1.1 Geothermal Development in Kenya

Kenya is blessed with a significant geothermal resource estimated at 10,000MW (GoK, 2020) and an additional low and medium enthalpy resource estimated at 50,000MW to 60,000MW (GoK, 2017) as shown in Figure 1.2 in Appendix III. This is due to the Country's geological setting that makes it one of the largest geothermal producers globally, alongside the USA, Indonesia, Philippines, Turkey, and Mexico (Merem et al., 2019). Geothermal energy exploitation in Kenya commenced in the 1950s, but the first successful power plant, the Olkaria I 45MW, was established between the years 1981 to 1985. (Karingithi, 2012; Saitet & Muchemi, 2015). Today, the current installed capacity stands at 983MW and ranks position six globally (Merem et al., 2019).

The development of geothermal energy in Kenya is the subject of extensive planning. In 2007, KenGen, Kenya's top power production firm, announced a geothermal-led strategy as part of its Good to Great transformation strategy, intending to develop up to 1500MW of geothermal power by 2020. (KenGen, 2007). Aiming to lead geothermal development in Kenya, Geothermal Development Company (GDC) was established in 2008. As a result, KenGen gave GDC the geothermal fields except for Olkaria. GDC committed to developing up to 4000MW of geothermal energy by 2030 in its initial Business Plan for 2009 through 2019

(GDC, 2009). Although the use of geothermal energy has many advantages, there are still challenges that face production. The performance of geothermal energy projects is influenced by many factors, including financial, technological, and operational (Amri, 2017). The functional aspects are the plant system design, turbine and generator efficiencies, and equipment heat loss (Avci et al., 2020).

1.1.2 Success Factors for Geothermal Energy Development

Success factors (SF) refer to important organizational aspects whose emphasis leads to the enhancement of effectiveness and growth (Ortiz & Leal, 2020). These factors are scarce, and how they are distributed throughout a company and how much attention is paid to them affect how successfully they may influence performance and competitiveness (Ndile, 2021). The project team's financial plan, risk management strategies, information technology integration strategies, socioeconomic considerations, and project management team's leadership skills are all included in SFs. The policy paper by the International Renewable Energy Agency (IRENA, 2014) identified the criteria for evaluating renewable energy policy: effectiveness, efficiency, equity, and institutional feasibility. Ortiz and Leal (2020) asserted that it is necessary to assess the success of a policy, which is considered to be the accomplishment of the purpose or aim.

According to Yudha et al. (2022), Geothermal power development is a multifaceted and evolving procedure that encompasses technologies, institutions, regulations, policies, stakeholders, and other changing and interconnected elements. Due to these complexities, governments often struggle to attain their objectives (Nasruddin et al., 2016). Therefore, correctly understanding geothermal energy development requires a holistic and systematic approach, including exploring success factors. Additionally, for the purpose of developing long-term strategies, it is essential to comprehend the variables that influence the growth of geothermal energy in various nations (Chu et al., 2021; Yudha et al., 2022). In Eastern Africa, there is a dearth of literature concerning SFs, including relevant policies, institutions, data and information, and finance (IRENA, 2020).

APEC (2015) identified some of the organizational development success factors comprising legal and institutional framework, access to geothermal resources, data and information, government support on financial incentives, human resources, research and development, and access to the electricity market as policy success factors for geothermal development. Likewise, ESMAP (2013) identified four critical success factors for developing geothermal energy. These include policies, institutions, finance, and information, which directly influence the outcome of the geothermal project or program (Ortiz & Leal, 2020). The applicability of the success factors identified as managerial, financial, regulatory and technical were explored to determine both successes and barriers to geothermal energy development and make appropriate recommendations for the Kenyan scenario.

1.2 Problem Statement

For a nation to flourish and experience economic progress, it is essential to have access to abundant and affordable power (Basosi et al., 2020; Mohammed et al., 2021). Many nations now have the opportunity to

transform their energy supply sustainably thanks to geothermal energy. It is a sustainable form of energy that can continuously produce baseload electricity (Avci et al., 2020). It also has significant local and global environmental advantages when appropriately constructed. Geothermal energy is more affordable than fossil fuels and is also better for the environment (Kipngok et al., 2013). Additionally, geothermal energy contributes to the stability of electricity costs because it is unaffected while operating by variations in the cost of commodities worldwide (Younger, 2015; Chelminski, 2022).

The utilization of geothermal resources for power generation commenced about 60 years ago, although its potential had been identified a century ago (Wahyudi, 2017). However, the full exploitation of geothermal resources in many countries has not been attained. Today, geothermal resource utilization globally is estimated at 10% (Franco & Vaccaro, 2020). Considering the current energy crisis occasioned by high oil prices, it is a moment for geothermal energy, especially for countries endowed with this naturally renewable resource. The exploitation of geothermal power faces some barriers, which include regulatory uncertainty, pricing uncertainty, and lack of technical expertise (Wahyudi, 2017; Karytsas et al., 2022). Various critical success factors contribute to the growth of geothermal energy in a country, including the existence of relevant policies, the putting in place of relevant institutions, proper data collection and management, and the availability of funds (Yudha et al., 2022; Kabeyi & Olanrewaju, 2022). However, few studies in Kenya have examined the extent or actualisation of these Success Factors on geothermal power development.

Insufficient sector-specific legislation, high upfront costs of developing the steam field and power plant, transmission access from load centers to geothermal locations, a lack of basic access infrastructure, and a lack of technical experience are challenges to geothermal power development (Engola, 2019). High resource risk at the early drilling stage and the necessity for a large upfront capital outlay may slow geothermal development and occasionally prevent projects from progressing further (Yudha et al., 2022).

Geothermal energy shows promise due to its advantages, which include environmental sustainability and cost-effectiveness (Omenya et al., 2020). Moreover, geothermal power can help mitigate the effects of climate change worldwide (Mangi, 2018). In light of these considerations, the East African Rift region is giving geothermal energy greater attention than it has in the past. For example, in Kenya, Geothermal energy contributes 14% to the national grid (Nechenje & Ngugi, 2018). As a result, it is essential to look at the crucial success elements for development of geothermal power in Kenya, one of the lower-income nations where little study has been conducted so far. Despite the significant geothermal resources available in Kenya, it is only the Olkaria field that has been developed to produce the current 983MW, only 9.83% of the 10,000MW potential in all the other fields.

With an installed capacity of 983MW, plans to develop geothermal energy in the country are not being realized promptly, exposing the country to more expensive modes of generation such as fossil fuels and intermittent sources of power from wind and solar, which alongside being more expensive, subjects the country to an unreliable power supply (Engola, 2019). Previous local studies on geothermal energy are either

too generic or fall short of describing in detail the obstacles to Kenya's complete geothermal power development (Nechenje & Ngugi, 2018; Engola, 2019; Omenya et al., 2020; Kabeyi & Olanrewaju, 2022). Against the preceding background, this study sought to evaluate factors for successful geothermal energy development by administering questionnaires to industry stakeholders. Specifically, the study examined the extent to which financial, technical, managerial and regulatory factors influence geothermal development in Kenya.

1.3 Objectives

1.3.1 General Objective

To examine the influence of success factors on the development of geothermal energy sector in Kenya.

1.3.2 Specific Objectives

i. To investigate the influence of financial factors on the development of geothermal energy sector in Kenya.
ii. To evaluate the influence of technical factors on the development of geothermal energy sector in Kenya.
iii. To determine the influence of managerial factors on the development of geothermal energy sector in Kenya.
iv. To examine the influence of regulatory factors on the development of geothermal energy sector in Kenya.

1.4 Research Questions

i. What is the influence of financial factors on the development of geothermal energy sector in Kenya?
ii. How is the influence of technical factors on the development of geothermal energy sector in Kenya?
iii. What is the influence of managerial factors on the development of geothermal energy sector in Kenya?
iv. How is the influence of regulatory factors on the development of geothermal energy sector in Kenya?

1.5 Scope of the Study

The study focused on success factors for successful geothermal energy development in Kenya. This study investigated through a census of all the geothermal entities in the energy sector and conducted a document analysis on the degree to which these factors have been applied or implemented in Kenya. Data was primarily obtained from questionnaires administered to key stakeholders in Kenya's geothermal energy sector. Primary data collection using questionnaires was obtained from the following companies: Ministry of Energy, Energy and Petroleum Regulatory Authority (EPRA), KenGen, GDC, and two other private companies.

1.6 Significance of the Study

This research makes a substantial input to the corpus body of knowledge by offering a comprehensive and integrated assessment of the geothermal system in Kenya while taking important success criteria into account. Therefore, the study is essential in various facets. First, the study findings may be helpful to policy makers in

the Kenya Government on the factors and mechanisms that need to be put in place to ensure successful and rapid development of geothermal energy in Kenya. This may go a long way, in enhancing geothermal development and guaranteeing the availability of firm and cheaper electric power sources. Second, the study findings can add significant value to companies mandated to provide sufficient, reliable, and affordable electric power in the Country by identifying factors that will enable them to unlock this immense geothermal energy potential and create a conducive environment to execute their mandates. Finally, the research contributed to the body of knowledge in academia.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

In this chapter, a survey of the existing literature was reviewed to identify factors determining successful development of geothermal energy. It covered theoretical framework, empirical literature survey, study gap and conceptual framework. The theoretical review focused on the theory of production and institutional theory. On the other hand, empirical review addressed the study variables concerning geothermal energy development in Kenya.

2.2 Theoretical Literature Review

The study was anchored on the theory of production and institutional theory as discussed below.

2.2.1 Theory of Production

The theory of production was proposed by a French economist, Jean-Baptiste Say in 1803. The theory outlines how inputs are transformed into outputs by firms. It argues that businesses target to optimize their production processes so as to maximize their profits. Say (1803) enlightens the knowledge of theory of production as discussed later by Charles W. Cobb and Paul Douglas (1928) using the Cobb Douglas production function. The production function demonstrates that components of production including labour and capital are needed to produce commodities and services. He emphasizes that the primary factors of production are not only labour and capital but also technology and use of machines. He claimed that employing machinery that uses forces of nature rather than division of labor led to the greatest advancement in productivity (Béraud, 2016). In addition, he also argued that all productions are governed by the laws of nature and by the preservation of energy. Say also made a significant contribution by recognizing that human production was utilizing new machinery to draw power from untapped sources, and that production theory needed to address the basic roles that natural resources and forces of nature play in human production (Fare & Grosskopf, 2019).

Further, he also notes that the operations of an industry or factory requires the same basic factors of production, including capital, labour, forces of nature and machines (Schiffer, 2016). However, in his research he also identifies another important factor of production which is natural resources. He claims that in the absence of resources and a power supply, workers and machines cannot generate anything on their own. Therefore, the theory acknowledges energy as an essential factor of production which if used effectively in combination with the other factors can enable firms increase their outputs and maximize their profits (Shephard, 2015).

Moreover, Apaydin and Tagdogan (2019) study also revealed that the effects of industrial revolution and the goal of increasing energy production have necessitated the need for identifying alternative renewable energy

sources, aside from the non-renewable sources of energy such as fossil fuel reserves. In addition, Schiffer (2016) observed that countries focus on renewable energy to reduce pollution and environmental degradation and lower electricity prices. Further, Lu and Yang (2019) argue that the increasing demand for electricity influenced by increased population in countries and rapid technological advancements have also necessitated massive energy consumption. This study aimed to explore geothermal energy as a form of renewable energy with numerous advantages and the success factors that have contributed to the development of the geothermal energy sector in Kenya. The theory was found to be applicable to financial, managerial and technical factors to the extent that the theory posits labour and capital as crucial inputs needed to produce commodities and services. Labour is attributed to human capital which relates to managerial factors in this study. The theory also illustrates that labour and capital are not sufficient factors of production but also includes the use of technology and machines. Finance factors have been addressed by the theory to the extent that capital and funding would be required to acquire both technology and machines whereas both technology and machines are some of the technical factors required for successful development of geothermal. Therefore, the theory of production was found to be applicable to this research since it examined the influence of financial, technical and managerial factors on the development of the geothermal energy sector in Kenya.

2.2.2 Institutional Theory

This theory was first developed by John Meyer in 1977 (Scott, 2005). The theory stipulates that organizations tend to adopt similar structures and practices over time to gain legitimacy and acceptance from their institutional environment. This environment includes formal and informal rules, norms, and practices that guide social interactions, such as laws, policies, organizational practices, and cultural beliefs. As a result, these institutional structures and practices provide a sense of stability, predictability, and legitimacy to social life, and that individuals and organizations are shaped by these institutional forces (Meyer, 2010).

Meyer (2017) describes the core concepts of institutional theory including institutional isomorphism, institutional logics, and institutional entrepreneurship. Institutional isomorphism describes organizations' propensity to implement like structures, procedures, and standards in order to obtain legitimacy and abide by institutional influences. Institutional logic refers to the underlying values, beliefs, and assumptions that shape institutional structures and practices. Institutional entrepreneurship refers to the role of actors who challenge existing institutional arrangements and promote alternative logics and practices (Jepperson & Meyer, 2021).

DiMaggio and Powell (1983) extended Meyer's ideas of isomorphism by introducing three different mechanisms of isomorphism: coercive, mimetic, and normative. Coercive isomorphism occurs when organizations are compelled to follow institutional norms through laws, regulations, or other forms of coercion (Zilber, 2012). Mimetic isomorphism occurs when firms emulate the approaches utilized by competing businesses that are regarded as successful or respectable. Normative isomorphism occurs when organizations embrace institutional norms because they are perceived as the correct or appropriate methods of operation (Najeeb, 2014).

Institutional theory has been applied to a wide range of fields, including organizational behavior, public policy, and international relations. It has been used to explain the adoption of environmental regulations by firms and the convergence of policies across countries. The study by Jha et al. (2010) also used this theory to understand why hospitals adopt Electronic Medical Records (EMRs). They found that hospitals adopt EMRs to gain legitimacy and social acceptance from external stakeholders, such as patients, regulators, and insurers, and to conform to institutional norms and expectations. Hoffman (1999) also utilized the theory in a different study to explain why businesses follow environmental requirements. According to the study, businesses follow environmental laws to achieve credibility and yield to institutional constraints. The study also revealed that firms that are more heavily scrutinized by the public and regulatory bodies are more likely to comply with environmental regulations.

Therefore, this theory was also applicable to this study particularly when the researcher examined the influence of various regulatory factors on the development of the geothermal energy sector in Kenya. This also entailed the particular reasons that the geothermal energy sector adopts and implement governmental and organizational policies and regulations and how they affect their development.

2.3 Empirical Literature review

The empirical literature review covered the four success factors for geothermal development: financial, technical, managerial as well as regulatory factors. The success factors are the study's main variables, informing the progress Kenya has made in its geothermal power development.

2.3.1 Financial Factors

Financial factors refer to any aspect of an organization's financial situation that can have an impact on its operations, decisions, and overall performance. Johansson and Harvey (2017) study investigated on the financial mechanisms that have supported the development of the geothermal energy sector in Iceland, New Zealand, and United States. The study employed a case study approach to analyze the financing strategies used in the three countries and examine their effectiveness. The study results revealed that the availability of low- cost capital, long-term power purchase agreements, and supportive government policies have been critical for the successful development of geothermal energy projects in these countries. However, the study suggested that further examination is needed to examine the possibilities of cutting-edge finance tools, such as green bonds and crowdfunding, to assist the development of geothermal energy. In order to close this knowledge gap, the present research looked at various financial incentives that have greatly aided Kenya's geothermal energy sector's growth.

Ghasemi, et al. (2020) study examines the financial barriers that have hindered the development of the geothermal energy sector in Iran, using the Sabalan geothermal power plant as a case study. The study employed a qualitative approach, where interview guides were used in engaging 30 stakeholders of the geothermal energy sector and document analysis to identify the financial challenges faced by the Sabalan

project. The research outcome showed that there have been substantial barriers to the expansion of geothermal energy in Iran, including high drilling costs, low electricity costs, and a lack of official backing. The research suggested that further investigation is needed to explore the potential for international financing mechanisms, such as the Green Climate Fund, to support geothermal development in countries like Iran.

Gungor-Demirci et al. (2018) study assesses the financial risks associated with geothermal power plant development in Turkey and identified strategies for mitigating those risks. The study also employed a quantitative approach, using financial modeling and sensitivity analysis to evaluate the financial viability of geothermal energy projects in Turkey. The study results found that project financing, exchange rate risk, and regulatory uncertainty are the most significant financial risks facing geothermal power plant developers in Turkey. The study advocated that further research should consider examining the potential for risk-sharing mechanisms, such as insurance and hedging strategies, to support geothermal energy development in Turkey.

Sari and Suryani (2018) study aimed to determine the influence of government subsidies on the growth of the geothermal energy sector in Indonesia. The study employs a quantitative research design, using a panel dataset covering the period from 2001 to 2016, and a fixed-effects model to estimate the impact of subsidies on geothermal capacity. The study findings noted that government subsidies have a positive and significant impact on the growth of geothermal capacity in Indonesia. Specifically, the study concluded that subsidies for exploration and drilling activities had the most significant impact on geothermal capacity growth. However, the study also found a research gap highlighting the necessity for further investigation into the impact of subsidies on the sustainability of geothermal projects, as well as the need for a more comprehensive approach to the evaluation of subsidies in the geothermal sector.

Johnston and Santoyo-Castelazo (2016) study examined the different funding instruments that have been used to support geothermal energy development in South Africa and evaluated their effectiveness. The study used an organized review methodology, to analyze the available literature on funding instruments in the geothermal sector. The results of the investigation showed that a range of funding instruments, including government grants, tax incentives, and feed-in tariffs, have been used to support geothermal energy development in different countries, and that the most effective instruments depend on local circumstances. Similarly, this study also suggested that further research is needed to evaluate the effectiveness of innovative funding instruments, such as green bonds and crowdfunding, in supporting geothermal energy development.

Walekhwas and Gitonga (2018) study assessed the impact of financial incentives on the development of geothermal energy in East Africa, with a focus on Ethiopia and Kenya. The study utilized a literature review and a case study approach. The findings established that financial incentives, including tax exemptions, feed-in tariffs, and subsidies, have been effective in promoting investment in the geothermal sector in both countries. However, the study also noted a lack of coordination between different government agencies, the need for long-term policy frameworks to ensure sustained investment and ineffective budget utilization mechanisms.

Furthermore, the study highlighted the need for further analysis of the effectiveness of financial incentives in promoting local ownership and participation in geothermal energy projects.

Nyakundi and Keramati (2019) study investigated on the role of private sector investment in the development of the geothermal energy sector in Kenya. The study used exploratory research design, using semi-structured interviews with key stakeholders in the geothermal industry, including private sector investors, government officials, and industry experts. The study finds that private sector investment has played a critical role in the development of geothermal energy in Kenya, both in terms of financing and technical expertise. Furthermore, the study identifies the importance of policy and regulatory frameworks in attracting private sector investment in the geothermal sector. However, the study also highlights research gaps in the need for further analysis of the risks and challenges associated with private sector investment in the geothermal sector, as well as the likelihood effect of investment on local communities and surroundings.

Kamunge and Karekezi (2017) study assessed the possibility of crowdfunding as a financing mechanism for geothermal energy projects in Africa. The study used the systematic review approach and case study analysis of a geothermal crowdfunding project in Kenya. The results of the study revealed that crowdfunding has the potential to complement traditional financing mechanisms and increase community involvement and ownership in geothermal energy projects. The study also identified several challenges to the use of crowdfunding in the African context, including limited access to technology, low levels of financial literacy, and regulatory barriers. Furthermore, the study also contributed in filling the research gap as outlined in Johansson and Harvey (2017) and Johnston and Santoyo-Castelazo (2016) studies. However, this study highlighted research gaps in the need for further analysis of the scalability and replicability of crowdfunding models for geothermal energy projects in other African countries.

2.3.2: Technical Factors

Technical factors refer to any aspect related to the technology, equipment, or processes used in a business or industry. These factors can include technological advancements, innovations, automation, production processes, research and development, and intellectual property. González-Aparicio and de la Hoz (2020) study conducted an extensive examination of the current status, challenges, and prospects of geothermal energy development in Europe. The study utilized a systematic review methodology, which involved analyzing previous studies on geothermal energy sectors in Europe. The results revealed that Europe has significant geothermal energy potential, but its development is facing several challenges, including high upfront costs in implementing innovative technologies in their power-generation systems and technical and economic feasibility of geothermal energy systems. However, the study noted that the EU's 2020 renewable energy targets and the 2030 climate and energy framework may provide the necessary impetus to increase geothermal energy development in Europe. The study also recommended that the European Union and national governments need to take a more proactive role in promoting and supporting geothermal energy development, and that a more

coordinated and integrated approach is needed to attain an environmentally-friendly and low-emission energy system in Europe.

Sanyal et al. (2019) research explored the technological aspects affecting the growth of geothermal energy in India. The study employed a mixed-methods approach comprising of literature review, case studies, and expert interviews to uncover the crucial technical aspects and their influence on geothermal growth in India. The results showed that the availability of suitable geothermal reservoirs, government support, and technological advancements are essential factors for successful geothermal development in India. The study highlighted the potential of geothermal energy as a clean and reliable energy source for India and suggested policymakers should focus on providing adequate funding and incentives to support geothermal development and incentivize research and development aimed at tackling technical hurdles, such as the high costs associated with drilling and inadequate exploration techniques.

Fujii and Tomiyasu's (2020) conducted an overview study of geothermal power generation technology, current status, and challenges in Sub-saharan Africa. The study reviewed and analyzed previous studies on the current state of geothermal power generation technology and its challenges. The study indicated that geothermal power generation technology in Africa has advanced significantly in recent years, with new techniques such as Enhanced Geothermal Systems (EGS) being developed to boost efficiency of geothermal energy production. However, the growth of geothermal power generation still has a number of obstacles to overcome, including high upfront costs, a lack of suitable sites, a skilled workforce shortage, and potential environmental effects. The study thus, suggested that the industry's managers should develop more effective methods for raising efficiency in geothermal energy production, reduce costs, and explore new geothermal energy resources. It also suggested that governments should provide more policy support and investment incentives to promote geothermal energy development.

Mekonnen, Lind, and Wu's (2020) study investigated on the technological challenges and prospects of geothermal energy development in Ethiopia. The study carried out a systematic review methodology to analyze previous studies on geothermal energy in Ethiopia. The study revealed that Ethiopia has significant geothermal energy potential, with an approximate capacity of up to 10,000 MW. However, there are a number of technical obstacles to the development of geothermal energy in Ethiopia, including a lack of institutional competence, inadequate infrastructure, and funding limitations. The study also identified several future prospects for geothermal energy development in Ethiopia, including increased investment in the sector, technology transfer, and the development of public-private partnerships. Hence, the study concluded that the expansion of geothermal energy in Ethiopia has the potential to contribute significantly to the Country's sustainable energy transition and economic development.

The study by Kipyegon and Kinyua (2019) sought to analyze the technological challenges and opportunities facing the geothermal energy sector in Kenya. The research adopted a qualitative research methodology, which involved reviewing previous studies on the topic, as well as conducting interviews with 25 industry

experts in Kenya. The study indicated that while Kenya has made significant progress in the development of geothermal energy, there are still some technological challenges that need to be addressed, including inadequate drilling equipment and limited capacity in power generation. Additionally, the study highlighted the opportunities for innovation in the sector, particularly in the areas of binary technology, geothermal energy storage, and enhanced geothermal system (EGS) technology. Therefore, the research highlighted that addressing the technological challenges and leveraging the opportunities in the geothermal sector can contribute to Kenya's sustainable energy transition, as well as create job opportunities and economic growth.

2.3.3: Managerial Factors

Managerial factors refer to the various aspects related to the management and leadership of an organization. These factors can include the management style, decision-making processes, communication methods, organizational structure, and corporate culture. The study by Hassan and Al-Louzi (2019) sought to determine the managerial factors that influence the development of geothermal energy sector in Jordan. The study utilized a systematic review of previous studies on geothermal energy sector in the Jordanian context. The study highlighted the importance of community involvement and technical expertise as well as strong government support, for successful geothermal energy projects in Jordan. The study also identified challenges related to the sector's corporate strategy frameworks, land-use conflicts, and infrastructure that hindered development of geothermal energy sector. The study concluded that the development of geothermal energy in Jordan requires collaboration between stakeholders, including the government, private sector, and local communities. It also advocated for the need of the management team to consistently review the implementation of corporate strategies and improve them in line with the sector needs which change often.

Ezemonye et al. (2017) study examined the managerial challenges facing the development of geothermal energy in Nigeria and the possible strategies to curb the challenges. The study used structured questionnaires which were administered to 120 employees in the geothermal energy sector in Nigeria. The study findings indicated that lack of data, use of innovative technologies and highly skilled employees with top-notch managerial and soft skills were the primary hurdles to the development of geothermal energy sector. The study concluded that the management requires a comprehensive approach that will leverage the opportunities offered by technology and prioritize the establishment of geothermal energy research and development centers, as well as implement effective employee training programs.

Ssekabira et al. (2019) carried out a comparative research to analyze the key factors influencing the development of geothermal energy projects in East Africa. The study used a qualitative methodology where an interview guide was used to interview 48 stakeholders involved in the development of geothermal projects in Kenya, Tanzania, and Ethiopia. The study discovered that successful geothermal projects in East Africa required strong leadership, stakeholder engagement, and supporting policy. The growth of geothermal energy in the area was also hampered by problems with funding, technical capability, and infrastructure, according to the researchers. It was concluded that all parties, including the government, the commercial sector, and local

people, must promote the development of geothermal energy in East Africa. The research also recommended that policymakers should prioritize the development of supportive policies, capacity-building, and investment in infrastructure to overcome these challenges.

Osiolo et al. (2018) study intended to determine the management elements impacting the growth of geothermal energy projects in Kenya and to make recommendations for measures to enhance project outcomes. The study conducted interviews with 20 stakeholders involved in geothermal projects in Kenya. The results of the study found that financial and technical capacity-building for local communities and governments was critical to the success of geothermal projects in Africa. The study also identified challenges related to political instability, corruption, and inadequate infrastructure that hindered the development of geothermal energy in the region. The research advocated that the development of the geothermal sector in Kenya requires the involvement of all stakeholders, including the government, private sector, and local communities. The research also recommended that policymakers should prioritize implementation of favourable policies to enable the management of the sector invest in infrastructure and capacity-building.

Munene et al. (2020) was to investigate the influence of managerial factors on the development of the geothermal energy sector in Kenya. The study also assessed the implications of geothermal energy exploitation in Kenya for energy security, environmental conservation, and sustainable development. It used a qualitative analysis of data from case studies carried out in Kenya to identify hardships and prospects in the sector. The results disclosed that effective governance, stakeholder engagement, and investment in research and development are crucial for successful geothermal energy exploitation in Kenya. The study also emphasized on the importance of policymakers enhancing local community involvement, environmental conservation, and sustainable development goals when designing geothermal energy projects.

2.3.4: Regulatory Factors

Regulatory factors are defined as the rules, regulations, policies, and laws that oversee the operations of businesses and industries. These factors can include environmental regulations, labor laws, trade policies, tax laws, health and safety regulations, and licensing requirements. The study by Jansen et al. (2020) investigated on the regulatory factors that have hindered the development of the geothermal energy sector in the United States. The research used a qualitative research methodology and analyzed existing literature on geothermal energy policy and regulation in the United States. The study outcome showed that failure of federal policies and uncertain state-level policies have hindered the development of the sector. Thus, the study concluded that improving the regulatory framework and developing a favorable policy environment are crucial for the growth of the geothermal sector in the US. This will require a comprehensive federal policy framework that provides certainty and support for the geothermal energy sector. The study also suggested the adoption of a national renewable energy standard, establishment of a federal geothermal leasing program, and streamlining of the regulatory process to attract investment and promote growth.

Ghosh and Kojima (2018) study examined the key regulatory factors that have influenced the growth of the geothermal energy sector in Japan. The methodology involved a comprehensive analysis of geothermal policy and regulatory frameworks in Japan, as well as a comparison with other countries. The study findings indicated that Japan has made significant progress in developing its geothermal resources, however, it faces several regulatory barriers, including complex licensing processes, limited access to geothermal resources, and uncertain feed-in tariffs. These challenges have been found to be the key factors hindering investment and have prevented the sector from reaching its full potential. To counter these challenges and barriers, the study advocates for the development of a favorable policy on environment and creation of a coherent and openly visible regulatory structure that provides certainty and support for the growth of the geothermal energy sector in Japan. The study also recommended several policy reforms, including the simplification of licensing procedures, the introduction of more favorable feed-in tariffs, and the establishment of a national geothermal development fund.

Moreover, Okoye et al. (2020) study assessed the regulatory factors that influence the development of the geothermal energy sector in Nigeria. The study found that Nigeria's geothermal sector also faces similar regulatory barriers, including complex licensing processes, inadequate incentives for investors, inadequate funding, lack of a clear policy framework and data on geothermal resources. They concluded by highlighting the need for a comprehensive policy framework that provides certainty and support for the geothermal energy sector in Nigeria. The researcher also recommends the establishment of a national geothermal development plan, the creation of a geothermal regulatory agency, and the allocation of dedicated funding for geothermal projects.

Mokaya and Muathe (2019) study sought to understand the regulatory elements that impact the growth of geothermal energy projects in Kenya. The research carried out semi-structured interviews with significant geothermal industry participants. The study results found that government policies and regulations, as well as the political environment, were critical to the success of geothermal projects in Kenya. The study also identified challenges related to financing, technical expertise, and stakeholder engagement that hindered the development of the sector. The conclusion of the study was that the development of geothermal energy in Kenya requires the involvement of all stakeholders. The researchers recommended that policymakers prioritize capacity-building, investment in infrastructure, and stakeholder engagement to overcome these challenges.

Keter et al. (2018) study analyzed the effectiveness of the current regulatory framework of the geothermal energy sector in Kenya and identified areas for improvement. The study managed to conduct semi-structured interviews and held a focus group discussion with three groups of stakeholders in the industry. The study findings revealed that Kenya's geothermal energy sector has seen significant growth over the years, with over 690 MW of installed capacity, making it one of the largest producers of geothermal energy in Africa. However, the sector is still struggling with inadequate regulatory framework, bureaucratic hurdles, limited funding, and land use issues that have affected the sector's further development. Hence, the study concludes by

advocating for the establishment of an independent regulatory body to oversee the sector and development of a transparent and streamlined licensing process for geothermal projects.

2.4 Research Gaps in Literature

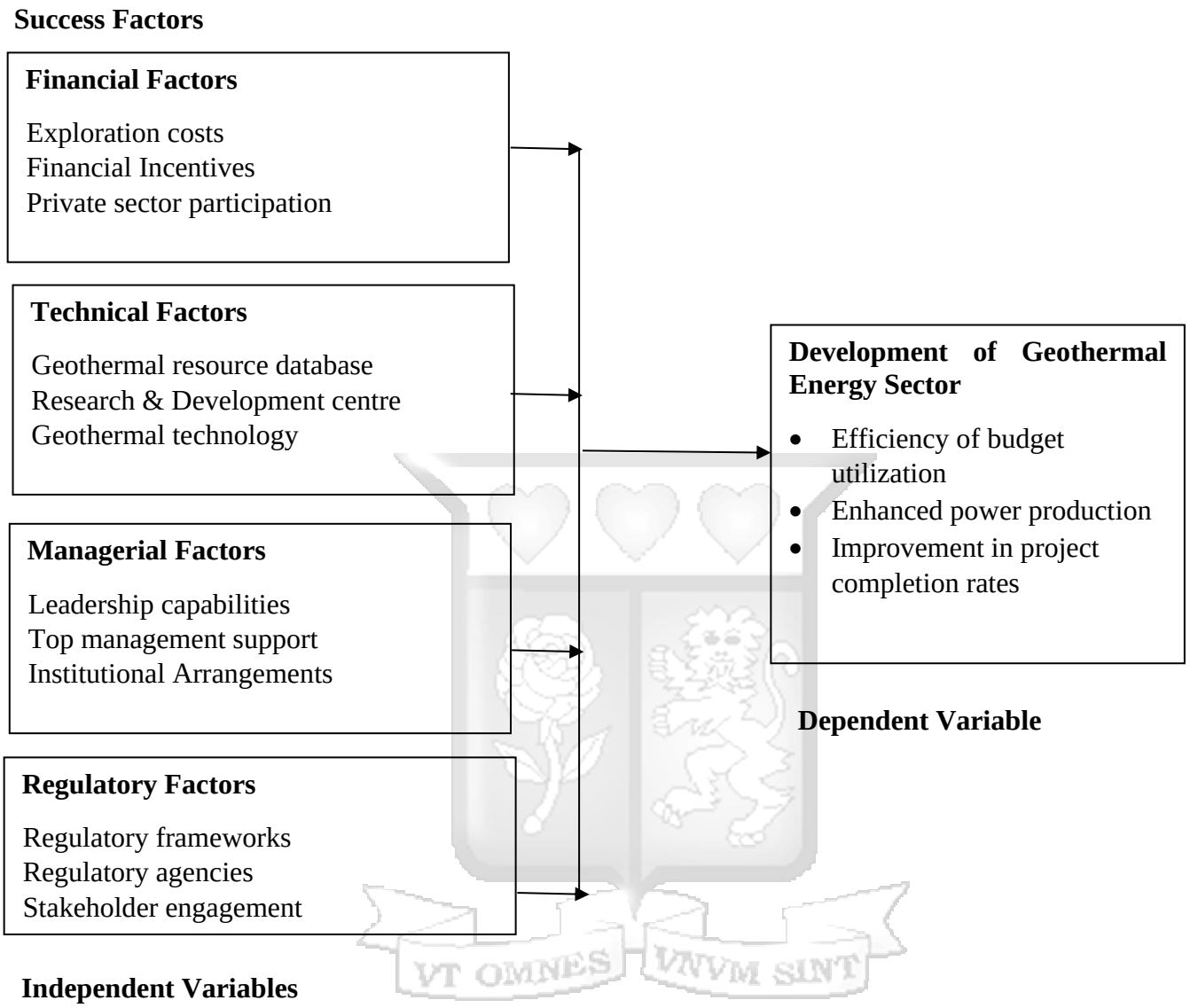
The empirical studies reviewed have to a good extent discussed the influence of financial, technical, managerial and regulatory factors on development of geothermal energy sector in Kenya. However, it is observed that most of the studies emphasized more on the key barriers and challenges to the development of geothermal energy sector in Kenya. Some of the studies that have successfully outlined the success factors and their influence on the development of the geothermal energy include Osiolo et al. (2018), Ssekabira et al. (2019), Jansen et al. (2020), Munene et al. (2020) and Sanyal et al. (2019). Other studies also consisted of methodological gaps since they relied on secondary data from review on previous studies and case studies such as Ghosh and Kojima (2018), Johansson and Harvey (2017), Johnston and Santoyo-Castelazo (2016), Walekhwa and Gitonga (2018) and González-Aparicio and de la Hoz (2020).

In addition, Ssekabira et al. (2019), Fujii and Tomiyasu's (2020) and Walekhwa and Gitonga (2018) were found to consist of contextual gaps since they carried comparative studies of the critical success factors between different countries, yet the development of geothermal energy sector between countries varies. Further, studies by Ghasemi, et al. (2020) and Gungor-Demirci et al. (2018) had conceptual gaps. This is because their findings were not varied and were limited to discussing factors that only hinder the development of geothermal energy sector in Kenya. The study bridged the existing gap by evaluating the extent to which the four critical success factors have been applied in Kenya and in detail discussed their influence in development of the geothermal sector. The study also employed quantitative data collection method since they were not extensively utilized in the reviewed studies.

2.5 Conceptual framework

Wanjohi (2014) observes that a conceptual framework is an arrangement of concepts presented as a map for the study and further argues that a conceptual framework is the vital center of the study. Figure 2.2 presents the conceptual framework adopted in this study. The success factors that were evaluated comprised of financial, technical, managerial and regulatory factors and the dependent variable was development of geothermal energy.

Figure 2.2: Conceptual Framework



Source: Researcher (2023)

2.6 Operationalization of the Study Variables

Moreover, table 2.1 gave a breakdown of the study variables, its indicators as outlined in the conceptual framework, the research measures and the supporting literature.

Table 2.1: Operationalization of the Study Variables

Variable Name	Variable Indicators	Measurement	Supporting Literature
Financial factors	• Exploration costs • Financial incentives • Private sector participation	5 point- Likert Scale	Walekhwa and Gitonga (2018); Nyakundi and Keramati (2019)
Technical Factors	• Geothermal resource database • Research & Development centre • Geothermal technology	5 point-Likert Scale	Fujii and Tomiyasu's (2020); Kipyegon and Kinyua (2019)
Managerial Factors	• Leadership capabilities • Top management support • Institutional Arrangements	5 point-Likert scale	Ssekabira et al. (2019); Osiolo et al. (2018)
Regulatory factors	• Regulatory frameworks • Regulatory agencies • Stakeholder engagement	5 point- Likert Scale	Ghosh and Kojima (2018); Mokaya and Muathe (2019)
Development of geothermal energy sector	• Efficiency of budget utilization • Improvement in power production • Project completion rates	5 point- Likert Scale	Walekhwa and Gitonga (2018); Fujii and Tomiyasu's (2020)

Source: Researcher (2023)

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Introduction

The section covered the research methodology, including the study's design, target population and sample, data collection tools and methodologies, data analysis techniques, quality, and research ethics. Additionally, the chapter delineated the data analysis strategy, detailing the preparation, processing, and interpretation of collected data. Brief discussions were held on the validity and reliability of research instruments. Lastly, constraints and ethical concerns pertaining to the study were addressed.

3.2 Research Philosophy

The research philosophy defines and demonstrates the ideas about creations of knowledge. This includes presumptions regarding the truth of the research outcome, general human knowledge, and the impact of interpretations on the study's methodology. This study was guided by the positivism philosophy (Saunders et al., 2017). Positivism is a philosophical perspective on knowledge that prioritizes empirical evidence and scientific methodologies for comprehending particular research phenomena (Kennedy, 2017). In quantitative research, positivism is particularly important because it provides a foundation for the use of statistical analysis and other quantitative methods to study social issues. It presupposes the existence of an objective reality that is observable and quantifiable using scientific methodologies, suggesting that this reality can be comprehended by gathering empirical evidence over time (Dougherty, Slevc & Grand, 2019). Therefore, using the positivist approaches, the researcher was able to quantify and measure the research objectives using systematic methods to collect and analyze data, which helped to establish causal relationships and provided accurate answers to the research questions.

3.3 Research Design

Sileyew (2019) outlines that a research design serves as the project's road map. It consists of the methods used, the population being studied, the sample size, the methods and tools used for sampling, the tools utilized to gather data, and the techniques used to analyse the data (Tomaszewski et al., 2020). As stated by Asenahabi (2019), research typically employs two primary methodologies: qualitative and quantitative. Quantitative research involves measurements conducted in discrete and quantifiable values, resulting in empirical measures. Conversely, qualitative research delves into understanding the significance that individuals or groups attribute to a phenomenon (Creswell & Creswell, 2017). In a mixed design, both qualitative and quantitative techniques are applied (Dawadi et al., 2021).

This study utilized the descriptive research approach. It is a quantitative research design that allows researchers to systematically collect and analyze data in order to describe and understand a particular

phenomenon or group of individuals (Dannels, 2018). It also provides a detailed and accurate picture of a particular situation, population, or group, and to identify patterns and relationships among variables. The data is collected from a representation sample of the population and analyzed using statistical techniques are utilized to recognize trends and patterns, enabling conclusions to be drawn regarding the entire population (Bloomfield & Fisher, 2019). In this study, the descriptive approach involved use of primary data collection instruments, data analysis, discussions and interpretation of data then drew conclusion and recommendations (Creswell & Creswell, 2017). The researcher then used the descriptive information to examine the influence of success factors on the development of geothermal energy sectors, then draw conclusions and recommendations for the study.

3.4 Target Population

Population is defined as a comprehensive collection of objects bearing common characteristics that a researcher is interested in (Shone, 2015). The study targeted the senior managers and middle level employees particularly from the finance, legal, technical and managerial departments in six energy sector entities where four were government-owned enterprises and 2 private enterprises in the geothermal industry (See Appendix V). Thus, the unit of analysis for this study was the senior managers and the middle level employees while the unit of observation was the six selected energy sector entities. Table 3.1 below presents the target population as obtained from the companies' management profile of the six selected energy sector entities.

Table 3.1: Target Population

Category	Target Population	Percentage
Senior Managers	80	16.95%
Middle level employees	392	83.05%
Total	472	100%

Source: Companies' Management Profile of the six Energy Sector Entities (2023)

Table 3.2: Target population disaggregated per organisation.

Category	Target Population	Percentage
KenGen	264	56%
GDC	184	39%
MoEP	10	2%
EPRA	10	2%
Private1	2	0.5%
Private2	2	0.5%
Total	472	

Source: Companies' Management Profile of the six Energy Sector Entities (2023)

3.4 Sampling Design and Sample size

A sample refers to a subset of the entire population (Welman, 2005). The aim of sampling is to extract a small subset from the population and extrapolate conclusions about the entire population (Tomaszewski et al., 2020). To ascertain the suitable sample size from the target population, the study employed the stratified random sampling method. This method was employed to ensure adequate representation of the subgroups within the population. The research deployed the two subgroups to represent the two strata within the target population then the criteria for determining the proportion for each stratum was based on Mugenda & Mugenda (2008) sample size recommendation, that a sample size of 30% of the population is representative of the total population and economically viable. Therefore, using the sample of 30% on the target population resulted to a sample size of 24 senior managers and 118 middle level employees.

Table 3.2: Distribution of Sample Size

Category	Sample size	Percentage of Sample Size (%)
Senior Managers	0.3*80= 24	16.9
Middle level employees	0.3*392= 118	83.1
Total	142	100

Source: Companies' Management Profile of the six Energy Sector Entities (2023)

3.5 Data Collection Methods

Data collection methods encompass the procedures and instruments employed to procure data for research or analysis. This data may be categorized as either primary or secondary data. Primary data entails information acquired directly from original sources and involves data gathering tools such as questionnaires, interviews, focus group discussions, etc (Apuke, 2017). This study used structured questionnaires to collect data from the selected managers. The questionnaires were preferred since they allow researchers to collect standardized data, as all respondents receive the same set of questions in the same order. This reduces the potential for bias and ensures that data can be compared across respondents. In addition, the anonymity nature of questionnaires also gives confidence to respondents to disclose sensitive information, and this enables the researcher to obtain honest and accurate responses.

The questionnaire consisted of closed-ended questions and divided into six sections. Section A consisted of demographic information of the selected managers, Section B-F consisted of statement in regard to financial factors, technical factors, managerial factors, regulatory factors and development of the geothermal energy sector in Kenya. The Likert interval scale which used six markers (strongly agree, agree, moderately agree, moderately disagree, disagree and strongly disagree) was used to vary the responses of the respondents.

3.6 Research Quality

According to Shone (2015), the objective of piloting data collection instruments is to establish if these research instruments will achieve the intended objective once applied in research. The pilot study in the current research involved testing the reliability and validity of the questionnaires. A sample of 6 non-managers each from the six entities was selected randomly and the researcher ensured not to include their responses when carrying out the actual study analysis. The pilot test aided the research in identifying any defects, restrictions, or other problems in the instrument design. It also allowed the researcher to implement any required adjustments prior to the inception of the actual research.

3.6.1 Validity

Hess & Johnson (2015) observed that validity evaluates if the proposed measurement instruments will accurately measure the concepts under research. Similarly, Pandey (2015) argues that a measuring device is valid if it measures what is expected to be measured. Validity is a technique for evaluating or keeping track of the dependability of research findings. Measurement validity assesses whether the devised measure employed in a study precisely mirrors the concept. Construct validity evaluates if the devised measure utilized in a study accurately represents the idea, while reliability examines the consistency of the devised measure employed in a study (Mohajan, 2017). A conclusion establishing a causal link between several variables is evaluated for internal validity (Cohen, Manion & Morrison, 2017). To check on content validity, the researcher consulted with the supervisors who examined the research items to ensure that they are relevant and comprehensive. The suggestions were then taken into consideration when developing and enhancing the data collection instrument's validity.

3.6.2 Reliability

Eller (2018) defines reliability as the possibility of repeatedly yielding the same or similar findings from measuring the same object of interest. Reliability pertains to the extent to which the data collection and analysis methods yield consistent results, thereby determining the trustworthiness of the collected and analyzed data. Additionally, the extent to which other researchers can replicate the study is crucial. Internal reliability focuses on the consistency of what researchers or observers perceive during the study (Lowe, 2019). After the sample of 7 non-managers from each of the six entities filled the questionnaires, the data collected was edited then input into the Statistical Package of Social Sciences (SPSS) V27 which generated the Cronbach's alpha coefficient. The alpha coefficient was used to measures internal consistency among the research items. Cortina (2020) provided the following rules of thumb: >0.9 – Excellent, >0.8 – Good, >0.7 – Moderate, >0.6 – Questionable, >0.5 – Poor and <0.5 – Unacceptable. In addition, it was also concluded that if the Cronbach's alpha coefficient ranges from 0.7 to 1, this indicates higher reliability. Similarly, this study also used the Cronbach's alpha coefficient range of 0.7 to 1.

3.7 Data Analysis

The data collected through the questionnaires was first edited, categorized and coded in the MS Excel in readiness for analysis. The refined data was then fed into the SPSS v27 which was used to generate descriptive and inferential statistics. The SPSS was chosen for analysis because it can accommodate huge data, offers a wide range of statistical methods, and is very effective in analysis (Pallant, 2020). The descriptive statistics that were generated included mean, standard deviation and percentages while the inferential statistics comprised of correlation and regression analysis results (Judd, McClelland & Ryan, 2017). The correlation and regression analysis was also used to examine the relationship between the independent variables and dependent variable.

The study used a multiple linear regression model to determine the direction and strength of influence of the independent variables (financial, technical, managerial and regulatory factors) on the dependent variable (Development of geothermal energy sector in Kenya). It offered enhanced insight into the correlation between changes in the independent variables' values and changes in the dependent variable's value.

The multiple regression model was presented as follows.

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + e$$

Where;

Y= Development of geothermal energy sector in Kenya

β_0 = constant Y intercept

βi; {i=1,2,3,4,5} = The coefficients representing the independent variables (X_1, X_2, X_3, X_4)

X_1= Financial Factors

X_2= Technical Factors

X_3= Managerial Factors

X_4= Regulatory Factors

e = the error term which is assumed to be normally distributed with mean zero and constant variance.

Further, the research used the Ordinary Least Squares (OLS) method to estimate the parameters (coefficients) of the linear regression model. While OLS is widely used and provides reliable parameter estimates when the linear regression assumptions are held, it's important to perform diagnostic tests to check whether these assumptions have been violated. Thus, the research carried out three diagnostic test to ensure that the assumptions are not violated.

3.8 Diagnostic Tests

The study conducted three statistical tests including the normality test, multicollinearity test, and heteroscedasticity test.

3.8.1 Normality Test

It is a statistical test used to assess whether a given dataset follows a normal distribution or not (Mishra et al., 2019). Parametric tests such as correlation and multiple regression analysis require normal data. When data is not normally distributed it can distort the results of any further analysis (Schober & Vetter, 2019). This study used the Shapiro-Wilk test to test for normality. This test entails calculating a test statistic by examining the correlation between the ordered data values and their corresponding expected values from a normal distribution. The test produces a p-value, representing the likelihood of observing the data if it were sampled from a normal distribution (Osborne & Waters, 2019). The null hypothesis posited by this test is that the data adheres to a normal distribution. If the p-value associated with the test statistic exceeds the chosen significance level (p= 0.05), the null hypothesis is upheld, suggesting that the data conforms to a normal distribution. Conversely, if the p-value falls below the chosen significance level, the null hypothesis is rejected, indicating significant deviation of the data from normality (Elkin et al., 2021).

3.8.2 Multicollinearity Test

Multicollinearity is characterized by a scenario in which two or more independent variables exhibit high correlation with each other (Tamura et al., 2019). This statistical issue can lead to challenges within the regression model, such as unstable coefficient estimates, inflated standard errors, and complexities in interpreting the individual effects of the variables (Shrestha, 2020). In this study, the Variance Inflation Factor (VIF) analysis was employed to examine multicollinearity issues. VIF serves as a metric that gauges the extent of multicollinearity for each independent variable, quantifying how much the variance of the estimated regression coefficient is augmented due to multicollinearity (Oke et al., 2019). If the VIF values surpass 1, it signifies a degree of multicollinearity, with higher values suggesting more pronounced multicollinearity. Conversely, a VIF of 1 indicates the absence of multicollinearity (Ullah et al., 2019).

3.8.3 Heteroscedasticity Test

Heteroscedasticity refers to the violation of the assumption of homoscedasticity in regression analysis, where the variability of the errors (residuals) is not constant across all levels of the independent variables (Wilcox, 2019). This statistical problem can affect the reliability of statistical inferences and the accuracy of regression coefficient estimates (Rice, Wirjanto & Zhao, 2020). This study used the Breusch-Pagan test to detect heteroscedasticity. It involves regressing the squared residuals (e^2) from the original regression on the independent variables then calculating a test statistic that follows a chi-square distribution (Dalic & Terzic, 2021). If the p-value associated with the test statistic is below significance level (p=0.05) then it indicates the presence of heteroscedasticity, while if $p > 0.05$, it indicates absence of heteroscedasticity (Martin, 2023).

3.9 Research Ethical Considerations

The ethical standards protecting the rights of the research participants were upheld in this study. A commitment to secrecy and the concept of voluntary participation was made so that no respondents would be forced to take part in the study. As far as the principle of anonymity is concerned, consent was also sought from the respondents for disclosure of their identity, and informed consent of the respondents was ensured by explaining the aim of the study. In addition, clearance from the Institutional Ethics Review Committee (IERC) and the National Commission for Science, Technology, and Innovation (NACOSTI) to carry out the study was sought.

CHAPTER FOUR: PRESENTATION OF RESEARCH FINDINGS

4.1 Introduction

This chapter presented the findings from the analyzed study data and their discussions. This included the response rate, demographic information, descriptive statistics, diagnostic tests and inferential statistics.

4.2 Response Rate

The researcher administered 142 questionnaires to the selected sample of 142 respondents. The findings from table 4.1 revealed that the number of returned questionnaires was 102 which represented a response rate of 72% while the number of unreturned questionnaires was 40 (28%). According to Mugenda and Mugenda (2013), a response rate of above 70% in any data collection is said to be excellent for data analysis. Therefore, the response rate of 72% was also found to be satisfactory for further analysis in this study.

Table 4.1 Response Rate

Response Rate	Frequency	Percentage
Returned Questionnaires	102	72
Unreturned Questionnaires	40	28
Total	142	100

Table 4.2 Response Rate Disaggregated Per Organization

Category	30% Sample size	Percentage	Response	Percentage
KenGen	74	52%	51	70%
GDC	50	35%	35	72%
MoEP	07	5%	06	85%
EPRA	07	5%	06	85%
Private1	02	1.5%	02	100%
Private2	02	1.5%	02	100%
Total	142		102	

Source: Author, 2023

4.3 Pilot Study Results

A pilot study was undertaken on 6 non-managers each from the six entities selected randomly from the sample population.

4.3.1 Validity of Research Instruments

The validity of the questionnaires was determined by carrying out the Kaiser-Meyer-Olkin KMO-Bartlett's test of sphericity in order to determine the validity of the individual variables. According to Shrestha (2021), KMO values closer to 1.0 are said to be the most preferable while values less than 0.5 are unsatisfactory. The results in table 4.2 showed that financial, technical, managerial and regulatory factors as well as development of geothermal energy sector had KMO values of more than 0.5. In addition, the Bartlett's test of sphericity was found to be significant for all variables. This implied that the study variables were suitable for further analysis.

Table 4.2: Validity of Research Instruments

Variable	KMO	Bartlett's Test of Sphericity			Conclusion Validity	
		Approx. Chi Square	Df	Sig		
Financial Factors	0.749	114.321	36	0.000	Middling	Valid
Technical Factors	0.693	120.459	36	0.000	Middling	Valid
Managerial Factors	0.655	75.785	36	0.000	Middling	Valid
Regulatory Factors	0.656	67.915	36	0.000	Middling	Valid
Development of geothermal energy	0.634	69.640	15	0.000	Middling	Valid

4.3.2 Reliability of Research Instruments

The study used the Cronbach's alpha method to determine the reliability of the questionnaires. According to Cortina (2020), the acceptable value of 0.7 was used as a cut-off of reliability for this study. The results in table 4.3 highlighted that all the study variables had a Cronbach's alpha value greater than the recommended cutoff of 0.7. This shows that the questions met the reliability criteria (α>0.7); suggesting that all the variables were reliable and were used for further data analysis.

Table 4.3: Reliability of Research Instruments

Variable	Cronbach's Alpha	Number of items	Interpretation
Financial factors	0.910	11	Excellent
Technical factors	0.915	11	Excellent
Managerial factors	0.899	11	Good
Regulatory factors	0.923	11	Excellent
Development of geothermal energy	0.963	11	Excellent

4.3.3 Factor Analysis of Study Variables

Factor analysis was conducted after successfuly testing for the validity and reliability of the study variables. The essence of conducting the factor analysis is to explore the underlying structure of a set of variables (Kyriazos, 2018). The component matrix shown in table 4.4 generated from the factor analysis represents the relationships between the observed variables (items or questions) and the identified factors (latent variables)

that best explain the variability in the data. The factor loading are crucial outputs that helps in understanding how each variable loads on the extracted factors (George & Mallery, 2019). The values in the component matrix are known as component/factor loadings. These values indicate how strongly each variable is associated with each factor. Factor loadings are correlation coefficients that can range from -1 to 1 (Kyriazos, 2018). According to Shrestha (2021), a factor loading equal to or greater than 0.4 is considered adequate, has good factor stability and deemed to lead to desirable and acceptable solutions. The findings in table 4.4 revealed that development of geothermal energy sector, regulatory, managerial, technical and financial factors have high positive factor loadings (0.751, 0.756, 0.925, 0.942 and 0.933 respectively) implying that the variables are strongly associated with the corresponding factors. Thus, the research retained all the variables for further analysis.

Table 4.4: Factor Analysis Component Matrix

Variables	Factor Loadings
Av_ Financial factors	0.933
Av_Technical factors	0.942
Av_ Managerial factors	0.925
Av_ Regulatory factors	0.756
Av_ Development of geothermal energy	0.751

Extraction Method: Principal Component Analysis.

4.4 Demographic Information

4.4.1 Gender

The respondents were asked to indicate their gender and the results were presented in figure 4.1.

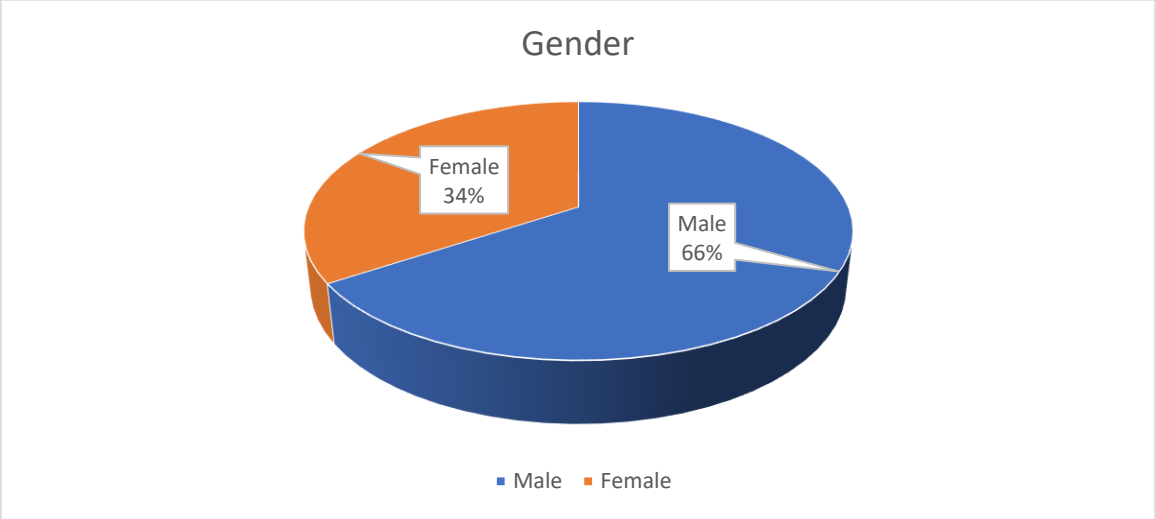


Figure 4.1: Gender

The findings from figure 4.1 revealed that 66% of the respondents were male while the remaining 34% were female. These results showed that the study was not gender biased as it included both male and female employees working in the geothermal energy sector. Similarly, Kimathi (2019) study also highlighted the number of male respondents (57.3%) was higher than that of female employees (42.7%) in SimGas biogas

project in Imenti, Meru County. Additionally, Heath et al (2018) study on advancing the geothermal energy sector in East Africa also agreed with these results as it revealed that 67% of the respondents were male whereas, 33% were female.

4.4.2 Job Position

The respondents were also requested to indicate their job position and the results were presented in figure 4.2 below.

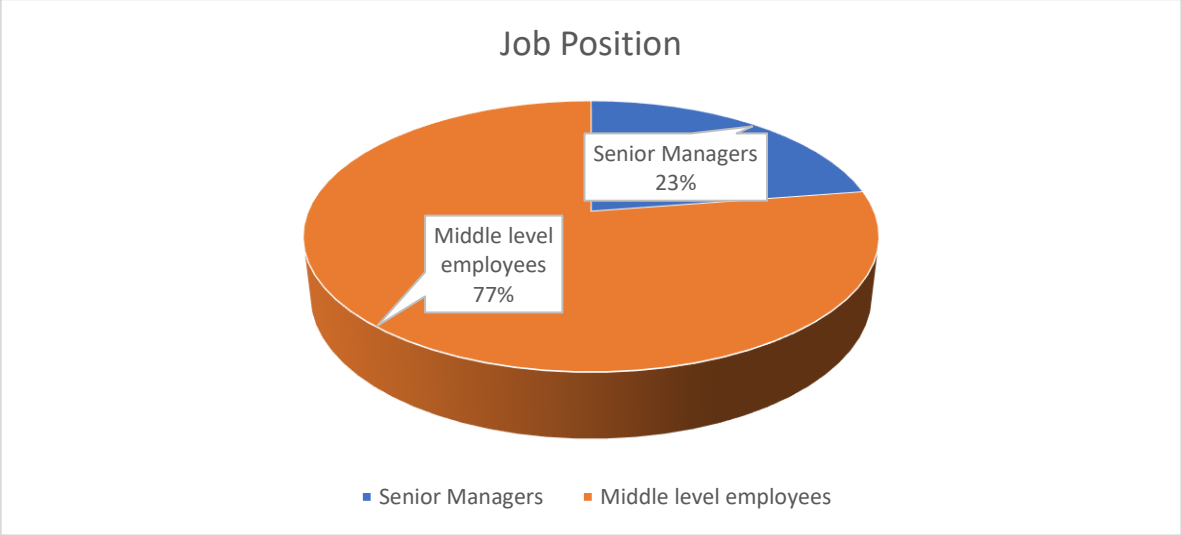


Figure 4.2: Job Position

The results showed that 77% of the total respondents were middle level employees while 23% were senior managers. The job position analysis was relevant as the study variables and the associated research instruments questions required respondents that were both sufficiently tenured and well educated to provide informed responses. In addition, Walekhwa and Gitonga (2018) study also noted that majority of the respondents (83%) were middle level employees while 17% were senior level managers.

4.4.3: Age Distribution

The researcher also sought to determine the age distribution of the respondents. The results were presented in figure 4.3.

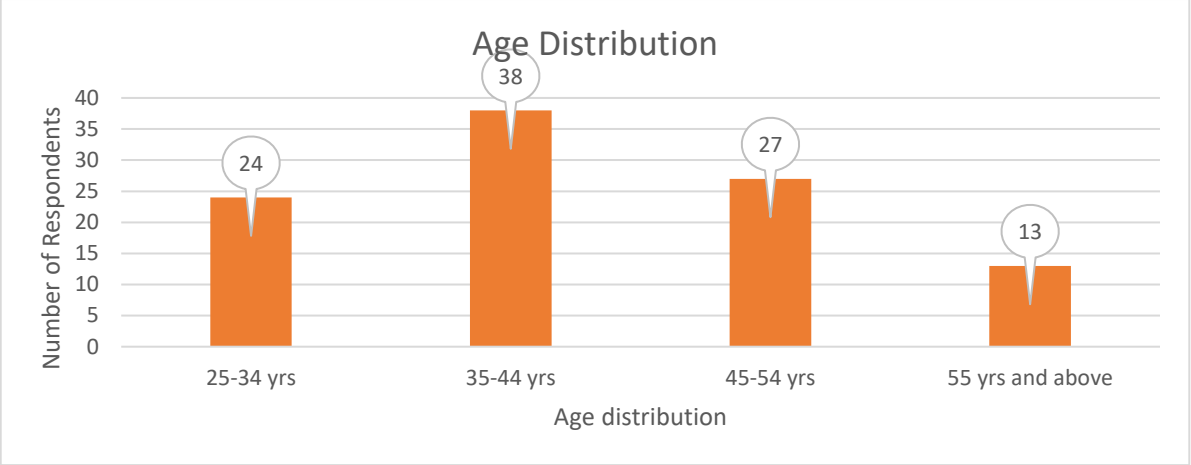


Figure 4.3: Age Distribution

The findings revealed that 37.3% (38) of the respondents were aged between 35-44 yrs, 26.5% (27) were aged between 45-54 yrs, 23.5% (24) were aged between 25-34 yrs and 12.8% (13) were 55 yrs and above. Moreover, Kong'ani, Wahome and Thenya (2021) study also revealed that the highest percentage of respondents were aged between 31-40 yrs (43.3%) followed by 41-50 yrs (21.6%), then 51-60 yrs (18.7%) and 20-30 yrs (16.4%). The age distribution was relevant to the study as it showed that a majority of the respondents had sufficient and many years of experience to understand the dynamics and the history of geothermal development in Kenya.

4.4.4 Academic Qualifications

Respondents were requested to indicate their highest academic qualifications. Figure 4.4 presents the findings obtained.

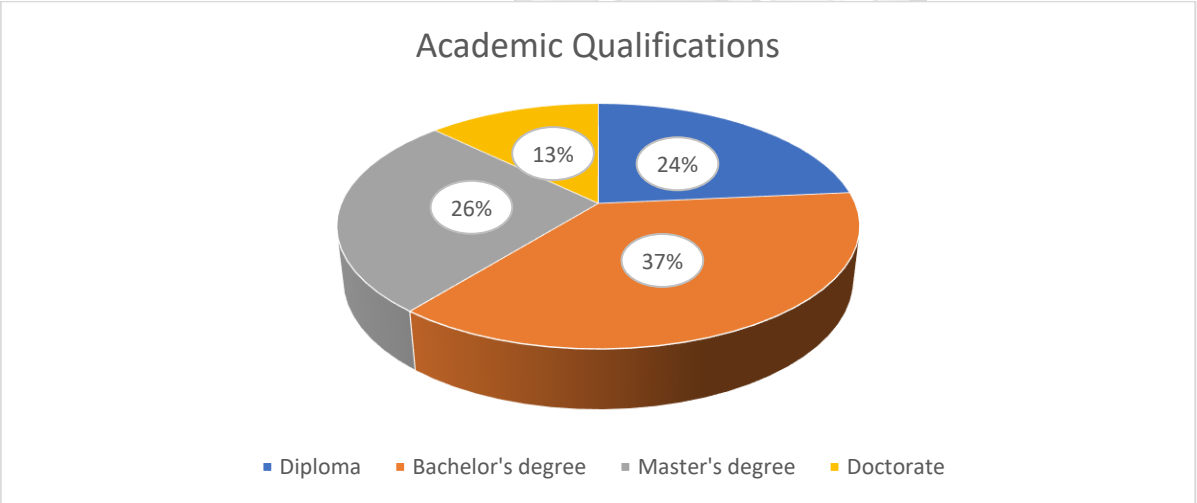


Figure 4.4: Academic Qualifications

The findings showed that 37% of the respondents had a bachelor's degree, 26% had master's degree, 24% had diplomas while 13% had doctorate. This implied that majority of the respondents had attained high levels of education. Additionally, Kimathi (2019) study also discovered that employees at the SimGas biogas project in Imenti, Meru County had a degree (55%) as their highest academic qualification, followed by a diploma (19.9%)

then masters' degree (14%) and lastly PhD (6.4%). The academic qualification of the respondents was relevant to the study as it showed that the majority of the respondents were well educated to understand the specialized and sophisticated field of geothermal development.

4.4.5 Work Experience

The study sought to determine the work experience of the selected respondents. The findings obtained were as presented in Figure 4.5

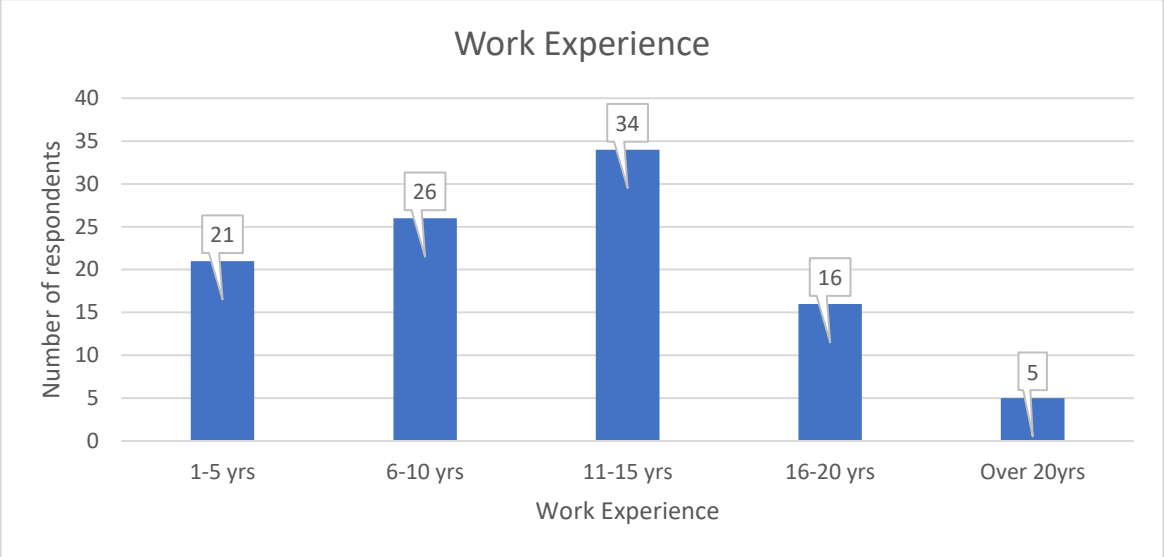


Figure 4.5: Work Experience

The results revealed that 33.3% (34) of the respondents had worked in the geothermal energy sector for 11-15 years, 25.5% (26) had worked for 6-10 years, 20.6% (21) had worked for 1-5 years, 15.7% (16) had worked for 16-20 years and 4.9% (5) had worked for over 20 years. The long work experience indicated that the respondent understood the various aspects of geothermal development, including its success and challenges. Moreover, Kipngok & Kemboi(2013) study also revealed that the largest percentage of respondents (48%) in Olkaria IV geothermal energy project had a work experience of between 10-20 years followed by those with below 10 years(34%) and those with above 20 years (18%).

4.5 Descriptive Statistics

To measure the indicators of the study variables, a six-point Likert scale was used. Where 1 was strongly disagree, 2-disagree, 3-moderately disagree, 4-moderately agree and 5-Agree and 6- strongly agree. The descriptive results were presented as per each study variable.

4.5.1 Descriptive Results for Financial Factors

The first objective of the study was to determine the influence of financial factors on the development of geothermal energy sector in Kenya. Respondents were asked to indicate their level of agreement with the

following statement on financial factors influencing development of geothermal energy sector in Kenya. Table 4.5 presents the findings obtained.

Table 4.5: Descriptive Results for Financial Factors

Statements	Strongly disagreed	Disagree	Moderately disagree	Moderately agree	Agree	Strongly agree	Mean	Std Dev
The organization incurs high exploration costs on geologic and geophysical surveys for geothermal resource exploration.	1.96%	9.80%	24.51%	22.55%	24.51%	16.67%	4.08	1.32
The organization incurs high average cost per well for drilling and testing in the geothermal projects.	5.88%	4.90%	17.65%	29.41%	22.55%	19.61%	4.17	1.38
The government of Kenya funds pre-exploration research for geothermal energy.	6.86%	7.84%	19.61%	16.67%	28.43%	20.59%	4.14	1.5
The government provide sufficient financial incentives to support geothermal projects	6.86%	11.76%	15.69%	16.67%	22.55%	26.47%	4.16	1.59
The available government grants have stimulated completion of geothermal projects	2.94%	10.78%	16.67%	24.51%	25.49%	19.61%	4.18	1.37
Availability of tax incentives has helped mobilize risk capital to cater for the high upfront costs of drilling.	4.90%	5.88%	12.75%	16.67%	31.37%	28.43%	4.49	1.43
Private sector companies invest heavily in the company's projects.	6.86%	8.82%	19.61%	24.51%	21.57%	18.63%	4.01	1.47
Private sector participation is one of the cost-sharing scheme used by the company.	6.86%	9.80%	17.65%	19.61%	22.55%	23.53%	4.12	1.54
The level of private sector participation influences investor decisions to invest with the company.	1.96%	6.86%	21.57%	26.47%	22.55%	20.59%	4.23	1.3
Overall Average							4.18	1.43

The results in table 4.5 showed that 16.67% of the respondents strongly agreed with the statement that the organization incurs high exploration costs on geologic and geophysical surveys for geothermal resource exploration, 24.51% agreed and 22.55% moderately agreed with the statement. On the other hand, 24.51% moderately disagreed, 9.8% disagreed while 1.96% strongly disagreed with the statement. The mean of the responses was 4.08 implying that majority of the respondents, 63.73% agreed with the first statement under financial factors and their responses were varied as shown by the standard deviation of 1.32.

The results also highlighted that 19.61% of the respondents strongly agreed with the statement that the organization incurs high average cost per well for drilling and testing in the geothermal projects. 22.55% agreed

and 29.41% moderately agreed with the statement. In addition, 17.65% moderately disagreed, 4.9% disagreed whereas 5.88% strongly disagreed. The mean of responses of 4.17 revealed that most of the respondents, 71.57% agreed with the second statement on financial factors and the standard deviation of 1.38 showed the variation of responses.

The findings also revealed that 20.59% of the respondents strongly agreed with the statement that the government of Kenya funds pre-exploration research for geothermal energy, 28.43% and 16.67% agreed and moderately agreed respectively with the statement. Moreover, 19.61% moderately disagreed, 7.84% disagreed and 6.86% strongly disagreed with the statement. The mean of responses was 4.14 showing that most of the respondents, 65.69% agreed with the third statement on financial factors and their responses were varied as shown by the standard deviation of 1.5.

Additionally, 26.47% of the respondents strongly agreed, 22.55% agreed and 16.67% moderately agreed with the statement that the government provides sufficient financial incentives to support geothermal projects. Whereas 15.69% moderately disagreed, 11.76% disagreed and 6.84% strongly disagreed with the statement. According to the mean of responses of 4.16, the highest percentage of respondents, 65.69% agreed with the fourth statement on financial factors and the standard deviation of 1.59 showed the variation of responses.

The results also found that 19.61% of the respondents strongly agreed, 25.49% agreed as well as 24.51% moderately agreed with the statement that the available government grants have stimulated completion of geothermal projects. On the other hand, 16.67% moderately disagreed, 10.78% disagreed and 2.94% strongly disagreed with the statement. The mean of responses was 4.18 showing that most of the respondents, 69.61% agreed with the fifth statement on financial factors and their responses were varied as shown by the standard deviation of 1.37.

Moreover, the study also discovered that 28.43% of the respondents strongly agreed, 31.37% agreed and 16.67% moderately agreed with the statement that availability of tax incentives has helped mobilize risk capital to cater for the high upfront costs of drilling. Whereas 12.75% moderately disagreed, 5.88% disagreed and 4.9% strongly disagreed with the statement. The mean of responses of 4.49 meant that most of the respondents, 71.57% agreed with the sixth statement on financial factors and the standard deviation of 1.43 indicated the variation of responses.

The findings also disclosed that 18.63% of the respondents strongly agreed, 21.57% agreed and 24.51% moderately agreed with the statement that private sector companies invest heavily in the company's projects. In addition, 19.61% moderately disagreed, 8.82% disagreed, 6.86% strongly disagreed with the statement. According to the mean of responses of 4.01, the highest percentage of respondents, 64.71% agreed with the seventh statement on financial factors and the standard deviation of 1.47 showed the variation of responses.

The results also outlined that 23.53% of the respondents strongly agreed, 22.55% agreed, 19.61% moderately agreed with the statement that private sector participation is one of the cost-sharing scheme used by the

company. Consequently, 17.65% moderately disagreed, 9.8% disagreed and 6.86% strongly disagreed with the statement. The mean of responses was 4.12 showing that most of the respondents, 65.69% agreed with the eighth statement on financial factors and their responses were varied as shown by the standard deviation of 1.54.

Additionally, 20.59% of the respondents strongly agreed, 22.55% agreed, 26.47% moderately agreed with the statement that the level of private sector participation influences investor decisions to invest with the company. On the other hand, 21.57% moderately disagreed, 6.86% disagreed and 1.96% strongly disagreed with the statement. The mean of responses of 4.23 meant that most of the respondents, 69.61% agreed with the ninth statement on financial factors and the standard deviation of 1.3 indicated the variation of responses.

Similarly, these findings corroborate with those of Kipchumba and Ndiangu (2017) which revealed that funding from the government to the geothermal energy sector in form of grants helped in filling the financial gap and supported the high-risk exploration activities. In addition, Walekhwa and Gitonga (2018) study also concurred with these results as it noted that financial incentive such as tax exemptions and subsidies were effective in promoting investment in the geothermal sector in Kenya. However, Ghasemi, et al. (2020) study disagreed with these results as it outlined that the geothermal energy sector in Iran lacks sufficient government backing which is a significant barrier in expansion if the sector.

4.5.2 Descriptive Results for Technical Factors

The second objective of the study was to evaluate the influence of technical factors on the development of geothermal energy sector in Kenya. Respondents were asked to indicate their level of agreement with the following statement on technical factors influencing development of geothermal energy sector in Kenya. Table 4.6 presents the findings obtained.

Table 4.6: Descriptive Results for Technical Factors

Statements	Strongly disagree	Disagree	Moderately disagree	Moderately agree	Agree	Strongly agree	Mean	Std Dev
The company has access to reliable and up-to-date geothermal resource data.	2.94%	3.92%	26.47%	13.73%	31.37%	21.57%	4.31	1.33
The use of geothermal resource databases has helped the company in selection of potential geothermal sites for development in Kenya.	8.82%	11.76%	18.63%	14.71%	30.39%	15.69%	3.93	1.55
The geothermal resource databases provide accurate data and information to be used by investors in decision-making.	5.88%	6.86%	19.61%	21.57%	28.43%	17.65%	4.13	1.41
The company's research and development center has been well equipped with geothermal technologies	4.90%	6.86%	18.63%	27.45%	20.59%	21.57%	4.17	1.4

program that assist in R&D activities.								
The company allocate a certain amount of money yearly to equip the research and development center with the latest R& D programs.	1.96%	7.84%	16.67%	15.69%	34.31%	23.53%	4.43	1.33
The resource and development center is also equipped to offer trainings and technical assistance when undertaking geothermal projects.	3.92%	7.84%	13.73%	25.49%	25.49%	23.53%	4.31	1.39
The company has an innovative edge on geothermal energy as it allocates intensive resource on technology development.	2.94%	6.86%	19.61%	20.59%	20.59%	29.41%	4.37	1.41
The company invests in training its employees to effectively use its innovative geothermal technology.	4.90%	8.82%	20.59%	19.61%	22.55%	23.53%	4.17	1.47
The use of innovative geothermal systems has contributed to the timely completion of geothermal projects.	5.88%	3.92%	18.63%	23.53%	24.51%	23.53%	4.27	1.42
Overall Average							4.23	1.41

The findings in table 4.6 showed that 21.57% of the respondents strongly agreed, 31.37% agreed and 13.73% moderately agreed with the statement that the company has access to reliable and up-to-date geothermal resource. Whereas, 26.47% moderately disagreed, 3.92% disagreed while 2.94% strongly disagreed with the statement. The mean of the responses was 4.31 meaning that majority of the respondents 66.67% agreed with the first statement on technical factors and their responses were varied as shown by the standard deviation of 1.33.

The results also revealed that 15.69% of the respondents strongly agreed, 30.39% agreed and 14.71% moderately agreed with the statement that the use of geothermal resource databases has helped the company in selection of potential geothermal sites for development in Kenya. In addition, 18.63% moderately disagreed, 11.76% disagreed whereas 8.82% strongly disagreed. The mean of responses of 3.93 showed that most of the respondents, 67.63% agreed with the second statement on technical factors and the standard deviation of 1.55 showed the variation of responses.

The findings also outlined that 17.65% of the respondents strongly agreed, 28.43% and 21.57% agreed and moderately agreed respectively with the statement that the geothermal resource databases provide accurate data and information to be used by investors in decision-making. In addition, 19.61% moderately disagreed, 6.86% disagreed and 5.88% strongly disagreed with the statement. The mean of responses was 4.13 implied that the

highest percentage of the respondents. 67.65% agreed with the third statement on technical factors and their responses were varied as shown by the standard deviation of 1.41.

Moreover, 21.57% of the respondents strongly agreed, 20.59% agreed and 27.45% moderately agreed with the statement that the company's research and development center has been well equipped with geothermal technologies program that assist in Research and Development(R&D) activities. Consequently, 18.63% moderately disagreed, 6.86% disagreed and 4.9% strongly disagreed with the statement. According to the mean of responses of 4.17, the highest percentage of respondents, 69.61% agreed with the fourth statement on technical factors and the standard deviation of 1.4 explained the variation of responses.

The results also found that 23.53% of the respondents strongly agreed, 34.31% agreed as well as 15.69% moderately agreed with the statement that the company allocate a certain amount of money yearly to equip the research and development center with the latest R& D programs. On the other hand, 16.67% moderately disagreed, 7.84% disagreed and 1.96% strongly disagreed with the statement. The mean of responses was 4.43 showing that most of the respondents, 73.53% agreed with the fifth statement on technical factors and their responses were varied as shown by the standard deviation of 1.33.

Additionally, it was also discovered that 23.53% of the respondents strongly agreed, 25.49% agreed and moderately agreed respectively with the statement that the resource and development center is also equipped to offer trainings and technical assistance when undertaking geothermal projects. Whereas 13.73% moderately disagreed, 7.84% disagreed and 3.92% strongly disagreed with the statement. The mean of responses of 4.31 meant that most of the respondents, 71.57% agreed with the sixth statement on technical factors and the standard deviation of 1.39 explained the variation of responses.

The results also highlighted that 29.41% of the respondents strongly agreed, 20.59% agreed and moderately agreed respectively with the statement that the company has an innovative edge on geothermal energy as it allocates intensive resource on technology development. Consequently, 19.61% moderately disagreed, 6.86% disagreed, 2.94% strongly disagreed with the statement. According to the mean of responses of 4.37, the highest percentage of respondents, 70.59% agreed with the seventh statement on technical factors and the standard deviation of 1.41 showed the variation of responses.

The results also revealed that 23.53% of the respondents strongly agreed, 22.55% agreed, 19.61% moderately agreed with the statement that the company invests in training its employees to effectively use its innovative geothermal technology. In addition, 20.59% moderately disagreed, 8.82% disagreed and 4.9% strongly disagreed with the statement. The mean of responses was 4.17 implying that most of the respondents, 65.69% agreed with the eighth statement on technical factors and their responses were varied as shown by the standard deviation of 1.47.

Furthermore, 23.53% of the respondents strongly agreed, 24.51% agreed, 23.53% moderately agreed with the statement that the use of innovative geothermal systems has contributed to the timely completion of geothermal

projects. Whereas 18.63% moderately disagreed, 3.92% disagreed and 5.88% strongly disagreed with the statement. The mean of responses of 4.27 meant that most of the respondents, 71.57% agreed with the ninth statement on technical factors and the standard deviation of 1.42 indicated the variation of responses.

Additionally, Fujii and Tomiyasu's (2020) study concurred with these results as it indicated that geothermal power generation technology in Africa has advanced significantly in recent years, with new techniques such as Enhanced Geothermal Systems (EGS) being developed to boost the effectiveness of geothermal energy production. Sanyal et al. (2019) study also highlighted that access to suitable geothermal reservoirs, government support, and technological advancements are essential factors for successful geothermal development.

4.5.3 Descriptive Results for Managerial Factors

The third objective of the study was to determine the influence of managerial factors on the development of geothermal energy sector in Kenya. Respondents were asked to indicate their level of agreement with the following statement on managerial factors influencing development of geothermal energy sector in Kenya. Table 4.7 presents the findings obtained.

Table 4.7: Descriptive Results for Managerial Factors

Statements	Strongly disagree	Disagree	Moderately disagree	Moderately agree	Agree	Strongly agree	Mean	Std Dev
The leadership capabilities of managers assists the company in making effective decisions.	2.94%	5.88%	17.65%	26.47%	22.55%	24.51%	4.33	1.34
The leadership capabilities of managers contributes to the successful completion of geothermal projects.	2.94%	4.90%	12.75%	26.47%	26.47%	26.47%	4.48	1.3
The leadership capabilities of managers boosts the company's reputation.	4.90%	4.90%	12.75%	27.45%	26.47%	23.53%	4.36	1.36
The company prioritizes its employee needs with an aim of increasing their performance.	7.84%	9.80%	17.65%	18.63%	25.49%	20.59%	4.06	1.54
The company supports its managers and employees by implementing training programs that equip them with all the necessary skills.	1.96%	4.90%	16.67%	33.33%	18.63%	24.51%	4.35	1.26
The company engages its employees in making important decision regarding its operations.	4.90%	5.88%	13.73%	22.55%	30.39%	22.55%	4.35	1.38
The institutions arrangements are well aligned to ensure a harmonized approach and focus on the development strategy.	6.86%	3.92%	10.78%	27.45%	26.47%	24.51%	4.36	1.42
	5.88%	5.88%	11.76%	25.49%	23.53%	27.45%	4.37	1.45

The institutions arrangements are aligned with the regulatory policies implemented by the government.								
The institution arrangements are capable to accommodate developments in the company.	4.90%	3.92%	13.73%	26.47%	24.51%	26.47%	4.41	1.37
Overall Average							4.34	1.38

The results in table 4.7 indicated that 24.51% of the respondents strongly agreed, 22.55% agreed and 26.47% moderately agreed with the statement that the leadership capabilities of managers assist the company in making effective decisions. Whereas 17.65% moderately disagreed, 5.88% disagreed while 2.94% strongly disagreed with the statement. The mean of the responses was 4.33 meaning that majority of the respondents, 73.53% agreed with the first statement on managerial factors and their responses were varied as shown by the standard deviation of 1.34.

The results also found that 26.47% of the respondents strongly agreed, agreed and moderately agreed respectively with the statement that the leadership capabilities of managers contribute to the successful completion of geothermal projects. Additionally, 12.75% moderately disagreed, 4.9% disagreed while 2.94% strongly disagreed. The mean of responses of 4.48 showed that most of the respondents, 79.41% agreed with the second statement on managerial factors and the standard deviation of 1.3 indicated the variation of responses.

The findings also outlined that 23.53% of the respondents strongly agreed, 26.47% agreed and 27.45% moderately agreed with the statement that the leadership capabilities of managers boost the company's reputation. Consequently, 12.75% moderately disagreed, 4.9% disagreed and strongly disagreed respectively with the statement. The mean of responses was 4.36 implied that the highest percentage of the respondents, 77.45% agreed with the third statement on managerial factors and their responses were varied as shown by the standard deviation of 1.36.

Moreover, 20.59% of the respondents strongly agreed, 25.49% agreed and 18.63% moderately agreed with the statement that the company prioritizes its employee needs with an aim of increasing their performance. In addition, 17.65% moderately disagreed, 9.8% disagreed and 7.84% strongly disagreed with the statement. According to the mean of responses of 4.06, the highest percentage of respondents, 69.61% agreed with the fourth statement on managerial factors and the standard deviation of 1.54 explained the variation of responses.

The results also found that 24.51% of the respondents strongly agreed, 18.63% agreed as well as 33.33% moderately agreed with the statement that the company supports its managers and employees by implementing training programs that equip them with all the necessary skills. Furthermore, 16.67% moderately disagreed, 4.9% disagreed and 1.96% strongly disagreed with the statement. The mean of responses was 4.35 showing that most of the respondents, 76.47% agreed with the fifth statement on managerial factors and their responses were varied as shown by the standard deviation of 1.26.

The results also discovered that 22.55% of the respondents strongly agreed, 30.39% agreed and 22.55% moderately agreed with the statement that the company engages its employees in making important decisions regarding its operations. Whereas 13.73% moderately disagreed, 5.88% disagreed and 4.9% strongly disagreed with the statement. The mean of responses of 4.35 implied that most of the respondents, 71.57% agreed with the sixth statement on managerial factors and the standard deviation of 1.38 explained the variation of responses.

The results also highlighted that 24.51% of the respondents strongly agreed, 26.47% agreed and 27.45% moderately agreed with the statement that the institutional arrangements are well aligned to ensure a harmonized approach and focus on the development strategy. In addition, 10.78% moderately disagreed, 3.92% disagreed, 6.86% strongly disagreed with the statement. According to the mean of responses of 4.36, the highest percentage of respondents, 78.43% agreed with the seventh statement on managerial factors and the standard deviation of 1.42 explained the variation of responses.

The results also indicated that 27.45% of the respondents strongly agreed, 23.53% agreed, 25.49% moderately agreed with the statement that the institutions arrangements are aligned with the regulatory policies implemented by the government. Consequently, 11.76% moderately disagreed, 5.88% disagreed and strongly disagreed respectively with the statement. The mean of responses was 4.37 implying that most of the respondents (76.47%) agreed with the eighth statement on managerial factors and their responses were varied as shown by the standard deviation of 1.45.

Additionally, 26.47% of the respondents strongly agreed, 24.51% agreed, 26.47% moderately agreed with the statement that the institution arrangements are capable of accommodating developments in the company. Whereas 13.73% moderately disagreed, 3.92% disagreed and 4.9% strongly disagreed with the statement. The mean of responses of 4.41 meant that most of the respondents, 77.45% agreed with the ninth statement on managerial factors and the standard deviation of 1.37 indicated the variation of responses.

Furthermore, these results also concurred with Ssekabira et al. (2019) study as it indicated that successful geothermal projects in East Africa required strong leadership, stakeholder engagement, and supporting policy. These results were also in agreement with Hassan and Al-Louzi (2019) study findings which concluded that the development of geothermal energy sector requires collaboration between stakeholders, including the government, private sector, and local communities. Additionally, they were also related to Osiolo et al. (2018) research as it concluded that political instability, corruption, and inadequate infrastructure hinder the development of geothermal energy in Africa.

4.5.4 Descriptive Results for Regulatory Factors

The fourth objective of the study was to determine the influence of regulatory factors on the development of geothermal energy sector in Kenya. Respondents were asked to indicate their level of agreement with the following statement on regulatory factors influencing development of geothermal energy sector in Kenya. Table 4.8 presents the results obtained.

Table 4.8: Descriptive Results for Regulatory Factors

Statements	Strongly disagree	Disagree	Moderately disagree	Moderately agree	Agree	Strongly agree	Mean	Std Dev
The company has a clear geothermal strategic plan for developing geothermal energy.	4.90%	10.78%	20.59%	20.59%	26.47%	16.67%	4.03	1.42
The regulatory frameworks implemented support the companies associated budgetary allocations on its geothermal projects.	6.86%	10.78%	14.71%	20.59%	27.45%	19.61%	4.1	1.51
The regulatory frameworks implemented encourage private sector participation in geothermal projects.	4.90%	11.76%	20.59%	21.57%	23.53%	17.65%	4	1.44
Policies implemented by regulatory agencies affect the level of investment in the geothermal energy sector.	4.90%	7.84%	13.73%	26.47%	24.51%	22.55%	4.25	1.41
Collaboration between regulatory agencies and industry stakeholders assists the company in making informed decisions.	6.86%	11.76%	12.75%	19.61%	30.39%	18.63%	4.11	1.51
Effective collaboration between regulatory agencies and industry stakeholders attract more investors to invest in the company.	1.96%	7.84%	13.73%	9.80%	31.37%	35.29%	4.67	1.39
Stakeholders have full trust in the company.	6.86%	6.86%	15.69%	35.29%	24.51%	10.78%	3.96	1.32
The company frequently holds forums with their stakeholders to keep them posted on its development and also listen to their views.	3.92%	11.76%	17.65%	27.45%	23.53%	15.69%	4.02	1.37
Stakeholders are happy with the engagement mechanisms used by the company.	5.88%	12.75%	16.67%	29.41%	18.63%	16.67%	3.92	1.44
Overall Average							4.12	1.42

The results in table 4.8 revealed that 16.67% of the respondents strongly agreed, 26.47% agreed and 20.59% moderately agreed with the statement that the company has a clear geothermal strategic plan for developing geothermal energy. In addition, 20.59% moderately disagreed, 10.78% disagreed while 4.9% strongly disagreed with the statement. The mean of the responses was 4.03 meaning that majority of the respondents, 63.73% agreed with the first statement on regulatory factors and their responses were varied as shown by the standard deviation of 1.42.

The findings also showed that 19.61% of the respondents strongly agreed, 27.45% agreed and 20.59% moderately agreed with the statement that the regulatory frameworks implemented support the companies associated budgetary allocations on its geothermal projects. Additionally, 14.71% moderately disagreed, 10.78% disagreed and 6.86% strongly disagreed. The mean of responses of 4.1 showed that most of the respondents, 67.65% agreed with the second statement on regulatory factors and the standard deviation of 1.51 explained the variation of responses.

The findings also outlined that 17.65% of the respondents strongly agreed, 23.53% agreed and 21.57% moderately agreed with the statement that the regulatory frameworks implemented encourage private sector participation in geothermal projects. Consequently, 20.59% moderately disagreed, 11.76% disagreed and 4.9% strongly disagreed with the statement. The mean of responses was 4 implied that the highest percentage of the respondents, 62.75% agreed with the third statement on regulatory factors and their responses were varied as shown by the standard deviation of 1.44.

Moreover, 22.55% of the respondents strongly agreed, 24.51% agreed and 26.47% moderately agreed with the statement that policies implemented by regulatory agencies affect the level of investment in the geothermal energy sector. In addition, 13.73% moderately disagreed, 7.84% disagreed and 4.9% strongly disagreed with the statement. According to the mean of responses of 4.25, the highest percentage of respondents, 73.53% agreed with the fourth statement on regulatory factors and the standard deviation of 1.41 explained the variation of responses.

The results also outlined that 18.63% of the respondents strongly agreed, 30.39% agreed as well as 19.61% moderately agreed with the statement that collaboration between regulatory agencies and industry stakeholders assists the company in making informed decisions. Additionally, 12.75% moderately disagreed, 11.76% disagreed and 6.86% strongly disagreed with the statement. The mean of responses was 4.11 showing that most of the respondents, 68.63% agreed with the fifth statement on regulatory factors and their responses were varied as shown by the standard deviation of 1.51.

The results also discovered that 35.29% of the respondents strongly agreed, 31.37% agreed and 9.8% moderately agreed with the statement that effective collaboration between regulatory agencies and industry stakeholders attract more investors into the company. Whereas 13.73% moderately disagreed, 7.84% disagreed and 1.96% strongly disagreed with the statement. The mean of responses of 4.67 implied that most of the respondents, 76.46% agreed with the sixth statement on regulatory factors and the standard deviation of 1.39 explained the variation of responses.

The results also highlighted that 10.78% of the respondents strongly agreed, 24.51% agreed and 35.29% moderately agreed with the statement that stakeholders have full trust in the company. In addition, 15.69% moderately disagreed, 6.86% disagreed and strongly disagreed respectively with the statement. According to the mean of responses of 3.96, the highest percentage of respondents, 70.58%

agreed with the seventh statement on regulatory factors and the standard deviation of 1.32 explained the variation of responses.

The findings also indicated that 15.69% of the respondents strongly agreed, 23.53% agreed, 27.45% moderately agreed with the statement that the company frequently holds forums with their stakeholders to keep them posted on its development and also listen to their views. Consequently, 17.65% moderately disagreed, 11.76% disagreed and 3.92% strongly disagreed with the statement. The mean of responses was 4.02 implying that most of the respondents, 66.67% agreed with the eighth statement on regulatory factors and their responses were varied as shown by the standard deviation of 1.37.

Further, the results showed that 16.67% of the respondents strongly agreed, 18.63% agreed, 29.41% moderately agreed with the statement that the institutional arrangements are capable to accommodate developments in the company. Whereas 16.67% moderately disagreed, 12.75% disagreed and 5.88% strongly disagreed with the statement. The mean of responses of 3.92 meaning that most of the respondents, 64.71% agreed with the ninth statement on managerial factors and the standard deviation of 1.44 indicated the variation of responses.

These descriptive results were also in alignment with Gungor-Demirci et al. (2018) study as it revealed that project financing and regulatory uncertainty are the most significant challenges facing geothermal power plant developers in Turkey. Additionally, they also concurred with Ghosh and Kojima (2018) study findings which highlighted that complex licensing processes, limited access to geothermal resources, and uncertain feed-in tariffs are some of the key factors hindering the investment and expansion of geothermal energy sector.

4.5.4 Descriptive Results for Development of Geothermal Energy Sector

Respondents were also asked to indicate their level of agreement with the following statement on development of geothermal energy sector in Kenya. Table 4.9 presents the findings obtained.

Table 4.9: Descriptive Results for Development of Geothermal Energy Sector

Statements	Strongly disagree	Disagree	Moderately disagree	Moderately agree	Agree	Strongly agree	Mean	Std Dev
The company's budget utilization of total installed geothermal capacity has been on an increasing trend for the last five years.	1.96%	5.88%	15.69%	27.45%	27.45%	21.57%	4.37	1.26
The company's budget utilization of net power generation has been on an increasing trend for the last five years.	4.90%	3.92%	18.63%	21.57%	27.45%	23.53%	4.33	1.38
The growth of power production has been on an increasing trend for the last five years.	4.90%	5.88%	19.61%	28.43%	17.65%	23.53%	4.19	1.41
The growth of power production has been	2.94%	4.90%	15.69%	26.47%	30.39%	19.61%	4.35	1.26

exceeding the annual firm's target for the last five years.								
The rate of project completion has been on an increasing trend for the last five years.	2.94%	4.90%	16.67%	23.53%	28.43%	23.53%	4.4	1.31
The actual project spending has been lower than the targeted spending on geothermal projects.	3.92%	6.86%	8.82%	26.47%	29.41%	24.51%	4.44	1.35
Overall Average							4.35	1.33

The results in table 4.9 showed that 21.57% of the respondents strongly agreed, 27.45% agreed and moderately agreed respectively with the statement that there was increased efficiency in geothermal development budget utilization for the last five years. In addition, 15.69% moderately disagreed, 5.88% disagreed while 1.96% strongly disagreed with the statement. The mean of the responses was 4.37 meaning that majority of the respondents, 76.47% agreed with the first statement on development of geothermal energy sector and their responses were varied as shown by the standard deviation of 1.26.

The findings also showed that 23.53% of the respondents strongly agreed, 27.45% agreed and 21.57% moderately agreed with the statement that there was increased efficiency in geothermal development budget utilization for the last five years. Additionally, 18.63% moderately disagreed, 3.92% disagreed and 4.9% strongly disagreed. The mean of responses of 4.33 showed that most of the respondents, 72.55% agreed with the second statement on development of geothermal energy sector and the standard deviation of 1.38 explained the variation of responses.

The results also outlined that 23.53% of the respondents strongly agreed, 17.65% agreed and 28.43% moderately agreed with the statement that there was enhanced power production over the last five years. Consequently, 19.61% moderately disagreed, 5.88% disagreed and 4.9% strongly disagreed with the statement. The mean of responses was 4.19 implied that the highest percentage of the respondents, 69.61% agreed with the third statement on development of geothermal energy sector and their responses were varied as shown by the standard deviation of 1.41.

Moreover, 19.61% of the respondents strongly agreed, 30.39% agreed and 26.47% moderately agreed with the statement that there was enhanced power production and exceeded the annual firm's target for the last five years. In addition, 15.69% moderately disagreed, 4.9% disagreed and 2.94% strongly disagreed with the statement. According to the mean of responses of 4.35, the highest percentage of respondents, 76.47% agreed with the fourth statement on development of geothermal energy sector and the standard deviation of 1.26 explained the variation of responses.

The results also outlined that 23.53% of the respondents strongly agreed, 28.43% agreed as well as 23.53% moderately agreed with the statement that the rate of project completion has been on an increasing trend for the

last five years. Additionally, 16.67% moderately disagreed, 4.9% disagreed and 2.94% strongly disagreed with the statement. The mean of responses was 4.4 showing that most of the respondents, 75.49% agreed with the fifth statement on development of geothermal energy sector and their responses were varied as shown by the standard deviation of 1.31.

The results also discovered that 24.51% of the respondents strongly agreed, 29.41% agreed and 26.47% moderately agreed with the statement that the actual project spending has been lower than the annual targeted spending on geothermal projects. Whereas 8.82% moderately disagreed, 6.86% disagreed and 3.92% strongly disagreed with the statement. The mean of responses of 4.44 implied that most of the respondents, 75.49% agreed with the sixth statement on development of geothermal energy sector and the standard deviation of 1.35 explained the variation of responses.

Further, these findings were consistent with those of Kombe and Muguthu (2018) study which outlined that most of the employees in the geothermal energy sector agreed that its revenue has been rising over the years, the scope of geothermal activities and the amount of geothermal power generated has also been increasing. They were also in agreement with those of Kong'ani, Wahome and Thenya (2021) research which revealed that there has been an increasing growth in annual power production and improvement in the rate of project completion.

4.6. Diagnostic Tests

4.6.1 Normality Test

Normality was tested by use of Shapiro Wilk Test. The null hypothesis for this test is that the population is normally distributed. The results in table 4.10 indicated that the p-value for all the study variables was greater than the chosen alpha level (0.05), hence the null hypothesis was accepted, and it was concluded that there is evidence that the data tested has a normally distributed population (Elkin et al., 2021).

Table 4.10: Normality Test

Variables	Shapiro-Wilk		
	Statistic	Df	Sig.
Financial Factors	.922	102	.127
Technical Factors	.920	102	.139
Managerial Factors	.945	102	.103
Regulatory Factors	.985	102	.086
Development of geothermal energy	.974	102	.125

4.6.2 Multicollinearity Test

The study used the Variance Inflation Factor (VIF) to determine if there is presence of multicollinearity in the research data. Multicollinearity exists if Tolerance values are below 0.2 and VIF values are more than 5. The

findings in table 4.11 revealed that Tolerance values for all study variables were above 0.2 and VIF values being less than 5, thus it was concluded that there was no multicollinearity problem in the study and hence acceptable for analysis (Ullah et al.,2019).

Table 4.11: Multicollinearity Test

Model		Collinearity Statistics	
	Variables	Tolerance	VIF
1	(Constant)		
	Av_ Financial factors	0.216	4.262
	Av_Technical factors	0.208	4.803
	Av_ Managerial factors	0.219	4.238
	Av_ Regulatory factors	0.559	1.789

4.6.3 Heteroscedasticity Test

The study used the Breuch-pagan test to determine if there is presence of heteroscedasticity in the study variables. According to Martin (2023), homoscedasticity, which implies absence of heteroscedasticity would be evident when the p-value is greater than 0.05.

Table 4.12: Heteroscedasticity Test

Ho: Constant variance			
Statistics	Df	Stat value	p-value
Chi-squared	102	0.212	0.931

Table 4.12 showed that the constant variance ($Chi^2 = 0.212$) is insignificant ($P = 0.931$). Therefore, there is no instance of heteroscedasticity in the data and the variability of the errors (residuals) is constant across all levels of the independent variables thus, the data was suitable for further regression analysis.

4.7 Inferential Statistics

The study computed the inferential statistics which comprised of the Pearson correlation analysis to test the relationship between the dependent and the independent variables. It also consisted of a linear regression analysis which used the Ordinary Least Squares (OLS) method to determine the direction and strength influence of the independent variables and dependent variable of the study. The method was also used to estimate the parameters (coefficients) of the linear regression model between independent variables (financial, technical, managerial and regulatory factors) on the dependent variable (Development of geothermal energy sector in Kenya).

4.7.1 Correlation Results

The Pearson R correlation was used to determine the degree and direction of linear relationship between the study variables. The results are as shown in table 4.13.

Table 4.13: Correlation Results

Variables		Av_ Financial factors	Av_Technical factors	Av_ Managerial factors	Av_ Regulatory factors	Av_ Development of geothermal energy
Av_ Financial factors	Pearson Correlation	1	.874**	.885**	.625**	.602**
	Sig. (2-tailed)		0.000	0.000	0.000	0.000
Av_Technical factors	Pearson Correlation	.874**	1	.842**	.635**	.686**
	Sig. (2-tailed)	0.000		0.000	0.000	0.000
Av_ Managerial factors	Pearson Correlation	.885**	.842**	1	.637**	.588**
	Sig. (2-tailed)	0.000	0.000		0.000	0.000
Av_ Regulatory factors	Pearson Correlation	.625**	.635**	.637**	1	.411**
	Sig. (2-tailed)	0.000	0.000	0.000		0.000
Av_ Development of geothermal energy	Pearson Correlation	.602**	.686**	.588**	.411**	1
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	

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

The correlation results showed that financial factors had a positive and significant relationship with development of geothermal energy sector, and there is a tendency for the variables to move in the same direction. (0.602, p=0.000). These results were also in agreement with Kipchumba and Ndirangu (2017) study as it highlighted that grant financing had a positive and significant relationship with organizational growth of geothermal energy sector. They also concurred with Johnston and Santoyo-Castelazo (2016) study which found that government grants, tax incentives, and feed-in tariffs have a positive association with development of geothermal energy sector.

The results also indicated that technical factors had the strongest positive and significant association with development of geothermal energy sector (0.686, p=0.000), hence the variables tend to move in the same direction. In addition, these results also concurred with Sanyal et al. (2019) research since it established that technological advancement and access to government reservoirs had a positive relationship with growth of geothermal energy sector.

The findings also highlighted that managerial factors and development of geothermal energy sector were positively and significantly correlated (0.588, p=0.000), and the variables tend to move in the same direction. These findings were also in agreement with Kong'ani, Wahome and Thenya (2021) research as it showed that operations management has a positive association with development of the Olkaria geothermal project.

Moreover, regulatory factors were also found to have a weak positive and significant relationship with development of geothermal energy sector (0.411, p=0.000), and the variables tend to move in the same direction. These findings were also in agreement with Okoye et al. (2020) study which revealed that regulatory factors and development of geothermal sector were positively and significantly correlated.

4.7.2 Multiple Linear Regression results for Success Factors and Development of Geothermal Energy Sector

The regression results consisted of the model summary, analysis of variance (ANOVA) and the regression coefficients of the four success factors and development of geothermal energy sector.

Table 4.14: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.688a	0.473	0.451	0.36284

a Predictors: (Constant), Av_ Regulatory factors, Av_ Financial factors, Av_Technical factors, Av_ Managerial factors

The model summary results showed that the R-square was 0.688. This implies that financial, technical, managerial and regulatory factors explained 68.8% of the variations in development of the geothermal energy sector, the remaining 31.2% of the variations in development of geothermal energy sector are explained by other factors that were not discussed in this study. These results also revealed that the four success factors examined in this study were satisfactory variables in predicting development of geothermal energy sector.

Table 4.15: ANOVA

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	11.455	4	2.864	21.752	.000b
	Residual	12.77	97	0.132		
	Total	24.224	101			

The ANOVA findings also indicated that the overall model of regression was statistically significant, and the four success factors were found to be good predictors of development of geothermal energy sector. This was supported by the calculated F statistic of 21.752 that was greater than the f-critical value 3.936 obtained, and the p-value of (0.000) was less than 0.05 significance level.

Table 4.16: Regression Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	3.002	0.251		11.937	0.000
	Av_ Financial factors	0.193	0.094	0.125	2.053	0.007
	Av_Technical factors	0.326	0.078	0.678	4.199	0.000
	Av_ Managerial factors	0.334	0.1	0.658	3.342	0.003
	Av_ Regulatory factors	0.267	0.076	0.5	3.513	0.011

a Dependent Variable: Av_ Development of geothermal energy

The regression coefficients findings highlighted that the success factors beginning with managerial factors which had the highest positive and significant influence on development of geothermal energy sector (β=0.334, p=0.003). This implied that a unit improvement in managerial factors can lead to a corresponding improvement in development of geothermal energy sector by 0.334 units. These results were in agreement with those of Munene et al. (2020) research as it disclosed that effective governance and management, stakeholder engagement had a positive and significant impact on development of geothermal energy sector in Kenya. They also concurred with Kimathi (2019) study which revealed that strong leadership had a positive and significant influence on improving access to renewable energy through the SimGas biogas project in Meru County. Additionally, these findings were related to Ssebakira et al (2019) study as it concluded that all parties, including the government, the commercial sector, and local people, must promote the development of geothermal energy in East Africa.

The regression results also revealed that technical factors followed as the second success factor with a positive and significant influence on development of geothermal energy sector (β=0.326, p=0.000). This meant that a unit improvement in technical factors can result to a corresponding improvement in development of geothermal energy sector by 0.326 units. These results also concurred with Kipyegon and Kinyua (2019) research as it found that innovation in the sector, particularly in the areas of binary technology, geothermal energy storage, and enhanced geothermal system (EGS) technology had a positive impact on development of geothermal energy sector. They were also in agreement with those of Mekonnen, Lind, and Wu's (2020) study which concluded that increased investment in the sector, technology transfer, and the development of public-private partnerships can contribute significantly to expansion of geothermal energy sector.

Moreover, these results also found that regulatory factors also had a positive and significant influence on development of geothermal energy sector (β=0.267, p=0.000). This implied that a unit improvement in regulatory factors can lead to a corresponding improvement in development of geothermal energy sector by 0.267 units. These findings were also in alignment with those of Mukaya and Muathe (2019) study which established that government policies and regulations, as well as the political environment had a positive and significant impact on development of geothermal energy sector in Kenya. However, they contradicted with

those of Keter et al. (2018) research since it concluded that the current regulatory framework had a positive but insignificant effect on development of geothermal energy sector.

Consequently, these results revealed that financial factors had the least positive and significant influence on the development of geothermal energy sector (β=0.193, p=0.000). This meant that a unit improvement in financial factors can lead to a corresponding improvement in development of geothermal energy sector by 0.193 units. These findings were also consistent with those of Sari and Suryani (2018) research which indicated that government subsidies for exploration and drilling activities have a positive and significant impact on the growth of geothermal capacity in Indonesia. They were also in alignment with Nyakundi and Keramati (2019) study results which showed that participation by private sector investors, government officials, and industry experts in geothermal energy sector has a positive and significant impact on expansion of geothermal energy sector. Additionally, they also concurred with Johansson and Harvey (2017) study which established that the availability of low-cost capital, long-term power purchase agreements, and supportive government policies have been critical for the successful development of geothermal energy projects.

Therefore, the overall regression model for this study as outlined in chapter three was presented as follows.

Development of geothermal energy sector = 3.002 + 0.193 financial factors + 0.326 Technical factors + 0.334 managerial factors + 0.267 regulatory factors

CHAPTER FIVE: DISCUSSION

5.1 Introduction

This chapter presents a discussion of the research findings illustrated in chapter four.

5.2 Findings Discussion

5.2.1 Financial Factors and Development of Geothermal Energy Sector

This study sought to determine the influence of financial factors on the development of geothermal energy sector in Kenya. The descriptive results revealed that more than 50% of the respondents agreed with the statements on exploration costs, financial incentives and private sector participation. The overall average responses of 4.18 also demonstrated that the financial factors discussed are among the success factors that are playing an important role in enhancing development of geothermal energy sector. Whereas the standard deviation of 1.43 showed that the responses from the respondents were relatively varied across the entire Likert scale.

Moreover, the correlation results also indicated that financial factors were found to have a positive and significant relationship with development of geothermal energy sector (0.602, p=0.000). The regression findings also showed that financial factors had a positive and significant influence on development of geothermal energy sector (β=0.193, p=0.000). This implied that a unit improvement in financial factors will lead to a corresponding improvement in development of geothermal energy sector by 0.193 units. These findings also concurred with those of Sari and Suryani (2018) which noted that government subsidies for exploration and drilling activities have a positive and significant impact on the growth of geothermal capacity in Indonesia. Nyakundi and Keramati (2019) study also showed that participation by private sector investors, government officials, and industry experts in geothermal energy sector has a positive and significant impact on expansion of geothermal energy sector.

5.2.2 Technical Factors and Development of Geothermal Energy Sector

The second objective of the study was to evaluate the influence of technical factors on the development of geothermal energy sector in Kenya. The descriptive results outlined that more than 50% of the respondents agreed with the statements on geothermal resource database, geothermal technology and Resource & Development center. The overall average of responses of 4.23 also showed that technical factors discussed are also success factors that promote development of geothermal energy sector. In addition, the standard deviation of 1.41 explained the variation of the responses provided by the targeted respondents.

Furthermore, the correlation findings also revealed that technical factors and development of geothermal energy sector were positively and significantly correlated (0.686, p=0.000). The regression results also highlighted

those technical factors had a positive and significant influence on development of geothermal energy sector (β=0.326, p=0.000). This implied that a unit improvement in technical factors will lead to a corresponding improvement in development of geothermal energy sector by 0.326 units. Additionally, Kipyegon and Kinyua (2019) research concurred with these results as it revealed that innovation in the sector, particularly in the areas of binary technology, geothermal energy storage, and enhanced geothermal system (EGS) technology had a positive impact on development of geothermal energy sector.

5.2.3 Managerial Factors and Development of Geothermal Energy Sector

The third objective of the study was to examine the influence of managerial factors on the development of geothermal energy sector in Kenya. The descriptive results indicated that more than 50% of the respondents agreed with the statements on leadership capabilities, top management support and institutional arrangements. The overall average of responses of 4.34 also demonstrated that managerial factors are also success factors that promote development of geothermal energy sector. Additionally, the standard deviation of 1.38 explained the variation of the responses provided by the targeted respondents.

Furthermore, the correlation findings also revealed that managerial factors had a positive and significant association with development of geothermal energy sector (0.588, p=0.000). The regression results also disclosed that managerial factors had a positive and significant influence on development of geothermal energy sector (β=0.334, p=0.000). This meant that a unit improvement in managerial factors will lead to a corresponding improvement in development of geothermal energy sector by 0.334 units. Additionally, Munene et al. (2020) agreed with these results as it discovered that effective governance and management, stakeholder engagement had a positive and significant impact on development of geothermal energy sector in Kenya. Kimathi (2019) study outcome also concurred that strong leadership had a positive and significant influence on improving access to renewable energy through the SimGas biogas project in Meru County.

5.2.4 Regulatory Factors and Development of Geothermal Energy Sector

The fourth objective of the study was to determine the influence of regulatory factors on the development of geothermal energy sector in Kenya. The descriptive results outlined that more than 50% of the respondents agreed with the statements on regulatory frameworks, regulatory agencies and stakeholder engagement. The overall average of responses of 4.12 also revealed that regulatory factors are also success factors that enhance development of geothermal energy sector. The standard deviation of 1.42 explained the variation of the responses across the Likert scale as provided by the targeted respondents.

Moreover, the correlation findings highlighted that regulatory factors and development of geothermal energy sector were positively and significantly correlated (0.411, p=0.000). The regression results also disclosed that regulatory factors had a positive and significant influence on development of geothermal energy sector (β=0.267, p=0.000). This meant that a unit improvement in regulatory factors will lead to a corresponding improvement in development of geothermal energy sector by 0.267 units. Similarly, Mukaya and Muathe (2019)

study results agreed with these findings as they stated that government policies and regulations, as well as the political environment had a positive and significant impact on development of geothermal energy sector in Kenya. However, Keter et al. (2018) study disagreed with these results since it concluded that the current regulatory framework had a positive but insignificant effect on development of geothermal energy sector.

The model summary results showed that the R-square was 0.688. This meant that financial, technical, managerial and regulatory factors explained 68.8% of the variations in development of the geothermal energy sector, meaning that the remaining 31.2% of the variations in development of geothermal energy sector are explained by other factors that were not discussed in this study. These results also revealed that four success factors examined in this study were satisfactory variables in predicting development of geothermal energy sector.

CHAPTER SIX: CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

6.1.1 Financial Factors and Development of Geothermal Energy Sector

According to the descriptive and inferential results obtained, it can be concluded that financial factors are success factors that have a positive and significant relationship and influence on development of geothermal energy sector. The study can also conclude that in case of an improvement in exploration costs, financial incentives and private sector participation, there will be an improvement in development of geothermal energy sector by 0.193 units. In addition, the high level of agreement by the respondents in regard to the sector deploying the financial factors, showed that most of the employees in the sector are supportive of the fact that financial factors are key for development of geothermal energy sector.

6.1.2 Technical Factors and Development of Geothermal Energy Sector

The study also concluded that the present investment in technical factors including geothermal technology, geothermal resource database and resource & development centre has to a good extent promoted development in geothermal energy sector. As per descriptive and inferential results obtained, it can be concluded that technical factors are also success factors that have a positive and significant relationship and influence on development of geothermal energy sector. The study also concluded that an improvement in geothermal technology, geothermal resource database and resource and development centre will lead to an improvement in development of geothermal energy sector by 0.326 units.

6.1.3 Managerial Factors and Development of Geothermal Energy Sector

The study also concluded that the high level of agreement from the respondents on the current managerial factors such as leadership capabilities, top management support and institutional arrangements, showed that employees concur that managerial factors is a key success factor to development in geothermal energy sector. As per the descriptive and inferential results obtained, it can be inferred that managerial factors are also success factors that have a positive and significant relationship and influence on development of geothermal energy sector. The study can also conclude that an improvement in leadership capabilities, top management support and institutional arrangements will lead to an improvement in development of geothermal energy sector by 0.334 units.

6.1.4 Regulatory Factors and Development of Geothermal Energy Sector

The study also concluded that the present regulatory factors in terms of regulatory frameworks, regulatory agencies and stakeholder engagements have to a good extent played the role of promoting development of

geothermal energy sector. According to the descriptive and inferential results obtained, it can also be inferred that regulatory factors are also success factors that have a positive and significant relationship and influence on development of geothermal energy sector. The study can also conclude that an improvement in regulatory frameworks, regulatory agencies and stakeholder engagements will lead to an improvement in development of geothermal energy sector by 0.267 units.

6.1.5 The Four Success Factors and Development of Geothermal Energy Sector

The model summary results showed that the R-square was 0.688. This meant that financial, technical, managerial and regulatory factors explained 68.8% of the variations in development of the geothermal energy sector, meaning that the remaining 31.2% of the variations in development of geothermal energy sector are explained by other factors that were not discussed in this study. These results also revealed that four success factors examined in this study were satisfactory variables in predicting development of geothermal energy sector and their influence on development of geothermal energy sector in Kenya is significant at 68.8%. The study can conclude that management and policy makers attention to the four study variables is important to ensure successful development of geothermal in Kenya.

6.2 Recommendations

According to the study findings, discussions and conclusions, the study provided the following policy recommendations and recommendations to the management of geothermal energy sector.

6.2.1 Policy Recommendations

Policymakers in the energy sector should enforce favorable policies to strengthen collaboration between the government, private sector, and energy companies, to optimize funding and incentives for geothermal projects. This collaboration can include creating a fund for upfront geothermal exploratory costs, providing clearer financial incentives, and fostering partnerships for research and development.

Policymakers should also review existing government funding mechanisms and financial incentives to ensure they adequately support geothermal projects. This may involve increasing funding for pre-exploration research, refining grant criteria to better align with industry needs, and expanding tax incentives to attract more investment in geothermal energy development.

Policymakers should also ensure that institutional arrangements within the geothermal energy sector are well-aligned with the overall development strategy and regulatory policies set forth by the government. This alignment is crucial for promoting a harmonized approach and facilitating the successful implementation of geothermal projects.

6.2.2 Managerial Recommendations

The study recommended that the management of the geothermal energy sector should strategize on how best to allocate resources towards pre-exploration research in order to reduce exploration costs and improve the efficiency of geothermal resource identification. This investment can lead to better targeting of drilling sites, thereby reducing overall project costs and increasing the success rate of geothermal exploration.

They should continue investing in the research and development center, ensuring it remains well-equipped with state-of-the-art geothermal technologies and resources. They should also establish channels for regular communication and exchange of data, research findings, and best practices related to geothermal energy development.

They should also provide training and capacity-building programs for employees involved in managing and utilizing geothermal resource databases to enhance their skills in data interpretation and decision-making.

The management should recognize the influence of private sector participation on investor decisions and thus prioritize efforts to maintain a conducive investment environment by promoting transparent communication and investor confidence as well as trust.

They should also promote a value-driven approach to leadership that prioritizes sustainability, accountability, and stakeholder engagement.

6.3 Implications of the Study

This study offers valuable insights and recommendations that have significant implications for policymakers, regulatory agencies, industry stakeholders, and practitioners in the geothermal energy sector. Policymakers can use the findings to refine regulatory frameworks, fostering a more conducive environment for investment, innovation, and sustainable development. Enhanced stakeholder engagement strategies can ensure that regulatory decisions align with industry needs and priorities, promoting transparency and collaboration. Regulatory agencies can leverage the findings to enhance their technical expertise and collaboration with industry stakeholders, improving regulatory compliance and industry performance. Industry stakeholders can benefit from recommendations on leadership development and research investment, cultivating a culture of excellence and innovation. Practitioners can use the study's insights to inform strategic planning and decision-making processes, enhancing project outcomes and maximizing socio-economic benefits. Overall, by collaborating and incorporating evidence-based recommendations, stakeholders can advance the growth, sustainability, and resilience of the geothermal energy sector, contributing to energy security, economic prosperity, and environmental sustainability.

6.4 Suggestions of Areas of Further Research

This study found that the discussed success factors explained 68.8% of the variations in development of geothermal energy sector, meaning that the remaining 31.2% are explained by other factors such as marketing

factors not discussed in this study. Thus, this research suggests that further studies should be carried out to determine the other factors that influence development of geothermal energy sector in Kenya. Further studies should also consider narrowing down to specific geothermal projects in Kenya and assessing the factors that have influenced the successful completion of such projects. In addition, comparative studies can also be conducted to assess the benefits and challenges of undertaking geothermal energy projects and renewable energy like solar and wind energy projects. This can provide better insights to the management of the sector on better and effective project management practices.

6.5 Limitations of the Research

The study had a limited scope of population targeting 6 energy sector entities that are concerned with Geothermal energy sector development. However, the entire energy sector consists of around 12 entities, thus to address this limitation future studies should examine success factors in the other 6 energy entities that were not assessed in this study. The study was also limited to using one quantitative data collection instrument which was a questionnaire. To address this limitation, the researcher ensured to reach out and administer all the questionnaires to the selected sample respondents, followed all the ethical considerations and followed up on them to ensure they fill all the spaces in the questionnaires and they also return them.

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APPENDICES

Appendix I: Letter of Introduction

Date……

To……..

Dear Sir/Madam,

RE: COLLECTION OF RESEARCH DATA

My name is Elizabeth Njenga. I am a post-graduate student from Strathmore University. I wish to conduct a research titled. "**THE INFLUENCE OF CRITICAL SUCCESS FACTORS ON THE DEVELOPMENT OF GEOTHERMAL ENERGY SECTOR IN KENYA**.". A questionnaire has been developed to assist in collecting relevant information for this study. You have been identified as one of the participants in this study, kindly spare some of your time to fill the questionnaire administered to you. Whatever information you shall provide will be strictly confidential and will be used for academic purpose only. Participation in the study is voluntary. Many thanks for your acceptance with regards to participation in this study

Yours Sincerely,

Elizabeth Njenga

Appendix II: Research Questionnaire

The purpose of this questionnaire is to gather information about the **Influence of critical success factors on the development of geothermal energy sector in Kenya**. Please respond to each of the questions as honestly and accurately as possible.

Section A. Demographic Information

1. Name of the institution (Optional) ……
2. Kindly indicate your gender.
   Male ☐
   Female ☐
3. What is your position in the institution
   Senior managers ☐
   Middle level employees ☐
4. Kindly indicate your age bracket
   25-34 years ☐
   35-44 years ☐
   45-54 years ☐
   55 years and above ☐
5. Kindly indicate your highest academic qualifications
   Diploma ☐
   Bachelor's degree ☐
   Master's degree ☐
   Doctorate ☐
6. For how long have you been working with the institution
   1-5 years ☐
   6-10 years ☐
   11-15 years ☐
   15-20 years ☐
   Over 20 years ☐

Section B: Financial Factors

This section consists of statements on the financial factors influence on development of geothermal energy sector in Kenya. Kindly respond by marking the item that matches your opinion with a tick (√). Use the scale of 1-6. Where 1=Strongly Disagree, 2= Disagree, 3= Moderately Disagree, 4= Moderately Agree, 5= Agree and 6= Strongly Agree.

	Statements	1	2	3	4	5	6
7	The organization incurs high exploration costs on geologic and geophysical surveys for geothermal resource exploration.						
8	The organization incurs high average cost per well for drilling and testing in the geothermal projects.						
9	The government of Kenya funds pre-exploration research for geothermal energy.						
10	The government provide sufficient financial incentives to support geothermal projects						
11	The available government grants have stimulated completion of geothermal projects						
12	Availability of tax incentives has helped mobilize risk capital to cater for the high upfront costs of drilling.						
13	Private sector companies invest heavily in the company's projects.						
14	Private sector participation is one of the cost-sharing scheme used by the company.						
15	The level of private sector participation influences investor decisions to invest with the company.						

Section C: Technical Factors

This section consists of statements regarding technical factors that influence development of geothermal sector in Kenya. Kindly respond by marking the item that matches your opinion with a tick (√). Use the scale of 1-6. Where 1=Strongly Disagree, 2= Disagree, 3= Moderately Disagree, 4= Moderately Agree, 5= Agree and 6= Strongly Agree.

	Statements	1	2	3	4	5	6
16	The company has access to reliable and up-to-date geothermal resource data.						
17	The use of geothermal resource databases has helped the company in selection of potential geothermal sites for development in Kenya.						
18	The geothermal resource databases provide accurate data and information to be used by investors in decision-making.						
19	The company's research and development center has been well equipped with geothermal technologies program that assist in R&D activities.						

20	The company allocate a certain amount of money yearly to equip the research and development center with the latest R& D programs.						
21	The resource and development center is also equipped to offer trainings and technical assistance when undertaking geothermal projects.						
22	The company has an innovative edge on geothermal energy as it allocates intensive resource on technology development.						
23	The company invests in training its employees to effectively use its innovative geothermal technology.						
24	The use of innovative geothermal systems has contributed to the timely completion of geothermal projects.						

Section D: Managerial Factors

This section consists of statements on managerial factors that influence development of geothermal sector in Kenya. Kindly respond by marking the item that matches your opinion with a tick (√). Use the scale of 1-6. Where 1=Strongly Disagree, 2= Disagree,3= Moderately Disagree, 4= Moderately Agree, 5= Agree and 6= Strongly Agree.

	Statements	1	2	3	4	5	6
25	The leadership capabilities of managers assists the company in making effective decisions.						
26	The leadership capabilities of managers contributes to the successful completion of geothermal projects.						
27	The leadership capabilities of managers boosts the company's reputation.						
28	The company prioritizes its employee needs with an aim of increasing their performance.						
29	The company supports its managers and employees by implementing training programs that equip them with all the necessary skills.						
30	The company engages its employees in making important decision regarding its operations.						
31	The institutional arrangements are well aligned to ensure a harmonized approach and focus on the development strategy.						
32	The institutional arrangements are aligned with the regulatory policies implemented by the government.						
33	The institutional arrangements are capable to accommodate developments in the company.						

Section E: Regulatory Factors

This section consists of statements on regulatory factors that influence development of geothermal sector in Kenya. Kindly respond by marking the item that matches your opinion with a tick (√). Use the scale of 1-6. Where 1=Strongly Disagree, 2= Disagree, 3= Moderately Disagree, 4= Moderately Agree, 5= Agree and 6= Strongly Agree.

	Statements	1	2	3	4	5	6
34	The company has a clear geothermal strategic plan for developing geothermal energy.						
35	The regulatory frameworks implemented support the companies associated budgetary allocations on its geothermal projects.						
36	The regulatory frameworks implemented encourage private sector participation in geothermal projects.						
37	Policies implemented by regulatory agencies affect the level of investment in the geothermal energy sector.						
38	Collaboration between regulatory agencies and industry stakeholders assists the company in making informed decisions.						
39	Effective collaboration between regulatory agencies and industry stakeholders attract more investors to invest in the company.						
40	Stakeholders have full trust in the company.						
41	The company frequently holds forums with their stakeholders to keep them posted on its development and also listen to their views.						
42	Stakeholders are happy with the engagement mechanisms used by the company.						

Section F: Development of Geothermal Energy in Kenya

This section consists of statements on development of the geothermal energy sector in Kenya. Kindly respond by marking the item that matches your opinion with a tick (√). Use the scale of 1-6. Where 1=Strongly Disagree, 2= Disagree, 3= Moderately Disagree, 4= Moderately Agree, 5= Agree and 6= Strongly Agree.

	Statements	1	2	3	4	5	6
43	The company's budget utilization of total installed geothermal capacity on has been on an increasing trend for the last five years.						

44	The company's budget utilization of net power generation has been on an increasing trend for the last five years.						
45	The growth of power production has been on an increasing trend for the last five years.						
46	The growth of power production has been exceeding the firm's target for the last five years.						
47	The rate of project completion has been on an increasing trend for the last five years.						
48	The actual project spending has been lower than the targeted spending on geothermal projects.						

Thank you for your participation.

Appendix III: Geothermal Sites in Kenya

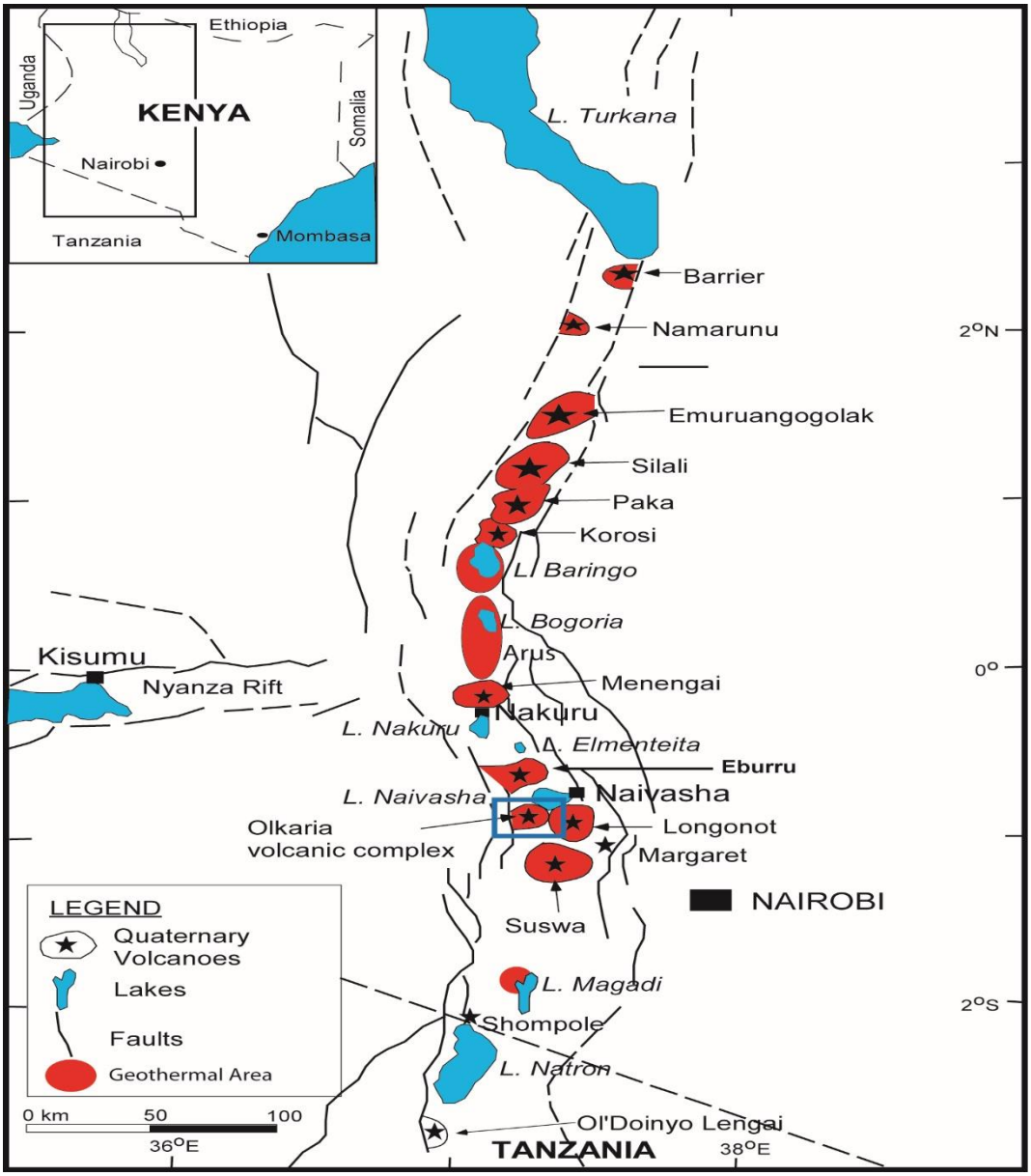

Figure 1.2: Geothermal sites in Kenya

Appendix IV: List of the Six Entities in the Geothermal Energy Sector in Kenya

S/No	Company
1	Ministry of Energy and Petroleum
2	EPRA
3	KenGen
4	GDC
5	Private1
6	Private2

Source: LCPDP (2023)

Appendix VI: SU-ISERC ETHICAL CLEARANCE CERTIFICATE

Strathmore University Institutional Scientific and Ethical Review Committee (SU-ISERC)

Final Decision

This is to certify that the application for ethics clearance submitted by:
Principal Investigator: Ms. NJENGA, ELIZABETH WAIRIMU
Reference number: SU-ISERC1804/23
For Study: "EXAMINING CRITICAL SUCCESS FACTORS FOR GEOTHERMAL POWER DEVELOPMENT IN KENYA"
Was reviewed and received the following status: "done"
Reviewer Comments
Final decision: **approved**
Comments sent:
Dear Ms Njenga,

See the recommendation given below.

Reviewer #1:
'Attach the consent form as an appendix in the main proposal
'

Regards
The SU-ISERC wishes you all the best with this research undertaking.
05 July 2023 08:57:52

Appendix VII: NACOSTI CLEARANCE

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **450554**

Date of Issue: **18/July/2023**

RESEARCH LICENSE

This is to Certify that Ms.. ELIZABETH WAIRIMU NJENGA of Strathmore University, has been licensed to conduct research as per the provision of the Science, Technology and Innovation Act, 2013 (Rev.2014) in Nairobi on the topic: EXAMINING CRITICAL SUCCESS FACTORS FOR GEOTHERMAL POWER DEVELOPMENT IN KENYA for the period ending : 18/July/2024.

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Director General
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Legal Notice No. 108: The Science, Technology and Innovation (Research Licensing) Regulations, 2014

The National Commission for Science, Technology and Innovation, hereafter referred to as the Commission, was the established under the Science, Technology and Innovation Act 2013 (Revised 2014) herein after referred to as the Act. The objective of the Commission shall be to regulate and assure quality in the science, technology and innovation sector and advise the Government in matters related thereto.

CONDITIONS OF THE RESEARCH LICENSE

1. The License is granted subject to provisions of the Constitution of Kenya, the Science, Technology and Innovation Act, and other relevant laws, policies and regulations. Accordingly, the licensee shall adhere to such procedures, standards, code of ethics and guidelines as may be prescribed by regulations made under the Act, or prescribed by provisions of International treaties of which Kenya is a signatory to
2. The research and its related activities as well as outcomes shall be beneficial to the country and shall not in any way;
    i. Endanger national security
    ii. Adversely affect the lives of Kenyans
    iii. Be in contravention of Kenya's international obligations including Biological Weapons Convention (BWC), Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO), Chemical, Biological, Radiological and Nuclear (CBRN).
    iv. Result in exploitation of intellectual property rights of communities in Kenya
    v. Adversely affect the environment
    vi. Adversely affect the rights of communities
    vii. Endanger public safety and national cohesion
    viii. Plagiarize someone else's work
3. The License is valid for the proposed research, location and specified period.
4. The license any rights thereunder are non-transferable
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14. The Commission shall have powers to acquire from any person the right in, or to, any scientific innovation, invention or patent of strategic importance to the country.
15. Relevant Institutional Scientific and Ethical Review Committee shall monitor and evaluate the research periodically, and make a report of its findings to the Commission for necessary action.

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