

**Midocean University**

**College Of Business Administrator**

**Major: Master Of Business Administrator**



**Research title:**

Strategic Transition of Geophysical Companies in Saudi Arabia: From Infrastructure Support to Mineral  
Exploration under Vision 2030

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Academic Year:

2025/2026

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**Abstract:**

The strategic transformation of geophysical companies in Saudi Arabia from infrastructure-based service providers to integrated mineral exploration partners represents a pivotal shift within the broader framework of national economic diversification. Historically, geophysical firms in the Kingdom have concentrated primarily on infrastructure-related services, including groundwater exploration, geotechnical investigations, environmental assessments, and seismic hazard studies. While these services have significantly contributed to rapid urban and industrial development, they remain largely reactive and project-based in nature. With the emergence of ambitious mining sector reforms and the prioritization of mineral resource development under Saudi Vision 2030, the operational and strategic orientation of geophysical enterprises requires substantial realignment toward advanced mineral exploration activities.

This study aims to develop a comprehensive strategic framework that supports the transition of Saudi geophysical companies into competitive and technologically advanced mineral exploration partners. The research examines the internal organizational determinants influencing this transformation, specifically focusing on innovation, effective communication, and financial resources as independent variables, and strategic transformation as the dependent variable. The study integrates theoretical foundations from the Resource-Based View, Innovation Diffusion Theory, Human Capital Theory, Strategic Management Theory, and Institutional Theory to construct a multidimensional analytical model explaining organizational change within a resource-based economy.

A quantitative, descriptive—analytical research design was employed to achieve the study objectives. Primary data were collected through a structured questionnaire distributed to 190 professionals working in geophysical service companies across Saudi Arabia, including managers, engineers, geophysicists, financial officers, and strategic planners. The instrument measured perceptions related to technological readiness, organizational coordination, financial capability, and transformation outcomes using a five-point Likert scale. Statistical analysis was conducted using SPSS, incorporating descriptive statistics, reliability testing (Cronbach's Alpha), exploratory factor analysis, Pearson correlation, and multiple regression analysis to test the study hypotheses and assess predictive relationships.

The findings reveal a moderate overall readiness for strategic transformation within the sector. Innovation emerged as a significant driver of transformation; however, while employees are encouraged to generate innovative ideas, systematic adoption of advanced mineral exploration technologies remains limited. Effective communication was found to support transformation efforts, yet coordination mechanisms require further strengthening to facilitate multidisciplinary collaboration essential for mineral exploration projects. Financial resources were identified as a critical constraint, with limited long-term investment capacity affecting technology acquisition, workforce specialization, and research development initiatives. Additionally, organizational and cultural barriers, including resistance to change and lack of clear strategic direction, were observed to influence the pace and effectiveness of transition efforts.

The study confirms the existence of statistically significant relationships between technological capability, communication effectiveness, financial strength, and successful strategic transformation. These findings highlight the necessity of integrated capacity-building strategies combining technological investment, human capital development, structured change management, and institutional collaboration. From a theoretical perspective, the research contributes to the literature on industrial upgrading and strategic transformation in emerging mining economies by linking geophysical innovation with organizational strategy. From a practical standpoint, it provides actionable recommendations for policymakers and industry leaders seeking to enhance local content participation, reduce dependency on foreign exploration contractors, and strengthen the competitiveness of domestic geophysical enterprises.

In conclusion, the transformation of geophysical companies into advanced mineral exploration partners constitutes a strategic imperative for sustainable resource development, national economic resilience, and long-term industrial diversification in Saudi Arabia. Strengthening internal capabilities and aligning organizational strategy with national mining priorities will enable the geophysical services sector to play a central role in the Kingdom's evolving mineral economy.

# Chapter 1:

## **Introduction:**

The geophysical services industry in Saudi Arabia is making changes. This is a step forward for the country. It wants to be a leader in using resources in a sustainable way and making its economy stronger. For a time, geophysical companies in Saudi Arabia have been helping to build things like roads and cities. They do things like find water underground check if the ground is safe for building and make sure the environment is not hurt. They also study if there are going to be earthquakes. These things are important for building cities and roads The country's plans for development are. The world needs more important minerals. This means geophysical companies must change what they do. Now they have chances to look for minerals and find new resources. This is what Alghafis said in 2025. The geophysical services industry, in Saudi Arabia is going to keep changing and growing (Alghafis, 2025).

The importance of aiming for different revenue sources other than oil and gas is emphasized in the national transformation plan of Saudi Vision 2030. The plan states that improving mining and mineral processing is of the utmost importance. The kingdom of Saudi Arabia has a large unutilized reserve of minerals that include gold, copper, and phosphates, as well as bauxite, rare earth elements, and other critical minerals that are currently necessary for the renewable energy, modern manufacturing, and supply chain minerals. With the increased need for energy transition minerals, the kingdom aspires to grow as a major mining center for these minerals. As part of the continued plans for the country's development, the government intends to establish new regulations for the private sector that will create new avenues and investments. Within this framework, geophysical firms can be at the forefront of mineral development, leveraging their capabilities in subsurface imaging, geological interpretation, and surveying (Darandary, 2021).

Despite their technical information, several geophysical groups predominantly consciousness on infrastructure tasks, consequently constraining their involvement in moneymaking mineral exploration undertakings. Shifting to exploration-centric offerings necessitates the implementation of sophisticated geophysical technology, the amalgamation of diverse exploration strategies, and the augmentation of specialized group of workers abilities. This transformation isn't only an operational adjustment but represents a strategic reposition that matches neighborhood enterprise strengths with national monetary priorities and worldwide market needs. By expanding their service portfolios to encompass airborne surveys, deep

subsurface imaging, mineral focused on, and incorporated geological modeling, geophysical enterprises can play a critical position in accelerating resource discovery and reducing reliance on foreign exploration contractors (Perikleous, 2025).

Furthermore, the transformation of geophysical firms contributes directly to improving neighborhood content introduction, information switch, and technological innovation in the Kingdom. It additionally fosters the introduction of high-professional employment opportunities for Saudi professionals in geosciences, engineering, and advanced facts analytics. The enlargement of mineral exploration services stimulates collaboration between authorities corporations, instructional institutions, and personal area companions, allowing the development of a aggressive and sustainable mining environment. As Saudi Arabia continues to implement bold development applications and increase its worldwide financial have an impact on, the strategic transition of geophysical companies closer to mineral exploration represents a essential step in achieving lengthy-term national sustainability, industrial diversification, and aid protection (Al-Hajri, 2024).

#### **Research problem:**

The geophysical services sector in Saudi Arabia is currently suffering a structural gap between its conventional operational focus and the increasing government priorities connected with the expansion of the mining and mineral exploration industry. Historically, most local geophysical enterprises have concentrated on delivering infrastructure-related services such as groundwater exploration, environmental and geotechnical surveys, and construction site investigations. While these services have supported national development initiatives well, they do not entirely correspond with the growing demand for advanced mineral exploration skills required to support the economic diversification agenda championed under Saudi Vision 2030 (Chen, 2025).

One of the key difficulties facing the sector is the low technical specialization of local geophysical enterprises in mineral exploration technologies. Mineral exploration involves advanced geophysical techniques, high-resolution subsurface imaging, integrated geological interpretation, and deep resource targeting methodologies that differ dramatically from typical infrastructure survey methods. Many domestic

businesses lack access to cutting-edge exploration technologies such as airborne geophysical systems, induced polarization surveys, and magneto telluric exploration tools, which inhibits their capacity to compete with multinational exploration contractors (Kouhi1, 2025).

Another key challenge is to the shortage of specialized human capital with experience in economic geology, mineral resource modeling, and advanced geophysical data analytics. Although Saudi geophysical businesses include skilled technical staff in engineering and environmental surveys, the transition toward mineral exploration demands multidisciplinary capabilities combining geophysics, geology, geochemistry, and data science. The restricted availability of such expertise hinders the development of integrated exploration service platforms and increases dependence on foreign technical help (Elshehabi, 2025).

Financial and investment troubles also contribute to the predicament. The acquisition of advanced exploration device, software systems, and airborne survey technology includes important capital commitment and lengthy-term strategic planning. Many nearby geophysical establishments operate below assignment-primarily based enterprise models that focus on quick-time period infrastructure contracts, making it difficult to devote widespread economic sources in the direction of studies, development, and technological innovation (Alonge, 2024).

Additionally, there is a dearth of coordinated coordination between geophysical businesses, academic institutions, and government regulatory authorities to enable knowledge transfer, innovation, and workforce development in mineral exploration. The absence of organized relationships reduces prospects for training, technology adoption, and cooperative exploration projects, which are crucial for developing a competitive national exploration ecosystem (Ediriweera, 2021).

If these difficulties stay ignored, Saudi geophysical businesses risk missing huge economic potential related with the rapidly increasing mining sector. Furthermore, continued reliance on overseas exploration service providers may restrict local content participation and hinder the long-term sustainability of the national mining industry. Therefore, identifying and overcoming these structural, technological, financial, and human resource hurdles is vital to assist the effective strategic transfer of geophysical enterprises onto mineral exploration activities.

### **Importance of the study:**

The development of the geophysical services sector in Saudi Arabia toward mineral exploration constitutes a deliberate reaction to the fundamental economic shifts induced by Saudi Vision 2030. As the Kingdom accelerates the development of its mining sector to become a key contributor to GDP, jobs, and non-oil exports, the readiness of local geophysical businesses becomes a decisive aspect in assuring sustained sector growth. This paper acquires importance by addressing the strategic, technological, and institutional prerequisites necessary for repositioning geophysical enterprises from infrastructure-focused service providers to integrated mineral exploration partners.

#### **- Scientific Importance**

From a scientific perspective, this work adds to the growth of knowledge in applied geophysics, economic geology, and strategic industrial transformation. It bridges the gap between geophysical theory and practical mineral exploration applications by assessing how existing subsurface investigation capabilities might be tailored to support mineral targeting and resource delineation (Zhang, 2025).

The study also extends scholarly discourse on sectoral transformation within resource-based economies by giving a structured framework for industrial upgrading in technical service industries. It blends concepts from geology, strategic management, innovation systems, and workforce development, so creating a multidisciplinary analytical model applicable to comparable rising mining economies' (Adach-Pawelus, 2021).

Moreover, the research contributes to understanding how technological adoption, knowledge transfer, and human capital development influence exploration efficiency and resource discovery rates. By focusing on local capacity building, the project supports scientific inquiry into sustainable resource development and the optimization of geophysical approaches for dry and geologically complex regions characteristic of Saudi Arabia (Abubakar, 2024).

#### **- Practical Importance**

Practically, this report provides decision-makers, politicians, and industry leaders with a defined roadmap for strengthening the competitiveness of Saudi geophysical enterprises in the mineral exploration market. It identifies operational gaps, technology requirements, and strategic investment priorities necessary for integrating industry capabilities with national mining objectives.

The findings support government agencies in establishing policies that encourage local content engagement, technology purchase, and specialized labor training. For private sector enterprises, the report presents actionable solutions for diversification, risk management, and long-term success within the increasing mining ecosystem.

Additionally, the research contributes to lowering dependency on foreign exploration contractors by developing domestic technical competence. This improves economic sustainability, boosts national resource security, and encourages job creation in high-skill geoscience and engineering disciplines. Ultimately, the report serves as a practical reference for assisting a systematic and economically feasible transfer of geophysical enterprises toward mineral exploration activities, assuring congruence with national development priorities and global mineral market dynamics (Chaaben, 2025).

#### **Study objectives:**

- **Main Objective**

To develop a comprehensive strategic framework that enables geophysical companies in Saudi Arabia to transition effectively from infrastructure-based service providers to competitive and technologically advanced mineral exploration partners, in alignment with the economic diversification goals of Saudi Vision 2030.

- **Sub-Objectives**

1. To examine the existing operating organization, technical capabilities, and service portfolios of geophysical firms in Saudi Arabia.

2. To identify the technological, financial, and human resource limitations that hinder their involvement in mineral exploration initiatives.
3. To analyse the unique geophysical methodologies and sophisticated exploration technology necessary for mineral targeting and resource delineation in the Saudi geological environment.
4. To analyse the amount of congruence between existing geophysical services and the strategic aims of the national mining sector.
5. To explore legislative, institutional, and market variables impacting the transition of the geophysical services industry.
6. To offer strategic investment, capacity-building, and collaboration approaches that support sustainable sectoral upgrading.
7. To create policy suggestions that improve local content participation and lessen dependency on foreign exploration contractors.
8. To develop an implementation roadmap outlining short-term, medium-term, and long-term transition plans for geophysical businesses entering the mineral exploration domain.

**Research questions:**

- **Main Question**

How can geophysical businesses in Saudi Arabia strategically convert from infrastructure-based service providers to competitive mineral exploration partners in alignment with the objectives of Saudi Vision 2030?

- **Sub-Questions**

1. What is the current technological, operational, and organizational profile of geophysical businesses operating in Saudi Arabia?
2. What are the biggest technological limitations limiting these enterprises from effectively participating in mineral exploration activities?
3. What specific geophysical methodologies and advanced survey technologies are required to enable mineral targeting and resource delineation within the Saudi geological framework?

4. What human capital competences and multidisciplinary expertise are necessary to support the transformation toward mineral exploration services?
5. What financial and economic hurdles hinder the purchase of modern exploration technology and research capabilities?
6. How do regulatory frameworks, institutional support systems, and mining sector policies influence the evolution of the geophysical services industry?

### **Study Hypotheses**

#### **- Main Hypothesis**

There is a statistically and strategically significant relationship between the development of technological capabilities, human capital competencies, and institutional support mechanisms and the successful transition of geophysical companies in Saudi Arabia from infrastructure-based services to competitive mineral exploration activities in alignment with Saudi Vision 2030.

#### **- Sub-Hypotheses**

1. There is a positive relationship between the adoption of advanced mineral exploration technologies and the operational readiness of geophysical companies to enter the mining exploration market.
2. There is a significant relationship between specialized workforce competencies (economic geology, advanced geophysical interpretation, and data analytics) and the competitiveness of local geophysical firms in mineral exploration projects.
3. Financial investment capacity significantly influences the ability of geophysical companies to acquire advanced exploration equipment and software systems.
4. Institutional and regulatory support positively affects the integration of local geophysical companies into national mineral exploration initiatives.
5. Strategic partnerships with mining companies, research institutions, and international technology providers enhance the effectiveness of the transition process.

Organizational restructuring and diversification strategies significantly contribute to expanding service portfolios from infrastructure surveys to integrated mineral exploration solutions.

### **Scientific Theory Used in Preparing the Research:**

#### **1. Resource-Based View (RBV) Theory**

The Resource-Based View (RBV) contends that a corporation's sustainable aggressive benefit originates from its distinct resources and capabilities. In the context of geophysical firms, RBV stresses using technical understanding, specialized gadget, and experienced human capital to migrate from infrastructure services to mineral exploration. Companies owning valuable, unusual, inimitable, and non-substitutable resources are higher positioned to embody new exploration generation and stable essential contracts inside the mining zone. Applying RBV allows research to analyse how inner competencies and assets are probably reformed to obtain Vision 2030 objectives and long-term organizational competitiveness (Komakech, 2025).

#### **2. Strategic Change and Organizational Transition Theory**

Strategic trade idea investigates how corporations adapt to environmental alterations, technology breakthroughs, and coverage changes. For geophysical corporations, switching in the direction of mineral exploration constitutes an enormous strategic change requiring new operational fashions, labour competencies, and investment strategies. This concept gives a framework for inspecting the causes, impediments, and methods involved in organizational model. It stresses prepared planning, danger control, and stakeholder engagement to reap powerful alternate. In this research, strategic alternate principle drives the identity of fine practices and strategies for aligning company structures and talents with countrywide mining objectives beneath Saudi Vision 2030 (Unter, 2023).

#### **3. Innovation Diffusion Theory**

Innovation Diffusion Theory outlines how modern era and practices unfold amongst organizations and industries. Geophysical groups want to appoint state-of-the-art exploration methods which include airborne geophysics, far off sensing, and 3D subsurface modeling. The theory highlights aspects affecting adoption,

consisting of perceived gain, compatibility with modern-day strategies, complexity, trialability, and observability. Understanding those standards helps provide an explanation for the charge and fulfillment of technological adoption inside Saudi geophysical organisations. Applying this theory within the studies lets in for examining solutions to hurry technological integration, reduce resistance to trade, and boost the effectiveness of mineral exploration operations, supporting the wider Vision 2030 transformation power (Guo, 2024).

#### **4. Human Capital Theory**

Human Capital Theory says that investment in education, skills, and knowledge promotes individual productivity and organizational success. Transitioning geophysical enterprises into mineral exploration requires people with competencies in economic geology, geophysics, data analytics, and resource modeling. This theory provides a platform for examining the function of workforce development, training programs, and talent acquisition in facilitating strategic change. In this research, human capital theory informs the analysis of how skills, knowledge transfer, and continuous professional development influence operational readiness and competitiveness, highlighting the critical importance of building a technically proficient workforce aligned with national mining priorities (Awu, Human Capital Theory: Viewing Employees As Organizational Asset, 2025).

#### **5. Systems Theory**

Systems Theory research agencies as related components working together to gain goals. Geophysical enterprises perform inside complicated systems incorporating era, people, procedures, laws, and marketplace dynamics. Transitioning to mineral exploration includes integrated coordination of those components to improve exploration results. Systems theory provides a framework for expertise connections among technological adoption, organizational structure, human assets, and strategic making plans. In this studies, it assists knowledge how adjustments in one machine issue (e.G., technology acquisition) affect others (e.G., labour necessities, challenge performance). This holistic perspective allows building sustainable transition strategies matched with Vision 2030 targets.

#### **6. Contingency Theory**

Contingency Theory asserts that organizational efficiency relies upon on alignment among inner systems and external environmental conditions. In the Saudi mining setting, geophysical corporations ought to connect their operational plans with regulatory guidelines, marketplace demand, useful resource availability, and technical advances. The idea emphasizes that there is no unmarried foremost strategy; as an alternative, organization's must include flexible and adaptive techniques to successfully pass to mineral exploration. In this studies, contingency idea helps the examination of strategic selection-making, together with generation selection, team of workers planning, and partnership creation, ensuring that organizational structures are adaptable to developing country wide and international exploration environments.

# **Chapter 2: Previous Studies:**

**Introduction:**

The chapter on the theoretical framework and prior research establishes the basis for comprehending the strategy shift of geophysical businesses in Saudi Arabia from infrastructure support to mineral exploration in alignment with the state goals of Saudi Vision 2030. This chapter situates the study within scientific and managerial frameworks, connecting theories of organizational transformation, technological adoption, and resource-based competitive advantage with empirical insights from peer-reviewed research in geophysical methods and mineral exploration. The chapter commences by contextualizing the geophysical services sector historically, emphasising that these firms have predominantly offered infrastructure-related services, including groundwater exploration, geotechnical surveys, environmental assessments, and seismic hazard analysis. These activities have facilitated the Kingdom's swift urban and industrial advancement; nonetheless, they predominantly exhibit a reactive and service-oriented nature, with minimal involvement in value-added mineral exploration endeavors.

Vision 2030 has initiated a paradigm exchange by prioritizing financial diversification and the development of strategic industries, appreciably mining, that appeared as an important catalyst for national commercial enlargement, technical innovation, and sustainable task advent. In this environment, geophysical groups are strategically positioned to significantly contribute to mineral improvement via making use of their proficiency in subsurface imaging, records acquisition, and geological modelling. The exchange necessitates technological adaptation, organizational restructuring, employees upskilling, strategic alliances, and alignment with countrywide policy frameworks. The twin emphasis on technical and strategic skills establishes the conceptual foundation for the look at, synthesizing principles from useful resource-based totally theory,

innovation diffusion, and strategic control to assess how firms can acquire sustainable aggressive advantage within the nascent mineral exploration enterprise.

The chapter additionally analyses prior empirical research on geophysical methodologies, mineral resource identification, and exploration strategies in Saudi Arabia and the larger Arabian Peninsula. These research delivers proof of beneficial geophysical programs which include far off sensing, aeromagnetic surveys, gravity and brought on polarization strategies which have demonstrated capable of figuring out mineralization zones and helping with useful resource targeting. Additionally, the literature highlights the relevance of institutional assistance, regulatory frameworks, and expertise networks in helping technological adoption and ability boom. By summarizing those concepts, the chapter demonstrates how geophysical organisations may comprise modern survey generation, multidisciplinary abilities, and strategic planning to convert from reactive provider companies to proactive contributors in mineral exploration.

Furthermore, the theoretical debate addresses organizational trade fashions and strategic transition frameworks, which function equipment for expertise how corporations modify to changing marketplace needs, generation disruptions, and policy-pushed possibilities. It suggests the relationship between internal abilities inclusive of technical understanding, human assets, operational strategies and external forces, which includes authorities incentives, marketplace contention, and resource availability. Through this synthesis of concept and empirical proof, bankruptcy creates the conceptual foundation for understanding the causes of effective strategic transformation, directing the design of studies questions, objectives, and hypotheses for the look at. In sum, this bankruptcy not handiest situates the studies within a broader clinical and managerial context but also identifies gaps in contemporary understanding, mainly regarding the operational, technological, and

strategic demanding situations confronted through Saudi geophysical companies in transitioning toward mineral exploration below Vision 2030.

### **Study Variables:**

This study explores the determinants of strategic change within geophysical businesses operating in Saudi Arabia, specifically in the context of shifting from infrastructure support services to mineral exploration activities aligned with Saudi Vision 2030. The conceptual model is constructed around one dependent variable—strategic transformation—and three independent variables: innovation, effective communication, and financial resources. These variables collectively describe the internal organizational dynamics that influence the ability of enterprises to reposition themselves within an evolving mining and exploration ecosystem.

The dependent variable, strategic transformation refers to the systematic and long-term reorganization of organizational strategy, operational procedures, technological capabilities, and market orientation to fit with mineral exploration objectives. In this study, strategic transformation is not confined to incremental change but covers a total shift in service portfolio, competitive positioning, and value generating reasoning. It comprises the adoption of sophisticated exploration technologies, diversification into mineral targeting services, restructuring of organizational units to support exploration projects, and alignment of company strategy with national mining priorities. The measurement of this variable can be operationalized through indicators such as expansion into exploration contracts, acquisition of advanced geophysical equipment, establishment of exploration-focused departments, development of multidisciplinary technical teams, and integration into mining value chains.

The first independent variable, innovation, indicates the firm's capacity to develop, adopt, and apply new technologies, processes, and service models that boost exploration capabilities. Innovation in the geophysical environment involves technology innovation—such as the use of aerial geophysics, induced polarization methods, magneto telluric surveys, and 3D subsurface modeling—as well as organizational and process innovation. It also involves data analytics integration, digital transformation, and research and development efforts. Innovation is crucial because mineral exploration demands higher levels of technical complexity than typical infrastructure services. Companies that actively invest in research partnerships, adopt emerging technology, and deploy current data interpretation methods are more likely to achieve successful strategic transformation.

The second independent variable, effective communication, refers to the quality of internal and external information sharing channels within and across businesses. Internally, excellent communication promotes knowledge sharing between geophysicists, geologists, engineers, and management teams, assuring coordinated implementation of exploration initiatives. Externally, it strengthens collaboration with mining businesses, regulatory authorities, research institutes, and technology vendors. Transparent and structured communication channels promote strategy alignment, reduce operational uncertainty, and assist decision-making processes throughout organizational transition. In complex exploration environments, interdisciplinary coordination is important; consequently, communication effectiveness greatly determines the success of strategic change projects.

The third independent variable, financial resources, indicates the firm's capacity to deploy sufficient capital toward technology acquisition, personnel development, research projects, and long-term strategic investments. Mineral exploration needs large upfront investment in advanced equipment, specialist software,

training programs, and trial projects. Firms with great financial stability and investment flexibility are better positioned to absorb transition risks and sustain innovation activities. Financial strength also enables enterprises to compete in large-scale exploration tenders and develop strategic relationships.

Together, these independent factors provide a systematic analytical framework for understanding how internal organizational skills influence strategic transformation across Saudi geophysical enterprises intending to expand into mineral exploration markets.

### **Previous Studies:**

The improvement in technology such as renewable energy systems, satellite missions, and others, has led to the investigation of new raw materials classified as key minerals. The energy transition in particular the creation and manufacture of electric vehicles, wind turbines, and semiconductors needs important minerals like lithium, cobalt and nickel, but their supply chain is now present in the most susceptible locations, posing a threat to the international markets. For instance, approximately 70 % of cobalt originates in the Democratic Republic of Congo, whereas China controls processing 80 % of essential minerals. This article considers worldwide distribution, supply risk, and eco-friendly extraction of essential minerals, with special attention on the unutilized potential of the Arabian Peninsula. Arabian Shield (a Precambrian geological formation stretching over Saudi Arabia and Oman) is host to major amounts of phosphates, copper, gold, and essential minerals. Supported by strategic ideas like Saudi Vision 2030, the area is ready to diversify the hydrocarbon-driven economy through sustainable mineral development. This article analyses the importance of essential minerals in energy transition with a focus on greener technologies, and challenges related to their worldwide supply networks. Critical mineral potential of the Arabian Peninsula is also studied for the next generation. Mineral potential of the Arabian Peninsula based on next-generation exploration technology like AI and remote sensing. Examples of effective sustainable mining operations (e.g., Ma'aden phosphate projects) and policy measures for decreasing environmental and social consequences. Through integrating geology, economics,

and logistics, this assessment emphasises the Arabian Peninsula's capacity to secure global mineral supply chains in a manner that is in line with ESG (Environmental, Social, and Governance) principles (Emad, 2026).

This work presents an integrated geophysical investigation to map the subsurface distribution and describe volcanogenic massive sulphide (VMS) deposits in the Hawiah area of the Wadi Bidah Mineral Belt (WBMB), western Saudi Arabia. The Hawiah deposit, part of the Mamilah District, is a prospective VMS occurrence containing economically significant quantities of copper, gold, silver, and zinc inside strata-bound pyrite lenses. The research utilized ground transient electromagnetic (TEM) and magnetic data to designate mineralized zones and develop a complete knowledge library for future mineral exploitation, aligned with the goals of Saudi Arabia's Vision 2030. TEM data analysis required filtering, integration of high- and low-moment soundings, and inversion. The generated 2D and 3D resistivity models clearly illustrate subsurface conductivity changes. High-resistivity zones at shallow depths correlate to the weathered gossan cap, whereas the dramatic reduction in resistivity at larger depths implies fresh massive sulphides, identifying places for further exploration. The TEM results successfully mapped the oxide (gossan) - shallow, transition - intermediate, and fresh (massive sulphides) - deep zones. Magnetic data were gathered along six profiles, processed with corrections for external noise, diurnal variations, and the International Geomagnetic Reference Field (IGRF). Reduction-to-Pole (RTP) transformation and upward continuation were applied. Analysis utilizing the analytic signal and the Werner deconvolution methods revealed a diverse distribution of magnetic sources, including both positive and negative anomalies. Positive anomalies may be associated with magnetite series compositions and magnetite-rich changes, while negative anomalies reflect extensive hydrothermal alteration zones. Depth solutions suggested shallow, near-vertical magnetic sources. Validation was accomplished by comparing geophysical responses with petrographic, lithological, and magnetic susceptibility analyses from core samples. These samples offered critical mineralogical and textural insights, verifying the definition of the mineralization zones and corroborating the TEM results. The analysis of magnetic susceptibility in cores demonstrated a high concentration of ferromagnetic materials in enormous sulphides that decreases with oxidation. The results underscore the usefulness of integrated geophysical approaches for VMS research, since the differences in resistivity and magnetic signatures efficiently identify the distinct oxidation levels (gossan, transitional zone, and giant sulphides). The findings expand the understanding of the Hawiah VMS deposit and offer important insights for future mineral development activities within the study region (Chavanidis, 2025).

The present study attempts to evaluate complicated geological formations and considerable mineralization utilizing remote sensing and aeromagnetic studies. Structural lineaments play a vital role in the localization and concentration of mineral deposits. For the first time over the study district, a combination of aeromagnetic data, Landsat 9, ASTER, and PRISMA hyperspectral data was applied to increase the characterization of both lithological units and structural features. Advanced image processing techniques, including false color composites, principal component analysis (PCA), independent component analysis (ICA), and SMACC, were applied to the remote sensing datasets. These methods enabled efficient classification between Phanerozoic rock formations and the complicated basement strata, which contain the island arc assemblage, Dokhan volcanics, and late-orogenic granites. The local and deep magnetic sources were separated using Gaussian filters. The Neoproterozoic basement rocks were estimated to be using the radial average power spectrum technique and the Euler deconvolution technique (ED). According to the RAPS approach, the average depths to shallow and deep magnetic sources are roughly 0.4 km and 1.6 km, respectively. The obtained ED contacts range in depth from 0.081 to 1.5 km. The research region revealed huge structural lineaments, particularly in the northeast and northwest sides, where a dense concentration of these lineaments was detected. The places with the highest densities are thought to imply increased fracturization in the rocks that are thought to be associated with mineralization. According to the automatic lineament extraction methods and rise diagram, NW-SE, NNE-SSW, and N-S are the key structural directions. These tendencies were confirmed and graphically portrayed by textural analysis and drainage pattern control. The lithological mapping results were validated through field observations and petrographic investigation. This integrated technique has been highly effective, demonstrating significant potential for both thorough structural analysis and accurate lithological differentiation, which may be related to additional mineralization exploration (El-Desoky, 2025).

The Zalm area in western Saudi Arabia has garnered significant attention from those interested in prospecting for gold mineralization. In the present study, the structural framework and significant structural trends that most likely determine the distribution of the gold mineral resources in the Zalm district are interpreted using aeromagnetic data. For this reason, the aeromagnetic data were subjected to enhancement filters to make the structural interpretation of the data easier. In this respect, the data were limited to the north magnetic pole and processed through two augmentation filters: the analytical signal (AS) and the first vertical

derivative (1VD). Lineament analysis of aeromagnetic maps reveals that three major fault sets dissected the Zalm area going in the northwest (NW), northeast (NE), and north-south (NS) directions. These faults certainly affected the mineralization occurrences in the Zalm district and could serve as key structural conduits for hydrothermal fluid channeling. Based on the current results, four areas were recognised as promising for continued mineral resource exploration. These areas are bounded and split by the NW, NE, and NS faulting and are intruded by a sequence of felsic and mafic—ultramafic intrusions. It is possible that, in like Bir Tawilah where the position is structurally controlled by NW and NS faulting, the interpreted felsic and mafic served as sources of mineralizing fluids which remobilized the ore in the district by channeling through the faults. Three of the suggested sites, one situated in close vicinity to Zalm city and two along the Rada and Nabilah fault zones, are characterized by strong magnetic anomalies, indicating the existence of ultramafic and volcanic rocks that most likely contain mineralization. The fourth locale found in the center portion of the area is distinguished by an elongated N—S low magnetic anomaly, interpreted as felsic diorite and granite rocks bordered by N—S faulting. To accurately locate mineral resources in the identified zones, extra thorough and in-depth geological and geophysical study are recommended (Alzahrani, 2025).

This academic enquiry proposes to assess mining income estimates in the Kingdom of Saudi Arabia for the years 2010 to 2023 by applying complex time series modeling tools, especially the SARIMA methodology. In alignment with Saudi Arabia's Vision 2030 plan, the Kingdom has undertaken enormous steps to diversify its economic framework, wherein the mining industry is seen as a crucial component for encouraging non-oil economic progress. The enquiry analyses historical data pertaining to mining income to create models and estimate potential changes within this domain, which is essential in the Kingdom's agenda for economic diversification. Following rigors analyses, the SARIMA (0,2,1)(0,0,1)[12] model emerged as the most efficacious for encapsulating both seasonal and non-seasonal aspects present in the data, hence generating exact and dependable forecasts. The model displays substantial predictive ability, with a projection horizon extending over the future 36 months, signaling a constant increase of mining income. The results underscore the significance of exact income forecasting for strategic decision-making, resource distribution, and policy formulation (Elgasim, 2024).

This study offers a unique end-to-end process for mineral exploration, merging ambient noise tomography (ANT) with artificial intelligence (AI) to accelerate the discovery and delineation of mineral deposits critical for the worldwide transition to a low carbon economy. We focus on copper as a crucial material, required in substantial quantities for renewable energy solutions. We show the benefits of utilizing ANT, characterized by its speed, scalability, depth penetration, resolution, and low environmental impact, alongside artificial intelligence (AI) techniques to refine a continent-scale prospectivity model at the deposit scale by fine-tuning our model on local high-resolution data. We highlight the promise of the strategy by first introducing a new data-driven AI prospectivity model for copper within Australia, which acts as our foundation model for subsequent fine-tuning. We then focus on the Hillside IOCG deposit on the projected Yorke Peninsula. We show that with just few local training samples (orebody intercepts), we can fine tune the foundation model to produce a fair estimate of the Hillside orebody shape. Our research demonstrates how AI may complement geophysical data interpretation, giving a revolutionary approach to mineral exploration with improved decision-making capabilities for locating mineralization, hence addressing the critical demand for increased mineral resource discovery (Jack Muir, 2024).

Lately, Saudi Arabia has been boosting its mineral exploration. However, full investigations of the acquired data are not accessible. Thus, the goal of this research is to identify and map the hydrothermal alteration zones and structural lineaments that govern the mineral occurrences in the Nuqrah region of the Kingdom of Saudi Arabia using remote sensing and aeromagnetic data. To achieve the objective purpose of the study, ASTER remote sensing data were applied, and they were processed in numerous methods, including principal component analysis, band ratio, and false color composites to highlight the zones of alteration and structure lineaments. In addition, aeromagnetic data was applied to map the lineaments governing the mineralization. These datasets were combined using GIS technologies to develop a new mineralization potential map of the Nuqrah area, which was divided into three classes: low, moderate, and high probability mineralization. The results identified thirteen fascinating anomalies (high potential mineralization) distributed over the research region to be prospected. Additionally, approaches such as residual, regional, first vertical derivative, and tilt derivative were applied to detect the possible mineral-related geologic formations. The results were validated by overlaying known mineralization spots on our maps. Six important faulting trends have been detected, according to the lineament map and rose diagrams using remote sensing: NE–SW, WNW–

ESE, N–S, ENE–WSW, NNE–SSW, NW–SE, and E–W. The research region is primarily impacted by the NW–SE, ENE–WSW, E–W, and N–S trends, which are grouped in decreasing order of magnitude, according to the rose diagram of the aeromagnetic maps. The applicable approach can be deployed to map probable mineral reserves in Saudi Arabia and similar zones around the globe (Alarifi, 2024).

The nascent state of Saudi Arabia's tourism industry belies its potential to ascend to a prominent position as a global tourist destination. Najran is poised to become an emerging and promising tourist destination due to its cultural and historical significance, which is exemplified by a variety of historical sites. This study's primary objective is to demonstrate that geoscience, geoeducation, and geotourism can all benefit from geological heritage (geo-heritage). When selecting geotourism resources in the province of Najran, the visibility of geigerite is a crucial factor to consider. Numerous geomorphological landscapes and pedomorphosis's have been discerned as focal points. This investigation employs Geographical Information System (GIS) methodology in conjunction with on-site field research to conduct a comprehensive evaluation of the study region. The evaluation of potential geoarchaeological heritage resources significantly contributes to reconsecration and efficient management strategies. By categorizing the geoarchaeological sites in the study area, it was discovered that the region is rich in geodiversity, particularly in areas where archaeologically significant sites and valuable geological features coexist. A substantial body of geoethane knowledge pertinent to the study area already exists, as the current research has yielded fundamental insights. However, it is evident that the Kingdom of Saudi Arabia places a greater emphasis on other developmental initiatives, marginalizing the necessity of sustainable regional growth. It is concluded that the area's geoarchaeological heritage resources should play a role in the research agenda and sustainability plan. Therefore, additional research is required for the prudent and effective use of the available geoarchaeological heritage resources (Abdullah, 2023).

The researched study region locates about 72 km from Jeddah City, Makkah District, Kingdom of Saudi Arabia. The study mainly aimed to characterize the most significant zones of potential mineralization and delineate their subsurface features (location and strike) in the southeast of Jabal Al-Qashah. Several geophysical approaches have been conducted to carry out the purpose, including ground magnetic, self-potential (SP), and induced polarization (IP) methods. Integrating these methodologies seeks to assist outline

the probable mineralization in the study area. The magnetic survey was done along 17 profiles where these profiles were chosen to be perpendicular to the strike of the quartz shear zone. Self-potential was applied together with five profiles encompassing the research area. At the same time, induced polarization was used along with one profile placed at the western side of the research region correlating to various magnetic and SP profiles. The most intriguing zones of mineralization were successfully discovered by comparing the results of residual magnetic profile (3), SP profile (1), and IP profile, where geological structures regulate some mineralization (Ali Y. Al-Bakri\*, 2023).

It is vital to develop and explore geothermal resources to achieve sustainable development and clean renewable energy around the Globe. Geothermal energy is vital to the future energy supply to meet the ecologically friendly energy demand of the World. The Rahat Volcanic Field (Kingdom of Saudi Arabia) is the oldest and lengthiest Cenozoic Volcanic Field in the World. It is a dominantly a mature mafic Volcanic Field that holds three significant geological occurrences; the historic eruption (1256 C.E.), the five fingers (~4500–1500 BP), and the seismic swarm (1999 C.E.). These accidents were analyzed by utilizing geological information and geophysical data sets. Geophysical and geostatistical study covers gravity and magnetic survey data, including distinct log curves and key elements, collected from water samples as well as volcanic rocks obtained by X-ray fluorescence (XRF). To get a knowledge of the underlying thermal structure, these measurements were studied. The fundamental purpose of this study is to identify the prominent possible geothermal resources with the use of an existing data set. Findings reveal that beneath the historic eruption site along with the fissure eruption, on the western side, there is a geothermal anomaly with a surface footprint of around 35 km<sup>2</sup>. Analyzing gravity and magnetic data as well as density and magnetic susceptibility differences in rock samples led to the mapping of this anomaly. It has been inferred through integrated study that statistical analysis of important factors will be beneficial to validate the conclusions of the outcome (Alqahtani, 2023).

Saudi Arabia comprises much of the Arabian Peninsula and is characterized by tectonic regimes spanning from Precambrian to Recent. Using gravity data to establish the lateral limits of subsurface density bodies, and edge detection of potential field data, a novel subsurface structural map was created to decode the structural framework controls on the distribution of gold deposits in Saudi Arabia. Moreover, we discovered the links

between key structures and mineral accumulations, so concurrently solving the problem of edge detectors over complicated tectonic patterns for both deeper and shallower origins. Analytic signal (ASg), theta map (TM), TDX, and soft sign function (SF) filters were applied to gravity data of Saudi Arabia. The results show limited connection along the Najd fault system (NFS) with depth, except potentially for the centre zones of each section. The core zones are the location of considerable gold mineralization, i.e., Fawarah, Gariat Avala, Hamdah, and Ghada rah. Moreover, significant fault zones parallel to the Red Sea continue northward from the south, and their connectedness increases with depth and controls multiple gold mines, i.e., Jadmah, Wadi Bidah, Mamilah, and Wadi Leif. These fault zones cross the NFS in the Median Terrane near the northern half of the AS, and their conjugation is proposed to be favorable for gold mineralization. The SF maps revealed the boundary between the Arabian Shield and Arabian Shelf, which encompasses large shear zones, meaning that most known mineralization locations are linked to post-accretionary structures and are not limited to the Najd fault system (NFS) (Eldosouky, 2022).

- **Commentary on Previous Studies: Similarities and Differences**

The evaluated papers collectively indicate the expanding scientific and strategic importance of mineral exploration in Saudi Arabia, particularly within the broader reform objective of Saudi Vision 2030. Although these studies vary in objectives, methodology, and disciplinary focus, they share common themes linked to mineral potential evaluation, geophysical innovation, and sustainable resource development.

- **First: Areas of Similarity**

A significant connection across the studies is their emphasis on modern geophysical and remote sensing techniques as essential instruments for mineral exploration. Research by Chavanidis (2025), El-Desoky (2025), Alzahrani (2025), Alarifi (2024), and Eldosouky (2022) consistently applies aeromagnetic, gravity, induced

polarization (IP), transient electromagnetic (TEM), and remote sensing datasets to discover subsurface structures and mineralization zones. These investigations demonstrate that integrated geophysical techniques greatly improve the identification of mineral targets and structural controls, notably inside the Arabian Shield.

Another similar element is the focus on structural geology as a regulating factor for mineralization. Several studies show the role of major fault systems—such as NW–SE, NE–SW, and N–S trends—in channeling hydrothermal fluids and localizing ore deposits. This structural interpretation framework is similar across gold, copper, VMS, and phosphate exploration reports, emphasising the geological continuity of mineralization controls in western Saudi Arabia.

Additionally, several studies stress sustainability and compatibility with Vision 2030 objectives. Emad (2026) relates mineral development to global energy transition and ESG principles, whereas Elgasim (2024) focuses on mining revenue forecasts as a cornerstone of economic diversification. These studies together contextualise mineral exploration within a broader economic and policy framework, rather than restricting analysis to simply geological considerations.

Technological progress is also a common subject. Studies using artificial intelligence (Jack Muir, 2024), hyperspectral data, machine learning, and integrated geophysical inversion models indicate the progress toward next-generation exploration methods. This represents a global shift toward data-driven exploration tactics.

- **Second: Areas of Difference**

Despite these commonalities, the research varied greatly in scope, direction, and analytical perspective. Most evaluated research assumes a technical or geological focus, focused on mineral identification, structural

mapping, or geophysical interpretation. For example, Chavanidis (2025) and Al-Bakri (2023) highlight localized deposit-scale examinations, whereas Eldosouky (2022) gives a national-scale structural analysis utilizing gravity data.

In contrast, Emad (2026) and Elgasim (2024) take macroeconomic and policy-oriented viewpoints, assessing mineral potential within global supply chains and estimating mining profits. These studies transcend beyond pure geophysics into economic modeling and strategic diversification research.

Another distinction rests in technological sophistication. Some investigations depend on standard enhancement filters and geophysical interpretation techniques (e.g., reduction to pole, analytic signal), whereas others integrate artificial intelligence and continent-scale prospectivity modeling. This difference reflects various levels of methodological innovation and data integration difficulty.

Moreover, none of the studied studies directly address the strategic transformation of geophysical service businesses as corporate entities. While they give significant scientific data about mineral exploration potential and technology requirements, they do not analyse organizational restructuring, innovation management, financial capacity, or communication systems inside geophysical enterprises.

- **Research Gap**

The significant gap arising from this research is the paucity of studies that relate technological mineral exploration breakthroughs with organizational strategy transformation in the Saudi geophysical services sector. Existing literature explains how mineral exploration can be conducted scientifically, but it does not discuss how geophysical businesses can strategically orient themselves to capitalize on this potential under Vision 2030.

Therefore, the present study distinguishes itself by integrating geological, technological, and strategic management perspectives to evaluate the drivers of transformation—innovation, communication, and financial resources—within Saudi geophysical enterprises migrating toward mineral exploration.

### **Theoretical Framework:**

The strategic transition of geophysical firms from infrastructure assistance to mineral exploration is anchored in numerous theoretical frameworks that incorporate geoscience, strategic management, technological adoption, and human capital development. These theoretical foundations give a basis to comprehend how enterprises might realign resources, embrace sophisticated exploration technologies, build worker competencies, and connect with national economic priorities under Vision 2030. The study depends on six interrelated theoretical pillars that explain organizational change, technology integration, and strategic alignment in the context of resource-based economic development.

- **Resource-Based View (RBV) Theory**

The Resource-Based View (RBV) highlights that a company's competitive advantage rests on its unique resources, capabilities, and knowledge. In the context of geophysical enterprises in Saudi Arabia, RBV says that their technical expertise, specialized survey equipment, and experience in subsurface data interpretation are strategic assets. By exploiting these resources successfully, enterprises can move from infrastructure services to mineral exploration. RBV also underlines the significance of adopting new capabilities such as modern geophysical techniques, mineral targeting software, and exploration modeling to sustain long-term competitiveness in the national mining sector. This hypothesis informs the study's focus on identifying and strengthening organizational capacities for strategic change (Mailani, 2024).

- **Technology Adoption and Diffusion Theory**

Technology Adoption and Diffusion Theory, particularly Rogers' Diffusion of Innovations concept, explains how new technologies are accepted within companies and sectors. For geophysical businesses, adopting advanced mineral exploration tools—such as aircraft geophysical surveys, resistivity imaging, and 3D modeling software—is vital to transition effectively. The approach highlights characteristics including perceived advantage, compatibility with current processes, complexity, trialability, and observability of technology. Applying this premise, the study explores how organizational preparation, management support, and technology infrastructure influence the pace and success of adoption. Understanding these dynamics helps build strategies for effective implementation of exploration technologies in line with Vision 2030 priorities (Miranda, 2016).

- **Strategic Management Theory**

Strategic Management Theory focuses on matching organizational objectives with environmental opportunities and risks to achieve sustainable growth. In the case of Saudi geophysical enterprises, the theory outlines how firms might shift their activities from infrastructure assistance toward mineral exploration to harness developing market prospects in the national mining sector. It stresses strategic planning, competitive analysis, diversification, and resource allocation. Applying this idea, the study explores how corporations construct strategic plans, restructure service portfolios, and form alliances with mining operators, government organizations, and research centers to achieve a competitive edge. It also stresses the significance of continuous environmental monitoring to connect corporate strategy with Vision 2030 aims (Mahmoud, 2025).

- **Human Capital Theory**

Human Capital Theory asserts that investment in workforce skills, knowledge, and competencies boosts organizational performance and innovation capacity. For geophysical businesses migrating into mineral exploration, specialist expertise in economic geology, geophysics, geochemistry, and data analytics is necessary. This theory provides the framework for studying how workforce training, recruitment of specialists, and knowledge-sharing systems influence the ability of organization's to adopt new exploratory approaches. It also underscores the necessity of continual professional development and capacity-building initiatives that link

technical skills with the increasing requirements of the mining sector, ensuring long-term sustainability and operational efficiency (Awu, Human Capital Theory: Viewing Employees As Organizational Asset, 2025).

- **Institutional Theory**

Institutional Theory proposes that organizational behavior is determined by regulatory frameworks, norms, and industry standards within the external environment. For geophysical firms in Saudi Arabia, compliance with government rules, mining regulations, and Vision 2030 programmes is crucial. This theory discusses how formal laws, incentives, and partnerships impact firm decisions to diversify into mineral exploration. It also underlines the impact of institutional assistance, such as government-provided exploration permits, research collaborations, and financing programs, in eliminating obstacles to entrance. Applying this premise helps the study understand how external influences and institutional legitimacy impact strategy transition and adoption of exploration approaches (Berthod, 2018).

## **Chapter 3: Methodology of the Study:**

**Introduction:**

This chapter presents the empirical methodology chosen to analyse the factors of strategic transformation among geophysical businesses in Saudi Arabia, particularly in their shift from infrastructure support services to mineral exploration operations aligned with Saudi Vision 2030. The technique is meant to assure scientific rigor, empirical validity, and analytical reliability in assessing the linkages between the study variables—innovation, effective communication, financial resources, and strategic transformation.

The nature of the research topic necessitates a strategy that captures both organizational behavior and sectoral transformation dynamics. Therefore, the study utilizes a quantitative research approach backed by descriptive and analytical methods. The descriptive component attempts to examine the current state of geophysical enterprises in terms of their operational emphasis, technological capabilities, communication networks, and financial preparation. The analytical component assesses the statistical correlations between the independent variables and the dependent variable, determining the extent to which internal organizational factors influence strategic transformation outcomes.

A cross-sectional survey methodology is performed to acquire primary data from targeted respondents within geophysical companies. The study population includes managers, geophysicists, engineers, finance officers, and strategic planners working in enterprises operating within Saudi Arabia's geophysical services sector. These respondents are selected because they hold firsthand knowledge of organizational skills, technical investments, and strategic planning procedures important to mineral exploration transformation.

The research instrument is a structured questionnaire designed based on theoretical ideas collected from strategic management, innovation theory, and organizational communication literature. The questionnaire is organized into sections related to the study variables. Items measuring strategic transformation

analyse variables such as service diversification, use of exploration technology, restructuring activities, and integration into mining value chains. Innovation is quantified through measures relating to research and development investment, technology adoption, digital transformation strategies, and collaborative innovation projects. Effective communication is evaluated by measures of internal coordination, information sharing, leadership communication, and external stakeholder involvement. Financial resources are analyzed by variables representing capital availability, investment flexibility, budgeting for technology acquisition, and long-term financial planning capabilities.

To ensure content validity, the questionnaire items are examined by academic experts in geophysics, strategic management, and mining economics. Reliability is verified using statistical measurements such as Cronbach's Alpha to evaluate internal consistency. Pilot testing is undertaken to refine item clarity and minimize ambiguity before large-scale data collecting.

The study employs inferential statistical techniques to analyze the collected data. Correlation analysis is used to examine the strength and direction of relationships between variables, while multiple regression analysis is employed to test the main and sub-hypotheses and determine the predictive power of innovation, communication, and financial resources on strategic transformation. Additional statistical tests may be run to investigate demographic influences or control variables such as company size, years of operation, or project portfolio diversification.

Ethical considerations are also addressed within the methodological framework. Participation is voluntary, confidentiality of responses is preserved, and gathered data are utilise purely for academic purposes. Respondents are informed about the aims of the study and guaranteed that their responses will not be disclosed.

Overall, this methodological design provides a structured and empirical way to analysing the internal organizational determinants of strategic transformation within Saudi geophysical firms. By integrating theoretical grounding with quantitative measurement and statistical analysis, the study intends to offer reliable findings that contribute to both academic knowledge and practical policy suggestions supporting the development of the national mining ecosystem.

## **Methodology and Research Methods:**

### **1. Research Design**

The study utilizes a quantitative, descriptive–analytical research approach to evaluate the relationship between innovation, effective communication, financial resources, and strategic transformation within geophysical enterprises in Saudi Arabia. The descriptive component assesses the existing organizational and technological status of enterprises, whereas the analytical component evaluates causal and correlational linkages among factors. A cross-sectional strategy is applied, gathering data at a specific moment in time to reflect prevailing transition patterns under Saudi Vision 2030. This design ensures systematic hypothesis testing and statistical generalization across the intended population.

### **2. Study Population and Sampling**

The study population includes of managers, engineers, geophysicists, finance officers, and strategic planners working in Saudi geophysical service organisations. These individuals are selected due to their direct engagement in technology investment decisions and strategic planning procedures. A stratified random sample technique is applied to assure representation across management and technical levels. Company size and

operational specialty are considered as stratification markers. The sample size is calculated using statistical sampling procedures to ensure enough power for regression analysis, boosting the representativeness and reliability of findings.

### **3. Data Collection Instrument**

Primary data are obtained using a standardized questionnaire constructed from recognised theoretical elements in strategic management and innovation literature. The instrument is organized into four sections relating to the study factors: strategic transformation (dependent variable), innovation, effective communication, and financial resources (independent variables). A five-point Likert scale is used to measure replies, ranging from strong disagreement to strong agreement. The questionnaire includes both organizational competence indicators and strategic orientation variables to capture the complex character of change within geophysical enterprises shifting toward mineral exploration activities.

### **4. Validity and Reliability Procedures**

To ensure scientific rigor, content validity is validated through expert assessment by academics and industry professionals specialized in geophysics and strategic management. Construct validity is examined by component analysis to confirm the dimensional structure of the variables. Reliability testing is undertaken using Cronbach's Alpha to determine internal consistency of the questionnaire scales. Pilot research is undertaken prior to full-scale data collecting to adjust phrasing, eliminate ambiguity, and validate clarity of items. These approaches boost measurement accuracy and reduce systematic error.

### **5. Data Analysis Techniques**

The study involves statistical analysis using software such as SPSS. Descriptive statistics (means, standard deviations, frequencies) are used to characterize respondent characteristics and variable distributions. Pearson correlation analysis explores correlations between independent and dependent variables. Multiple regression analysis is utilized to assess the main and sub-hypotheses and identify the predictive influence of innovation, communication, and financial resources on strategic transformation. Additional tests such as ANOVA may be used to explore variations across demographic or organizational groups.

## **6. Ethical Considerations and Research Limitations**

Ethical norms are scrupulously upheld throughout the study. Participation is voluntary, confidentiality is guaranteed, and replies are utilized purely for academic purposes. Informed consent is acquired from all subjects. Potential disadvantages include reliance on self-reported data, which may introduce response bias, and the cross-sectional design, which limits causal inference over time. Despite these constraints, the methodological approach ensures credible, methodical, and policy-relevant findings supporting the transformation of geophysical businesses within Saudi Arabia's growing mining sector.

### **Research Community:**

#### **1. Definition of the Research Community**

The research community refers to the overall number of individuals and organizational units directly involved in geophysical services inside Saudi Arabia. This includes specialists and decision-makers working in organisations that perform subsurface investigation, geological surveys, geotechnical services, and exploration-related operations. The community is selected because it represents the operational core of

enterprises likely to undergo strategic transformation toward mineral exploration in conformity with Saudi Vision 2030. Defining the study population properly offers clarity in sample boundaries and boosts the usefulness of obtained data.

## **2. Organizational Scope of the Community**

The research community covers private and semi-governmental geophysical service firms operating within Saudi Arabia. These businesses range in size, operating capacity, and speciality, ranging from tiny consultant firms to major integrated geoscience service providers. Companies involved primarily in infrastructure-related geophysical services, such as groundwater surveys and engineering site investigations, are included due to their potential to shift into mineral exploration services. The organizational scope also encompasses enterprises that have launched or showed interest in adopting sophisticated mineral exploration technology and participating in mining-related initiatives.

## **3. Professional Categories within the Community**

The research community contains numerous professional categories to guarantee full organizational representation. These categories include executive managers, strategic planners, financial managers, geophysicists, geologists, exploratory engineers, and technical supervisors. Including diverse professional roles ensures that solutions reflect both strategic and operational viewpoints. Senior management contributes insights into strategic planning and investment decisions, while technical people contribute expertise regarding technology capabilities, field operations, and innovative methods. This multidimensional depiction increases the analytical depth of the enquiry.

## **4. Geographic Distribution of the Community**

The research community is geographically scattered over significant regions within Saudi Arabia, particularly in places where mining and geological activity are concentrated, such as the western and central regions linked with the Arabian Shield. Companies operating near significant mining belts and industrial zones are of relevance due to their closeness to exploration prospects. Including geographically diverse enterprises strengthens the representativeness of the study and reflects regional variances in operational preparedness, resource availability, and institutional support systems.

#### **5. Sectoral Relevance to Mineral Exploration**

The selected research community is directly linked to sectors supporting mineral exploration and mining development. Many geophysical organisations currently provide services to construction, environmental, and water resource sectors; nevertheless, their technical expertise is transferable to mining exploration. The study focuses on those organisations capable of implementing modern geophysical methodologies such as magnetic, gravity, and electromagnetic surveys. This sectoral relevance assures that the research findings are useful to enterprises positioned to contribute to the national mining plan.

#### **6. Justification for Selecting the Research Community**

The selection of this research community is justified by its strategic importance to the national economic reform strategy. Geophysical businesses serve as core technical partners in subsurface resource discovery and mineral targeting. Their effective transformation into mineral exploration service providers is vital for enhancing local content participation and lowering dependency on foreign contractors. By focusing on this specific professional and organizational population, the study delivers targeted insights that support policy formation, capacity building, and sustainable development within Saudi Arabia's changing mining environment.

## **Limitations of the Study:**

### **1. Geographic Limitation**

The analysis is geographically constrained to geophysical businesses operating within Saudi Arabia. Although the findings are extremely relevant to the Saudi context—particularly under Saudi Vision 2030—they may not be directly generalizable to geophysical enterprises in other countries with differing regulatory frameworks, market maturity levels, or mineral resources. Variations in institutional frameworks, investment climates, and technological infrastructure among countries limit the external validity of the results outside the national environment explored in this research.

### **2. Sectoral Limitation**

The study focuses entirely on geophysical service companies migrating from infrastructure support to mineral exploration. It does not include mining operators, drilling contractors, equipment manufacturers, or regulatory authorities. While these stakeholders influence the broader mining ecosystem, their removal narrows the analytical scope to service providers exclusively. Consequently, the results reflect the internal capabilities and limitations of geophysical enterprises rather than the full mineral value chain, thereby restricting a holistic understanding of systemic change dynamics.

### **3. Temporal Limitation**

The research utilizes a cross-sectional design, gathering data at a specific point in time. Strategic change, however, is a dynamic and longitudinal process that develops over several years. The cross-sectional method reduces the capacity to track changes in organizational skills, financial investment patterns, and innovation

success across time. Therefore, causal implications regarding long-term transformation outcomes should be evaluated cautiously, as the study captures views and situations during a specific period of implementation.

#### **4. Methodological Limitation**

The study focuses mostly on quantitative data acquired through standardized questionnaires. Although statistical analysis increases objectivity and hypothesis testing, it may not fully capture the intricate organizational dynamics underpinning strategic transformation. Qualitative methods such as in-depth interviews or case studies could provide greater contextual information. The absence of mixed-method triangulation may consequently restrict the explanatory depth of the findings related management decision-making and organizational culture.

#### **5. Measurement Limitation**

The variables innovation, effective communication, financial resources, and strategic transformation are measured using perceptual scales based on respondents' self-assessments. Such subjective evaluations may induce response bias, social desirability bias, or overestimation of organizational capabilities. Although reliability and validity methods are followed, the reliance on perceptual indicators rather than objective financial or operational performance data may compromise measurement precision.

#### **6. Sample Representation Limitation**

Despite adopting stratified sampling procedures, reaching full representativeness of all geophysical businesses may be hampered by access limits or non-response bias. Smaller organisations or freshly created companies can be underrepresented due to limited involvement. Additionally, managerial respondents may

dominate the sample, thus pushing results toward strategic perspectives while underrepresenting technical or operational viewpoints.

## **7. Data Accessibility Limitation**

Access to important financial and strategic information within private companies may be restricted. Organizations may be hesitant to reveal extensive data regarding investment capacity, technology purchase plans, or internal restructuring initiatives. This constraint could result in incomplete data sets or conservative responses. Consequently, some aspects of financial preparation and strategic planning may not be adequately reflected, thereby impacting the comprehensiveness of the analytical results.

### **Data Collection Steps:**

#### **1. Instrument Development and Item Construction**

The first phase entails creating the study instrument based on existing theoretical constructs relating to strategic management, innovation, organizational communication, and financial competence. Measurement items are drawn from peer-reviewed literature and associated with the study variables: innovation, effective communication, financial resources, and strategic change. Each construct is operationalized into quantitative indicators using a five-point Likert scale. The phrasing of items is carefully crafted to represent the operational reality of geophysical businesses shifting toward mineral exploration activities within Saudi Arabia.

#### **2. Expert Review and Content Validation**

After creating the questionnaire, it is sent to academic specialists in strategic management and professionals in the geophysical and mining sectors for review. The goal of this step is to ensure content validity,

clarity of language, and applicability of items to the Saudi mining transformation scenario under Saudi Vision 2030. Experts analyse the comprehensiveness and accuracy of the device and recommend adjustments where appropriate. Feedback is included to correct ambiguous statements and increase conceptual congruence.

### **3. Pilot Study and Pre-Testing**

Pilot research is undertaken with a small group of respondents representing the target audience. The purpose is to examine the clarity, organization, and timing of the questionnaire. Respondents provide input on item comprehension, response alternatives, and overall survey flow. Preliminary reliability analysis, such as Cronbach's Alpha, is performed to assess internal consistency. Based on pilot results, improvements are made to enhance reliability and eliminate redundant or unclear elements before full-scale dissemination.

### **4. Sampling and Participant Selection**

Following instrument validation, the sampling process is commenced. A stratified random selection technique is used to ensure representation across managerial, financial, and technical responsibilities within geophysical enterprises. Company size and operational speciality are examined to ensure variety. A formal list of qualified companies is established, and targeted participants are selected within each organization. This organized selection procedure promotes representativeness and lowers sampling bias.

### **5. Questionnaire Distribution and Data Gathering**

The finalized questionnaire is delivered through formal communication channels, including email invites and professional networking platforms. In other circumstances, direct cooperation with firm management enhances internal circulation of the survey. Clear instructions, confidentiality pledges, and voluntary participation statements are provided. A fixed response period is created, and follow-up reminders are given to

boost response rates. Completed replies are gathered electronically to ensure accuracy and efficiency in data compilation.

## **6. Data Screening and Preparation for Analysis**

After data collection, responses are evaluated for completeness, consistency, and validity. Incomplete or inconsistent surveys are rejected according to preset criteria. Data coding is completed to prepare replies for statistical analysis using software such as SPSS. Descriptive checks are performed to discover outliers or anomalous patterns. This final preparation step ensures that the dataset is clean, dependable, and ready for hypothesis testing and sophisticated statistical processes.

### **Determinants of Sample Size:**

#### **1. Size of the Target Population**

The overall number of geophysical companies and specialists operating in Saudi Arabia represents a significant factor of sample size. When the population is very small, as is typically the case in specialized technical sectors, a larger sampling ratio is required to provide adequate representation. Conversely, if the population is vast and geographically dispersed, statistical methods are utilised to calculate the minimal sample needed for accurate generalization. Accurate identification of the accessible population frame directly influences the precision of sample size estimation.

#### **2. Desired Confidence Level and Margin of Error**

Statistical confidence criteria greatly impact sample size. A 95% confidence level is often utilised in management and social science research to achieve strong conclusion. Additionally, the permissible margin of

error—typically set at 5%—affects the number of respondents necessary. Lower margins of error necessitate greater samples to increase precision. In this study, maintaining high statistical confidence is critical to ensure that findings addressing strategic transformation and innovation methods are credible and generalized throughout the industry.

### **3. Variability of Study Variables**

The degree of heterogeneity in responses linked to innovation, communication efficacy, financial resources, and strategic change also determines sample size. Higher variability demands a larger sample to capture the diversity of organizational settings accurately. If replies are relatively homogeneous, a smaller sample may suffice. Since geophysical enterprises range in technological preparedness, financial capacity, and organizational maturity, predicting moderate to high variability warrants picking a suitably large sample to reflect industry disparities.

### **4. Research Design and Statistical Techniques**

The analytical methods applied in the investigation affect the minimum necessary sample size. Multiple regression analysis, correlation testing, and factor analysis require enough respondent numbers to provide statistical power and stability of estimates. A general rule advocates having at least 10–15 observations per independent variable in regression models. Given the inclusion of multiple independent variables and sub-dimensions, the study ensures an adequate sample to maintain analytical robustness and minimise model overfitting.

## **5. Accessibility and Response Rate Considerations**

Practical concerns such as access to companies and estimated response rates also impact sample size determination. In business environments, non-response or incomplete questionnaires are widespread. Therefore, the first distributed sample often exceeds the minimum required number to compensate for probable attrition. Estimating an average response rate allows the researcher to change distribution numbers, accordingly, ensuring that the final valid responses match statistical standards.

## **6. Resource and Time Constraints**

Available resources including time, financial capacity, and administrative support constitute another factor of sample size. While larger samples boost accuracy, data gathering within specialized industrial sectors requires cooperation and official approvals. Balancing methodological rigor with practical viability is key. The selected sample size consequently reflects an appropriate compromise between statistical sufficiency and operational constraints, ensuring credible results without surpassing the logistical capability of the research process.

## **Chapter 4: Results of the Study:**

**Introduction:**

This chapter summarizes the empirical findings of the study, focusing on the statistical analysis of data collected from professionals working in geophysical firms in Saudi Arabia. The primary purpose of this chapter is to explore the correlations between the independent variables—innovation, effective communication, and financial resources—and the dependent variable, strategic transformation. The analysis attempts to identify the extent to which these organizational elements influence the strategic movement of geophysical businesses from infrastructure-based services toward mineral exploration activities within the context of Saudi Vision 2030.

The chapter opens with a discussion of descriptive statistics to provide an overview of the sample characteristics and general response patterns. This contains demographic distributions such as work title, years of experience, and organizational role, which assist contextualize the findings. Measures of central tendency (means) and dispersion (standard deviations) are used to examine the overall levels of agreement about innovation practices, communication efficacy, financial capabilities, and strategic transformation readiness. These descriptive indicators offer an initial overview of the existing organizational climate within the sector.

Following the descriptive analysis, the chapter shows the findings of reliability and validity testing. Internal consistency is verified using Cronbach's Alpha to determine that the measurement scales for each variable are statistically trustworthy. Factor analysis results are also reviewed to evaluate the dimensional structure of the constructs and guarantee that the observed variables correctly represent the theoretical framework created in prior chapters. Establishing measurement reliability and validity increases the credibility of later inferential analysis.

The major body of the chapter focuses on hypothesis testing through inferential statistical techniques. Pearson correlation analysis is used to analyse the degree and direction of links between innovation, effective communication, financial resources, and strategic change. This analysis analyses whether statistically significant relationships exist among the research variables. Multiple regression analysis is then done to evaluate the predictive power of the independent variables collectively and individually. The regression model analyses which elements exert the largest influence on strategic transformation and quantifies their relative contributions.

The findings are analyzed in connection to the study hypotheses outlined in Chapter Two. Statistical significance levels (p-values), coefficients of determination ( $R^2$ ), standardized beta coefficients, and F-values are presented to measure model fitness and explanatory strength. Where appropriate, comparative analysis is undertaken to analyse disparities across demographic or organizational groups. These studies provide evidence-based insights on the determinants of strategic transformation across Saudi geophysical enterprises.

Overall, this chapter turns theoretical assumptions into measurable outcomes. It bridges the conceptual framework and practical ramifications by giving systematic, statistically supported data. The results not only clarify the linkages among innovation, communication, financial competence, and transformation but also offer empirical support for strategic decision-making in the developing Saudi mining sector.

#### **Data Analysis:**

The data analysis method was undertaken using a systematic statistical approach to explore the correlations between innovation, effective communication, financial resources, and strategic change within

geophysical enterprises operating in Saudi Arabia. The analysis relied on Statistical Package for the Social Sciences (SPSS) to ensure accuracy, consistency, and robustness in hypothesis testing. The analytical approach was implemented in successive steps, beginning with data screening and preparation, followed by descriptive statistics, reliability and validity testing, and ultimately inferential statistical analysis.

The first stage involved data screening to guarantee completeness and accuracy. Questionnaires were reviewed for missing data, inconsistent responses, and outliers. Cases with substantial missing data were eliminated in accordance with predefined criteria to protect dataset integrity. Coding processes were utilised to translate qualitative replies into numerical values appropriate for statistical computation. Reverse-coded elements, when relevant, were changed to guarantee scale uniformity. This stage ensured that the data set met the assumptions required for parametric statistical testing.

Descriptive statistics were then produced to summarize respondent characteristics and variable distributions. Frequencies and percentages were utilised to define demographic attributes such as job role, years of experience, and organizational position. For the key study variables, averages and standard deviations were computed to determine the overall level of agreement about innovation practices, communication efficacy, financial resource adequacy, and readiness for strategic change. Higher mean values indicated higher perceived organizational capabilities, while standard deviations showed the dispersion of responses across the sample.

Reliability study was undertaken using Cronbach's Alpha coefficient to determine the internal consistency of the measurement scales. Each construct innovation, effective communication, financial resources, and strategic transformation—was evaluated independently. Alpha scores exceeding 0.70 were regarded acceptable, showing that items within each scale consistently measured the same underlying notion. This step

was crucial to ensure that following regression and correlation studies were based on statistically reliable instruments.

Construct validity was explored by exploration factor analysis (EFA). The Kaiser-Meyer-Olkin (KMO) measure and Bartlett's Test of Sphericity were employed to confirm sampling adequacy and suitability for factor extraction. Factor loadings were examined to ensure that objects loaded adequately onto their intended structures, with acceptable loading levels often above 0.50. This approach validated that the empirical structure corresponded with the theoretical model created earlier in the study.

To assess the study hypotheses, inferential statistical techniques were utilised. Pearson correlation analysis was performed to investigate the degree and direction of correlations between independent variables and strategic transformation. Positive and statistically significant association coefficients suggested that higher levels of innovation, communication efficacy, and financial resources were related with stronger transformation outcomes.

Multiple regression analysis was subsequently conducted to analyse the predictive influence of the independent variables collectively and individually. The regression model investigated the extent to which innovation, effective communication, and financial resources predicted variances in strategic transformation. The coefficient of determination ( $R^2$ ) quantified the overall explanatory power of the model, whereas standardized beta coefficients revealed the relative strength of each predictor. The F-test was employed to estimate overall model significance, and p-values were examined at a 0.05 significance level.

Overall, the data analysis offered empirical evidence about the organizational drivers of strategic change. The organized statistical methodology provided scientific rigor and delivered data capable of supporting

managerial decision-making within the shifting Saudi mining and mineral exploration scenario under Saudi Vision 2030.

### Statistical Description of the Experimental Data:

The descriptive statistics table shows that the study sample consisted of 190 respondents. The demographic results indicate that the mean score for age was 3.01 (SD = 1.251), suggesting that most participants were concentrated in the third age category, while the mean score for gender was 1.64 (SD = 0.481), reflecting a tendency toward the second category. The educational degree recorded a mean of 2.41 (SD = 1.436), indicating that most respondents were at the second educational level. Regarding the statements related to the strategic shift toward mineral exploration, the mean scores ranged between 2.39 and 2.67, which reflects responses between disagreement and neutrality among the participants. The highest means were recorded for the statement related to encouraging employees to propose innovative solutions, followed by effective inter-departmental communication and continuous training, indicating relatively positive perceptions in these areas. In contrast, lower mean scores appeared in statements related to organizational difficulties, strategic clarity, and operational efficiency. Overall, the results indicate a moderate perception of the strategic shift, with some positive aspects in innovation and communication, alongside organizational and financial challenges that may affect the effectiveness of the transformation.

| Statistics |       |      |                       |        |                   |
|------------|-------|------|-----------------------|--------|-------------------|
|            | N     | Mean | Std. Error<br>of Mean | Median | Std.<br>Deviation |
|            | Valid |      |                       |        |                   |
| Age        | 190   | 3.01 | 0.091                 | 3.00   | 1.251             |
| Gender     | 190   | 1.64 | 0.035                 | 2.00   | 0.481             |

|                                                                                                                                 |     |      |       |      |       |
|---------------------------------------------------------------------------------------------------------------------------------|-----|------|-------|------|-------|
| Degree                                                                                                                          | 190 | 2.41 | 0.104 | 2.00 | 1.436 |
| You believe that the shift from infrastructure support to mineral exploration is a significant strategic move for your company. | 190 | 2.52 | 0.110 | 2.00 | 1.521 |
| Your company has a clear plan to align with the goals of Vision 2030 in the field of mineral exploration.                       | 190 | 2.42 | 0.111 | 2.00 | 1.530 |
| Senior management encourages innovation and new initiatives to support this strategic shift.                                    | 190 | 2.50 | 0.108 | 2.00 | 1.493 |
| Effective communication exists between different departments to ensure the success of the strategic shift.                      | 190 | 2.59 | 0.111 | 2.50 | 1.529 |
| The company possesses the necessary financial and human resources to support the shift towards mineral exploration.             | 190 | 2.53 | 0.113 | 2.00 | 1.556 |
| The company's existing information systems and technologies support the new mineral exploration activities.                     | 190 | 2.50 | 0.114 | 2.00 | 1.569 |
| Continuous employee training and development are available to ensure alignment with the requirements of the strategic shift.    | 190 | 2.55 | 0.112 | 2.00 | 1.545 |
| The company utilizes the latest geophysical technologies in its mineral exploration activities.                                 | 190 | 2.45 | 0.108 | 2.00 | 1.486 |
| Employees are encouraged to propose innovative solutions to improve exploration operations.                                     | 190 | 2.67 | 0.109 | 3.00 | 1.504 |
| An effective system is in place for evaluating and adopting new technologies within the company.                                | 190 | 2.52 | 0.108 | 2.00 | 1.483 |
| The strategic shift has contributed to improving the company's operational efficiency.                                          | 190 | 2.41 | 0.110 | 2.00 | 1.522 |
| The shift has a positive impact on the quality of production and processes within the company.                                  | 190 | 2.47 | 0.110 | 2.00 | 1.521 |

|                                                                                                                       |     |      |       |      |       |
|-----------------------------------------------------------------------------------------------------------------------|-----|------|-------|------|-------|
| The strategic shift enhances the company's competitiveness in the local and international markets.                    | 190 | 2.49 | 0.107 | 2.00 | 1.476 |
| The company faces organizational difficulties in transitioning from infrastructure support to mineral exploration.    | 190 | 2.39 | 0.108 | 2.00 | 1.482 |
| Financial challenges impact the company's ability to fully implement its transformation strategies.                   | 190 | 2.43 | 0.108 | 2.00 | 1.492 |
| There is internal resistance to change from some employees during the implementation of the strategic transformation. | 190 | 2.45 | 0.108 | 2.00 | 1.489 |

*Table 1 : Statistical description of experimental data.*

## 1. Age

The statistical description of age shows that the study sample included 190 respondents distributed across five age categories. The largest group was the 40–50 years category, representing 42.1% of the total sample, indicating that most participants were middle-aged and likely to have substantial work experience. This was followed by the 60 years and above group at 17.4%, and the 20–30 years category at 15.3%. The 30–40 years group accounted for 14.2%, while the 50–60 years category represented the smallest proportion at 11.1%. Overall, the distribution reflects a workforce mainly concentrated in the middle-aged categories, with reasonable representation across other age groups.

| Age   |       |           |         |               |                    |
|-------|-------|-----------|---------|---------------|--------------------|
|       |       | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | 20-30 | 29        | 15.3    | 15.3          | 15.3               |
|       | 30-40 | 27        | 14.2    | 14.2          | 29.5               |
|       | 40-50 | 80        | 42.1    | 42.1          | 71.6               |
|       | 50-60 | 21        | 11.1    | 11.1          | 82.6               |
|       | 60+   | 33        | 17.4    | 17.4          | 100.0              |

|  |       |     |       |       |  |
|--|-------|-----|-------|-------|--|
|  | Total | 190 | 100.0 | 100.0 |  |
|--|-------|-----|-------|-------|--|

Table 2 : Statistical description of Age.

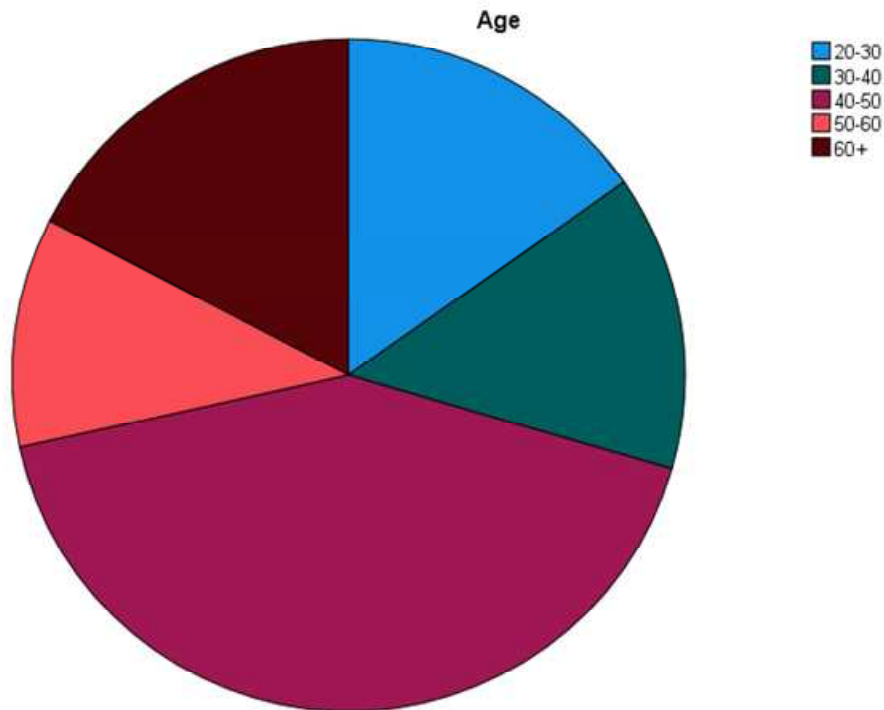


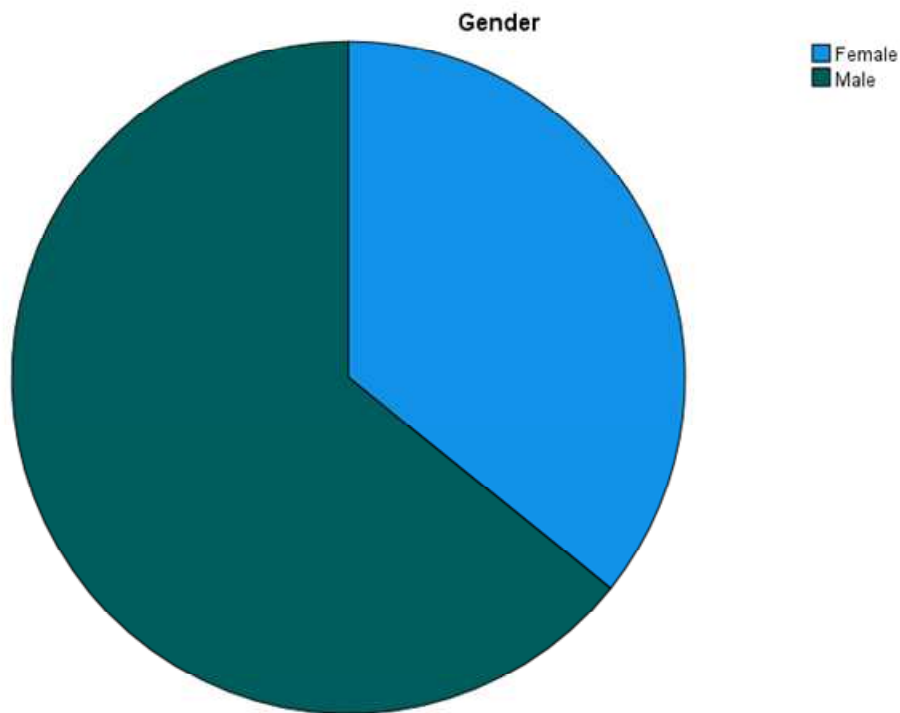
Figure 1 : Graphical representation of Age

## 2. Gender

The statistical description of gender shows that the study sample consisted of 190 respondents, with a higher representation of males than females. Males accounted for 64.2% of the total sample, while females represented 35.8%. This distribution indicates that most participants were male, suggesting a gender imbalance within the surveyed population. The cumulative percentage confirms that males form nearly two-thirds of the sample, which may reflect the general workforce composition in the organization or industry under study. Overall, the results show a clear dominance of male respondents, with females representing just over one-third of the participants.

| Gender |        |           |         |               |                    |
|--------|--------|-----------|---------|---------------|--------------------|
|        |        | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid  | Female | 68        | 35.8    | 35.8          | 35.8               |
|        | Male   | 122       | 64.2    | 64.2          | 100.0              |
|        | Total  | 190       | 100.0   | 100.0         |                    |

*Table 3 : Statistical description of Gender.*



*Figure 2 : Graphical representation of Gender*

### 3. Educational degree

The statistical description of educational degree indicates that the study sample of 190 respondents included participants with diverse academic backgrounds. The largest group held a bachelor's degree, representing 40.0% of the sample, which reflects a generally well-educated workforce. This was followed by those with a Diploma or associate degree at 18.9%, and respondents with less than high school education at

17.4%. Participants holding a Doctoral degree accounted for 12.6%, while those with a master's degree represented 11.1% of the sample. Overall, the results show that most respondents possess at least a bachelor's level qualification, indicating a relatively strong educational profile within the study population.

| Educational degree |                          |           |         |               |                    |
|--------------------|--------------------------|-----------|---------|---------------|--------------------|
|                    |                          | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid              | Bachelor's degree        | 76        | 40.0    | 40.0          | 40.0               |
|                    | Diploma/associate degree | 36        | 18.9    | 18.9          | 58.9               |
|                    | Doctoral degree          | 24        | 12.6    | 12.6          | 71.6               |
|                    | Less than high school    | 33        | 17.4    | 17.4          | 88.9               |
|                    | Master's degree          | 21        | 11.1    | 11.1          | 100.0              |
|                    | Total                    | 190       | 100.0   | 100.0         |                    |

Table 4 : Statistical description of educational degree.

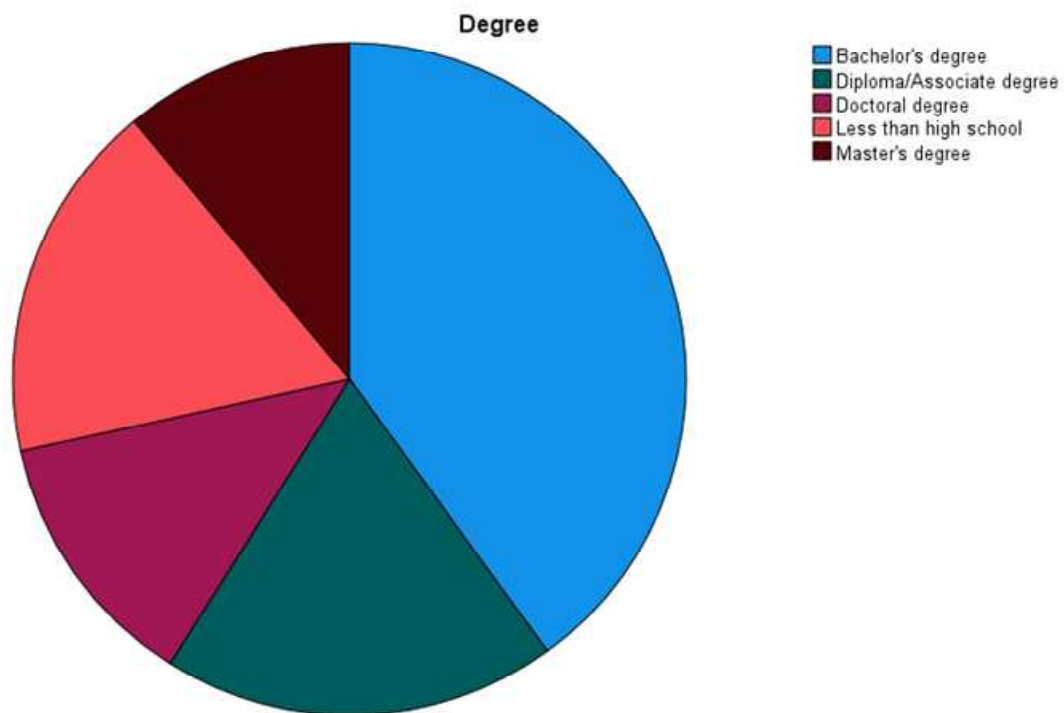


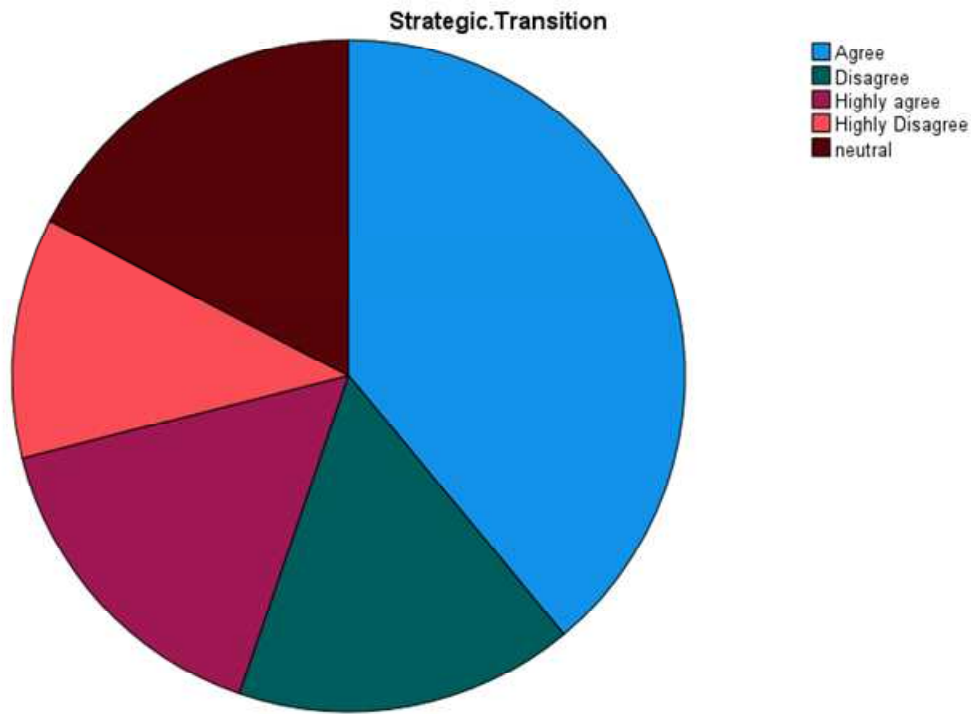
Figure 3 : Graphical representation of educational degree

4. You believe that the shift from infrastructure support to mineral exploration is a significant strategic move for your company

The statistical description shows that 38.9% of respondents agreed that the shift from infrastructure support to mineral exploration is a significant strategic move, representing the largest group. In addition, 15.8% highly agreed, indicating that more than half of the sample held a positive perception. On the other hand, 16.3% disagreed and 11.6% highly disagreed, reflecting a notable portion with negative views. Meanwhile, 17.4% of respondents remained neutral. Overall, the results suggest a generally positive attitude toward the strategic shift, although some respondents expressed uncertainty or disagreement.

| <b>You believe that the shift from infrastructure support to mineral exploration is a significant strategic move for your company.</b> |                 |           |         |               |                    |
|----------------------------------------------------------------------------------------------------------------------------------------|-----------------|-----------|---------|---------------|--------------------|
|                                                                                                                                        |                 | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid                                                                                                                                  | Agree           | 74        | 38.9    | 38.9          | 38.9               |
|                                                                                                                                        | Disagree        | 31        | 16.3    | 16.3          | 55.3               |
|                                                                                                                                        | Highly agree    | 30        | 15.8    | 15.8          | 71.1               |
|                                                                                                                                        | Highly Disagree | 22        | 11.6    | 11.6          | 82.6               |
|                                                                                                                                        | neutral         | 33        | 17.4    | 17.4          | 100.0              |
|                                                                                                                                        | Total           | 190       | 100.0   | 100.0         |                    |

*Table 5 : Statistical description of You believes that the shift from infrastructure support to mineral exploration is a significant strategic move for your company.*



*Figure 4 : Graphical representation of You believes that the shift from infrastructure support to mineral exploration is a significant strategic move for your company*

##### **5. Your company has a clear plan to align with the goals of Vision 2030 in the field of mineral exploration**

The statistical description indicates that 42.6% of respondents agreed that the company has a clear plan to align with the goals of Vision 2030 in the field of mineral exploration, representing the largest proportion. Additionally, 12.1% highly agreed, showing that more than half of the sample held a positive perception of the company's strategic planning. In contrast, 17.4% disagreed and 11.1% highly disagreed, reflecting a noticeable segment with negative views. Meanwhile, 16.8% of respondents remained neutral. Overall, the results suggest a generally positive perception of the company's alignment with Vision 2030, although some uncertainty and disagreement still exist among employees.

| Your company has a clear plan to align with the goals of Vision 2030 in the field of mineral exploration. |                 |           |         |               |                    |
|-----------------------------------------------------------------------------------------------------------|-----------------|-----------|---------|---------------|--------------------|
|                                                                                                           |                 | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid                                                                                                     | Agree           | 81        | 42.6    | 42.6          | 42.6               |
|                                                                                                           | Disagree        | 33        | 17.4    | 17.4          | 60.0               |
|                                                                                                           | Highly agree    | 23        | 12.1    | 12.1          | 72.1               |
|                                                                                                           | Highly Disagree | 21        | 11.1    | 11.1          | 83.2               |
|                                                                                                           | neutral         | 32        | 16.8    | 16.8          | 100.0              |
|                                                                                                           | Total           | 190       | 100.0   | 100.0         |                    |

Table 6 : Statistical description of Your company has a clear plan to align with the goals of Vision 2030 in the field of mineral exploration.

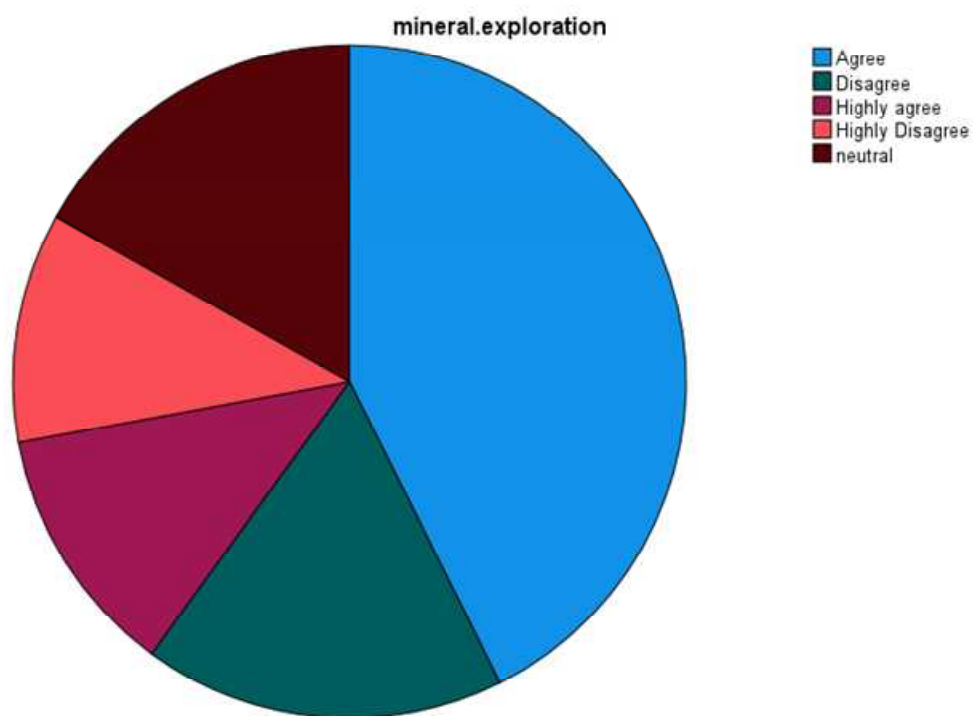


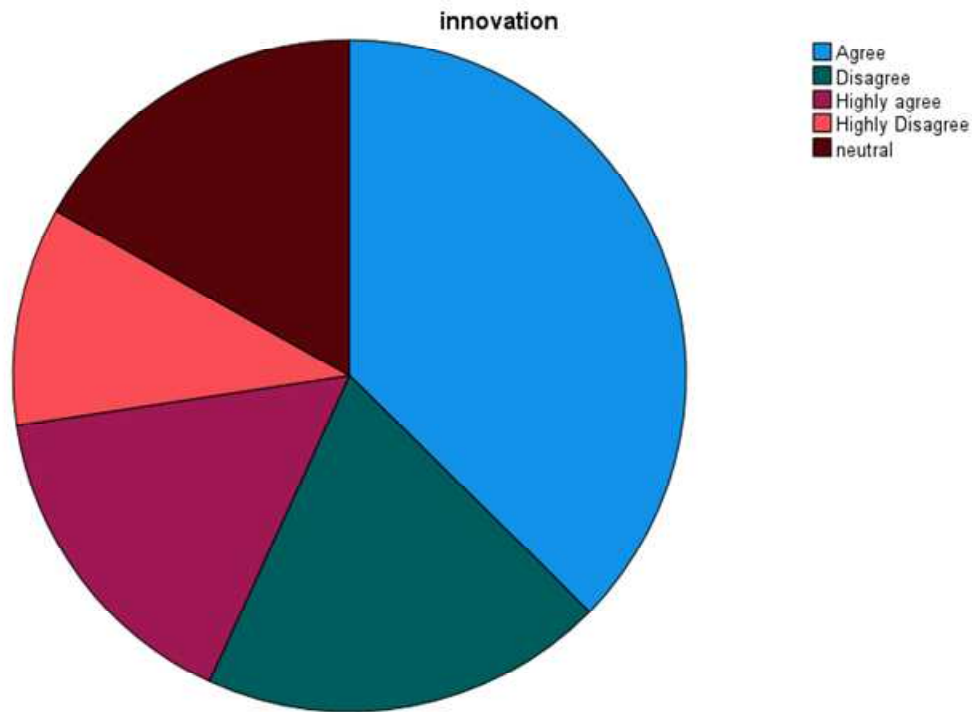
Figure 5 : Graphical representation of Your company has a clear plan to align with the goals of Vision 2030 in the field of mineral exploration

## 6. Senior management encourages innovation and new initiatives to support this strategic shift

The statistical description shows that 37.4% of respondents agreed that senior management encourages innovation and new initiatives to support the strategic shift, representing the largest group. In addition, 15.8% highly agreed, indicating that more than half of the respondents held a positive perception of management support for innovation. On the other hand, 19.5% disagreed and 10.5% highly disagreed, reflecting a noticeable segment with negative views. Meanwhile, 16.8% of respondents remained neutral. Overall, the results suggest a moderately positive perception of senior management's role in encouraging innovation, although some employees expressed uncertainty or disagreement.

| Senior management encourages innovation and new initiatives to support this strategic shift |                 |           |         |               |                    |
|---------------------------------------------------------------------------------------------|-----------------|-----------|---------|---------------|--------------------|
|                                                                                             |                 | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid                                                                                       | Agree           | 71        | 37.4    | 37.4          | 37.4               |
|                                                                                             | Disagree        | 37        | 19.5    | 19.5          | 56.8               |
|                                                                                             | Highly agree    | 30        | 15.8    | 15.8          | 72.6               |
|                                                                                             | Highly Disagree | 20        | 10.5    | 10.5          | 83.2               |
|                                                                                             | neutral         | 32        | 16.8    | 16.8          | 100.0              |
|                                                                                             | Total           | 190       | 100.0   | 100.0         |                    |

Table 7 : Statistical description of Senior management encourages innovation and new initiatives to support this strategic shift.



*Figure 6 : Graphical representation of Senior management encourages innovation and new initiatives to support this strategic shift*

#### **7. Effective communication exists between different departments to ensure the success of the strategic shift**

The statistical description indicates that 37.4% of respondents agreed that senior management encourages innovation and new initiatives to support the strategic shift, representing the largest proportion. Additionally, 15.8% highly agreed, showing that more than half of the sample held a positive perception of management support for innovation. In contrast, 19.5% disagreed and 10.5% highly disagreed, reflecting a notable segment with negative views. Meanwhile, 16.8% of respondents remained neutral. Overall, the results point to a moderately positive perception of senior management's encouragement of innovation, despite some uncertainty and disagreement among employees.

| Effective communication exists between different departments to ensure the success of the strategic shift |                 |           |         |               |                    |
|-----------------------------------------------------------------------------------------------------------|-----------------|-----------|---------|---------------|--------------------|
|                                                                                                           |                 | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid                                                                                                     | Agree           | 73        | 38.4    | 38.4          | 38.4               |
|                                                                                                           | Disagree        | 22        | 11.6    | 11.6          | 50.0               |
|                                                                                                           | Highly agree    | 38        | 20.0    | 20.0          | 70.0               |
|                                                                                                           | Highly Disagree | 23        | 12.1    | 12.1          | 82.1               |
|                                                                                                           | neutral         | 34        | 17.9    | 17.9          | 100.0              |
|                                                                                                           | Total           | 190       | 100.0   | 100.0         |                    |

Table 8 : Statistical description of Effective communication exists between different departments to ensure the success of the strategic shift.

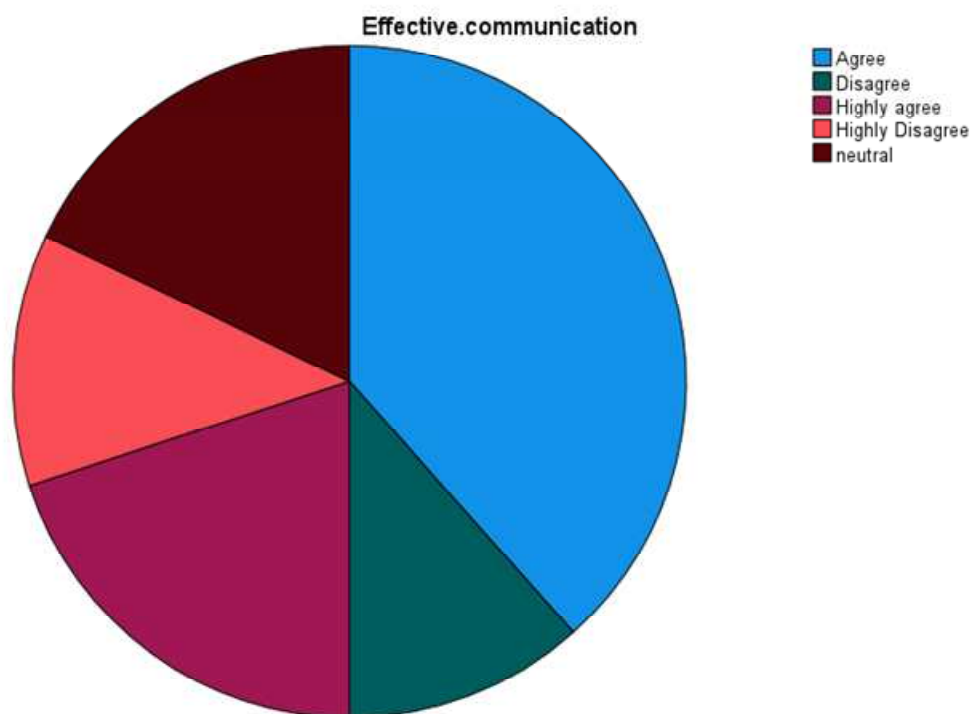


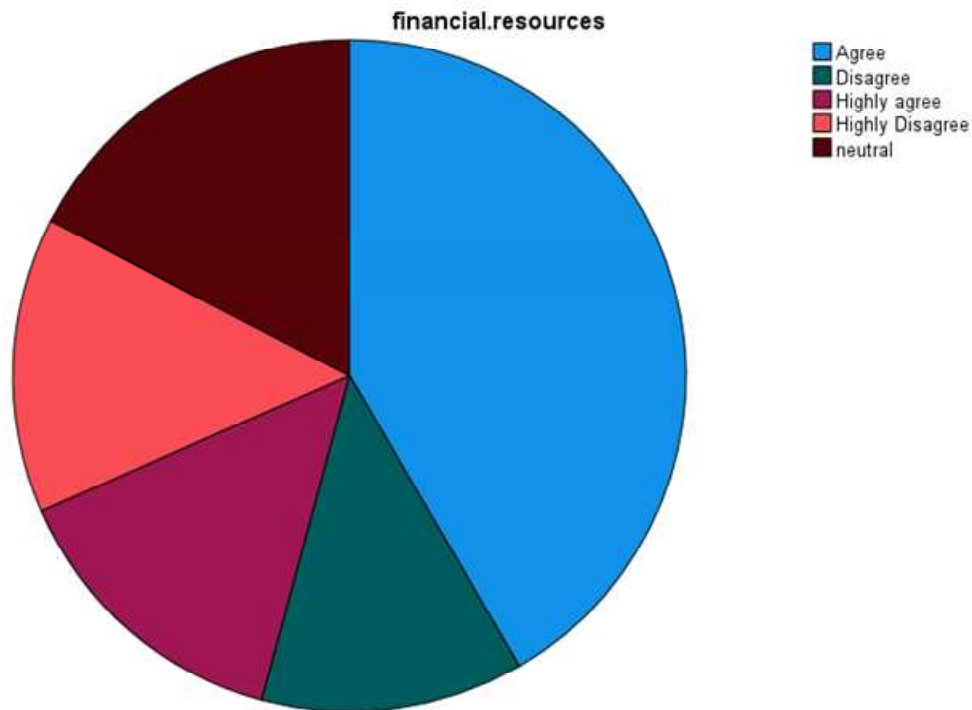
Figure 7 : Graphical representation of Effective communication exists between different departments to ensure the success of the strategic shift

**8. The company possesses the necessary financial and human resources to support the shift towards mineral exploration**

The statistical description shows that 41.6% of respondents agreed that the company possesses the necessary financial and human resources to support the shift toward mineral exploration, representing the largest group. Additionally, 14.2% highly agreed, indicating that more than half of the sample held a positive perception of resource availability. In contrast, 12.6% disagreed and 14.2% highly disagreed, reflecting a noticeable segment with negative views. Meanwhile, 17.4% of respondents remained neutral. Overall, the results suggest a moderately positive perception of the company's financial and human resource readiness, although some uncertainty and disagreement still exist among employees.

| <b>The company possesses the necessary financial and human resources to support the shift towards mineral exploration</b> |                 |           |         |               |                    |
|---------------------------------------------------------------------------------------------------------------------------|-----------------|-----------|---------|---------------|--------------------|
|                                                                                                                           |                 | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid                                                                                                                     | Agree           | 79        | 41.6    | 41.6          | 41.6               |
|                                                                                                                           | Disagree        | 24        | 12.6    | 12.6          | 54.2               |
|                                                                                                                           | Highly agree    | 27        | 14.2    | 14.2          | 68.4               |
|                                                                                                                           | Highly Disagree | 27        | 14.2    | 14.2          | 82.6               |
|                                                                                                                           | neutral         | 33        | 17.4    | 17.4          | 100.0              |
|                                                                                                                           | Total           | 190       | 100.0   | 100.0         |                    |

*Table 9 : Statistical description of the company possesses the necessary financial and human resources to support the shift towards mineral exploration.*



*Figure 8 : Graphical representation of the company possesses the necessary financial and human resources to support the shift towards mineral exploration*

### **9. The company's existing information systems and technologies support the new mineral exploration activities**

The statistical description indicates that 44.2% of respondents agreed that the company's existing information systems and technologies support the new mineral exploration activities, representing the largest proportion. In addition, 10.0% highly agreed, showing that more than half of the sample held a positive perception in this regard. On the other hand, 11.6% disagreed and 18.4% highly disagreed, reflecting a noticeable segment with negative views about the adequacy of current systems. Meanwhile, 15.8% of respondents remained neutral. Overall, the results suggest a moderately positive perception of the company's technological readiness, although some employees expressed concerns or uncertainty.

| The company's existing information systems and technologies support the new mineral exploration activities |                 |           |         |               |                    |
|------------------------------------------------------------------------------------------------------------|-----------------|-----------|---------|---------------|--------------------|
|                                                                                                            |                 | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid                                                                                                      | Agree           | 84        | 44.2    | 44.2          | 44.2               |
|                                                                                                            | Disagree        | 22        | 11.6    | 11.6          | 55.8               |
|                                                                                                            | Highly agree    | 19        | 10.0    | 10.0          | 65.8               |
|                                                                                                            | Highly Disagree | 35        | 18.4    | 18.4          | 84.2               |
|                                                                                                            | neutral         | 30        | 15.8    | 15.8          | 100.0              |
|                                                                                                            | Total           | 190       | 100.0   | 100.0         |                    |

Table 10 : Statistical description of the company's existing information systems and technologies support the new mineral exploration activities.

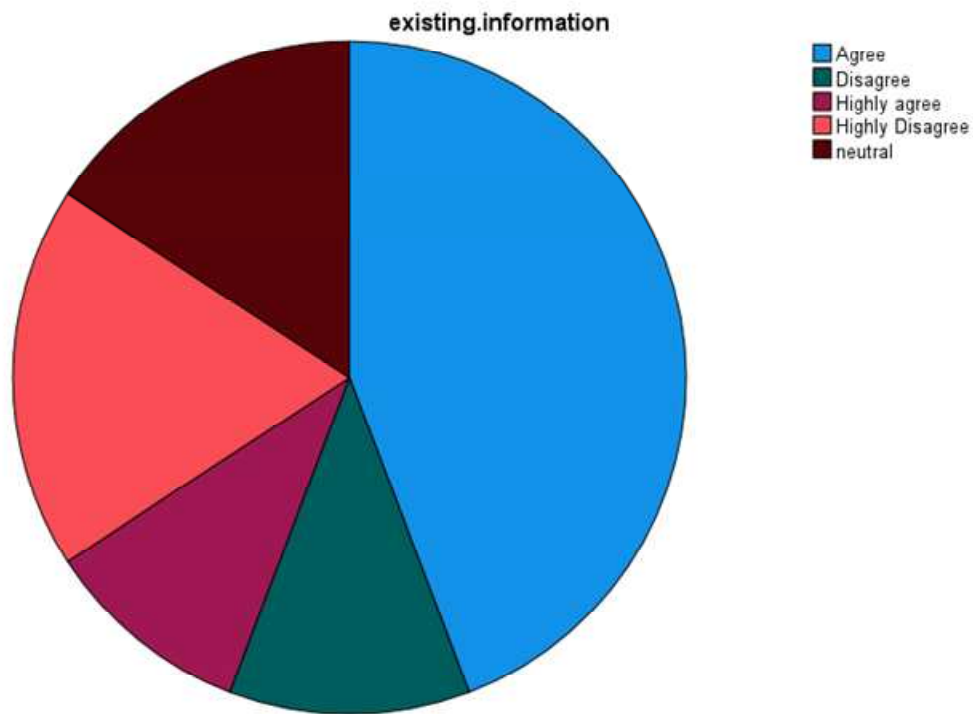


Figure 9 : Graphical representation of the company's existing information systems and technologies support the new mineral exploration activities

**10. Continuous employee training and development are available to ensure alignment with the requirements of the strategic shift**

The statistical description shows that 39.5% of respondents agreed that continuous employee training and development are available to support the requirements of the strategic shift, representing the largest group. Additionally, 11.1% highly agreed, indicating that about half of the sample held a positive perception of training efforts. In contrast, 16.3% disagreed and 16.3% highly disagreed, reflecting a considerable segment with negative views. Meanwhile, 16.8% of respondents remained neutral. Overall, the results suggest a moderately positive but divided perception of the availability of continuous training and development within the company.

| <b>Continuous employee training and development are available to ensure alignment with the requirements of the strategic shift</b> |                 |           |         |               |                    |
|------------------------------------------------------------------------------------------------------------------------------------|-----------------|-----------|---------|---------------|--------------------|
|                                                                                                                                    |                 | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid                                                                                                                              | Agree           | 75        | 39.5    | 39.5          | 39.5               |
|                                                                                                                                    | Disagree        | 31        | 16.3    | 16.3          | 55.8               |
|                                                                                                                                    | Highly agree    | 21        | 11.1    | 11.1          | 66.8               |
|                                                                                                                                    | Highly Disagree | 31        | 16.3    | 16.3          | 83.2               |
|                                                                                                                                    | neutral         | 32        | 16.8    | 16.8          | 100.0              |
|                                                                                                                                    | Total           | 190       | 100.0   | 100.0         |                    |

*Table 11 : Statistical description of Continuous employee training and development are available to ensure alignment with the requirements of the strategic shift.*

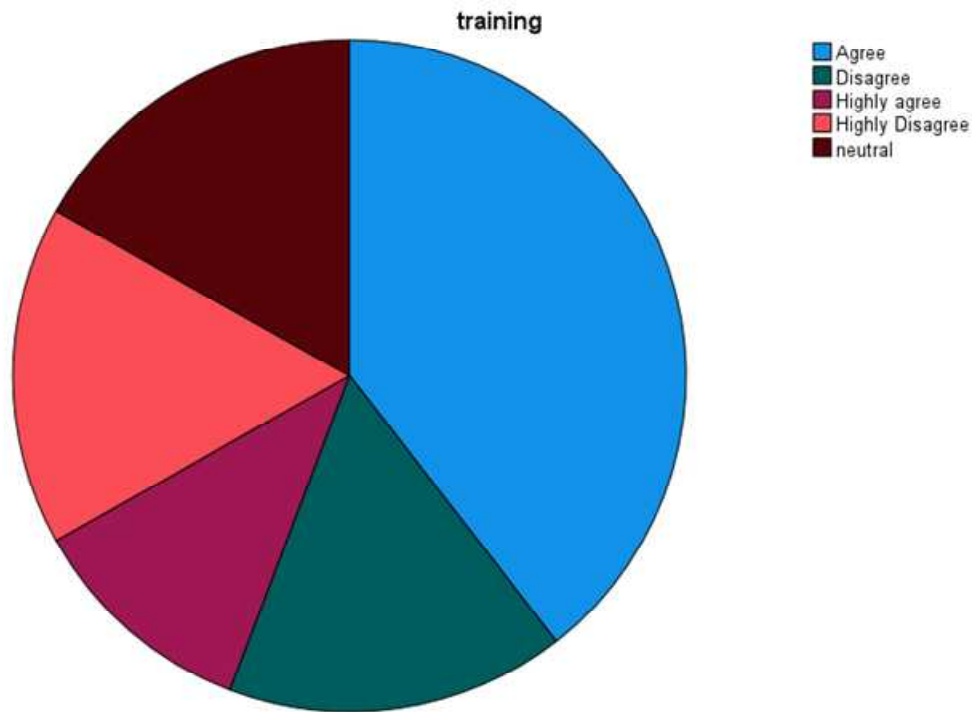


Figure 10 : Graphical representation of Continuous employee training and development are available to ensure alignment with the requirements of the strategic shift

#### 11. The company utilizes the latest geophysical technologies in its mineral exploration activities

The statistical description indicates that 41.6% of respondents agreed that the company utilizes the latest geophysical technologies in its mineral exploration activities, representing the largest proportion. Additionally, 14.7% highly agreed, suggesting that more than half of the sample held a positive perception of the company's use of advanced technologies. In contrast, 14.2% disagreed and 16.3% highly disagreed, reflecting a noticeable segment with negative views. Meanwhile, 13.2% of respondents remained neutral. Overall, the results point to a moderately positive perception of the company's use of modern geophysical technologies, despite some disagreement among employees.

| The company utilizes the latest geophysical technologies in its mineral exploration activities |                 |           |         |               |                    |
|------------------------------------------------------------------------------------------------|-----------------|-----------|---------|---------------|--------------------|
|                                                                                                |                 | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid                                                                                          | Agree           | 79        | 41.6    | 41.6          | 41.6               |
|                                                                                                | Disagree        | 27        | 14.2    | 14.2          | 55.8               |
|                                                                                                | Highly agree    | 28        | 14.7    | 14.7          | 70.5               |
|                                                                                                | Highly Disagree | 31        | 16.3    | 16.3          | 86.8               |
|                                                                                                | neutral         | 25        | 13.2    | 13.2          | 100.0              |
|                                                                                                | Total           | 190       | 100.0   | 100.0         |                    |

Table 12 : Statistical description of the company utilizes the latest geophysical technologies in its mineral exploration activities.

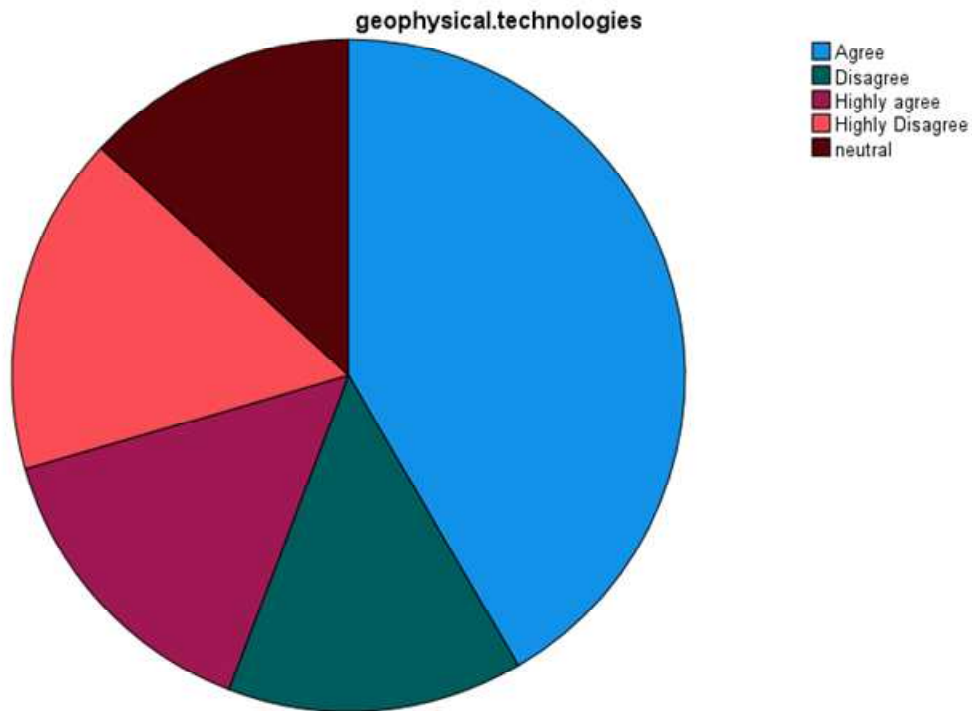


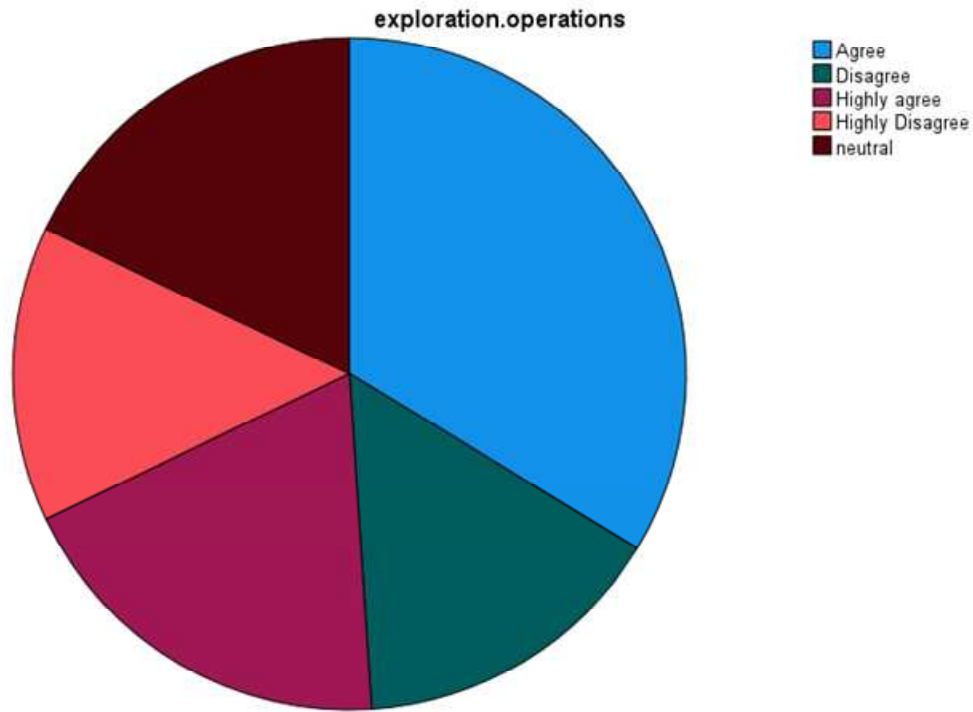
Figure 11 : Graphical representation of the company utilizes the latest geophysical technologies in its mineral exploration activities

## 12. Employees are encouraged to propose innovative solutions to improve exploration operations

The statistical description shows that 41.6% of respondents agreed that the company utilizes the latest geophysical technologies in its mineral exploration activities, representing the largest group. In addition, 14.7% highly agreed, indicating that more than half of the respondents held a positive perception. On the other hand, 14.2% disagreed and 16.3% highly disagreed, reflecting a noticeable portion with negative views. Meanwhile, 13.2% of respondents remained neutral. Overall, the results suggest a moderately positive perception of the company's use of advanced geophysical technologies, although some employees expressed disagreement or uncertainty.

| <b>Employees are encouraged to propose innovative solutions to improve exploration operations</b> |                 |           |         |               |                    |
|---------------------------------------------------------------------------------------------------|-----------------|-----------|---------|---------------|--------------------|
|                                                                                                   |                 | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid                                                                                             | Agree           | 64        | 33.7    | 33.7          | 33.7               |
|                                                                                                   | Disagree        | 29        | 15.3    | 15.3          | 48.9               |
|                                                                                                   | Highly agree    | 36        | 18.9    | 18.9          | 67.9               |
|                                                                                                   | Highly Disagree | 27        | 14.2    | 14.2          | 82.1               |
|                                                                                                   | neutral         | 34        | 17.9    | 17.9          | 100.0              |
|                                                                                                   | Total           | 190       | 100.0   | 100.0         |                    |

*Table 13 : Statistical description of Employees is encouraged to propose innovative solutions to improve exploration operations.*



*Figure 12 : Graphical representation of Employees is encouraged to propose innovative solutions to improve exploration operations*

### **13. An effective system is in place for evaluating and adopting new technologies within the company**

The statistical description indicates that 40.0% of respondents agreed that an effective system is in place for evaluating and adopting new technologies, representing the largest proportion. Additionally, 14.7% highly agreed, showing that more than half of the sample held a positive perception. In contrast, 12.6% disagreed and 20.5% highly disagreed, reflecting a considerable segment with negative views. Meanwhile, 12.1% of respondents remained neutral. Overall, the results suggest a moderately positive but somewhat divided perception regarding the effectiveness of the company's system for evaluating and adopting new technologies.

| An effective system is in place for evaluating and adopting new technologies within the company |                 |           |         |               |                    |
|-------------------------------------------------------------------------------------------------|-----------------|-----------|---------|---------------|--------------------|
|                                                                                                 |                 | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid                                                                                           | Agree           | 76        | 40.0    | 40.0          | 40.0               |
|                                                                                                 | Disagree        | 24        | 12.6    | 12.6          | 52.6               |
|                                                                                                 | Highly agree    | 28        | 14.7    | 14.7          | 67.4               |
|                                                                                                 | Highly Disagree | 39        | 20.5    | 20.5          | 87.9               |
|                                                                                                 | neutral         | 23        | 12.1    | 12.1          | 100.0              |
|                                                                                                 | Total           | 190       | 100.0   | 100.0         |                    |

Table 14 : Statistical description of an effective system is in place for evaluating and adopting new technologies within the company.

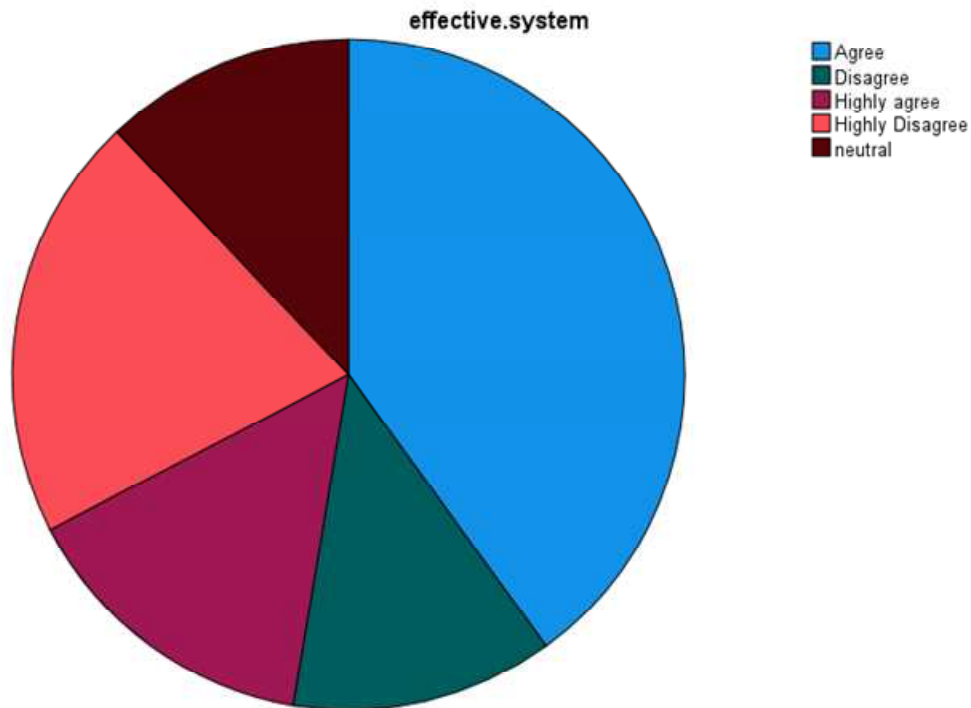


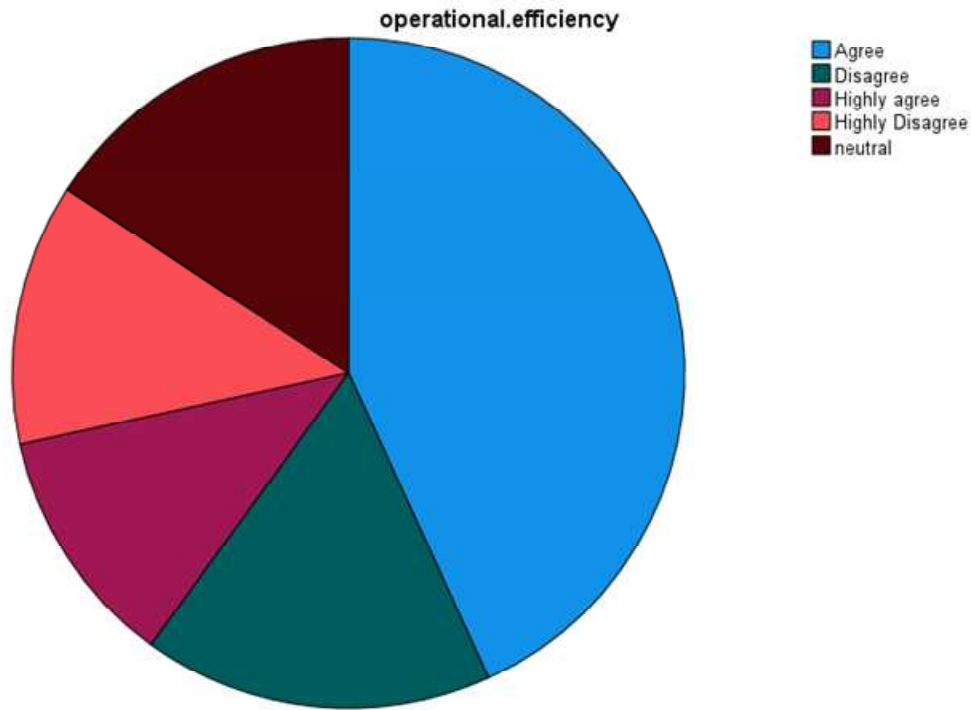
Figure 13 : Graphical representation of an effective system is in place for evaluating and adopting new technologies within the company

#### 14. The strategic shift has contributed to improving the company's operational efficiency

The statistical description shows that 43.2% of respondents agreed that the strategic shift has contributed to improving the company's operational efficiency, representing the largest group. In addition, 11.6% highly agreed, indicating that more than half of the sample held a positive perception of the shift's impact on efficiency. On the other hand, 16.8% disagreed and 12.6% highly disagreed, reflecting a noticeable segment with negative views. Meanwhile, 15.8% of respondents remained neutral. Overall, the results suggest a moderately positive perception of the strategic shift's effect on operational efficiency, although some respondents expressed uncertainty or disagreement.

| The strategic shift has contributed to improving the company's operational efficiency |                 |           |         |               |                    |
|---------------------------------------------------------------------------------------|-----------------|-----------|---------|---------------|--------------------|
|                                                                                       |                 | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid                                                                                 | Agree           | 82        | 43.2    | 43.2          | 43.2               |
|                                                                                       | Disagree        | 32        | 16.8    | 16.8          | 60.0               |
|                                                                                       | Highly agree    | 22        | 11.6    | 11.6          | 71.6               |
|                                                                                       | Highly Disagree | 24        | 12.6    | 12.6          | 84.2               |
|                                                                                       | neutral         | 30        | 15.8    | 15.8          | 100.0              |
|                                                                                       | Total           | 190       | 100.0   | 100.0         |                    |

Table 15 : Statistical description of the strategic shift has contributed to improving the company's operational efficiency.



*Figure 14 : Graphical representation of the strategic shift has contributed to improving the company's operational efficiency*

### **15. The shift has a positive impact on the quality of production and processes within the company**

The statistical description shows that 41.1% of respondents agreed that the strategic shift has a positive impact on the quality of production and processes, representing the largest proportion. Additionally, 11.1% highly agreed, indicating that just over half of the sample held a positive perception of the shift's effect on quality. In contrast, 16.8% disagreed and 15.8% highly disagreed, reflecting a considerable segment with negative views. Meanwhile, 15.3% of respondents remained neutral. Overall, the results suggest a moderately positive perception of the shift's impact on production quality, although some respondents expressed disagreement or uncertainty.

| The shift has a positive impact on the quality of production and processes within the company |                 |           |         |               |                    |
|-----------------------------------------------------------------------------------------------|-----------------|-----------|---------|---------------|--------------------|
|                                                                                               |                 | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid                                                                                         | Agree           | 78        | 41.1    | 41.1          | 41.1               |
|                                                                                               | Disagree        | 32        | 16.8    | 16.8          | 57.9               |
|                                                                                               | Highly agree    | 21        | 11.1    | 11.1          | 68.9               |
|                                                                                               | Highly Disagree | 30        | 15.8    | 15.8          | 84.7               |
|                                                                                               | neutral         | 29        | 15.3    | 15.3          | 100.0              |
|                                                                                               | Total           | 190       | 100.0   | 100.0         |                    |

Table 16 : Statistical description of the shift has a positive impact on the quality of production and processes within the company.

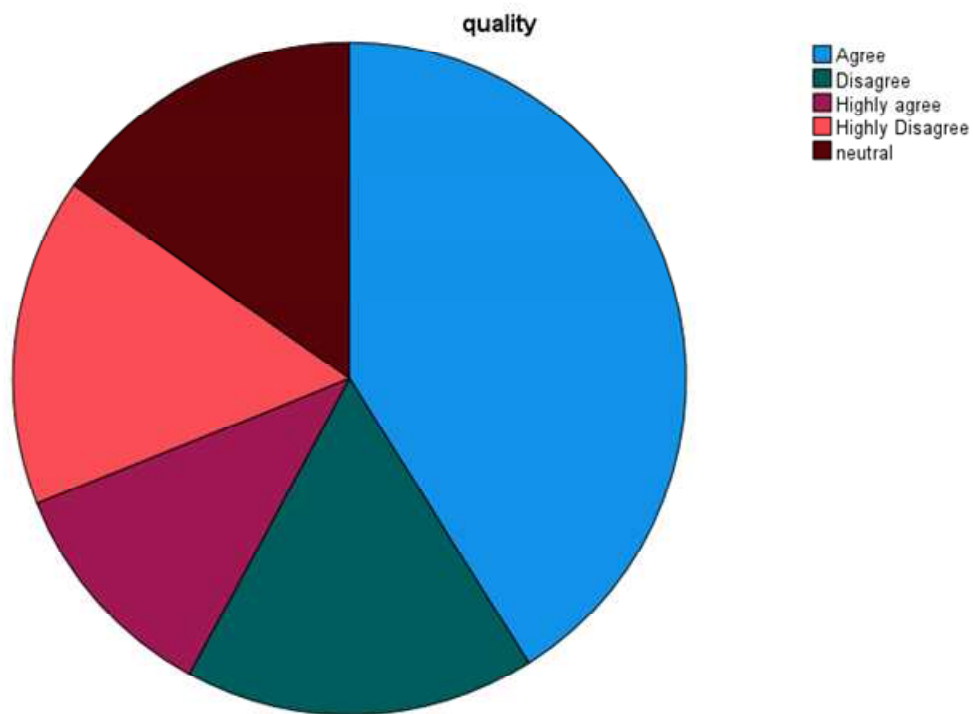


Figure 15 : Graphical representation of the shift has a positive impact on the quality of production and processes within the company

## 16. The strategic shift enhances the company's competitiveness in the local and international markets

The statistical description indicates that 40.0% of respondents agreed that the strategic shift enhances the company's competitiveness in local and international markets, representing the largest group. Additionally, 16.8% highly agreed, showing that more than half of the sample held a positive perception of the shift's impact on competitiveness. In contrast, 13.7% disagreed and 16.3% highly disagreed, reflecting a noticeable segment with negative views. Meanwhile, 13.2% of respondents remained neutral. Overall, the results suggest a moderately positive perception of the strategic shift's role in improving competitiveness, although some respondents expressed disagreement or uncertainty.

| The strategic shift enhances the company's competitiveness in the local and international markets |                 |           |         |               |                    |
|---------------------------------------------------------------------------------------------------|-----------------|-----------|---------|---------------|--------------------|
|                                                                                                   |                 | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid                                                                                             | Agree           | 76        | 40.0    | 40.0          | 40.0               |
|                                                                                                   | Disagree        | 26        | 13.7    | 13.7          | 53.7               |
|                                                                                                   | Highly agree    | 32        | 16.8    | 16.8          | 70.5               |
|                                                                                                   | Highly Disagree | 31        | 16.3    | 16.3          | 86.8               |
|                                                                                                   | neutral         | 25        | 13.2    | 13.2          | 100.0              |
|                                                                                                   | Total           | 190       | 100.0   | 100.0         |                    |

Table 17 : Statistical description of the strategic shift enhances the company's competitiveness in the local and international markets.

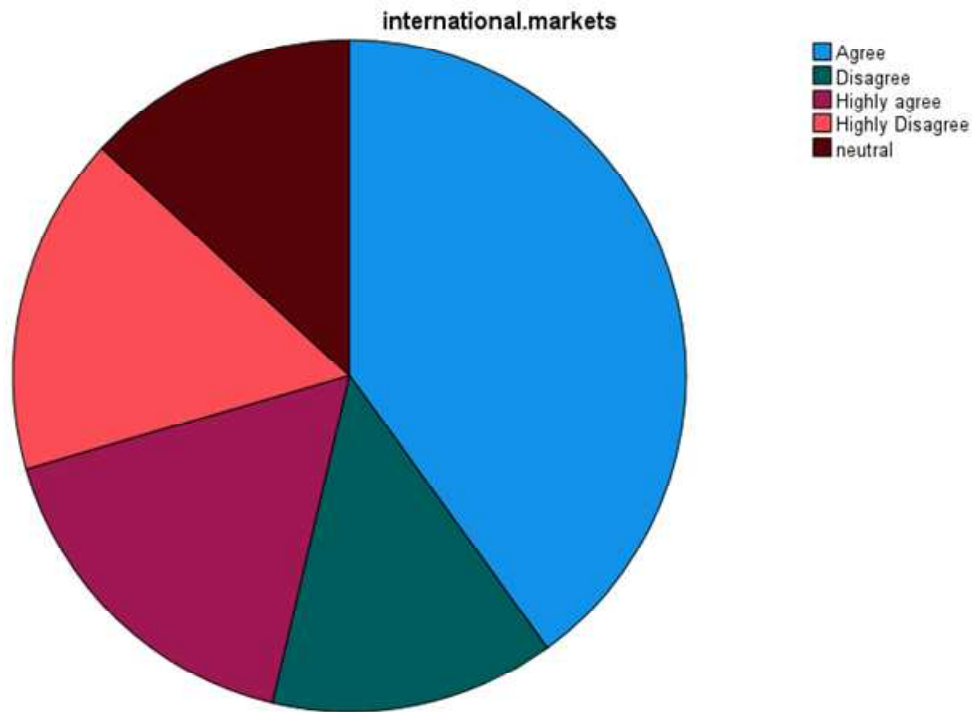


Figure 16 : Graphical representation of the strategic shift enhances the company's competitiveness in the local and international markets

### 17. The company faces organizational difficulties in transitioning from infrastructure support to mineral exploration

The statistical description shows that 42.6% of respondents agreed that the company faces organizational difficulties in transitioning from infrastructure support to mineral exploration, representing the largest group. Additionally, 14.7% highly agreed, indicating that more than half of the sample perceived the presence of organizational challenges. In contrast, 16.3% disagreed and 12.1% highly disagreed, reflecting a smaller segment with negative views. Meanwhile, 14.2% of respondents remained neutral. Overall, the results suggest that a considerable proportion of employees believe the company encounters organizational difficulties during the strategic transition.

| The company faces organizational difficulties in transitioning from infrastructure support to mineral exploration |                 |           |         |               |                    |
|-------------------------------------------------------------------------------------------------------------------|-----------------|-----------|---------|---------------|--------------------|
|                                                                                                                   |                 | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid                                                                                                             | Agree           | 81        | 42.6    | 42.6          | 42.6               |
|                                                                                                                   | Disagree        | 31        | 16.3    | 16.3          | 58.9               |
|                                                                                                                   | Highly agree    | 28        | 14.7    | 14.7          | 73.7               |
|                                                                                                                   | Highly Disagree | 23        | 12.1    | 12.1          | 85.8               |
|                                                                                                                   | neutral         | 27        | 14.2    | 14.2          | 100.0              |
|                                                                                                                   | Total           | 190       | 100.0   | 100.0         |                    |

Table 18 : Statistical description of the company faces organizational difficulties in transitioning from infrastructure support to mineral exploration.

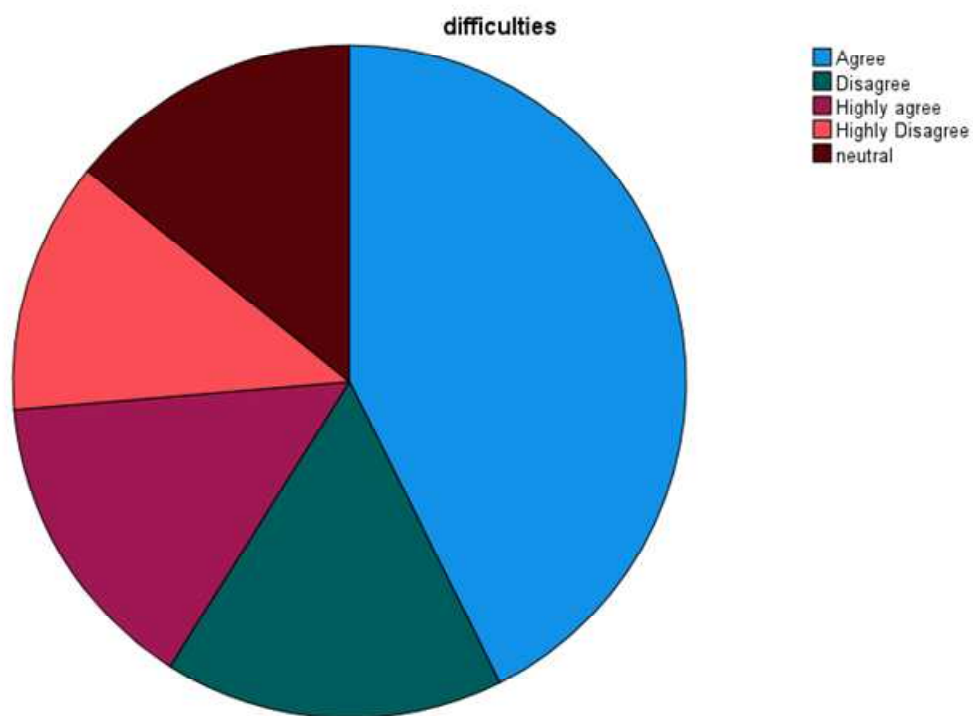


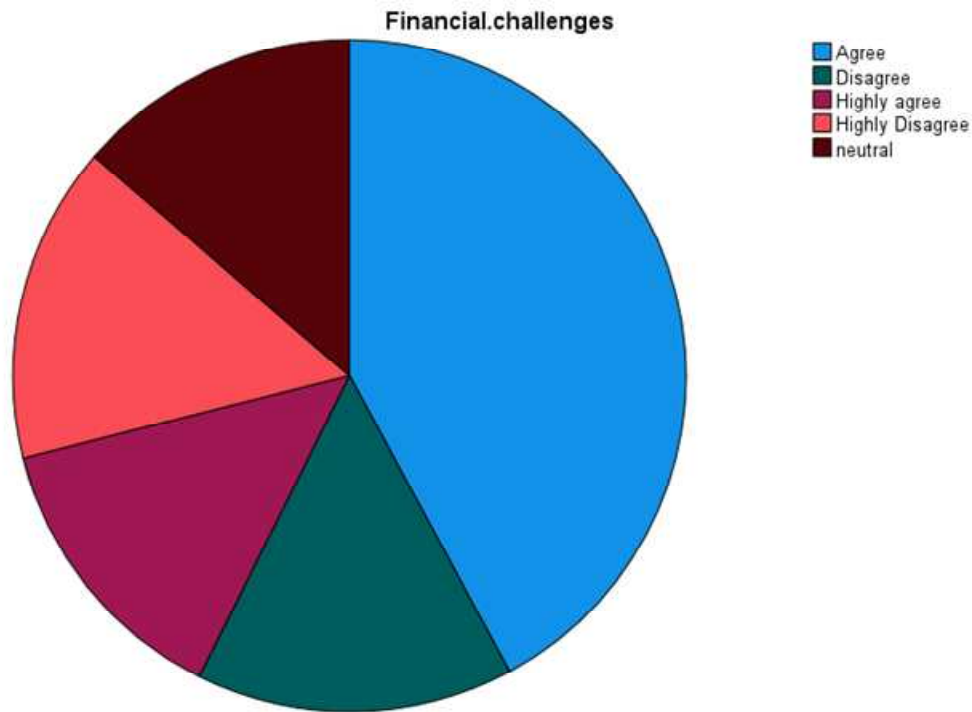
Figure 17 : Graphical representation of the company faces organizational difficulties in transitioning from infrastructure support to mineral exploration

### 18. Financial challenges impact the company's ability to fully implement its transformation strategies

The statistical description indicates that 42.1% of respondents agreed that financial challenges impact the company's ability to fully implement its transformation strategies, representing the largest proportion. Additionally, 13.7% highly agreed, showing that more than half of the sample perceived financial constraints affecting the transformation process. In contrast, 15.3% disagreed and 15.3% highly disagreed, reflecting a notable segment with opposing views. Meanwhile, 13.7% of respondents remained neutral. Overall, the results suggest that many employees believe financial challenges are a significant factor influencing the company's ability to successfully implement its strategic transformation.

| Financial challenges impact the company's ability to fully implement its transformation strategies |                 |           |         |               |                    |
|----------------------------------------------------------------------------------------------------|-----------------|-----------|---------|---------------|--------------------|
|                                                                                                    |                 | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid                                                                                              | Agree           | 80        | 42.1    | 42.1          | 42.1               |
|                                                                                                    | Disagree        | 29        | 15.3    | 15.3          | 57.4               |
|                                                                                                    | Highly agree    | 26        | 13.7    | 13.7          | 71.1               |
|                                                                                                    | Highly Disagree | 29        | 15.3    | 15.3          | 86.3               |
|                                                                                                    | neutral         | 26        | 13.7    | 13.7          | 100.0              |
|                                                                                                    | Total           | 190       | 100.0   | 100.0         |                    |

*Table 19 : Statistical description of financial challenges impacts the company's ability to fully implement its transformation strategies.*



*Figure 18 : Graphical representation of financial challenges impacts the company's ability to fully implement its transformation strategies*

#### **19. There is internal resistance to change from some employees during the implementation of the strategic transformation**

The statistical description shows that 40.0% of respondents agreed that there is internal resistance to change from some employees during the implementation of the strategic transformation, representing the largest group. Additionally, 13.7% highly agreed, indicating that more than half of the sample perceived the presence of internal resistance. In contrast, 17.9% disagreed and 13.7% disagreed, reflecting a notable segment with opposing views. Meanwhile, 14.7% of respondents remained neutral. Overall, the results suggest that a considerable proportion of employees believe that internal resistance to change exists during the strategic transformation process.

| There is internal resistance to change from some employees during the implementation of the strategic transformation |                 |           |         |               |                    |
|----------------------------------------------------------------------------------------------------------------------|-----------------|-----------|---------|---------------|--------------------|
|                                                                                                                      |                 | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid                                                                                                                | Agree           | 76        | 40.0    | 40.0          | 40.0               |
|                                                                                                                      | Disagree        | 34        | 17.9    | 17.9          | 57.9               |
|                                                                                                                      | Highly agree    | 26        | 13.7    | 13.7          | 71.6               |
|                                                                                                                      | Highly Disagree | 26        | 13.7    | 13.7          | 85.3               |
|                                                                                                                      | neutral         | 28        | 14.7    | 14.7          | 100.0              |
|                                                                                                                      | Total           | 190       | 100.0   | 100.0         |                    |

Table 20 : Statistical description of There is internal resistance to change from some employees during the implementation of the strategic transformation.

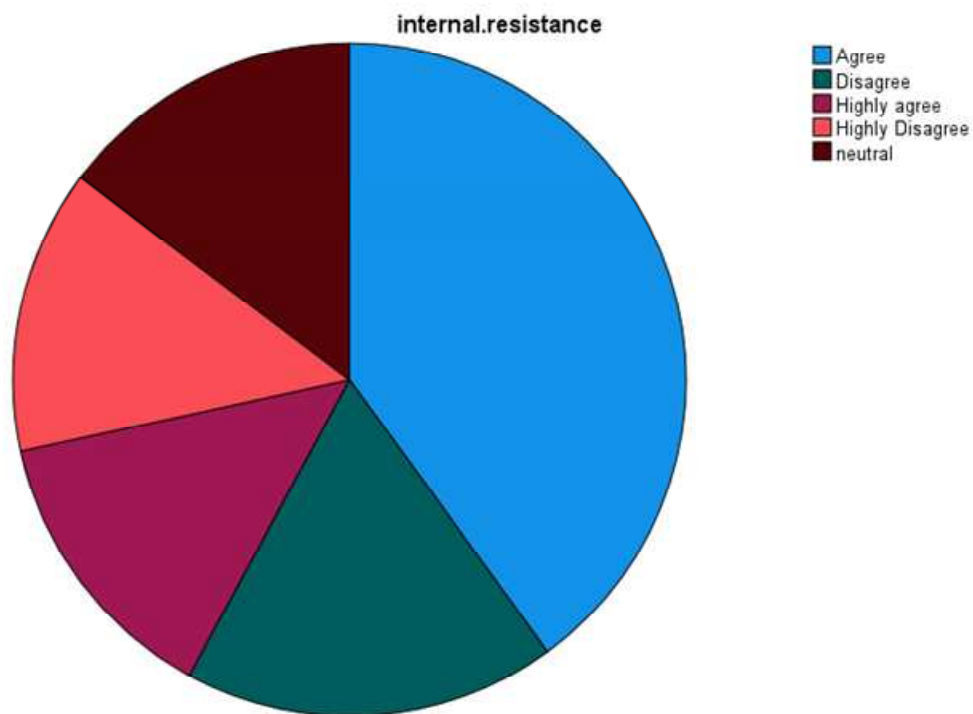


Figure 19 : Graphical representation of There is internal resistance to change from some employees during the implementation of the strategic transformation

- Reliability and credibility analysis of experimental data

The case processing summary shows that the total number of valid cases included in the analysis was 190, representing 100% of the sample. No cases were excluded, as indicated by an exclusion rate of 0.0%, which means that all responses were complete and suitable for statistical analysis. The use of listwise deletion confirms that only cases with complete data across all variables were considered, and since no cases were removed, the dataset can be regarded as fully valid. Overall, this result reflects a high level of completeness and reliability, ensuring the accuracy and credibility of the subsequent statistical analyses.

| Case Processing Summary                                       |                       |     |       |
|---------------------------------------------------------------|-----------------------|-----|-------|
|                                                               |                       | N   | %     |
| Cases                                                         | Valid                 | 190 | 100.0 |
|                                                               | Excluded <sup>a</sup> | 0   | .0    |
|                                                               | Total                 | 190 | 100.0 |
| a. Listwise deletion based on all variables in the procedure. |                       |     |       |

*Table 21 : Case Processing Summary.*

The reliability statistics table shows that the Cronbach's Alpha value for the study items is 0.887, while the Cronbach's Alpha based on standardized items is 0.869, across 19 items. These values are considered high and exceed the commonly accepted threshold of 0.70, indicating strong internal consistency among the questionnaire items. This suggests that the items measure the same underlying construction in a reliable and consistent manner. The close values between the two alpha coefficients also reflect stability in the measurement regardless of item standardization. Overall, the results confirm that the measurement scale used in the study is reliable and suitable for further statistical analysis.

### Reliability Statistics

| Cronbach's Alpha | Cronbach's Alpha Based on Standardized Items | N of Items |
|------------------|----------------------------------------------|------------|
| .887             | .869                                         | 19         |

*Table 22 : Reliability Statistics.*

- **Cross table analysis**
- **The role of strategic transformation in encouraging innovation and new initiatives to support this strategic shift**

The Chi-square test results indicate a statistically significant relationship regarding the role of strategic transformation in encouraging innovation and new initiatives. The Pearson Chi-Square value was 92.053 with 16 degrees of freedom, and a significance level of 0.000, which is less than the accepted threshold of 0.05. This indicates that the observed differences in responses are statistically significant and not due to random variation. The Likelihood Ratio test also produced a significant value of 96.591 ( $p = 0.000$ ), confirming the same result. In addition, the Linear-by-Linear Association value of 39.582 with a significance level of 0.000 suggests a significant linear relationship between the variables.

| Chi-Square Tests                                                                        |                     |    |                                   |
|-----------------------------------------------------------------------------------------|---------------------|----|-----------------------------------|
|                                                                                         | Value               | df | Asymptotic Significance (2-sided) |
| Pearson Chi-Square                                                                      | 92.053 <sup>a</sup> | 16 | .000                              |
| Likelihood Ratio                                                                        | 96.591              | 16 | .000                              |
| Linear-by-Linear Association                                                            | 39.582              | 1  | .000                              |
| N of Valid Cases                                                                        | 190                 |    |                                   |
| a. 9 cells (36.0%) have expected count less than 5. The minimum expected count is 2.32. |                     |    |                                   |

*Table 23 : Kai Square tests for the role of strategic transformation in encouraging innovation and new initiatives to support this strategic shift.*

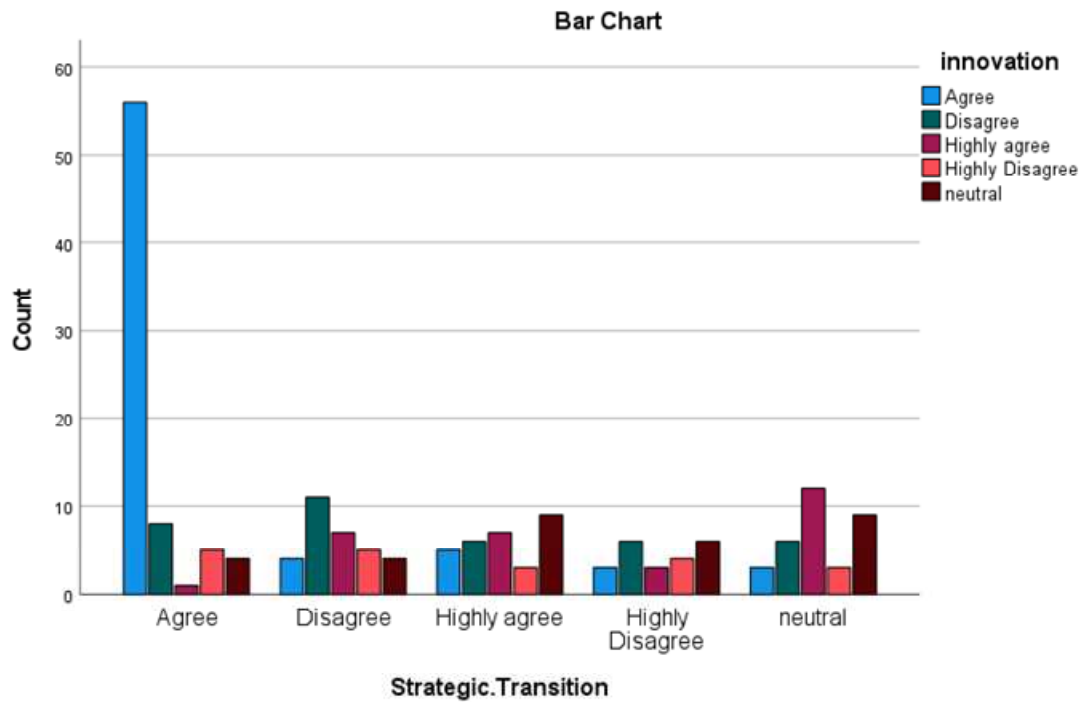


Figure 20 : Symmetric measures in cross-table analysis for the role of strategic transformation in encouraging innovation and new initiatives to support this strategic shift

- **The role of strategic transformation in securing the necessary financial and human resources to support this shift towards mineral exploration**

The Chi-square test results indicate a statistically significant relationship regarding the role of strategic transformation in securing the necessary financial and human resources to support the shift toward mineral exploration. The Pearson Chi-Square value was 74.131 with 16 degrees of freedom, and a significance level of 0.000, which is below the accepted threshold of 0.05. This confirms that the differences in responses are statistically significant and not due to chance. The Likelihood Ratio test also showed a significant value of 76.885 ( $p = 0.000$ ), supporting the same conclusion. Additionally, the Linear-by-Linear Association value of 29.392 with a significance level of 0.000 indicates a significant linear relationship between the variables.

Overall, the results confirm a statistically significant association between strategic transformation and the availability of financial and human resources.

| Chi-Square Tests                                                                         |                     |    |                                   |
|------------------------------------------------------------------------------------------|---------------------|----|-----------------------------------|
|                                                                                          | Value               | df | Asymptotic Significance (2-sided) |
| Pearson Chi-Square                                                                       | 74.131 <sup>a</sup> | 16 | .000                              |
| Likelihood Ratio                                                                         | 76.885              | 16 | .000                              |
| Linear-by-Linear Association                                                             | 29.392              | 1  | .000                              |
| N of Valid Cases                                                                         | 190                 |    |                                   |
| a. 13 cells (52.0%) have expected count less than 5. The minimum expected count is 2.78. |                     |    |                                   |

Table 24 : Kai Square test for the role of strategic transformation in securing the necessary financial and human resources to support this shift towards mineral exploration.

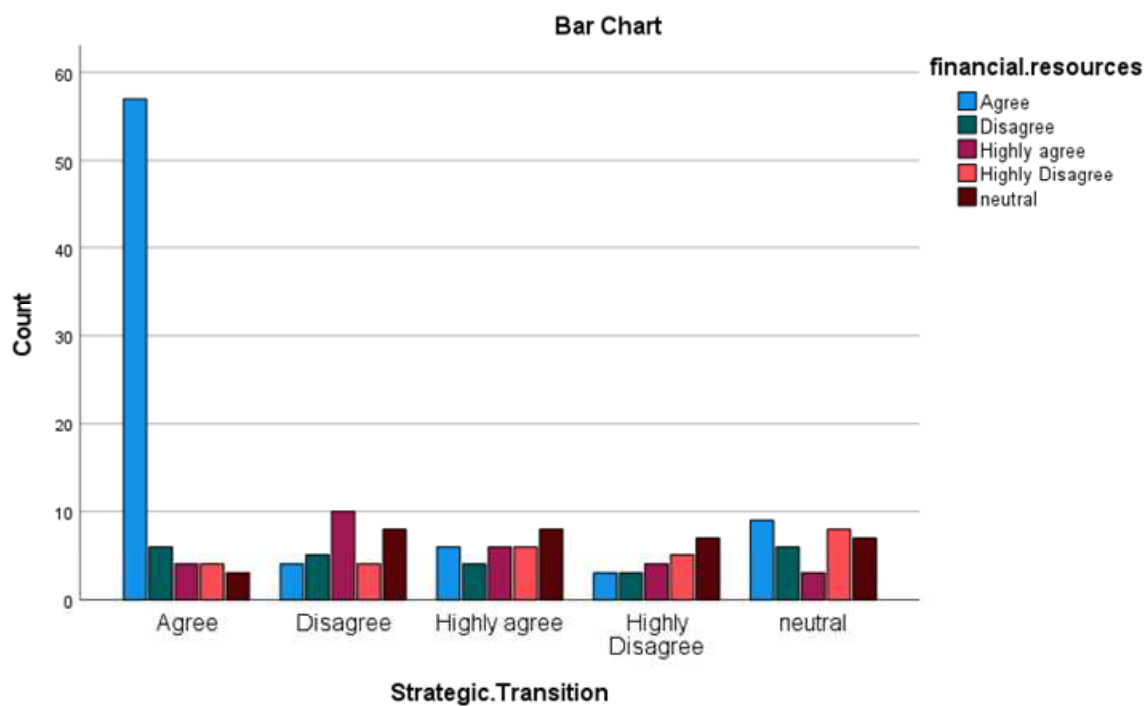


Figure 21 : Symmetric measures in cross-table analysis for the role of strategic transformation in securing the necessary financial and human resources to support this shift towards mineral exploration

- The role of strategic transformation in fostering effective communication between different departments to ensure the success of this strategic transformation

The Chi-square test results indicate a statistically significant relationship regarding the role of strategic transformation in fostering effective communication between different departments. The Pearson Chi-Square value was 70.824 with 16 degrees of freedom, and a significance level of 0.000, which is below the accepted threshold of 0.05. This confirms that the differences in responses are statistically significant and not due to random variation. The Likelihood Ratio test also showed a significant value of 73.823 ( $p = 0.000$ ), supporting the same conclusion. Additionally, the Linear-by-Linear Association value of 8.849, with a significant level of 0.003, indicates a significant linear relationship between the variables. Overall, the results confirm a statistically significant association between strategic transformation and effective interdepartmental communication.

| Chi-Square Tests                                                                         |                     |    |                                   |
|------------------------------------------------------------------------------------------|---------------------|----|-----------------------------------|
|                                                                                          | Value               | df | Asymptotic Significance (2-sided) |
| Pearson Chi-Square                                                                       | 70.824 <sup>a</sup> | 16 | .000                              |
| Likelihood Ratio                                                                         | 73.823              | 16 | .000                              |
| Linear-by-Linear Association                                                             | 8.849               | 1  | .003                              |
| N of Valid Cases                                                                         | 190                 |    |                                   |
| a. 10 cells (40.0%) have expected count less than 5. The minimum expected count is 2.55. |                     |    |                                   |

*Table 25 : Kai Square test for the role of strategic transformation in fostering effective communication between different departments to ensure the success of this strategic transformation.*

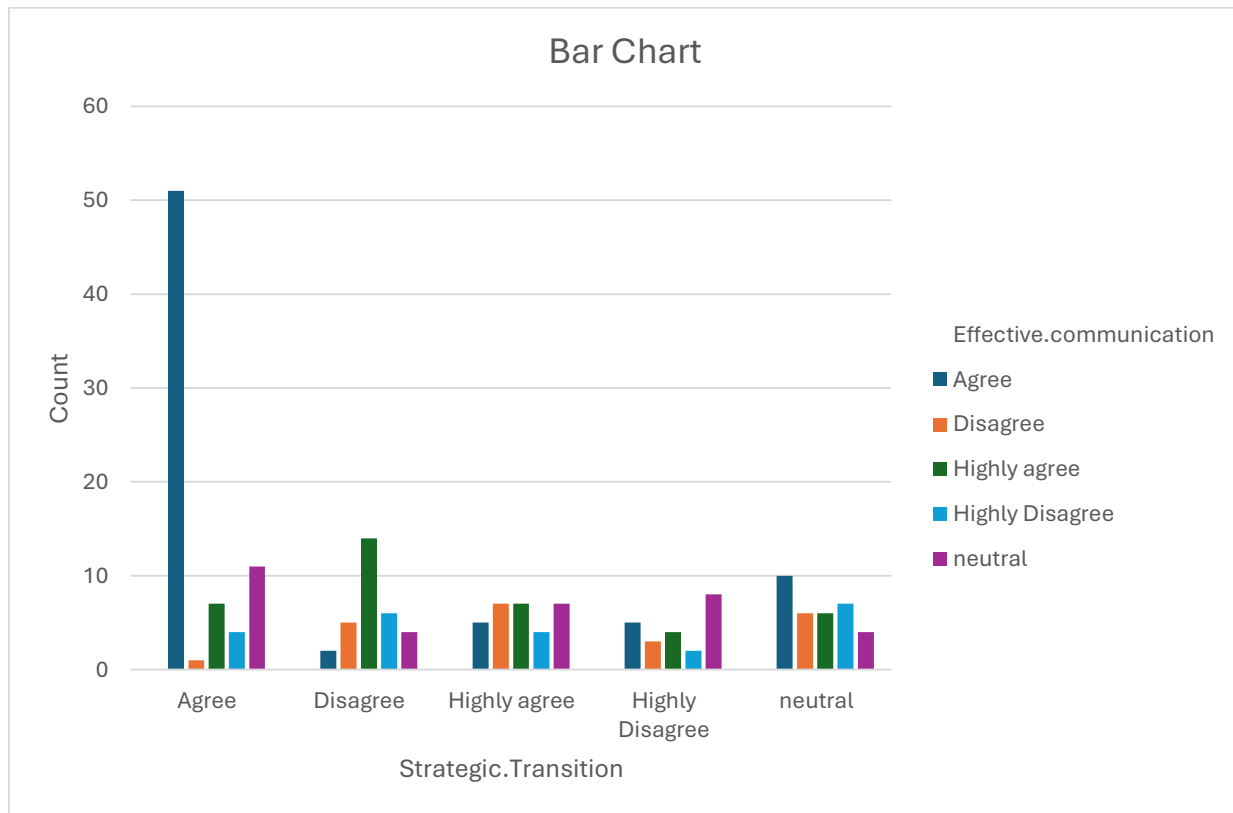


Figure 22 : Symmetric measures in cross-table analysis for the role of strategic transformation in fostering effective communication between different departments to ensure the success of this strategic transformation

## 20. One-Way ANOVA analysis

The ANOVA results indicate a statistically significant effect of the independent variables on the strategic transition. The regression sum of squares was 173.466 with 12 degrees of freedom, while the residual sum of squares was 263.950 with 177 degrees of freedom. The calculated F-value was 9.694, with a significance level of 0.000, which is below the accepted threshold of 0.05. This indicates that the overall regression model is statistically significant and that the independent variable innovation, effective communication, and financial resources—have a meaningful combined effect on the strategic transition. Overall, the results confirm that the model explains a significant portion of the variance in the dependent variable, suggesting that these factors play an important role in influencing the strategic transition.

| ANOVA <sup>a,b</sup>                                                            |                |     |             |       |      |
|---------------------------------------------------------------------------------|----------------|-----|-------------|-------|------|
| Source                                                                          | Sum of Squares | df  | Mean Square | F     | Sig. |
| Regression                                                                      | 173.466        | 12  | 14.456      | 9.694 | .000 |
| Residual                                                                        | 263.950        | 177 | 1.491       |       |      |
| Total                                                                           | 437.416        | 189 |             |       |      |
| a. Dependent Variable: Strategic Transition                                     |                |     |             |       |      |
| b. Model: (Intercept), innovation, Effective communication, financial resources |                |     |             |       |      |

Table 26 : One-way analysis of variance.

The Bayes Factor model summary indicates strong evidence supporting the proposed model compared to the null model. The **Bayes Factor** value was **4,130,447,468.134**, which is extremely high and suggests very strong evidence in favor of the model that includes innovation, effective communication, and financial resources as predictors of strategic transition. The model achieved a correlation coefficient (**R**) of **0.630**, indicating a moderate to strong relationship between the independent variables and the dependent variable. The **R Square** value of **0.397** shows that approximately **39.7%** of the variance in the strategic transition can be explained by the model, while the **Adjusted R Square** of **0.356** confirms a good model fit after adjusting for the number of predictors. Overall, the results provide strong statistical support for the model's explanatory power.

| Bayes Factor Model Summary <sup>a,b</sup>                                       |      |          |                   |                            |
|---------------------------------------------------------------------------------|------|----------|-------------------|----------------------------|
| Bayes Factor <sup>c</sup>                                                       | R    | R Square | Adjusted R Square | Std. Error of the Estimate |
| 4130447468.134                                                                  | .630 | .397     | .356              | 1.22                       |
| a. Method: JZS                                                                  |      |          |                   |                            |
| b. Model: (Intercept), innovation, Effective communication, financial resources |      |          |                   |                            |
| c. Bayes factor: Testing model versus null model (Intercept).                   |      |          |                   |                            |

Table 27 : Summary of Bayes' Factor Model.

The Bayesian estimates of error variance indicate the level of unexplained variation in the model. The posterior mode of the error variance was 1.475, while the mean was 1.508, suggesting a consistent estimate of the model's residual variability. The variance of the estimate was 0.026, reflecting a relatively stable posterior distribution. The 95% credible interval for the error variance ranged from 1.224 to 1.858, indicating that the true error variance is likely to fall within this interval. Overall, the results suggest a moderate level of unexplained variance in the model, with reasonably stable and reliable Bayesian estimates under the assumed standard reference priors.

| Bayesian Estimates of Error Variance <sup>a</sup> |           |       |          |                       |             |
|---------------------------------------------------|-----------|-------|----------|-----------------------|-------------|
| Parameter                                         | Posterior |       |          | 95% Credible Interval |             |
|                                                   | Mode      | Mean  | Variance | Lower Bound           | Upper Bound |
| Error variance                                    | 1.475     | 1.508 | .026     | 1.224                 | 1.858       |
| a. Assume standard reference priors.              |           |       |          |                       |             |

Table 28 : Bayesian estimates of error variance.

## Results and Recommendations:

### - Results of the Study

#### 1. General Perception of Strategic Transformation

The statistical data suggest that the overall perception of the strategic shift from infrastructure assistance to mineral exploration is moderate rather than substantially positive. While more than half of the respondents think that the transition constitutes an essential strategic move, the mean values between 2.39 and 2.67 suggest uncertainty and partial readiness among firms. This shows that although understanding of the necessity of mineral exploration exists, implementation methods are still growing. Companies appear to comprehend the

strategic imperative of transformation, although practical execution, clarity of direction, and formal planning remain insufficiently developed to ensure full organizational alignment.

## **2. Innovation as a Key Driver of Transformation**

The empirical analysis reveals that innovation greatly influences strategic transformation outcomes. Respondents reported moderate levels of technological adoption and innovation support within their workplaces. The highest-rated item involves encouraging employees to develop new solutions, demonstrating a strong cultural basis. However, lower evaluations relating to actual application of sophisticated exploration technologies show a mismatch between intention and execution. Companies appear to possess innovation awareness but lack formal research and development structures. The findings show that innovation capability exists at a conceptual level, although operational integration of modern geophysical instruments remains limited and requires stronger institutional commitment.

## **3. Effective Communication and Organizational Coordination**

Effective communication was seen as moderately good, particularly in connection to inter-departmental collaboration. Respondents noted the presence of communication channels supporting transformation activities. However, the moderate mean score implies that communication methods may lack strategic depth and formal structure. Successful mineral discovery needs multidisciplinary coordination between geophysicists, geologists, engineers, and financial planners. The data show that while communication occurs, it may not yet be adequately integrated to support sophisticated exploration operations. Enhancing organized information exchange, leadership transparency, and cross-functional collaboration will be crucial to strengthening organizational preparation for strategic transformation.

#### **4. Financial Resources and Investment Capacity**

Financial capabilities emerged as a significant limiting factor impacting strategic transformation. Respondents expressed moderate agreement regarding the availability of financial and human resources to support mineral exploration efforts. However, financial constraints were also highlighted as hurdles to full implementation of transformation methods. Mineral exploration involves major capital investment in new technologies, training, and research projects. The findings imply that many organisations operate under short-term project-based financial models that restrict long-term strategic investment. Without strengthened capital allocation mechanisms and varied funding sources, the rate of shift toward mineral exploration may remain sluggish and constricted.

#### **5. Organizational and Cultural Barriers**

The results show the presence of moderate organizational problems and internal resistance to change during the transformation process. Structural rigidity, uncertain strategic direction, and inadequate change management approaches lead to implementation issues. Although people are encouraged to innovate, resistance from certain organizational levels may delay growth. Strategic change involves not only technological readiness but also cultural alignment and leadership support. The statistics imply that organisations must address internal hurdles through structured change management frameworks, clearer communication techniques, and stronger leadership commitment to facilitate smooth transition into mineral exploration activities.

- **Recommendations**

**1. Strengthening Technological Innovation**

Geophysical companies should prioritize systematic investment in advanced mineral exploration technologies to enhance operational readiness and competitiveness. This includes adopting airborne geophysical systems, induced polarization surveys, magnetotelluric techniques, and three-dimensional subsurface modeling software. Establishing internal research and development units will support continuous innovation and technology evaluation. Furthermore, integrating artificial intelligence and advanced data analytics into exploration workflows can significantly improve mineral targeting accuracy. Companies should implement structured technology assessment frameworks to ensure effective adoption and utilization. Strengthening technological infrastructure will accelerate the transition process and reduce dependence on foreign exploration contractors.

**2. Enhancing Human Capital Development**

Human capital development is essential for supporting strategic transformation. Companies should implement continuous professional development programs focusing on economic geology, advanced geophysical interpretation, mineral resource modeling, and digital data analytics. Encouraging multidisciplinary teamwork will enhance knowledge integration across departments. Strategic partnerships with universities and research institutions can facilitate knowledge transfer and specialized training opportunities. Additionally, introducing performance-based incentive systems will motivate employees to engage in innovation and exploration initiatives. Building a technically skilled and adaptable workforce aligned with mining sector requirements will significantly improve long-term organizational sustainability and competitiveness.

### **3. Improving Financial Planning and Investment Strategy**

To support the transition effectively, companies must adopt long-term financial planning models that allocate dedicated budgets for mineral exploration technologies and workforce development. Diversifying funding sources through joint ventures, government-backed mining initiatives, and strategic partnerships will reduce financial risk exposure. Implementing phased investment strategies allows gradual expansion of exploration capabilities without overextending capital resources. Companies should also develop financial risk management frameworks tailored to exploration projects. Strengthening financial resilience will enable sustained innovation, technology acquisition, and competitive participation in large-scale mineral exploration contracts.

### **4. Strengthening Organizational Structure and Change Management**

Organizations should adopt structured change management frameworks to address internal resistance and ensure smoother strategic transition. This includes establishing specialized mineral exploration departments with clearly defined roles and responsibilities. Senior management must communicate a clear long-term vision aligned with national mining priorities and ensure employee engagement throughout the transformation process. Implementing performance monitoring systems will track progress toward strategic goals. Additionally, fostering a culture of adaptability and continuous improvement will reduce structural rigidity. Strong leadership commitment and organizational alignment are critical to sustaining transformation success.

### **5. Enhancing Institutional and Government Collaboration**

Government institutions should play an active role in supporting local geophysical companies through regulatory facilitation and financial incentives. Providing grants, tax incentives, or subsidized technology acquisition programs can accelerate local capability development. Policies encouraging local content participation in national mining projects will strengthen domestic industry growth. Collaboration platforms linking companies, universities, and regulatory authorities should be established to promote knowledge exchange and innovation. Institutional alignment with national mining objectives under Saudi Vision 2030 will ensure that geophysical firms become strategic contributors to economic diversification and sustainable development.

### **Conclusion:**

The strategic transition of geophysical companies in Saudi Arabia from infrastructure support services to mineral exploration represents a critical transformation aligned with national economic diversification objectives. This study aimed to examine the organizational determinants influencing this transition, focusing on innovation, effective communication, and financial resources as key drivers of strategic transformation. The findings demonstrate that while geophysical companies possess foundational technical capabilities and experienced human resources, their readiness to fully engage in mineral exploration remains moderate and still evolving.

Empirical results indicate that innovation plays a central role in enabling transformation. Although employees are encouraged to propose new ideas, the adoption of advanced mineral exploration technologies remains limited. This suggests a gap between innovative intention and structured technological implementation. Effective communication was identified as a supportive but underdeveloped mechanism,

where internal coordination exists but requires stronger integration to manage multidisciplinary exploration projects. Financial resources emerged as a significant constraint, with limited long-term investment capacity slowing technology acquisition and large-scale exploration engagement.

Organizational and cultural barriers further influence the pace of transformation. Resistance to change, unclear strategic direction, and structural rigidity reduce the effectiveness of transition initiatives. These findings confirm the main hypothesis that technological capability, human capital, financial strength, and institutional support are significantly associated with successful strategic transformation.

From a theoretical perspective, the study contributes to the integration of Resource-Based View, Human Capital Theory, Innovation Diffusion Theory, and Strategic Management frameworks in explaining sectoral transformation within resource-based economies. Practically, the research provides actionable insights for decision-makers seeking to strengthen the competitiveness of local geophysical firms within the expanding Saudi mining ecosystem.

Ultimately, the transformation of geophysical companies into advanced mineral exploration partners is essential for achieving the objectives of Saudi Vision 2030. By strengthening innovation systems, investing in human capital, improving financial planning, and enhancing institutional collaboration, Saudi geophysical enterprises can position themselves as strategic contributors to sustainable mineral development, national resource security, and long-term economic diversification.

## المستخلص:

يمثل التحول الاستراتيجي لشركات الجيوفيزياء في المملكة العربية السعودية، من مزودي خدمات البنية التحتية إلى شركاء متكاملين في استكشاف المعادن، نقلة نوعية ضمن الإطار الأوسع للتنوع الاقتصادي الوطني. تاريخيًا، ركزت شركات الجيوفيزياء في المملكة بشكل أساسي على الخدمات المتعلقة بالبنية التحتية، بما في ذلك استكشاف المياه الجوفية، والدراسات الجيوتقنية، والتقييمات البيئية، ودراسات المخاطر الزلزالية. ورغم إسهام هذه الخدمات بشكل كبير في التنمية الحضرية والصناعية السريعة، إلا أنها لا تزال في معظمها ذات طبيعة تفاعلية وقائمة على المشاريع. ومع ظهور إصلاحات طموحة في قطاع التعدين، وإعطاء الأولوية لتطوير الموارد المعدنية في إطار رؤية السعودية 2030، يتطلب التوجه التشغيلي والاستراتيجي لشركات الجيوفيزياء إعادة تنظيم جوهري نحو أنشطة استكشاف المعادن المتقدمة.

تهدف هذه الدراسة إلى تطوير إطار استراتيجي شامل يدعم انتقال شركات الجيوفيزياء السعودية إلى شركاء تنافسيين ومتقدمين تقنيًا في استكشاف المعادن. يبحث البحث في المحددات التنظيمية الداخلية المؤثرة في هذا التحول، مع التركيز بشكل خاص على الابتكار، والتواصل الفعال، والموارد المالية كمتغيرات مستقلة، والتحول الاستراتيجي كمتغير تابع. تدمج هذه الدراسة الأسس النظرية من منظور الموارد، ونظرية انتشار الابتكار، ونظرية رأس المال البشري، ونظرية الإدارة الاستراتيجية، والنظرية المؤسسية، لبناء نموذج تحليلي متعدد الأبعاد يشرح التغيير التنظيمي في اقتصاد قائم على الموارد.

وقد استخدم تصميم بحثي كمي وصفي تحليلي لتحقيق أهداف الدراسة. جُمعت البيانات الأولية من خلال استبانة مهيكلّة وزُرع على 190 متخصصًا يعملون في شركات الخدمات الجيوفيزيائية في المملكة العربية السعودية، بمن فيهم مديرون ومهندسون وجيوفيزيائيون ومسؤولون ماليون ومخططون استراتيجيون. قاس الاستبانة تصورات المشاركين حول الجاهزية التكنولوجية، والتنسيق التنظيمي، والقدرة المالية، ونتائج التحول، باستخدام مقياس ليكرت خماسي النقاط. أُجري التحليل الإحصائي باستخدام برنامج SPSS ، وشمل الإحصاء الوصفي، واختبار الموثوقية (معامل ألفا لكرونباخ)، والتحليل العاملي الاستكشافي، ومعامل ارتباط بيرسون، وتحليل الانحدار المتعدد لاختبار فرضيات الدراسة وتقييم العلاقات التنبؤية.

وُشير النتائج إلى وجود جاهزية عامة متوسطة للتحول الاستراتيجي في هذا القطاع. برز الابتكار كمحرك رئيسي للتحول؛ ومع ذلك، فبينما يُشجع الموظفون على توليد أفكار مبتكرة، لا يزال التبنّي المنهجي لتقنيات استكشاف المعادن المتقدمة

محدودًا. وقد وُجد أن التواصل الفعال يدعم جهود التحول، إلا أن آليات التنسيق تحتاج إلى مزيد من التعزيز لتيسير التعاون متعدد التخصصات الضروري لمشاريع استكشاف المعادن. وتم تحديد الموارد المالية كعائق حاسم، حيث تؤثر القدرة المحدودة على الاستثمار طويل الأجل على اقتناء التكنولوجيا، وتخصص القوى العاملة، ومبادرات تطوير البحث. بالإضافة إلى ذلك، لوحظ أن الحواجز التنظيمية والثقافية، بما في ذلك مقاومة التغيير والافتقار إلى توجيه استراتيجي واضح، تؤثر على وتيرة وفعالية جهود الانتقال.

تؤكد الدراسة وجود علاقات ذات دلالة إحصائية بين القدرة التكنولوجية، وفعالية التواصل، والقوة المالية، ونجاح التحول الاستراتيجي. وتُبرز هذه النتائج ضرورة استراتيجيات بناء القدرات المتكاملة التي تجمع بين الاستثمار التكنولوجي، وتنمية رأس المال البشري، وإدارة التغيير المنظمة، والتعاون المؤسسي. من منظور نظري، يُسهم هذا البحث في الأدبيات المتعلقة بالتحديث الصناعي والتحول الاستراتيجي في اقتصادات التعدين الناشئة من خلال ربط الابتكار الجيوفيزيائي بالاستراتيجية التنظيمية. من الناحية العملية، يقدم هذا التقرير توصيات قابلة للتنفيذ لصناع السياسات وقادة الصناعة الساعين إلى تعزيز مشاركة المحتوى المحلي، وتقليل الاعتماد على شركات التنقيب الأجنبية، وتعزيز القدرة التنافسية للشركات الجيوفيزيائية المحلية.

وختامًا، يُعدّ تحوّل شركات الجيوفيزياء إلى شركاء متقدمين في مجال استكشاف المعادن ضرورة استراتيجية لتحقيق التنمية المستدامة للموارد، وتعزيز المرونة الاقتصادية الوطنية، والتنويع الصناعي طويل الأجل في المملكة العربية السعودية. وسيُمكن تعزيز القدرات الداخلية ومواءمة الاستراتيجية التنظيمية مع أولويات التعدين الوطنية قطاع الخدمات الجيوفيزيائية من لعب دور محوري في اقتصاد المعادن المتنامي في المملكة.

## Appendices:

### - Appendix (A): General Abbreviations

| No. | Abbreviation | Full Term                                         |
|-----|--------------|---------------------------------------------------|
| 1   | KSA          | Kingdom of Saudi Arabia                           |
| 2   | MBA          | Master of Business Administration                 |
| 3   | GDP          | Gross Domestic Product                            |
| 4   | R&D          | Research and Development                          |
| 5   | AI           | Artificial Intelligence                           |
| 6   | GIS          | Geographic Information System                     |
| 7   | ESG          | Environmental, Social, and Governance             |
| 8   | RBV          | Resource-Based View                               |
| 9   | ANT          | Ambient Noise Tomography                          |
| 10  | VMS          | Volcanogenic Massive Sulphide                     |
| 11  | TEM          | Transient Electromagnetic Method                  |
| 12  | IP           | Induced Polarization                              |
| 13  | SP           | Self-Potential                                    |
| 14  | RTP          | Reduction to the Pole                             |
| 15  | IGRF         | International Geomagnetic Reference Field         |
| 16  | AS           | Analytical Signal                                 |
| 17  | 1VD          | First Vertical Derivative                         |
| 18  | PCA          | Principal Component Analysis                      |
| 19  | ICA          | Independent Component Analysis                    |
| 20  | SMACC        | Sequential Maximum Angle Convex Cone              |
| 21  | RAPS         | Radial Average Power Spectrum                     |
| 22  | ED           | Euler Deconvolution                               |
| 23  | ANOVA        | Analysis of Variance                              |
| 24  | SARIMA       | Seasonal Autoregressive Integrated Moving Average |
| 25  | Vision 2030  | Saudi Vision 2030                                 |

*Table 29: General Abbreviations*

- **Appendix (B): Statistical Abbreviations**

| No. | Abbreviation     | Meaning                                         |
|-----|------------------|-------------------------------------------------|
| 1   | N                | Sample Size                                     |
| 2   | M                | Mean                                            |
| 3   | SD               | Standard Deviation                              |
| 4   | SE               | Standard Error                                  |
| 5   | r                | Pearson Correlation Coefficient                 |
| 6   | R <sup>2</sup>   | Coefficient of Determination                    |
| 7   | $\beta$ (Beta)   | Standardized Regression Coefficient             |
| 8   | F                | F-Statistic                                     |
| 9   | t                | t-Statistic                                     |
| 10  | Sig.             | Significance Level                              |
| 11  | p-value          | Probability Value                               |
| 12  | $\alpha$ (Alpha) | Significance Level / Cronbach's Alpha           |
| 13  | df               | Degrees of Freedom                              |
| 14  | EFA              | Exploratory Factor Analysis                     |
| 15  | CFA              | Confirmatory Factor Analysis                    |
| 16  | KMO              | Kaiser-Meyer-Olkin Measure of Sampling Adequacy |
| 17  | MS               | Mean Square                                     |
| 18  | SS               | Sum of Squares                                  |
| 19  | CI               | Confidence Interval                             |
| 20  | VIF              | Variance Inflation Factor                       |
| 21  | Durbin–Watson    | Test for Autocorrelation                        |

*Table 30: Statistical Abbreviations*

- **Appendix (c): Survey**

Strategic Transition of Geophysical Companies in Saudi Arabia:

From Infrastructure Support to Mineral Exploration under Saudi Vision 2030

Instructions:

Please read each statement carefully and select the response that best reflects your opinion. All responses will remain confidential and will be used for academic research purposes only.

- **Section A: Demographic Information**

1. Age \*

☐ 20–30

☐ 30–40

☐ 40–50

☐ 50–60

☐ 60+

2. Gender \*

☐ Male

☐ Female

3. Educational Degree \*

☐ Less than high school

☐ Diploma / associate degree

☐ bachelor's degree

☐ master's degree

☐ Doctoral degree

- **Section B: Strategic Transformation Toward Mineral Exploration**

**Please indicate your level of agreement with the following statements:**

Scale:

1 = Highly Disagree

2 = Disagree

3 = Neutral

4 = Agree

5 = Highly Agree

---

- 4. You believe that the shift from infrastructure support to mineral exploration is a significant strategic move for your company. \***

☐ 1

☐ 2

☐ 3

☐ 4

☐ 5

- 5. Your company has a clear plan to align with the goals of Vision 2030 in the field of mineral exploration. \***

☐ 1

☐ 2

☐ 3

☐ 4

☐ 5

**6. Senior management encourages innovation and new initiatives to support this strategic shift.**

**\***

☐ 1

☐ 2

☐ 3

☐ 4

☐ 5

**7. Effective communication exists between different departments to ensure the success of the strategic shift. \***

☐ 1

☐ 2

☐ 3

☐ 4

☐ 5

**8. The company possesses the necessary financial and human resources to support the shift towards mineral exploration.**

☐ 1

☐ 2

☐ 3

☐ 4

☐ 5

**9. The company's existing information systems and technologies support the new mineral exploration activities.**

☐ 1

☐ 2

☐ 3

☐ 4

☐ 5

**10. Continuous employee training and development are available to ensure alignment with the requirements of the strategic shift.**

☐ 1

☐ 2

☐ 3

☐ 4

☐ 5

**11. The company utilizes the latest geophysical technologies in its mineral exploration activities.**

\*

☐ 1

☐ 2

☐ 3

☐ 4

☐ 5

**12. Employees are encouraged to propose innovative solutions to improve exploration operations.**

☐ 1

☐ 2

☐ 3

☐ 4

☐ 5

**13. An effective system is in place for evaluating and adopting new technologies within the company.**

☐ 1

☐ 2

☐ 3

☐ 4

☐ 5

**14. The strategic shift has contributed to improving the company's operational efficiency. \***

☐ 1

☐ 2

☐ 3

☐ 4

☐ 5

**15. The shift has a positive impact on the quality of production and processes within the company.**

☐ 1

☐ 2

☐ 3

☐ 4

☐ 5

**16. The strategic shift enhances the company's competitiveness in the local and international markets. \***

☐ 1

☐ 2

☐ 3

☐ 4

☐ 5

**17. The company faces organizational difficulties in transitioning from infrastructure support to mineral exploration. \***

☐ 1

☐ 2

☐ 3

☐ 4

☐ 5

**18. Financial challenges impact the company's ability to fully implement its transformation strategies. \***

☐ 1

☐ 2

☐ 3

☐ 4

☐ 5

**19. There is internal resistance to change from some employees during the implementation of the strategic transformation.**

☐ 1

☐ 2

☐ 3

☐ 4

☐ 5

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التحول الاستراتيجي لشركات الجيوفيزياء في المملكة العربية السعودية: من دعم البنية التحتية إلى استكشاف المعادن في إطار رؤية 2030

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2025/2026