Leadership styles that promote innovation performance among engineers during the energy transition in South Africa

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A research dissertation submitted to the Faculty of Commerce, Law and Management, University of the Witwatersrand, in partial fulfilment of the requirements for the degree of Master of Business Administration

Johannesburg, 2025

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Abstract

This thesis investigates the relationship between leadership styles and innovation performance among engineers within the energy transition sector in South Africa, focusing specifically on sensing capabilities, seizing capabilities, transforming capabilities, and learning capabilities as core variables. The research is grounded in the context of the global shift toward renewable energy and the increasing pressures on organizations to innovate amidst evolving technological landscapes. The study aims to explore how various leadership styles—transformational, transactional, and participative—can foster the dynamic capabilities of engineers to enhance innovation performance within this rapidly changing environment.

Using a quantitative research methodology, data were collected via surveys from a sample of engineers actively working in the South African renewable energy sector. Factor analysis, reliability testing, and other quantitative methods, including tests for normality and multicollinearity, were employed to ensure robust data analysis. Key insights into the role of leadership in fostering innovation within the energy transition sector were uncovered, revealing the critical importance of leadership in nurturing organizational capabilities necessary for innovation. The findings suggest that leadership styles promoting learning and adaptability, such as transformational leadership, are particularly effective in driving innovation performance. Moreover, the study demonstrates the interconnectedness of the sensing, seizing, transforming, and knowledge-sharing capabilities within engineering teams, particularly in the context of rapid technological changes, regulatory demands, and sustainability goals in South Africa's energy landscape.

This research contributes to the body of knowledge on leadership and innovation within the energy sector and offers actionable recommendations for industry leaders aiming to optimize their teams' performance during the energy transition. It highlights the need for leadership strategies that not only address current challenges but also prepare organizations for future innovations. In addition to providing insights into how leadership styles can enhance innovation performance, the thesis identifies areas for future research, including the exploration of leadership's influence on long-term innovation outcomes and how leadership can further support the energy transition's sustainability objectives. The study also considers the ethical implications of leadership decisions in the context of engineering projects, particularly in relation to environmental and social impacts.

Acknowledgements

I would like to express my deepest gratitude to Prof. Christopher Maier for his invaluable guidance, insightful feedback, and unwavering support throughout the development of this thesis. His mentorship has been instrumental in shaping the direction and depth of this work, and I am truly thankful for his dedication.

I am also profoundly grateful to my family for their continuous encouragement and understanding. To my husband Floridas and children, Kwena, Tshegofatso, and Kganya, thank you for your love and support, which have been a constant source of motivation during this journey.

Lastly, I extend my heartfelt thanks to Wits Business School for providing me with the resources and opportunities to pursue this research. Your commitment to academic excellence has been a significant part of my growth throughout this process.

List of Figures

Figure 2.1: The Study's Conceptual Framework Showing Hypotheses 1 to 5 (H1 to H5) 19
Figure 4.1: Reliability Analysis of Survey Constructs 28

List of Tables

Table 2.1. The Study's Concepts 18
Table 4.1: Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) and Bartlett's Test Results .29
Table 4.2: Factor Analysis Structure Matrix 30
Table 4.3: Factor Correlation Matrix 32
Table 4.4: Hypothesis 1 Spearman Correlation Results for Sensing Leadership (SS) and Innovative Performance (IP) 33
Table 4.5: Hypothesis 2 Spearman Correlation Results for Seizing Leadership (SZ) and Innovative Performance (IP) 33
Table 4.6: Hypothesis 3 Spearman Correlation Results for Transforming Leadership (TF) and Innovation Performance (IP).. 34
Table 4.7: Hypothesis 4 Results Summary 34
Table 4.8: Hypothesis 5 Results Summary 35

List of Abbreviations and Acronyms

H: Hypothesis

KMO: Kaiser-Meyer-Olkin Measure of Sampling Adequacy

rs: correlation coefficient

SPSS: Statistical Program for Social Sciences

Table of Contents

ABSTRACT .... **I**

LIST OF FIGURES .... **III**

LIST OF TABLES .... **III**

LIST OF ABBREVIATIONS AND ACRONYMS .... **III**

1 INTRODUCTION **1**

1.1 BACKGROUND OF THE STUDY 1
1.2 CONTEXT OF THE STUDY 3
1.3 RESEARCH PROBLEM 4
1.4 RESEARCH QUESTIONS 4
1.5 SIGNIFICANCE OF THE STUDY 5
1.6 DELIMITATIONS OF THE STUDY 5
1.7 OPERATIONAL DEFINITIONS 6
1.7.1 Innovation performance 6
1.7.2 Leadership styles 6
1.7.3 Dynamic capabilities 6
1.8 STRUCTURE OF THE DISSERTATION 7

2 SYSTEMATIC REVIEW OF LITERATURE **8**

2.1 INTRODUCTION 8
2.2 LITERATURE REVIEW 8
2.2.1 Energy industry and the energy transition 8
2.2.2 Energy transition in South Africa and the role of engineers 9
2.2.3 The importance of innovation performance during the energy transition 9
2.2.4 Factors influencing innovation performance 10
2.2.5 The influence of leadership on innovation performance 11
2.2.6 Knowledge sharing 11
2.2.7 Identification of research gaps 12
2.2.8 Theoretical review of models 13
2.3 THEORETICAL UNDERPINNINGS: DYNAMIC CAPABILITIES 13
2.3.1 Dynamic capabilities theory overview 14
2.3.2 Framework: Ordinary vs dynamic capabilities 14
2.3.3 The 1997 version of the dynamic capabilities framework 15
2.3.4 The 2007 version of the dynamic capabilities framework 15
2.3.5 Additional concepts in the dynamic capabilities framework 16
2.3.6 Relevance of the dynamic capabilities framework to the study 17
2.4 CONCEPTUAL FRAMEWORK FOR LEADERSHIP AND INNOVATION PERFORMANCE THROUGH DYNAMIC CAPABILITIES 17
2.4.1 Hypotheses 1 to 3: The leadership style and dynamic capabilities relationship 19
2.4.2 Hypothesis 4: The leadership style and innovation performance relationship 19
2.4.3 Hypothesis 5: Knowledge internalisation and sharing as a moderator 20

3 RESEARCH METHODOLOGY **21**

3.1 INTRODUCTION 21
3.2 RESEARCH PARADIGM 21
3.3 RESEARCH APPROACH 22
3.4 RESEARCH DESIGN 23
3.5 DATA COLLECTION 23
3.5.1 Population and sample 24
3.5.2 Sampling procedure 24

3.5.3 Development of the research instrument ... *25*
3.6 DATA ANALYSIS ... 26
3.7 ETHICAL CONSIDERATIONS ... 26

4 RESEARCH FINDINGS ... 27

4.1 DATA CLEANING PROCESS ... 27
4.2 RELIABILITY ANALYSIS ... 27
4.3 DESCRIPTIVE ANALYSIS ... 28
4.3.1 Current role in the organisation ... *28*
4.3.2 Engineering discipline ... *28*
4.3.3 Province of employment ... *28*
4.4 EXPLORATORY FACTOR ANALYSIS ... 29
4.5 EXPLORATORY FACTOR ANALYSIS RESULTS ... 29
4.6 NORMALITY TESTS ... 32
4.7 HYPOTHESIS TESTING ... 33
4.7.1 Hypothesis 1: Sensing leadership and innovation performance ... *33*
4.7.2 Hypothesis 2: Seizing leadership and innovation performance ... *33*
4.7.3 Hypothesis 3: Transforming leadership and innovation performance ... *33*
4.7.4 Hypothesis 4: Innovation performance through learning capabilities ... *34*
4.7.5 Hypothesis 5: Sensing, seizing and transforming leadership ... *34*
4.8 SUMMARY OF FINDINGS ... 35

5 DISCUSSION ... 36

6 CONCLUSION ... 39

REFERENCES ... 41

APPENDIX A: SURVEY QUESTIONNAIRE ... 49

1 Introduction

The energy transition and introduction of renewable power into the South African national grid is impending. Engineers are expected to play a major role in the facilitation of the energy transition; therefore, it is imperative that they are innovative to ensure success during this process. The management of innovation performance is, therefore, a concern for engineers' leaders (engineering managers). This study investigated the leadership styles that can be adopted or implemented by engineering managers to promote innovation performance among engineers during the energy transition in South Africa.

1.1 Background of the Study

The study's background details the energy transition and the role of engineers. It defines and explains innovation performance, innovation management through leadership and the different leadership styles found in literature.

The energy transition is a global trend. The term "energy transition" refers to the change from an energy mix that is based on electricity generation through fossil fuels to an energy mix that is based on renewable energy (DMRE, 2020; Enel Green Power, 2023). Energy mix refers to the group of sources from which electricity is generated. Based on a study conducted by the Council for Scientific and Industrial Research in 2021, South Africa's energy mix is heavily based on fossil fuels, with electricity generation sources consisting of 81.4% coal, 6.7% renewable energy (wind, solar PV), 5.4% nuclear, 1.4% diesel and 5.1% hydro (Pierce & Ferreira, 2022). South Africa, like the rest of the world, is being driven to transition to using renewable energy sources due to the need for decarbonisation through the use of greener energy sources, the increased reliability and efficiency of renewable energy sources, the need for electrification of rural areas, load shedding (particularly in South Africa) and the move to digitalisation of the energy sector, which is the design of power grids as smart grids (Enel Green Power, 2023). Engineers (including electrical, mechanical, civil, etc.) are the professionals central to the energy transition.

Engineers are expected to play a critical role in the energy transition(Horner, n.d.). They are not only expected to implement the shift towards renewable energy, but they are also expected to generate new ideas, design innovative technologies and find ways to do things better during the transition. Rios, senior vice president of engineering at BP, believes that engineers are expected to generate new and innovative ideas that can be scaled very quickly to address the challenges related to the energy transition (Rios et al., 2022). Furthermore, innovative solutions have to be scaled such that costs can be reduced significantly for the wide distribution of the solution globally (Rios et al., 2022). Organisations that have such innovative engineers may achieve a sustained competitive advantage that sets them apart from their competitors and improves their organisational performance.

Innovation performance refers to the use of ideas to improve the performance and usefulness of products, services and processes. The prevalence of innovation in organisations is a determinant of organisational performance and success (Hou et al., 2019). Literature refers to two different types of innovation performance, namely incremental and radical. Incremental innovation performance is the gradual refinement and improvement of products, services and processes, whereas radical innovation performance refers to the drastic and fundamental changes made to existing products and processes or the introduction of new products, services or processes (Forés & Camisón, 2016). The energy transition and the shift towards renewable energy require both incremental and radical innovation performance from engineers in South Africa. Incremental innovation is to be applied to existing technologies, such as solar PV, inverters and wind. Radical innovation performance is more critical in developing new technologies to facilitate the energy transition. Such technologies include using hydrogen, batteries, smart grids and carbon capture and utilisation technologies (Precht, 2021). Cultivating an environment that promotes a culture of innovation among engineers is imperative for organisations to gain a sustained competitive advantage during the energy transition.

Organisations can create a culture of innovation through engineers' leaders. Engineering managers can, therefore, improve innovation performance through the effective leadership of engineers. Literature demonstrates that the effects of certain leadership styles, such as transformational leadership, positively impact innovation performance and knowledge internalisation and sharing in the organisation (Zheng et al., 2017). Hence, this study's objective was to investigate the leadership styles adopted by engineering managers to promote innovation performance among engineers during the energy transition in South Africa. Engineering managers can adopt different leadership styles, including transformational, transactional, ambidextrous, authentic, humble, humorous, ethical, charismatic, altruistic, paternalistic, entrepreneurial, servant or strategic (Zheng et al., 2017).

It has been established that engineering managers, as leaders, are expected to leverage the capabilities of engineers to promote innovation performance during the energy transition in

South Africa; therefore, the dynamic capabilities framework was used to explain this. The dynamic capabilities framework suggests that an organisation's ability to adapt to changing market conditions by using the firm's resources to sense, seize and transform opportunities determines its competitive advantage and organisational performance (Teece et al., 1997). The dynamic capabilities theory is based on the resource-based view theory; however, it incorporates the dynamism factor, which accounts for the speed at which market conditions are changing (Ayaz, 2022). Literature shows that six types of dynamic capabilities could be sources of sustained competitive advantage for organisations. This includes perceptibility, absorbency, adaptability, networking capability, integration capability and innovation capability (Ayaz, 2022; Tseng & Lee, 2014). The dynamic capabilities theory is used in this context as leadership is a critical component in leveraging the organisation's dynamic capabilities. Studies in literature have used this framework to propose that different types of leadership (ambidextrous, transformational and entrepreneurial) can promote dynamic capabilities that promote innovation performance in the organisation (Akkaya, 2020; Ayaz, 2022; Ferreira et al., 2021). Hence, this study used the dynamic capabilities theory to propose different leadership styles that promote innovation among engineers during the energy transition in South Africa by exploring how leaders can help engineers sense, seize and transform to adapt to market conditions that require rapid innovation during this time.

1.2 Context of the Study

In the fast-paced environment of the fourth industrial revolution, organisations look for ways to obtain and maintain a sustained competitive advantage by implementing and promoting innovation among organisations. An example of such a situation is the impending energy transition and introduction of renewable energy into South Africa's national power grid. This transition requires active participation from engineers across the country. Although most engineers work hard to solve complex problems and implement difficult projects, very few are encouraged to be innovative. Engineering managers of South African organisations that are participating in the implementation of the energy transition should, therefore, be concerned with the leadership style they can implement to promote innovation and improve organisational performance. Literature demonstrates a correlation between transformational leadership and increased innovation performance (Zheng et al., 2017), whereas others argue that different leadership styles are required at different stages of innovation to encourage engineers. Furthermore, the lack of a culture of knowledge internalisation and sharing may impact the level of innovation performance among engineers. This study investigated the factors that influence innovation performance among engineers and the leadership styles that engineering managers can implement to promote innovation and improve business performance during the implementation of the energy transition in South Africa. The study's primary research question was: What characteristics of engineering managers' leadership styles promote engineers' innovation performance during the energy transition in South Africa? The secondary research questions investigated the relationship between innovation and transformational leadership, transactional leadership, and knowledge internalisation and sharing using the dynamic capabilities framework.

1.3 Research Problem

The purpose of this study is to investigate the relationship between engineering managers' leadership styles and the innovation performance of engineers, with a specific focus on the role of knowledge internalisation and sharing within an organisation. Existing studies have examined the relationship between leadership styles and innovation performance, highlighting the positive impact of transformational, strategic, and inclusive leadership on fostering innovation within organisations (Akparep et al., 2019; Alblooshi et al., 2021; Naqshbandi et al., 2019). Similarly, research has established that knowledge internalisation and sharing play a crucial role in enhancing an organisation's innovation capacity by facilitating the exchange of ideas, improving problem-solving, and promoting continuous learning (Zhao et al., 2021; Chiang & Hung, 2010). While these studies provide valuable insights, they often examine these factors in isolation rather than as interconnected components within a broader leadership-innovation framework.

Despite evidence supporting the importance of leadership and knowledge-sharing in driving innovation, there remains a gap in understanding how leadership styles simultaneously influence both knowledge internalisation and innovation performance. Existing research has yet to fully explore how leadership fosters a culture of knowledge sharing that, in turn, enhances engineers' ability to develop innovative solutions. Furthermore, limited studies have investigated these relationships within the specific context of South Africa's energy transition, where innovation is critical for addressing energy security challenges such as load shedding. As South Africa transitions toward renewable energy, engineers play a key role in developing innovative technologies to enhance energy security and sustainability. However, the extent to which leadership styles influence engineers' ability to innovate within this transition remains unclear.

Addressing this gap is essential because ineffective leadership and limited knowledge-sharing practices can hinder innovation, ultimately slowing down the development of renewable energy solutions in South Africa. By examining the relationship between leadership styles, knowledge-sharing culture, and innovation performance, this study seeks to contribute to both academic literature and industry practice. The findings will provide insights into how leadership can better support engineers in developing innovative solutions for the energy transition. In doing so, the study informs leadership development strategies that can foster knowledge-driven innovation in engineering organisations, ultimately contributing to South Africa's long-term energy sustainability.

1.4 Research Questions

This study aimed to address the research gap by answering the following primary research question:

- What characteristics of engineering managers' leadership styles promote engineers' innovation performance during the energy transition in South Africa?

The secondary research questions were:

- Does having leaders who promote the dynamic capabilities of sensing, seizing and transforming promote innovation performance?
- Does knowledge internalisation and sharing culture have a positive relationship with innovation performance?

These secondary research questions sought to understand the correlation between innovation, leadership, and knowledge internalisation and sharing using the dynamic capabilities framework. The secondary questions also addressed how engineering managers can promote sensing, seizing and transforming to help engineers be innovative during the energy transition in South Africa.

1.5 Significance of the Study

The energy transition and shift towards renewable energy is trending globally. Although relevant studies have been conducted, it has been established that the energy transition will unfold significantly differently in Africa and South Africa (Israel-Akinbo & Fraser, 2018). This calls for drastic innovation performance from engineers in organisations in South Africa. This study contributes valuable information to government, business leaders, engineering managers and other stakeholders who are looking to facilitate the energy transition process and gain a competitive advantage. The dynamic capabilities perspective of the study provides information on how leaders can assist engineers in sensing, seizing and transforming to boost innovation performance and lead the required innovation of the energy transition in South Africa.

1.6 Delimitations of the Study

This study provides valuable information on the leadership styles that could be implemented to promote innovation performance among engineers in South Africa to facilitate the country's energy transition. However, it is important to acknowledge the study's contextual and conceptual limitations.

Contextually, this study was performed in South Africa, focusing specifically on engineers within the renewable energy sector. The energy transition is a critical issue in the country due to its heavy reliance on coal, the need for sustainable energy solutions, and the economic and policy challenges associated with the shift to renewable energy. Given the urgency of this transition, the study focuses on how leadership styles can enhance innovation performance in this sector. While leadership is relevant across various engineering fields, this study does not extend its findings beyond the renewable energy sector, and the results may differ in other contexts.

Furthermore, this study is guided by the dynamic capabilities framework, which consists of sensing, seizing, and transforming capabilities. These were chosen as they provide a structured approach to understanding how leadership can drive innovation by identifying opportunities, capitalizing on them, and transforming organizations to maintain a competitive edge. While establishing a baseline measurement of leadership effectiveness is beyond the scope of this research, the study contributes to understanding how leadership can support engineers in driving innovation within the renewable energy sector

1.7 Operational Definitions

The following operational definitions are used in the context of leadership styles that promote innovation performance during the energy transition in South Africa.

1.7.1 Innovation performance

The definition of innovation performance adopted in this study is the ability of an organisation to generate and implement ideas that result in new and/or improved products, services, processes and procedures (Hou et al., 2019). Literature describes two types of innovation performance, namely incremental and radical. The difference between the two concepts is the extent of the applied change and the novelty of the idea. Incremental innovation performance refers to the gradual improvement of existing products, services or processes, whereas radical innovation performance refers to the drastic change of existing products or the generation of new products, services or processes (Forés & Camisón, 2016). In the context of the energy transition, both incremental and radical innovation performance are required to create a competitive advantage and improve organisational performance.

1.7.2 Leadership styles

Leadership style, in the context of this study, is defined as the process of influencing and encouraging subordinates (engineers) to achieve a goal. There are multiple styles of leadership;

however, this study investigates the effects of transformational, transactional, ambidextrous, autocratic and knowledge-based leadership. Literature demonstrates the relationship between different leadership styles and innovation performance. Therefore, this study investigated the leadership style that engineering managers could use to promote innovation performance among engineers during the energy transition in South Africa.

1.7.3 Dynamic capabilities

The dynamic capabilities framework suggests that an organisation's ability to adapt to changing market conditions by making use of the firm's resources to sense, seize and transform opportunities determines its competitive advantage and organisational performance (Teece et al., 1997). The dynamic capabilities framework is based on the resource-based view theory; however, it incorporates the dynamism factor, which accounts for the speed at which market conditions are changing (Ayaz, 2022). The dynamic capabilities theory is used in this context as leadership is a critical component in leveraging the organisation's dynamic capabilities. With reference to the energy transition, the dynamic capabilities theory can be used to explain how leaders could help engineers sense, seize and transform to adapt to market conditions that require rapid innovation during this time.

1.8 Structure of the Dissertation

This study is reported in the following structure: the literature review, which includes the context and concepts relating to the study, is detailed in Chapter 2. Chapter 3 details the research methodology, including the research approach and data collection methods. Chapter 4 provides the study's results and the statistical analysis. The penultimate chapter, Chapter 5, analyses the results and discusses them. The study is concluded by summarising the findings and making recommendations for future studies in Chapter 6.

2 Systematic Review of Literature

2.1 Introduction

A systematic literature review was conducted to detail the relevant literature and the study's conceptual framework. The objective of the literature review is to explore and provide a summary of existing research studies and findings related to the current research. The outcome of the empirical literature review is the identified research gaps and limitations. The topics explored in the empirical literature review include the current status of the energy industry and the looming energy transition, the progression of the energy transition in South Africa, the role of engineers and the importance of innovation performance during the energy transition, factors influencing innovation performance, the influence of leadership on innovation performance, effective leadership styles for innovation performance, knowledge internalisation and sharing, and the relationship between leadership, innovation performance and knowledge sharing. Furthermore, the literature review seeks to detail the conceptual framework (dynamic capabilities), which was used as the study's theoretical perspective. The main objective of the literature review is to identify the research gaps through the perspective of the theoretical dynamic capabilities framework.

2.2 Literature Review

2.2.1 Energy industry and the energy transition

The main energy sources used in the global energy sector are fossil fuels, mostly coal. Electricity is generated through coal-fired power stations. Other less prominent fossil fuels are oil and natural gas, the use of which has significant environmental and social implications. However, concerns about climate change and energy security, driven by technological advancements, have increased the development and use of renewable energy sources for electricity generation (Abdelilah et al., 2020). Hafner and Tagliapietra (2020) summarised possible scenarios ranging from complete global cooperation in the adoption of renewable energy sources to scenarios where using renewable energy is done in conjunction with the continued use of fossil fuels (Bazilian et al., 2020; Hafner & Tagliapietra, 2020). The authors of the study agree that the rise of renewables will shape relations between countries and will lead to fundamental changes in economies and societies. Literature studies show that the shift to sustainable, low-carbon energy systems is gaining momentum, although developments were briefly slowed down by the COVID-19 pandemic. Several countries and regions, including the United States, the European Union and China, are already transitioning towards renewable energy, investing extensively in renewable energy technologies, including solar, wind and geothermal power. Developing countries like South Africa and India are also adopting ambitious renewable energy goals to diminish their reliance on fossil fuels while increasing access to energy for their citizens (Bahar et al., 2020).

2.2.2 Energy transition in South Africa and the role of engineers

Essex and de Groot (2019) argue that South Africa has undergone three energy transitions and is moving towards the fourth. These are the colonial, apartheid, post-apartheid and low-carbon phases (Essex & de Groot, 2019). The focus of the current study is on the fourth phase of energy transition, which is the shift towards the use of renewable energy technologies.

The World Federation of Engineering Organizations believes that it is the responsibility of engineers across the disciplines of electrical, civil, mechanical and chemical to be involved in the implementation and execution of the energy transition (Ke, 2021). The role of electrical engineers in the transition is to design and implement the use of renewable energy sources and to develop energy storage technologies such as batteries. Mechanical engineers are responsible for designing and implementing energy-efficient equipment and systems, such as heat pumps, and optimising production processes. Chemical engineers will be involved with the development and manufacture of biofuels and other renewable sources such as hydrogen. Lastly, the role of civil engineers will be to design efficient renewable energy infrastructure. Several authors agree that the engineering discipline will play a vital role in the energy transition (Harper & Merten, 2021; Ke, 2021; Singh, 2022). Jones et al. (2019) argue that the demand for renewable energy is rising; however, the development of solutions is slow. Therefore, the conditions are ripe for innovation among engineers leading the energy transition.

2.2.3 The importance of innovation performance during the energy transition

The concept of innovation performance is described as “the successful implementation of ideas within an organization” or the ability of an individual or organisation to develop and implement products, services or processes that are of social and economic value and contribute towards organisational success (Yuen & Ng, 2021; Zou & Zhu, 2020). Implementing the energy transition, therefore, requires an increase in innovation performance to facilitate the development and implementation of new technologies, processes and business models in the energy sector. In addition, according to the International Renewable Energy Agency (IRENA, 2022) and the International Energy Agency (IEA, 2021), supercharged innovation is required to develop efficient renewable energy production systems, deploy technologies that utilise clean energy sources, increase energy security and alleviate energy poverty, create a sustainable energy sector and achieve net-zero emissions by 2050. Furthermore, innovation performance is a tool for organisations to gain and sustain a competitive advantage in the energy market.

2.2.4 Factors influencing innovation performance

It has been established that South Africa will undergo the energy transition in the next few years; therefore, engineers are required to play a vital role and be innovative in developing and implementing renewable energy solutions and clean technology to facilitate the energy transition. Since innovation performance is at the centre of the successful deployment of renewable energy, it is in the interest of organisations to understand the factors that influence innovation performance and how engineering leaders/managers can promote innovation among engineers during this transition. Several studies have been conducted to determine the factors that influence innovation performance in organisations, and multiple relationships with innovation performance have been investigated.

Hanifah et al. (2019) investigated the key factors of innovation and found a positive relationship between an organisation's innovation culture and innovation performance (Hanifah et al., 2019). The study demonstrated that innovation strategy, together with alignment and adaptability, significantly impacted innovation culture and innovation performance. These findings correspond with the results from studies by Zainol et al. (2011). Salim et al. (2019) expanded on this knowledge by conducting a systematic literature review that confirmed the internal capabilities of an organisation must be explored and developed to achieve innovation performance and business success. In addition, Fischer et al. (2019) investigated the influence of intrinsic and extrinsic motivators on the innovation performance of 90 knowledge workers. Their study confirmed the positive relation between intrinsic motivators and innovation performance. In addition, their findings demonstrate that relational rewards, as an extrinsic motivator, moderate the relationship between intrinsic motivation and innovation performance (Fischer et al., 2019). Furthermore, Alrowwad et al. (2020) and Novitasari et al. (2021) argue that both transactional and transformational leadership positively influence innovation performance and organisational success. In contrast, Huang et al. (2019) argue that transformational leadership plays a vital role in influencing an organisation's innovation performance. To summarise the literature findings, innovation performance is influenced by the availability of resources, organisational culture, innovation culture, relational reward and other extrinsic motivators, training and effective leadership styles.

2.2.5 The influence of leadership on innovation performance

Studies have shown that leadership styles influence innovation performance and organisational success. In the context of this study, effective leadership styles are to be adopted by engineering managers to promote innovation performance among engineers. Akparep et al. (2019) argue that leadership styles are the highest determinant of organisational success; therefore, the current study investigated the influence of leadership on innovation performance.

A clear positive relationship between leadership styles and innovation has been established in multiple studies. Alblooshi et al. (2021) conducted a systematic literature review of 64 studies that investigated the relationship between different leadership styles and innovation. They found that different leadership styles directly or indirectly impact an organisation's innovation culture and innovation performance. This is done through the influence of organisational climate, employee behaviour, and knowledge internalisation and sharing through leadership (Alblooshi et al., 2021). These findings are in line with the study conducted by Naqshbandi et al. (2019), who found, through the analysis of data collected from a survey, that the effect of empowering leadership is positive on both inbound and outbound open innovation. Fang et al. (2019) identified a research gap in literature on the relationship between inclusive leadership and the innovation performance of employees. They found a positive relationship between inclusive leadership and innovation performance. Cortes and Herrmann (2021) investigated the strategic leadership of innovation and concluded that leaders should rather employ different strategies in the different phases of innovation (idea generation, idea exploration, idea development and idea implementation).

It is evident that different leadership styles can be adopted by engineering managers to promote engineers' innovation performance during the energy transition in South Africa. While the effects of different leadership styles vary, literature has demonstrated a clear positive relationship between transformational, strategic, ethical and inclusive leadership. Although transactional leadership may not be as effective as the rest, literature has demonstrated that it may be used in conjunction with specific extrinsic motivators to influence an organisation's innovation performance.

2.2.6 Knowledge sharing

When exploring studies on the factors that influence innovation performance, there was mention of education and training having an impact (Huang et al., 2019). The current study, therefore, sought to explore the effects of knowledge internalisation and sharing. Knowledge internalisation refers to the ability of an individual or organisation to acquire knowledge (through education and training), incorporate the knowledge into the existing knowledge base and apply it to daily work. Knowledge sharing, on the other hand, refers to the ability of an individual or organisation to transfer and disseminate knowledge with other employees within the organisation. Chiang and Hung (2010) argue that education and training employees can boost the organisation's innovation performance. However, Zhao et al. (2021) examined the effects of inbound and outbound knowledge sharing on organisational innovation performance. Their findings suggest that inbound knowledge sharing (which is acquiring knowledge from external sources through training, workshops and research) does not directly promote organisational innovation performance. They found that outbound knowledge sharing (knowledge dissemination through publications, presentations to customers and providing training), together with individual creativity, can improve organisational innovation performance (Zhao et al., 2021). Elier et al. (2022) agree with Zhao et al. (2021) as their findings suggest that outbound knowledge sharing positively affects organisational innovation, whereas inbound knowledge sharing insignificantly affects innovation performance.

Although a positive relationship between outbound knowledge sharing and innovation has been established, studies have conflicting findings regarding the relationship between inbound knowledge sharing and organisational innovation.

2.2.7 Identification of research gaps

What about the relationship between knowledge sharing, leadership styles and innovation performance?

The empirical literature review detailed the state of the energy sector globally and in South Africa, emphasising the energy transition and the role of engineers' innovation performance. The factors that influence innovation performance were discussed, and a clear relationship between leadership styles and innovation performance has been established. The concept of knowledge sharing was introduced, and some relationships between outbound knowledge sharing and innovation were established. One of the research gaps emanating from the literature review is the impact of leadership styles on innovation performance, with knowledge sharing as a moderating variable. Studies on the knowledge sharing-leadership styles-innovation performance relationship are limited. Jing et al. (2022) investigated the influence of female leadership characteristics on organisational innovation performance while considering knowledge sharing as an intermediary variable. They found that female leadership styles positively influence knowledge sharing and innovation performance, and knowledge sharing plays a good mediating role between female leadership and innovation performance. Although the current study investigated the knowledge sharing-leadership styles-innovation performance relationship, it was conducted in a unique context, and no other studies investigating this relationship were found. Furthermore, the study by Jing et al. (2022) considers knowledge sharing in general rather than from the perspective of inbound or outbound knowledge sharing, as other studies have done. In addition, unlike other studies that investigated the influence of knowledge sharing, this study did not consider the effect of absorptive capacity. The present study, therefore, sought to contribute to this research gap by investigating the relationship between leadership styles and innovation performance and the mediating role of inbound and outbound knowledge sharing for engineers during the energy transition in South Africa.

2.2.8 Theoretical review of models

Studies investigating organisations' innovation performance have been conducted from the perspective of the dynamic capabilities framework (Moccia et al., 2020; Pichlak, 2021). The framework is based on the idea that an organisation's ability to adapt in response to the changes in its environment will determine the organisation's success (Teece, 2007; Wilden et al., 2013). The dynamic capabilities framework is related to the resource-based view theory in that the company's ability to use its resources to create a sustained competitive advantage will determine its success. It follows that studies investigating innovation performance make use of the dynamic capabilities framework. Given that the post-pandemic market is a VUCA BANI (volatile, uncertain, complex, ambiguous, brittle, anxious, non-linear and incomprehensible) world, innovation performance is critical for organisations. Using the dynamic capabilities framework is further justified as the energy transition presents a situation where organisations must enter new markets and respond to industry disruptions and rapid changes. The sense, seize and reconfigure concepts of the dynamic capabilities framework are, therefore, used in the current study as the key concepts of an organisation's leadership styles, knowledge sharing and innovation performance.

2.3 Theoretical Underpinnings: Dynamic Capabilities

The world is moving towards the use of renewable energy sources, and South Africa is expected to participate in this transition. This is driven by climate change concerns and energy security. South African conditions are, however, different from the rest of the world. Therefore, the execution of a just energy transition will likely occur differently. Due to South Africa's energy security issues and load shedding, the demand for renewable energy technology is rising. However, the development of solutions is lagging. The engineering discipline will, therefore, play a vital role in the development and implementation or execution of the country's energy transition. Engineering leaders (or managers) are, therefore, focused on promoting innovation performance among engineers to actively participate in implementing the energy transition and gaining a sustainable competitive advantage for their organisations in the energy industry. This section details the theoretical underpinnings of the current study from the perspective of Teece et al.'s (1997) dynamic capabilities theory. The theory's concepts and constructs and the relationship between them are discussed, and their relevance to the study is established. The objective of this section is to present a conceptual framework developed from the dynamic capabilities perspective relating to how engineering leaders can make use of engineers' dynamic capabilities to promote innovation performance while leveraging knowledge transfer during the energy transition in South Africa.

2.3.1 Dynamic capabilities theory overview

The dynamic capabilities framework arose from investigating how organisations in competitive technology-driven industries achieved and sustained a competitive advantage. Teece et al. (1997) observed that large organisations like IBM, Phillips and Texas Instruments used the resource-based view theory to achieve a competitive advantage. It is argued that the resource-based view is insufficient to achieve a sustained competitive advantage (Teece, 2023, p. 202; Teece et al., 1997). For successful organisations, strategic management goes beyond merely attaining the right resources (that are valuable, rare, inimitable and non-substitutable). The dynamic capabilities theory was developed to outline how to acquire, develop and deploy the right resources and how to manage them over time to gain a competitive advantage. The resource-based view theory is useful in a static and steady-state context. The dynamic capabilities framework considers a context that is changing rapidly and requires constant adaptation. The energy industry is changing rapidly with the rise of renewable energy technology and the energy transition. This requires organisations to adapt to the changes using dynamic capabilities.

2.3.2 Framework: Ordinary vs dynamic capabilities

Teece distinguishes dynamic capabilities from ordinary capabilities. Ordinary capabilities, also referred to as zero-order capabilities by Winter (2003), usually form part of operations, administration or governance. They can be measured against the requirements of a specific task and form part of an organisation's best practices. Ordinary capabilities are relevant when the context does not change, that is, providing the same product to the same stagnant market and at the same scale (Winter, 2003). Ordinary capabilities can be bought and serve to achieve technical efficiency in the organisation and "doing things the right way" (Teece, 2014).

There are several differences between dynamic capabilities and ordinary capabilities. Dynamic capabilities are built through organisational learning processes with the priority of "doing the right things". The purpose of dynamic capabilities is to match customer needs with technological advancements. In managing dynamic capabilities, management should emphasise entrepreneurial leadership and orchestration (or coordination) of assets to achieve innovation (Teece, 2014). Given the abovementioned differences, dynamic capabilities are defined as an organisation's ability to build, integrate and reconfigure its capabilities in response to a rapidly changing environment (Teece et al., 1997).

2.3.3 The 1997 version of the dynamic capabilities framework

The dynamic capabilities framework is based on the resource-based view and clearly distinguishes between ordinary and dynamic capabilities; however, the presentation of the concepts has evolved since the first framework was presented in 1997. The initial version of the dynamic capabilities framework was presented in the form of positions, processes and paths, which represent the past, present and future of an organisation (Teece, 2023; Teece et al., 1997). The organisation's position is characterised by the resources and assets (technological, reputational and structural) that the business has, including technology, skilled staff and intellectual property. The processes concept of the dynamic capabilities framework refers to the managerial processes, organisational routines and culture, knowledge and learning, which govern how things are done at the organisation. The concept of managerial and organisational processes is seen to have the roles of coordination, integration, learning and reconfiguration (Teece et al., 1997). The paths refer to the organisation's potential strategic paths and technological opportunities (Teece, 2023). The 1997 version of the dynamic capabilities framework was upgraded in 2007.

2.3.4 The 2007 version of the dynamic capabilities framework

In 2007, Teece published a restated version of the dynamic capabilities framework. This version was developed to be applied for practical purposes. Three major clusters – sensing, seizing and transforming dynamic capabilities – were introduced (Teece, 2007, p. 2).

The sensing capability is vital to allow organisations to monitor the industry, identify opportunities and threats, and adjust their strategy accordingly (Buzzao & Rizzi, 2021). Teece (2007) described the sensing capability as the ability to identify, develop, codevelop and assess technological developments in relation to customer needs. In relation to the energy industry, engineering managers (leaders) are expected to scan the environment and monitor the external environment to identify changes in market conditions, customer needs, technological developments and other relevant factors. The rise in the demand for renewable energy solutions to combat climate change and energy security issues provides an opportunity for engineering managers to guide their subordinates (engineers) to develop renewable energy technologies to meet customer needs.

The seizing capability refers to the organisation's ability to take advantage of opportunities arising from the environment or industry and capture value from it. This is done by strategically deploying resources, coordinating and integrating resources to efficiently innovate products and services and doing so with speed and agility to ensure the first-mover's advantage to gain a competitive advantage (Buzzao & Rizzi, 2021; Teece, 2007, 2014). The seizing capability is relevant to the current study as engineering managers are expected to formulate strategies to deploy and coordinate engineering resources speedily to take advantage of the opportunities to develop and innovate renewable energy technologies to meet customer demands and create a sustained competitive advantage.

The transforming dynamic capability allows organisations to continually transform and reconfigure their resources and capabilities in response to changing market conditions, customer needs and technological developments (Teece, 2007). In the context of the energy transition in the energy industry, the ability of engineering managers to promote the innovation performance of engineers and the ability to develop competitive renewable energy technologies determines the organisation's competitive advantage.

2.3.5 Additional concepts in the dynamic capabilities framework

In addition to the three major clusters of dynamic capabilities, the concept of learning and how it influences dynamic capabilities and innovation performance are discussed (Farzaneh et al., 2021). Since dynamic capabilities are concerned with building (rather than buying) resources and capabilities, learning is a crucial element in achieving dynamic capabilities that create a competitive advantage for organisations. Learning is a crucial component for an organisation's dynamic capabilities to operate effectively. Without the ability to learn, organisations would not be able to detect changes in the environment, capitalise on new opportunities or evolve their capabilities. Additionally, learning can offer a competitive edge as organisations that can swiftly learn and adapt are better positioned to succeed in a rapidly evolving business landscape.

Furthermore, Teece (2014) argues that the effectiveness of dynamic capabilities is determined by the type of leadership. Strong dynamic capabilities emanate from strong leadership that includes managerial cognition and an entrepreneurial approach to leadership (Teece, 2014). As a result, managers must sense, seize (coordinate and integrate resources), transform and reconfigure the organisation to develop technological improvements that are in line with future market trends and create novel business models. In the context of the current study, engineering managers are expected to use dynamic capabilities to promote innovation performance among engineers during the energy transition in South Africa.

2.3.6 Relevance of the dynamic capabilities framework to the study

The dynamic capabilities framework is appropriate to study the relationship between leadership styles, innovation performance and knowledge sharing because it provides a theoretical foundation for understanding how firms can develop and deploy resources and capabilities to respond to changing market conditions and achieve sustainable competitive advantage.

In the context of a study on the relationship between leadership styles, innovation performance, and knowledge sharing, the dynamic capabilities framework can be used to explain how different leadership styles can affect a firm's ability to develop and deploy dynamic capabilities related to innovation and knowledge sharing. For example, transformational leadership may encourage a culture of innovation and knowledge sharing, which can lead to the development of dynamic capabilities related to innovation and knowledge management. On the other hand, transactional leadership may not be as effective in fostering such a culture and may, therefore, hinder the development of dynamic capabilities related to innovation and knowledge management.

2.4 Conceptual Framework for Leadership and Innovation Performance through Dynamic Capabilities

The current study was conducted from the perspective of the 2007 version of the dynamic capabilities framework. The concepts related to the study are summarised in Table 2.1.

Table 2.1. The Study's Concepts

Concept	**Interpretation**	**Measures**	**References**
Sensing capability	Scanning the environment for opportunities	Environmental scanning, strategic foresight, market intelligence	Teece, 2023
Seizing capability	Ability to take advantage of technological opportunities	Coordinating and integrating resources, agility, resource allocation speed, innovation speed	Teece, 2023
Transforming capability	Ability to reconfigure resources	Resource reconfiguration, agility, flexibility, innovation	Teece, 2023
Learning capability	Continuous adaptation to environmental trends	Learning culture, knowledge acquisition, knowledge sharing, experimentation and innovation, continuous improvement	Teece, 2023

The current study's conceptual framework, showing hypotheses 1 to 5 (H1 to H5), is depicted in Figure 2.1.

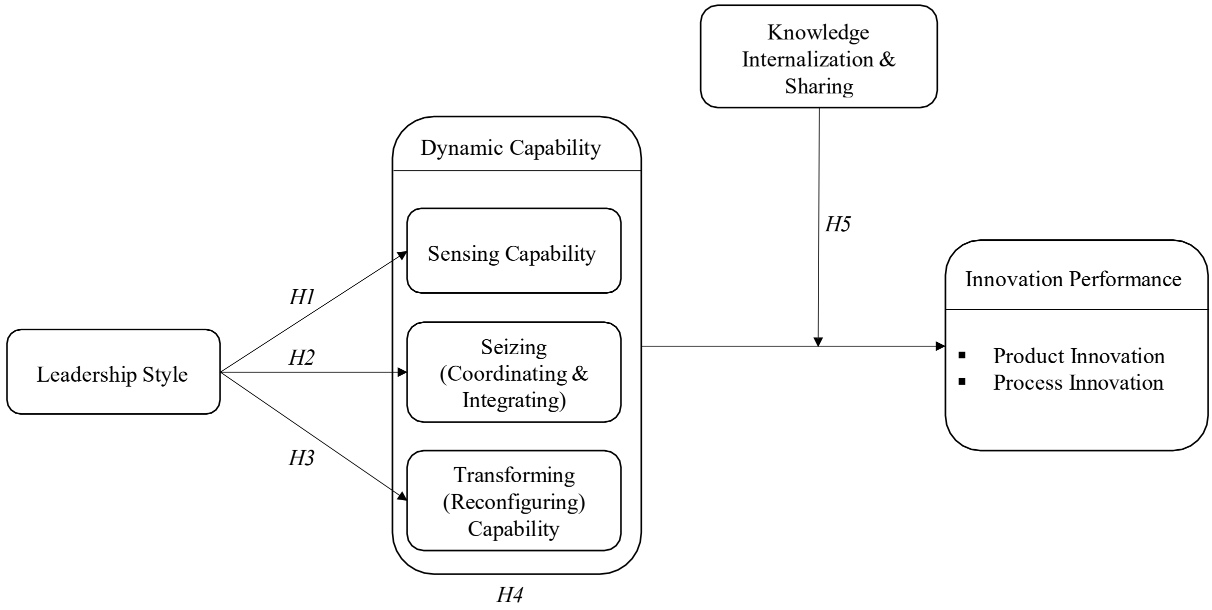

Figure 2.1: The Study's Conceptual Framework Showing Hypotheses 1 to 5 (H1 to H5)

2.4.1 Hypotheses 1 to 3: The leadership style and dynamic capabilities relationship

The dynamic capabilities framework states that the sustained competitive advantage of an organisation operating in a highly competitive technology-driven environment is dependent on the organisation's ability to build, integrate and reconfigure its resources to deliver superior products and services that meet customer needs (Eisenhardt & Martin, 2000; Teece et al., 1997). These dynamic capabilities are later described as the sensing, seizing and transforming capabilities (Teece, 2007). Hypotheses 1 to 3 (Figure 2.1) refer to the relationship between leadership style and the sensing, seizing and transforming dynamic capabilities (Akkaya, 2020). The hypotheses are:

H1: Leadership style is positively associated with organisational sensing capabilities

H2: Leadership style is positively associated with seizing (coordinating & integrating) capabilities

H3: Leadership style is positively associated with transforming (reconfiguring) capabilities

2.4.2 Hypothesis 4: The leadership style and innovation performance relationship

The relationship between leadership style and innovation performance through dynamic capabilities is a complex and multidimensional one (Figure 2.1). Leadership styles can significantly impact the innovation performance of a firm, and dynamic capabilities can act as a mediator in this relationship by enabling the firm to adapt and respond to changing market conditions (Gao & Sarwar, 2022). The fourth hypothesis explores the relationship between leadership styles, dynamic capabilities and innovation performance:

H4: The effect of leadership style on innovation performance is mediated by dynamic capabilities.

2.4.3 Hypothesis 5: Knowledge internalisation and sharing as a moderator

The relationship between leadership and innovation performance can be influenced by knowledge internalisation and sharing, which can act as a moderator in this relationship (Figure 2.1). Studies have found that transformational leadership is positively related to both knowledge sharing and innovation performance and can encourage knowledge sharing by creating a supportive organisational culture (Farhadi Rad et al., 2021). Hypothesis five, therefore, investigates the relationship between leadership style, innovation performance and knowledge internalisation and sharing:

H5: Leadership style has a greater positive impact on innovation performance in organisations with higher levels of knowledge internalisation and sharing.

3 Research Methodology

3.1 Introduction

The objective of this research methodology chapter is to detail the research design and data collection methods used to fulfil the study's purpose. The study aimed to identify the leadership styles that promote innovation performance among engineers in South Africa during the energy transition. The study considers the relationship between leadership styles, innovation performance, and knowledge internalisation and sharing through the perspective of the dynamic capabilities framework. The relationship between leadership, knowledge internalisation and sharing, and innovation performance was identified as a research gap for this study, as the literature review demonstrated that there is enough knowledge regarding the relationship between leadership and innovation performance. This study, therefore, involved hypothesis testing rather than being an exploratory or descriptive study based on the current knowledge base (Ochara, 2016). The study aimed to investigate the correlation and causality between a set of variables and to understand the relationship between the variables. This chapter details the research approach, research paradigm, research design, data collection methods, data analysis methods and ethical considerations pertaining to this study.

3.2 Research Paradigm

The research paradigm is defined as a worldview or perspective through which research is conducted and guides the research process implemented by the researcher (Khaldi, 2017). Creswell and Creswell (2017) define four main research paradigms: interpretivism, critical realism, pragmatism and positivism.

The interpretivist paradigm refers to the philosophical worldview that emphasises subjectivity and the unique interpretation of experiences. It is characterised by subjectivity, the development of unique insight and inductive reasoning and is associated with qualitative research methods. It seeks to answer the study's 'How does?' question. The critical realism research paradigm seeks to understand social sciences theories through subjective and objective human experiences. Due to the nature of this research paradigm, mixed research methods are encouraged. The pragmatism worldview, on the other hand, focuses on actions, consequences and results. There is less emphasis on research methods; rather, this paradigm prioritises finding solutions to a problem through different approaches, and thus, mixed research methods (quantitative and qualitative) are utilised (Creswell & Creswell, 2017; Rehman & Alharthi, 2016).

The positivist research paradigm refers to the worldview that is concerned with cause and effect and the relationships between research variables. The positivist paradigm is the appropriate paradigm for the current study because its objective is hypothesis testing of the various relationships between variables, as discussed in the previous section. Furthermore, similar studies by Chen et al. (2014) investigated the relationship between transformational leadership and innovation performance considering the effects of the variables corporate entrepreneurship and technology orientation through hypothesis testing and the use of the positivist paradigm.

3.3 Research Approach

The current study's objective was to investigate the relationship between engineering managers' leadership styles and engineers' innovation performance, considering knowledge internalisation and sharing within the organisation during the energy transition in South Africa. The literature review demonstrates an extensive knowledge base and several related studies have been conducted; therefore, the current study aimed to investigate the relationship between multiple variables included in the conceptual framework through hypothesis testing. Furthermore, deductive reasoning was employed to conduct this study; that is, a conceptual theory was proposed, and hypotheses were formulated. Data was collected, resulting in accepting or rejecting the hypotheses and the possible acceptance or modification of the proposed conceptual theory (Ochara, 2016). The research was, therefore, performed through a positivist paradigm or worldview. Based on these factors, the current study used a quantitative research approach (Creswell & Creswell, 2017; Ochara, 2016).

Quantitative research is a systematic research method that makes use of data collection and the analysis of numerical data to test hypotheses and answer research questions (Ochara, 2016; Sukamolson, 2007). The purpose of quantitative research is to explain and describe the observations derived from the numerical data. The data are analysed using various mathematically based models and statistical methods. The main advantage of using the quantitative research approach is to generalise the results obtained from a normal representative sample to the general population (Sukamolson, 2007).

In the case of the current study, the data collected was not numerical data. It was collected using quantitative methods, thus making this research approach appropriate for the study. If the collected data suggests that the sample follows a normal distribution and is representative of the population, the obtained results may be generalised across the entire population. Quantitative data collection methods are achieved through the design of research instruments that convert observations into numerical data that can be analysed through quantitative methods. To achieve the current study's objective, a survey questionnaire was used as the research instrument.

3.4 Research Design

Due to the nature of this study, a survey questionnaire was developed and used to collect data and perform quantitative analysis to determine the relationship between leadership styles, innovation performance, and knowledge internalisation and sharing. The questionnaire was designed as a group of pre-defined questions that were answered by respondents within defined alternatives. This was achieved through close-ended questions answered along the Likert scale. The survey questionnaire was a suitable research instrument for this study as multiple respondents from different locations were reached, and the required information was predetermined to be linked to the variables included in the conceptual framework. In addition, using a survey questionnaire for this study was advantageous as the results obtained from a representative sample of respondents may be generalised to the broader population (Ochara, 2016).

Using a survey questionnaire for this study has both benefits and limitations. The benefits include high efficiency and relatively low costs. A broader sample of the population can be reached to increase the validity and representation level of the sample, responses are objective, and generalisability to the population is possible.

The survey questionnaire was designed by considering the management problem, conceptual problem and this study's research questions. The research questions and conceptual framework were used to identify the variables and concepts investigated through the research instrument. The level of detail required from the data collected was established, and measurement questions were developed. The study's survey questionnaire is attached in Appendix A.

3.5 Data Collection

To achieve this study's objective, data was collected and analysed to test the abovementioned hypotheses and answer the research questions. To ensure the reliability and validity of the obtained results, careful consideration was given to the data collection methods. A survey was used to collect non-numerical data in a systematic and standardised way. Using the positivist paradigm, the analysis was conducted by looking for patterns in the obtained results to draw conclusions and generalise the findings to the population. To investigate the leadership styles that promote innovation performance among engineers during the energy transition in South Africa, the population, sample, sample procedure and survey instrument are detailed in the following sections.

3.5.1 Population and sample

This study used quantitative methods to analyse the non-numerical data through a positivist paradigm. The study's objective was to collect data from a representative sample and generalise the results to the population. It was, therefore, crucial that the appropriate population, sampling frame and sample were utilised for the study's accuracy, reliability and validity.

The study population refers to the clearly defined group of people to whom the study's results may be generalised. The sampling frame and sample were determined based on the population. The sampling frame refers to the listed group of people that is accessible to the researcher from which the sample is drawn. The sample is, therefore, the group selected to be part of the study and from which data is collected.

In the context of this study, the population refers to the group to which the findings related to innovation performance among engineers being promoted by leadership styles can be generalised. The study's population is engineers (defined as engineers and technicians) in South Africa. According to the Engineering Council of South Africa (ECSA, n.d.), the population of engineers in South Africa is 34000, 14800 of whom are professionally registered. Therefore, the population of the study is 34000 engineers (and technicians) who graduated from the country's recognised universities. The study's sampling frame is the number of engineers within the population that the researcher had access to. The sampling frame was accessed through the researcher's network of engineers, the network of engineers and engineering groups and organisations such as the International Council on Large Electric Systems and the South African Institute of Electrical Engineers. The sampling frame is estimated at 2000 engineers and technicians across South Africa. The sample, which is the group representative of the population, was determined based on accessibility and feasibility, considering the generally low response rates of surveys. The survey was to be distributed to the people in the sampling frame.

3.5.2 Sampling procedure

The data collection sample needs to be representative of the population, and the response rate needs to be high. The probabilistic sampling technique was used to select the survey's sample subjects because the study's main objective was the generalisability of the findings to the population. Probabilistic sampling techniques ensure that each person in the population has a certain chance or probability of being selected to participate in the study. The types of probabilistic sampling techniques are simple random, systematic, stratified and cluster sampling.

The stratified sampling method was chosen for the current study. In this case, the sample subjects are selected from pre-determined mutually exclusive groups within the population. For the purposes of the present study, sample subjects or respondents were selected from engineering disciplines that contribute towards the energy transition in South Africa. Therefore, the survey questionnaire was distributed to electrical, civil, chemical, mechanical and industrial engineers across. This method ensured that the sample was not only representative of the engineering population but of the various engineering disciplines involved in the energy transition.

Low response rates are characteristic of quantitative research through survey questionnaires. In this study, the study's importance and the respondent's value were outlined as a strategy to increase the response rate. In addition, the distributed survey questionnaire was not unnecessarily long to encourage respondents to complete it. Furthermore, the survey was distributed both online and in person to reach a larger number of the population.

3.5.3 Development of the research instrument

A survey questionnaire with close-ended questions and responses in the form of a five-point Likert scale was chosen as the research instrument to carry out the present study (Appendix A). The survey was primarily distributed electronically; however, hard-copy versions were distributed in some cases to increase the response rate. The survey questionnaire design is such that the survey questions were grouped according to the concept being investigated. The current study's survey questionnaire was organised into the following sections:

(a) Demographic information: This section collected data pertaining to the respondent's position, functional role and geographic location. The questions asked in this section included the respondents' role and engineering discipline. No personal information was collected, and anonymity was ensured.

(b) Sensing capabilities: This section asked questions regarding the ability of the engineering manager's leadership style to positively influence engineers' sensing capabilities to detect opportunities for innovation in the industry during the energy transition in South Africa.

(c) Seizing capabilities: This section contained questions relating to the ability of the engineering manager's leadership style to influence engineers' seizing, coordinating and integrating capabilities in designing innovative products, services or processes during the energy transition in South Africa.

(d) Transforming capabilities: This section included questions relating to the ability of the engineering manager's leadership style to positively influence the engineers' transforming and reconfiguring capabilities to take advantage of innovation opportunities during the energy transition in South Africa.

(e) Knowledge internalisation and sharing: This group of questions investigated the leader's cultivation of a knowledge internalisation and sharing culture and its influence on the engineer's ability to become innovative.

3.6 Data Analysis

The data obtained from the study were analysed to determine the leadership style that, through the dynamic capabilities framework, promotes innovation performance among engineers during the energy transition in South Africa. The IBM Statistical Program for Social Sciences (SPSS) version 15 statistical analysis tool is used to analyse the data. The data analysis process includes data screening or preparation, data familiarisation, assessing the goodness of data, hypothesis testing and analysis and interpretation of results.

The data screening phase of the analysis process involves the quality checks and preparation of data to be processed by SPSS. This includes coding, categorising, removing blank data and inputting data (in the case of surveys filled in hard copies). This ensured that the data was in the correct format for SPSS to process and produce useful data.

The data familiarisation phase involves processing demographic characteristics and calculating sample statistics that include the mean, standard deviation and correlation. The goodness of the data was assessed through reliability and validity analysis on SPSS. Hypothesis testing was conducted using statistical tests, including descriptive statistics, correlational analysis, inferential analysis and regression analysis.

3.7 Ethical Considerations

As the present study required that data be collected from human participants, ethics need to be considered. Informed consent from the sample subjects was obtained by attaching a cover letter to the survey that communicated the study's purpose, the duration of the survey, that anonymity would be maintained, that the survey was voluntary, and that the respondent could withdraw from the study at any time. Furthermore, the cover letter explained that the data provided by the respondents would be used for this study only and would not be reused in other contexts. Lastly, it stated that no data would be collected from the sample until ethical clearance had been granted by the University ethics committee (non-medical).

4 Research Findings

The objective of this research was to determine the characteristics of engineering managers' leadership styles that promote innovation performance among engineers during the energy transition in South Africa. The study was conducted by administering a survey as the research instrument, as discussed in the previous sections. This chapter presents and analyses the research findings in the form of statistical data supported by graphs and tables. The data from the 103 survey respondents underwent a data-cleaning process and were then tested for representativeness and suitability through reliability analysis, factor analysis and tests for normality. Descriptive data analysis was also performed using the IBM SPSS software.

4.1 Data Cleaning Process

Data cleaning was performed to prepare the survey data for analysis, ensuring its accuracy and completeness. The data set was checked for missing data and incomplete survey responses by scanning the survey data. Incomplete and blank responses were removed from the data set. Out of 110 responses, 15 (13.6%) were either incomplete or blank, resulting in a reduced data set of 95 responses and a higher quality data set. Once the data had been scanned for missing data, the data set was checked for duplicate responses by checking for multiple submissions from the same IP address. Furthermore, the first two questions asked the survey respondents to indicate whether they are engineers or technicians and which South African province they live in. These screening questions ensured that only eligible responses (based on profession and geographical location) were included in the data set, thus preventing the inclusion of non-target responses. Following the data cleaning process, a final data set of 95 responses with accurate and valid data was analysed.

4.2 Reliability Analysis

To ensure the consistency, stability and repeatability of the survey, reliability analysis was performed by computing Cronbach's alpha and interpreting its value. The Cronbach's alpha value was computed for each of the survey constructs – dynamic capabilities (sensing, seizing, transforming and learning) – using the IBM SPSS software.

The Cronbach's alpha values were interpreted using Landis and Koch's (1977) benchmarks to determine the reliability of each of the survey constructs (Figure 4.1).

Construct	Cronbach's Alpha	Interpretation
Sensing Capabilities	0.861	Almost perfect
Seizing Capabilities	0.898	Almost perfect
Transforming Capabilities	0.684	Moderately reliable
Learning Capabilities	0.920	Almost perfect

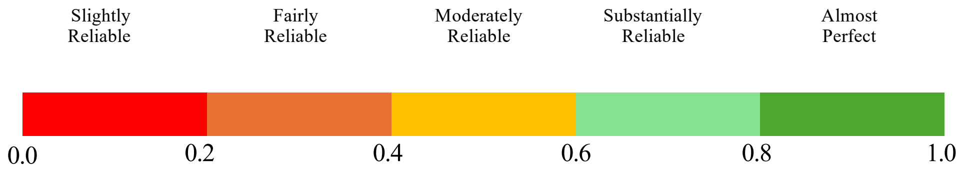

Figure 4.1: Reliability Analysis of Survey Constructs

In the interpretation of Cronbach's alpha values for this study, the reliability analysis for the sensing, seizing and learning capabilities exceeds the acceptable value of 0.7 (Landis & Koch, 1977). This indicates excellent internal consistency, and the items measuring these capabilities are both cohesive and reliable. The Cronbach's alpha value for the transforming capability is 0.684, which is considered substantially reliable; however, it is below the acceptable value of 0.7. Factor analysis was performed to identify underlying factors that contribute to correlations in the data set.

4.3 Descriptive Analysis

The survey data's descriptive analysis provides valuable insights into the respondents' demographic characteristics, focusing on their current roles, engineering disciplines and provinces of employment.

4.3.1 Current role in the organisation

Among the 95 participants, a significant majority identified their role as engineers, comprising 66.3% (n=63) of the sample, while technicians accounted for 33.7% (n=32). The mean score for this variable was 1.34, indicating a predominant representation of engineers. The median score of 1.00 further indicates that most respondents fell within this category.

4.3.2 Engineering discipline

The results indicate a strong inclination towards electrical engineering, which was reported by 58.9% (n=56) of the respondents. Other disciplines included mechanical engineering (8.4%, n=8), systems engineering (9.5%, n = 9), and smaller percentages in chemical engineering (2.1%, n=2) and civil engineering (2.1%, n = 2). The overall mean for this variable is 2.95, with a median of 1.00 and a standard deviation of 2.781, suggesting a diverse representation of engineering disciplines, albeit predominantly electrical engineering.

4.3.3 Province of employment

A considerable proportion of the participants are employed in Gauteng, accounting for 58.9% (n = 56) of the total respondents. This is followed by Limpopo at 20.0% (n = 19), while other provinces such as Western Cape (4.2%, n = 4) and Kwa-Zulu Natal (3.2%, n = 3) show significantly lower representation.

In summary, the demographic analysis reveals a predominance of engineers, particularly in electrical engineering, with a substantial representation from Gauteng. These findings not only reflect the current state of the engineering workforce in South Africa but also provide a foundation for further analysis of the relationships between leadership styles and innovation performance in the context of the energy transition.

4.4 Exploratory Factor Analysis

Following the reliability tests, the survey data was tested for construct validity through exploratory factor analysis using the IBM SPSS software. The Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) and Bartlett's Test of Sphericity are computed to perform factor analysis. The KMO value ranged between 0 and 1, where a number closer to 1 indicates that the data is adequately suited for factor analysis. KMO values above 0.6 are considered to be acceptable (Kaiser, 1974). Bartlett's Test of Sphericity checks for sufficient correlations between the variables. An acceptable result is a significance value that is less than 0.05. Table 4.1 shows the KMO and Bartlett's Test results for the survey data (n=88).

Table 4.1: Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) and Bartlett's Test Results

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.924
Bartlett's Test of Sphericity	Approx. Chi-Square	1359.487
	df	136
	Sig.	<0.001

df – degree of freedom; Sig. – significance value

The KMO and Bartlett's Test results indicate a high KMO value of 0.924 (Table 4.1). This suggests that the variables (sensing, seizing, transforming and learning) used to measure leadership styles and innovation are strongly related. In addition, the Bartlett's Test indicates that the survey variables are interconnected with potential latent factors that account for the correlations. Furthermore, the KMO and Bartlett's Test results, as they relate to the study of leadership styles and innovation during the energy transition in South Africa, suggest that the variables used are well suited for discovering latent structures through factor analysis. These structures assist in understanding the leadership behaviours that contribute to innovation performance.

4.5 Exploratory Factor Analysis Results

The outputs of the exploratory factor analysis (computed using the IBM SPSS software) are the structure matrix (Table 4.2) and factor correlation matrix (Table 4.3).

Table 4.2: Factor Analysis Structure Matrix

Structure Matrix		
	Factor 1	**Factor 2**
Learning: My manager encourages the sharing of lessons learned	0.889	0.597
Learning: My manager encourages frequent information-sharing sessions	0.870	0.561
Seizing: My manager gives access to resources (e.g. finances and time) to explore different technologies or solutions	0.855	0.576
Transforming: My manager accepts ideas proposed by employees	0.850	0.648
Sensing: My manager affords me training opportunities	0.828	0.483
Transforming: My manager promotes continuous improvement and innovation	0.828	0.649
Sensing: My manager gives opportunities and time for research and development	0.821	0.701
Learning: My manager allows time to attend training	0.803	0.541
Seizing: My manager mobilises resources to capture value from identified innovation opportunities	0.796	0.474
Seizing: My manager is flexible in how solutions are applied/work is done	0.786	0.543
Seizing: My manager promotes unconventional "never been done before" implementation methods	0.785	0.533
Learning: My manager encourages mentorship	0.745	0.495
Learning: My manager affords me opportunities to share knowledge through giving presentations	0.741	0.552
Transforming: My manager allows procedures to be changed and challenges the status-quo	0.722	0.456
Sensing: My manager allows me to explore different technologies or solutions	0.626	0.915
Sensing: My manager gives me opportunities to be exposed to the industry	0.702	0.803
Transforming: My manager is rigid and sticks to current procedures		

The pattern of item loadings in the structure matrix was used to deduce Factor 1 and Factor 2 as they relate to this study. Considering loadings above 0.8, Factor 1 is heavily loaded on the following items: (1) knowledge internalisation and sharing capability -–"My manager encourages the sharing of lessons learned" (0.889), (2) seizing capability – "My manager gives access to resources to explore different technologies" (0.855), (3) sensing capability – "My manager affords me training opportunities" (0.828) and (4) transforming capability – "My manager promotes continuous improvement and innovation" (0.828). These items suggest that Factor 1 represents leadership behaviours that support innovation by facilitating resource mobilisation, learning and knowledge-sharing. This is interpreted as "Enabling Leadership for Innovation", where managers support their teams by promoting learning opportunities, sharing knowledge and providing access to resources.

Factor 2 has higher loadings (greater than 0.8) for the following sensing capabilities: (1) "My manager allows me to explore different technologies or solutions" (0.915) and (2) "My manager gives me opportunities to be exposed to the industry" (0.803). The items suggest that Factor 2 focuses on exploration of and engagement with the external environment. This is done through managers who provide opportunities to explore the industry and new technologies. Factor 2 is, therefore, interpreted as "Opportunity Recognition and Exploration", where a manager's ability to promote external learning and exposure results in innovation performance.

The total variance table and Scree plot were computed using the IBM SPSS software to determine the eigenvalues for each of the factors. They demonstrate that Factor 1 and Factor 2 have eigenvalues higher than 1 (Figure 4.2), which is the criterion used to decide to retain them. Factor 1 and Factor 2 explain 61.579% and 7.066% of the variance, respectively. These factors capture a large portion of variability, as they explain a total of 68.644%.

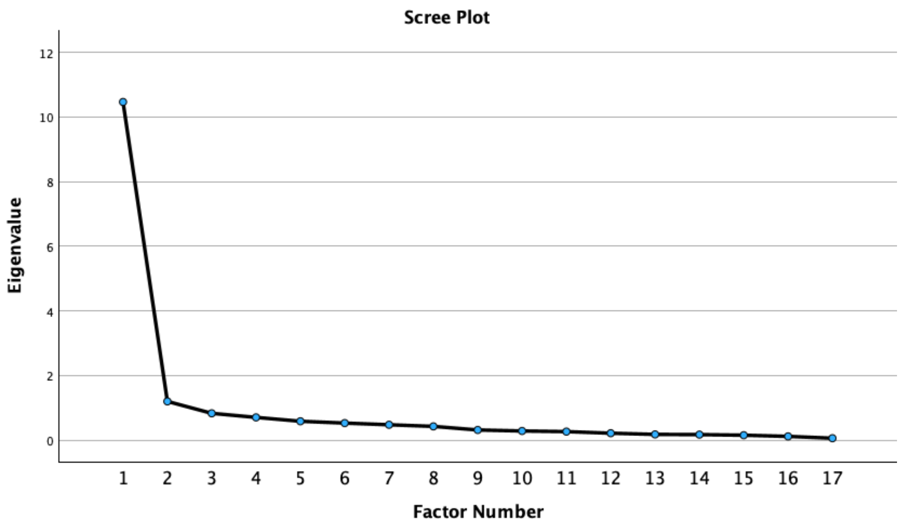

Figure 4.2: Scree Plot

Factor 1 is the dominating factor (61.579%), which suggests that most of the questions about leadership behaviours are related to this factor. Given the high loadings in the structure matrix on items related to sensing, seizing, transforming and knowledge internalisation and sharing capabilities, it reinforces the idea that Factor 1 could represent "Enabling Leadership for Innovation". This leadership style is characterised by behaviours that encourage resource mobilisation, knowledge-sharing and innovation support, all of which are critical for innovation performance. Factor 2 explains a smaller but still significant proportion of the variance (7.066%). This factor captures additional behaviours that are not fully explained by Factor 1 but are still important for leadership and innovation performance. The items loading more heavily on Factor 2 are those related to sensing capabilities (such as exploring new technologies and industry engagement), suggesting that Factor 2 may represent "Opportunity Recognition and Exploration". This factor highlights leadership behaviours that focus on external engagement and the discovery of new opportunities, which is essential for driving innovation in fast-changing environments like the energy sector.

Table 4.3: Factor Correlation Matrix

Factor	1	2
1	1.000	0.686
2	0.686	1.000

Factor 1 Enabling Leadership for Innovation

Factor 2 Opportunity Recognition and Exploration

The factor correlation matrix (Table 4.3) demonstrates a positive correlation of 0.686 between Factor 1 and Factor 2, which, according to Hair et al. (2022), corresponds to moderate correlation. In the context of the current study, this correlation factor means that these factors are not entirely independent. This implies that the leaders who focus on enabling innovation through internal support (Factor 1) are also likely to recognise and explore external opportunities for innovation (Factor 2).

4.6 Normality Tests

Normality tests were conducted on the survey data to determine whether the data follows a normal distribution. Using the IBM SPSS software, the Kolmogorov-Smirnov and Shapiro-Wilk tests were computed for each survey variable. These tests indicate significant departures from normality for all variables, with p-values less than 0.001. This suggests that the data does not follow a normal distribution, which is not unexpected given the Likert scale nature of the survey responses. The 5-point Likert scale used in the survey generates ordinal data. Ordinal data ranks responses but does not guarantee equal intervals between points, which often leads to non-normal distributions (Boone & Boone, 2012; Norman, 2010).

Given the nature of the Likert scale data and the non-normality results, non-parametric tests, which do not require the assumption of normality, were employed for subsequent analyses. Non-parametric tests allow for valid inferences to be made without relying on distributional assumptions. The factor analysis conducted (see Section 4.5) is still valid because the sample size of 95 provides sufficient power to uncover underlying factor structures even with non-normal data. This approach ensures that despite non-normality, the research can still yield valid, meaningful and reliable results that contribute to understanding leadership's impact on innovation during the energy transition.

4.7 Hypothesis Testing

This section presents the hypothesis testing results obtained through various analyses, including the Spearman correlation for the first three hypotheses and the PROCESS macro for SPSS, specifically designed to evaluate the direct and indirect effects of the independent variables on innovation performance within the context of the conceptual framework. Each hypothesis was analysed through a combination of correlation and regression models that assessed the relationships between leadership styles (sensing, seizing and transforming) and their respective mediators, as guided by the formulated hypotheses.

4.7.1 Hypothesis 1: Sensing leadership and innovation performance

The analysis for H1 sought to investigate the relationship between sensing leadership capabilities and innovation performance. Using Spearman correlation, a significant positive correlation was found ($r_s = 0.600$, $p < 0.01$), suggesting that higher levels of sensing capabilities are associated with increased innovation performance (Table 4.4). This finding aligns with the conceptual framework, indicating that leaders who effectively sense and respond to environmental changes are better positioned to foster innovation within their teams.

Table 4.4: Hypothesis 1 Spearman Correlation Results for Sensing Leadership (SS) and Innovative Performance (IP)

Variable	Correlation Coefficient (rs)	p-value
SS → IP	0.600	< 0.01

4.7.2 Hypothesis 2: Seizing leadership and innovation performance

H2 examined the correlation between seizing leadership capabilities and innovation performance. The Spearman correlation yielded a strong positive relationship ($r_s = 0.650$, $p < 0.01$), reinforcing the notion that leaders who capitalise on opportunities are likely to enhance innovation outcomes (Table 4.5). This supports the framework's assertion that seizing capabilities plays a critical role in driving organisational innovation.

Table 1.5: Hypothesis 2 Spearman Correlation Results for Seizing Leadership (SZ) and Innovative Performance (IP)

Variable	Correlation Coefficient (rs)	p-value
SZ → IP	0.650	< 0.01

4.7.3 Hypothesis 3: Transforming leadership and innovation performance

H3 focused on the relationship between transforming leadership capabilities and innovation performance. The Spearman correlation analysis indicated a robust positive correlation ($r_s = 0.700$, $p < 0.01$), signifying that leaders who engage in transformational behaviours significantly boost innovation performance (Table 4.6). This result is consistent with the theoretical perspective that transformational leadership fosters a culture of innovation by inspiring and motivating followers.

Table 4.6: Hypothesis 3 Spearman Correlation Results for Transforming Leadership (TF) and Innovation Performance (IP)

Variable	Correlation Coefficient (rs)	p-value
TF → IP	0.700	< 0.01

4.7.4 Hypothesis 4: Innovation performance through learning capabilities

The results for H4, which suggested that transforming leadership influences innovation performance through learning capabilities, were assessed using a multi-mediation model. The PROCESS output indicated a significant direct effect of transforming leadership on innovation performance, with a coefficient of 0.2137 ($p < 0.001$) (Table 4.7). This finding underscores the positive influence of transforming leadership on innovation performance, suggesting that leaders who adopt a transforming style can directly enhance innovation outcomes.

In terms of indirect effects, the total effect of transforming leadership on innovation performance, mediated by learning capabilities, sensing capabilities and seizing capabilities, was 0.3110, with significant contributions from each mediator. The specific indirect effects were: learning capabilities contributed 0.1252, sensing capabilities contributed 0.0917 and seizing capabilities contributed 0.0942, all demonstrating significant pathways ($p < 0.05$). These results suggest that transforming leadership not only directly impacts innovation performance but also does so through enhancing learning, sensing and seizing capabilities, thus aligning with the conceptual framework that advocates for a comprehensive view of leadership influence on innovation.

Table 4.7: Hypothesis 4 Results Summary

Variable	Coefficient	p-value	Indirect effect
TF → IP	0.2137	< 0.001	Total
L → IP	0.2541	< 0.001	L
SS → IP	0.2286	< 0.001	SS
SZ → IP	0.2091	< 0.001	SZ

IP: Innovation performance; L: learning capabilities; SS: sensing capabilities; SZ: seizing capabilities; TF: transforming leadership

4.7.5 Hypothesis 5: Sensing, seizing and transforming leadership

The results for H5 evaluated the interaction effects of sensing, seizing and transforming capabilities with learning capabilities on innovation performance. The analysis revealed that both sensing and seizing leadership styles significantly influence innovation performance, with coefficients of 0.4641 ($p < 0.001$) and 0.5767 ($p < 0.001$), respectively. The results show that the coefficients for learning capabilities were substantial as well, further validating the hypothesised relationships.

Notably, the interaction terms (sensing vs learning and seizing vs learning) did not yield significant results ($p > 0.10$), indicating that while sensing and seizing capabilities individually contribute to innovation performance, their interaction with learning capabilities does not enhance this relationship. The results for the interaction of transforming capabilities with learning capabilities demonstrated a significant effect ($p < 0.01$), suggesting that the relationship between transforming leadership and innovation performance is moderated by learning capabilities.

The conditional effects of transforming capabilities on innovation performance, based on varying levels of learning capabilities, indicate that at higher levels of learning capabilities, the positive effect of transforming leadership on innovation performance becomes more pronounced. For instance, when learning capabilities is at its highest value (5.0000), the effect of transforming capabilities on innovation performance was estimated at 0.2353 ($p < 0.001$), demonstrating that an increase in learning capabilities strengthens the impact of transforming leadership on innovation performance.

Table 4.8: Hypothesis 5 Results Summary

Variable	Coefficient	p-value	Interaction effect
SS → IP	0.4641	< 0.001	SS x L
SZ → IP	0.5767	< 0.001	SZ x L
TF → IP	0.6189	< 0.001	TF x L

IP: Innovation performance; L: learning capabilities; SS: sensing capabilities; SZ: seizing capabilities; TF: transforming leadership

4.8 Summary of findings

Overall, the hypothesis testing results reveal complex interactions between leadership styles and innovation performance, mediated by learning, sensing and seizing capabilities. These findings suggest that leadership styles significantly shape innovation outcomes, emphasising the importance of fostering a transformative leadership approach. This insight is crucial for organisations aiming to enhance their innovation performance, as it highlights the need to develop leadership that not only focuses on direct innovation strategies but also actively promotes capabilities that support innovation.

5 *Discussion*

The findings from this research explain the critical role that leadership styles play in promoting innovation performance among engineers during the energy transition in South Africa. The results derived from the 95 valid responses reveal significant insights into the relationship between various leadership capabilities and innovation outcomes. This chapter discusses the implications of these findings, reflecting on how they align with existing literature and theoretical frameworks.

The reliability analysis conducted using Cronbach's alpha demonstrated a strong internal consistency among the constructs measured. The results indicated that sensing, seizing and learning capabilities exhibited Cronbach's alpha values exceeding 0.7, with values of 0.834, 0.860 and 0.812, respectively, showing excellent reliability (Landis & Koch, 1977). In contrast, transforming capability had a Cronbach's alpha of 0.684, which, while considered substantially reliable, fell short of the acceptable threshold. This finding corroborates Nunnally and Bernstein (1994), who state that a Cronbach's alpha below 0.7 may indicate the need for further refinement of the measuring instrument. The reliability analysis thus provides a foundational understanding that leadership constructs must be consistently interpreted for effective analysis.

The demographic analysis highlighted a predominance of engineers, particularly in the electrical engineering discipline, with a significant representation from Gauteng. This demographic insight lays the groundwork for understanding the broader engineering workforce in South Africa and contextualises the subsequent findings regarding leadership styles and innovation performance.

The KMO value of 0.924 indicates excellent sampling adequacy, suggesting that the survey data are suitable for factor analysis (Kaiser, 1974). This finding is pivotal, as it supports the conceptual framework that links leadership styles to innovation performance. The significant Bartlett's Test result ($p < 0.001$) further substantiates the interconnectedness of the variables, highlighting the latent structures that contribute to innovation performance.

The KMO identified two main factors: "Enabling Leadership for Innovation" (Factor 1) and "Opportunity Recognition and Exploration" (Factor 2). Factor 1 accounted for 61.579% of the variance, highlighting the dominant role of leadership behaviours in facilitating knowledge-sharing, resource mobilisation and continuous improvement (Hair et al., 2022). This factor captures leadership behaviours that focus on creating an internal environment conducive to innovation. High loadings on this factor reflect leadership actions like encouraging knowledge-sharing, providing resources and promoting innovation-friendly policies. Leaders who excel in Factor 1 behaviours tend to focus on enabling their team members by giving them the tools, training and support necessary to explore new ideas and drive innovation. The strong explanatory power of this factor (61.579% of variance before rotation) indicates that much of the leadership behaviour impacting innovation performance is focused on resource mobilisation, support structures and internal development. These behaviours are crucial in driving innovation, aligning with Zhou and George's (2001) findings which indicate that enabling leadership fosters a culture of creativity and innovation.

Factor 2 accounted for 7.066% of the variance, emphasising the importance of external engagement in recognising and exploring new opportunities. This factor focuses on leadership behaviours related to sensing new opportunities and encouraging external engagement. Leadership behaviours in this factor include providing exposure to new technologies, encouraging exploration of external opportunities and promoting industry engagement. Leaders exhibiting Factor 2 behaviours are likely to focus on recognising emerging trends in the energy sector and equipping their teams to explore these opportunities. This factor explains an additional 7.066% of the variance and provides an essential complement to Factor 1 enabling behaviours by focusing on how leaders can seize external opportunities to drive innovation. This aligns with Senge's (1990) argument, which suggests that effective leadership involves fostering an environment where teams can engage with external innovations, thereby enhancing their overall performance.

The hypothesis testing revealed several important relationships:

H1: Sensing leadership and innovation performance

The significant positive correlation ($rs = 0.600$, $p < 0.01$) between sensing leadership capabilities and innovation performance supports the notion that effective sensing behaviours, such as recognising emerging trends, are essential for fostering innovation. This finding corroborates Tushman and O'Reilly's (1996) study, which argues that leaders who sense environmental changes can better mobilise their teams to exploit these changes for innovation.

H2: Seizing leadership and innovation performance

The significant positive correlation ($rs = 0.650$, $p < 0.01$) between seizing leadership capabilities and innovation performance reinforces the idea that leaders who capitalise on identified opportunities significantly enhance organisational innovation. This finding aligns with Teece's (2007) dynamic capabilities framework, which posits that seizing opportunities is critical for sustaining competitive advantage.

H3: Transforming leadership and innovation performance

The robust positive correlation ($rs = 0.700$, $p < 0.01$) between transforming leadership and innovation performance highlights the significant role that transformational leaders play in inspiring and motivating their teams. This finding is supported by Bass and Avolio (1994), who indicate that transformational leadership fosters an environment conducive to innovation by promoting enthusiasm and commitment among team members.

H4: Transforming leadership through learning capabilities

The significant direct effect of transforming leadership on innovation performance (coefficient = 0.2137, $p < 0.001$) illustrates the pivotal role of transformational leaders in enhancing innovation outcomes. Moreover, the total effect of transforming leadership, mediated by learning, sensing and seizing capabilities (total effect = 0.3110), underscores the complexity of leadership's impact on innovation. This aligns with the work of Dyer Jr and Wilkins (1991), which emphasises that effective leadership not only influences immediate outcomes but also cultivates an organisational culture that fosters learning and adaptability.

H5: Interaction effects of leadership capabilities

The analysis revealed that while both sensing and seizing leadership styles significantly influence innovation performance, their interactions with learning capabilities were not statistically significant ($p > 0.10$). However, the interaction of transforming capabilities with learning capabilities exhibited a significant effect ($p < 0.01$), indicating that high learning capabilities amplify the positive impact of transforming leadership on innovation performance. This finding is consistent with Gibson and Birkinshaw (2004), who argue that organisations that promote continuous learning are better positioned to innovate effectively.

Overall, the hypothesis testing results explain the intricate relationships between leadership styles and innovation performance, emphasising the mediating roles of learning, sensing and seizing capabilities. The findings underscore the necessity of fostering a transformative leadership approach that not only directly influences innovation outcomes but also nurtures an environment where learning and exploration are prioritised. Such insights are vital for organisations aiming to enhance their innovation performance during the energy transition, as they highlight the importance of developing leadership that is adaptive, resourceful and responsive to external changes.

6 Conclusion

This study explored the relationship between leadership styles and innovation performance among engineers in South Africa's energy sector during the energy transition. Specifically, it examined how sensing, seizing, transforming and learning capabilities influence innovation outcomes in an industry undergoing significant change. Using a sample of 95 engineers and technicians, the study's results reveal strong correlations between these leadership capabilities and innovation performance, with transforming leadership, in particular, emerging as a critical driver.

The findings contribute to the dynamic capabilities and leadership literature by demonstrating that leaders who emphasise opportunity recognition (sensing), resource mobilisation (seizing) and organisational learning (learning capabilities) enhance innovation performance. Moreover, transforming leadership – characterised by visionary, adaptive and motivational qualities – was found to be most effective in fostering a culture conducive to continuous innovation. These insights highlight the need for adaptive and transformational leadership styles in industries like energy, where technological disruption and environmental concerns require innovative solutions.

The study also identified that the energy transition necessitates not only technical expertise but also leadership that can steer organisations through complex changes. Leaders in this sector must be equipped to inspire their teams, recognise emerging opportunities, seize those opportunities and foster an environment where continuous learning drives innovation. In the South African context, the energy transition is particularly challenging, and effective leadership is pivotal in navigating this complexity while driving technological and organisational innovation.

While this study yielded valuable insights, several areas for future exploration remain. Broader investigations comparing leadership and innovation performance across various sectors, such as agriculture, transportation or manufacturing, may reveal whether similar leadership traits influence innovation in other contexts. Longitudinal studies could also deepen the understanding of how leadership styles affect innovation over time, providing insights into the sustainability of these effects. Additionally, conducting international comparisons, particularly in sub-Saharan Africa, could shed light on how the dynamics observed in South Africa apply in other regions undergoing similar energy transitions. Future research may also focus on the role of organisational culture in shaping leadership's impact on innovation, as well as exploring how gender and diversity in leadership influence the innovation process.

Several action plans can be recommended based on these findings. Organisations in the energy sector should develop leadership programmes that focus on cultivating transformational leadership traits that promote innovation. These programmes should emphasise a leader's ability to motivate teams, embrace change and execute a long-term vision. Leaders should also foster a culture of continuous learning through knowledge-sharing initiatives and mentorship. Encouraging collaboration across different engineering disciplines would help develop holistic approaches to addressing sector challenges. Additionally, leaders must adopt proactive strategies to sense and seize emerging opportunities in the external environment. Ethical considerations should also be integrated into leadership and innovation processes, ensuring that new technologies and practices align with long-term sustainability and social responsibility goals.

Despite the positive impact of leadership on innovation, several ethical considerations must be acknowledged. First, promoting specific leadership styles, such as transformational leadership, could inadvertently reinforce existing power dynamics, concentrating control over innovation among a select few. It is essential to ensure that leadership opportunities are inclusive and accessible at all organisational levels. Furthermore, innovation, especially when linked to automation, could displace workers, leading to job losses. Leaders should approach innovation with caution, balancing technological advancements with the need for workforce reskilling and redeployment. Finally, bias in leadership selection, favouring those perceived as innovative, could marginalise other effective leadership styles. Organisations should adopt inclusive leadership selection criteria that value diverse approaches, including empathy and collaboration.

In conclusion, the energy sector's successful transition to a more sustainable and innovative future largely depends on the leadership that guides it. Transformational leadership, combined with strong sensing, seizing and learning capabilities, could drive innovation and address the sector's pressing challenges. However, leaders must remain mindful of the ethical implications of their decisions, ensuring that innovation serves the greater good and benefits organisations, employees and society as a whole.

References

Abdelilah, Y., Bahar, H., Criswell, T., Bojek, P., Briens, F., & Le Feuvre, P. (2020). *Renewables 2020: Analysis and forecast to 2025*. International Energy Agency. https://iea.blob.core.windows.net/assets/1a24f1fe-c971-4c25-964a-57d0f31eb97b/Renewables_2020-PDF.pdf

Akkaya, B. (2020). Review of leadership styles in perspective of dynamic capabilities: An empirical research on managers in manufacturing firms. *Yönetim Bilimleri Dergisi*, *18*(36), 389–407. https://doi.org/10.35408/comuybd.681427

Akparep, J., Jengre, E., & Mogre, A. (2019). The influence of leadership style on organizational performance at TumaKavi Development Association, Tamale, Northern Region of Ghana. *Open Journal of Leadership*, *8*(1), 1–22.

Alblooshi, M., Shamsuzzaman, M., & Haridy, S. (2021). The relationship between leadership styles and organisational innovation: A systemic literature review and narrative synthesis. *European Journal of Innovation Management*, *24*(2), 338–370. https://doi.org/10.1108/EJIM-11-2019-0339

Alrowwad, A., Abualoush, S. H., & Masa'deh, R. (2020). Innovation and intellectual capital as intermediary variables among transformational leadership, transactional leadership, and organizational performance. *Journal of Management Development*, *39*(2), 196–222. https://doi.org/10.1108/JMD-02-2019-0062

Ayaz, S. (2022). Transformational leadership and dynamic capabilities in businesses: A review. *Uluslararası Yönetim Akademisi Dergisi*, *5*(3), 602–621.

Bass, B. M., & Avolio, B. J. (1994). Shatter the glass ceiling: Women may make better managers. *Human Resource Management*, *33*(4), 549–560. https://doi.org/10.1002/hrm.3930330405

Bazilian, M., Bradshaw, M., Gabriel, J., Goldthau, A., & Westphal, K. (2020). Four scenarios of the energy transition: Drivers, consequences, and implications for geopolitics. *Wiley Interdisciplinary Reviews: Climate Change*, *11*(2), e625. https://doi.org/10.1002/wcc.625

Boone Jr, H. N., & Boone, D. A. (2012). Analyzing Likert data. *Journal of Extension*, *50*(2), 48. https://doi.org/10.34068/joe.50.02.48

Buzzao, G., & Rizzi, F. (2021). On the conceptualization and measurement of dynamic capabilities for sustainability: Building theory through a systematic literature review. *Business Strategy and the Environment*, *30*(1), 135–175. https://doi.org/10.1002/bse.2614

Chen, Y., Tang, G., Jin, J., Xie, Q., & Li, J. (2014). CEOs' transformational leadership and product innovation performance: The roles of corporate entrepreneurship and technology orientation. *Journal of Product Innovation Management*, *31*(S1), 2–17. https://doi.org/10.1111/jpim.12188

Chiang, Y.-H., & Hung, K.-P. (2010). Exploring open search strategies and perceived innovation performance from the perspective of inter-organizational knowledge flows. *R&D Management*, *40*(3), 292–299. https://doi.org/10.1111/j.1467-9310.2010.00588.x

Cortes, A. F., & Herrmann, P. (2021). Strategic leadership of innovation: A framework for future research. *International Journal of Management Reviews*, *23*(2), 224–243. https://doi.org/10.1111/ijmr.12246

Creswell, J. W., & Creswell, J. D. (2017). *Research design: Qualitative, quantitative, and mixed methods approaches*. Sage publications.

DMRE. (2020). South Africa's Just Energy Transition Investment Plan (JET IP) for the initial period 2023-2027. The Presidency of the Republic of South Africa.

Dyer W. G., Jr., & Wilkins, A. L. (1991). Better stories, not better constructs, to generate better theory: A rejoinder to Eisenhardt. *Academy of Management Review*, *16*(3), 613–619. https://doi.org/10.5465/amr.1991.4279492

ECSA. (n.d.). *Transformation*. ECSA. https://www.ecsa.co.za/about/SitePages/Transformation.aspx#:~:text=There%20are%20approximately%2034%20000,blacks%20comprise%20less%20than%2012%25.

Eisenhardt, K. M., & Martin, J. A. (2000). Dynamic capabilities: What are they? *Strategic Management Journal*, *21*(10/11), 1105–1121. https://doi.org/10.1002/1097-0266(200010/11)21:10/11%3C1105::AID-SMJ133%3E3.0.CO;2-E

Elier, I., Kusumawardhany, P. A., & Setyawan, A. B. (2022). The effect of knowledge sharing, absorptive capacity, and individual creativity on innovation performance in East Java

Indonesia manufacturing companies. *Business and Finance Journal*, *7*(2), 175–182. https://doi.org/10.33086/bfj.v7i2.3482

Enel Green Power. (2023). *The energy transition*. Enel Green Power. https://www.enelgreenpower.com/learning-hub/energy-transition

Essex, S., & de Groot, J. (2019). Understanding energy transitions: The changing versions of the modern infrastructure ideal and the 'energy underclass' in South Africa, 1860–2019. *Energy Policy*, *133*, 110937. https://doi.org/10.1016/j.enpol.2019.110937

Fang, Y.-C., Chen, J.-Y., Wang, M.-J., & Chen, C.-Y. (2019). The impact of inclusive leadership on employees' innovative behaviors: The mediation of psychological capital. *Frontiers in Psychology*, *10*, 1803. https://doi.org/10.3389/fpsyg.2019.01803

Farhadi Rad, H., Shahi, S., & Fazeli, A. (2021). The role of transformational leadership and knowledge management in organizational innovation of schools. *Education and Self Development*, *16*(1), 40–53. https://doi.org/10.26907/esd16.1.05

Farzaneh, M., Ghasemzadeh, P., Nazari, J. A., & Mehralian, G. (2021). Contributory role of dynamic capabilities in the relationship between organizational learning and innovation performance. *European Journal of Innovation Management*, *24*(3), 655–676. https://doi.org/10.1108/EJIM-12-2019-0355

Ferreira, J., Cardim, S., & Coelho, A. (2021). Dynamic capabilities and mediating effects of innovation on the competitive advantage and firm's performance: The moderating role of organizational learning capability. *Journal of the Knowledge Economy*, *12*, 620–644.

Fischer, C., Malycha, C. P., & Schafmann, E. (2019). The influence of intrinsic motivation and synergistic extrinsic motivators on creativity and innovation. *Frontiers in Psychology*, *10*, 137. https://doi.org/10.3389/fpsyg.2019.00137

Forés, B., & Camisón, C. (2016). Does incremental and radical innovation performance depend on different types of knowledge accumulation capabilities and organizational size? *Journal of Business Research*, *69*(2), 831–848. https://doi.org/10.1016/j.jbusres.2015.07.006

Gao, J., & Sarwar, Z. (2022). How do firms create business value and dynamic capabilities by leveraging big data analytics management capability? *Information Technology and Management*, *25*, 283–304. https://doi.org/10.1007/s10799-022-00380-w

Gibson, C. B., & Birkinshaw, J. (2004). The antecedents, consequences, and mediating role of organizational ambidexterity. *Academy of Management Journal*, *47*(2), 209–226. https://doi.org/10.5465/20159573

Hafner, M., & Tagliapietra, S. (2020). The global energy transition: A review of the existing literature. In M. Hafner & S. Tagliapietra (Eds.), *The geopolitics of the global energy transition*, *Vol. 73. Lecture notes in energy* (pp. 1–24). OAPEN Library.

Hair, J. F., Babin, B. J., Anderson, R. E., & Black, W. C. (2022). *Multivariate data analysis* (8th ed.). Cengage Learning.

Hanifah, H., Abdul Halim, H., Ahmad, N. H., & Vafaei-Zadeh, A. (2019). Emanating the key factors of innovation performance: Leveraging on the innovation culture among SMEs in Malaysia. *Journal of Asia Business Studies*, *13*(4), 559–587. https://doi.org/10.1108/JABS-04-2018-0130

Harper, J., & Merten, S. (2021, June 16). *Engineers and geoscientists need new skills for a renewable future*. Elsevier. https://www.elsevier.com/connect/engineers-need-new-digital-skills-for-a-future-in-renewable-energy

Horner, H., How engineers drive the shift to renewable energy. *Engineering Institute of Technology.* https://www.eit.edu.au/how-engineers-drive-the-shift-to-renewable-energy/

Hou, B., Hong, J., & Zhu, R. (2019). Exploration/exploitation innovation and firm performance: The mediation of entrepreneurial orientation and moderation of competitive intensity. *Journal of Asia Business Studies*, *13*(4), 489–506. https://doi.org/10.1108/JABS-11-2017-0206

Huang, S., Chen, J., Mei, L., & Mo, W. (2019). The effect of heterogeneity and leadership on innovation performance: Evidence from university research teams in China. *Sustainability*, *11*(16), 4441. https://doi.org/10.3390/su11164441

IEA. (2021). *Net Zero by 2050. A roadmap for the global energy sector*. IEA. https://www.iea.org/reports/net-zero-by-2050

IRENA. (2022). *World Energy Transitions: Outlook 2022*. IRENA. https://www.irena.org/Digital-

Report/World-Energy-Transitions-Outlook-2022#page-0

Israel-Akinbo, S., & Fraser, J. S. G. (2018). The energy transition patterns of low-income households in South Africa: An evaluation of energy programme and policy. *Journal of Energy in Southern Africa*, *29*(3), 75–85.

Jing, Z., Hou, Q., Zhang, Y., & Zhao, Y. (2022). The relationship between female leadership traits and employee innovation performance—The mediating role of knowledge sharing. *Sustainability*, *14*(11), 6739. https://doi.org/10.3390/su14116739

Kaiser, H. F. (1974). An index of factorial simplicity. *Psychometrika*, *39*(1), 31–36. https://doi.org/10.1007/BF02291575

Ke, G. (2021, October). *Engineer: Responsible to energy transition for sustainable development and build the world back better and wiser from COVID*. World Federation of Engineering Organizations (WFEO). http://www.wfeo.org/wp-content/uploads/stc-energy/2021_Symposium/Gong-Ke-Engineer-responsible-energy-transition-2021-10-06.pdf

Khaldi, K. (2017). Quantitative, qualitative or mixed research: Which research paradigm to use? *Journal of Educational and Social Research*, *7*(2), 15–24.

Landis, J. R., & Koch, G. G. (1977). The measurement of observer agreement for categorical data. *Biometrics*, *33*(1), 159–174. https://doi.org/10.2307/2529310

Moccia, S., Zhao, S., & Flanagan, P. (2020). Innovation, dynamic capabilities, leadership, and action plan. *Journal of Enterprising Communities: People and Places in the Global Economy*, *14*(1), 113–127. https://doi.org/10.1108/JEC-10-2019-0108

Naqshbandi, M. M., Tabche, I., & Choudhary, N. (2019). Managing open innovation: The roles of empowering leadership and employee involvement climate. *Management Decision*, *57*(3), 703–723. https://doi.org/10.1108/MD-07-2017-0660

Norman, G. (2010). Likert scales, levels of measurement and the “laws” of statistics. *Advances in Health Sciences Education : Theory and Practice*, *15*, 625–632. https://doi.org/10.1007/s10459-010-9222-y

Novitasari, D., Supiana, N., Supriatna, H., Fikri, M. A. A., & Asbari, M. (2021). The role of leadership on innovation performance: Transactional versus transformational style. *JIMFE*, *7*(1), 27–36.

Nunnally, J., & Bernstein, I. (1994). *Psychometric theory* (3rd ed.). McGraw-Hill.

Ochara, N. M. (2016). *Practical business research: A knowledge discovery approach*.

Pichlak, M. (2021). The drivers of technological eco-innovation—Dynamic capabilities and leadership. *Sustainability*, *13*(10), 5354. https://doi.org/10.3390/su13105354

Pierce, W., & Ferreira, B. (2022). *Statistics of utility-scale power generation in South Africa in 2021*. CSIR. https://www.csir.co.za/sites/default/files/Documents/20220503-Statistics%20of%20power%20in%20SA%20H2-2021-CSIR-%5BFINAL%5D%20%281%29.pdf

Precht, P. (2021). *Technology and innovation in sustainable energy transition. Commonwealth Sustainable Energy Transition Series 2021/02*. The Commonwealth.

Rehman, A. A., & Alharthi, K. (2016). An introduction to research paradigms. *International Journal of Educational Investigations*, *3*(8), 51–59.

Rios, A., Olufon, D., & Yanosek, K. (2022, April 6). *Engineering the energy transition: An interview with Aleida Rios of BP*. McKinsey & Company. https://www.mckinsey.com/industries/travel-logistics-and-infrastructure/how-we-help-clients/global-infrastructure-initiative/voices/engineering-the-energy-transition-an-interview-with-aleida-rios-of-bp#/

Salim, N., Ab Rahman, M. N., & Abd Wahab, D. (2019). A systematic literature review of internal capabilities for enhancing eco-innovation performance of manufacturing firms. *Journal of Cleaner Production*, *209*, 1445–1460. https://doi.org/10.1016/j.jclepro.2018.11.105

Senge, P. (1990). Peter Senge and the learning organization. Dimension, 14.

Singh, S. (2022, June 9). *As the climate changes, so must the role of engineers*. University of Colorado Boulder. https://www.colorado.edu/herbst/2022/06/09/climate-changes-so-must-role-engineers

Sukamolson, S. (2007). *Fundamentals of quantitative research* [Course notes]. Language Institute Chulalongkorn University.

Teece, D. J. (2007). Explicating dynamic capabilities: The nature and microfoundations of (sustainable) enterprise performance. *Strategic Management Journal*, *28*(13), 1319–1350. https://doi.org/10.1002/smj.640

Teece, D. J. (2014). The foundations of enterprise performance: Dynamic and ordinary capabilities in an (economic) theory of firms. *Academy of Management Perspectives*, *28*(4), 328–352.

Teece, D. J. (2023). The evolution of the dynamic capabilities framework. In R. Adams, D. Grichnik, A. Pundziene & C. Volkmann (Eds.), *Artificiality and sustainability in entrepreneurship: Exploring the unforeseen, and paving the way to a sustainable future* (pp. 113–129). Springer International Publishing. https://doi.org/10.1007/978-3-031-11371-0_6

Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. *Strategic Management Journal*, *18*(7), 509–533. https://doi.org/10.1002/(SICI)1097-0266(199708)18:7%3C509::AID-SMJ882%3E3.0.CO;2-Z

Tseng, S.-M., & Lee, P.-S. (2014). The effect of knowledge management capability and dynamic capability on organizational performance. *Journal of Enterprise Information Management*, *27*(2), 158–179. https://doi.org/10.1108/JEIM-05-2012-0025

Tushman and O'Reilly 1996

Wilden, R., Gudergan, S. P., Nielsen, B. B., & Lings, I. (2013). Dynamic capabilities and performance: Strategy, structure and environment. *Long Range Planning*, *43*(1-2), 72–96.

Winter, S. G. (2003). Understanding dynamic capabilities. *Strategic Management Journal*, *24*(10), 991–995. https://doi.org/10.1002/smj.318

Yuen, Y., & Ng, X. (2021). Enhancing innovation performance of small and medium enterprises in Malaysia. *Management Science Letters*, *11*(3), 887–894.

Zhao, S., Jiang, Y., Peng, X., & Hong, J. (2021). Knowledge sharing direction and innovation performance in organizations: Do absorptive capacity and individual creativity matter? *European Journal of Innovation Management*, *24*(2), 371–394. https://doi.org/10.1108/EJIM-09-2019-0244

Zheng, J., Wu, G., & Xie, H. (2017). Impacts of leadership on project-based organizational innovation performance: The mediator of knowledge sharing and moderator of social capital. *Sustainability*, *9*(10), 1893. https://doi.org/10.3390/su9101893

Zhou, J., & George, J. M. (2001). When job dissatisfaction leads to creativity: Encouraging the expression of voice. *The Academy of Management Journal*, *44*(4), 682–696. https://doi.org/10.2307/3069410

Zou, L., & Zhu, Y. (2020). Research on innovation performance in heterogeneous region: Evidence from Yangtze Economic Belt in China. *Complexity*, *2020*(1), 8659134. https://doi.org/10.1155/2020/8659134

Appendix A: Survey Questionnaire

Dear Valued Participant

My name is Bakhekile Ndlovu, I am a Master of Business Administration (MBA) student at Wits Business School (WBS).

As part of my studies, I must undertake a research project. I am conducting research on **'Leadership styles that promote innovation performance among engineers during the energy transition in South Africa'** under the supervision of Dr Christopher Maier. The purpose of the study is to investigate the effects of the leadership style of engineering managers on the innovation performance of engineers. I kindly request your assistance in completing the survey to contribute to the outcome of the study and the completion of my master's degree.

About completing the survey:

- Completion of the survey is voluntary.
- You may stop participating from the survey at any stage.
- There are no personal identifiers or personal information collected therefore your identity will remain completely anonymous.
- The data collected will be kept confidential.
- It should take approximately 5 minutes to complete all the questions.
- By completing the survey you consent to the use of the data for the purposes of this research.

To participate, you must meet the following eligibility criteria:

- You currently work as engineer or technician in South Africa
- You directly or indirectly work on energy transition products services or processes

If you meet the above criteria, please click on the link below to access the survey:

https://wits.eu.qualtrics.com/jfe/form/SV_eeUHkAfWibfCSHQ

For any queries, contact: Email – 717143@students.wits.ac.za

Thanking you in advance.

Bakhekile Ndlovu

Section 1: Demographics

1. What is your current role in your organization?

   ☐ Engineer

   ☐ Technician

2. Which engineering discipline do you operate in?

   ☐ Electrical

   ☐ Mechanical

   ☐ Civil

   ☐ Chemical

   ☐ Other:

   Please Specify: _____________

3. Which province do you work in?

   ☐ Gauteng

   ☐ Western Cape

   ☐ Kwa-Zulu Natal

   ☐ Limpopo

   ☐ North West

   ☐ Free State

   ☐ Eastern Cape

   ☐ Mpumalanga

   ☐ Northern Cape

Section 2: Sensing Capabilities

		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
4.	My manager gives me opportunities to be exposed to the industry					
5.	My manager allows me to explore different technologies or solutions					
6.	My manager gives opportunities and time for research and development					
7.	My manager affords me training opportunities					

Section 3: Seizing Capabilities

		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
8.	My manager is flexible in how solutions are applied/work is done					
9.	My manager gives access to resources (eg. finances and time) to explore different technologies or solutions					
10.	My manager gives promotes unconventional "never been done before" implementation methods					
11.	My manager mobilises resources to capture vale from identified innovation opportunities					

Section 4: Transforming Capabilities

		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
12.	My manager is rigid and sticks to current procedures					
13.	My manager allows procedures to be changed and challenges the status-quo					
14.	My manager promotes continuous improvement and innovation					
15.	My manager accepts ideas proposed by employees					

Section 5: Knowledge Internalisation and Sharing

		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
16.	My organisation allows time to attend training					
17.	My organisation encourages mentorship					
18.	My organisation encourages frequent information-sharing sessions					
19.	My organisation encourages the sharing of lessons learned					
20.	My organisation affords me opportunities to share knowledge through giving presentations					