Exploring the barriers faced by South African universities in establishing spin-out companies

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DECLARATION

I hereby declare that the assignment submitted herewith to the North-West University in partial fulfilment of the requirements for the Master of Business Administration (MBA) degree is my own original work. It has been text-edited in accordance with professional communication standards and has not been previously submitted to any other institution for evaluation purposes.

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10749500
30 June 2024

DEDICATION

This dissertation is dedicated to the journey of personal and professional growth. It is dedicated to every challenge that shaped resilience, every setback that fuelled determination, and every triumph that reinforced the belief in one's abilities. It is a testament to the power of perseverance, continuous learning, and the unwavering commitment to self-improvement.

The passion to be the change and foster true leadership drives the journey of mastering the self to lead others. This self-improvement and professional development path were fuelled by a desire for intellectual stimulation and growth, building confidence and creating opportunities.

The extensive knowledge gained through my MBA journey is invaluable. It has profoundly reshaped my understanding of effective leadership and organisational behaviour, equipping me with the skills and insights necessary to drive positive change and foster a thriving workplace environment.

True leaders inspire and guide individuals toward shared objectives. The goal is to foster an organisational culture that not only motivates but also enhances the well-being and performance of employees. The commitment is to create an environment where team members feel valued, engaged, and empowered to contribute their best. Leadership is not just about achieving targets; it's about nurturing growth, fostering collaboration, and building a workplace where everyone can thrive.

This dedication also acknowledges the profound life experiences that shape one's journey. Overcoming adversities and achieving goals against the odds testify to the belief that what happens in life should not define where one goes. These experiences teach that true strength lies not in avoiding challenges but in facing them head-on and emerging stronger.

To anyone facing adversity, remember that circumstances do not dictate your future. Your response to these challenges shapes your path. Let your journey be defined by resilience, determination, and an unwavering belief in your potential.

PREFACE

This dissertation examines the barriers South African universities face in establishing spin-out companies, with a particular focus on the roles of leadership, digital transformation, and the Sustainable Development Goals (SDGs). It also includes a comprehensive analysis of the challenges and opportunities within South African universities' Technology Transfer Offices (TTOs) to provide practical solutions and strategic insights.

This study intends to bridge the gap between theoretical understanding and practical implementation in academic innovation and entrepreneurship. By highlighting the critical roles of leadership, digital transformation and integration, and alignment with SDGs, this research seeks to contribute to developing more effective strategies for fostering spin-out companies, thereby enhancing the economic and societal impact of university research.

The methodology employed in this dissertation is primarily qualitative. It utilises semi-structured interviews with key stakeholders, including TTO professionals, academic researchers, and industry experts. This approach allows for an in-depth exploration of personal experiences and perspectives, providing rich, contextual data that informs the analysis and recommendations.

This work is the culmination of the MBA academic effort and personal growth. I embarked on this academic journey because I am passionate about fostering true leadership and meaningful change. The extensive knowledge gained through my MBA has profoundly reshaped my understanding of effective leadership and organisational behaviour. It has prepared me for future roles where I can make a significant impact.

Overcoming significant adversities, including a battle with cancer, has reinforced my belief in the power of resilience and determination. This dissertation is a testament to the strength that comes from facing challenges head-on and continuously striving for self-improvement.

I hope this work will offer valuable insights and practical recommendations for universities, policymakers, and industry stakeholders in South Africa and beyond.

May it inspire others to pursue their goals with determination and resilience and to lead with integrity and compassion.

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I would like to thank our Heavenly Father for giving me health, strength, and blessings throughout this journey. His divine support has been the cornerstone of this achievement, making it possible.

To my children, my two wonderful boys who are also students, your perseverance and dedication to your studies have been a constant source of inspiration. I am incredibly proud of you both and deeply grateful for your understanding and encouragement during this demanding period. Pursuing my MBA alongside you allowed me to better understand and share in your academic challenges, creating opportunities for us to support each other with our coursework. You have always been my greatest joy and pride. Thank you for your patience and understanding when I couldn't spend precious time with you because of my MBA commitments.

To my husband, your support, love, and patience have been my foundation. Your thoughtful gestures, like bringing me countless cups of tea while I worked on my dissertation, provided comfort and encouragement during this journey. You understood when I could not spend time with you and supported me through late nights and weekends of work. Your unwavering belief in me and your endless sacrifices have been invaluable. Thank you for always being there.

To my family and friends, your encouragement, prayers, and constant motivation have been invaluable. Your faith in my abilities has helped me overcome many obstacles, and I am deeply thankful for your presence in my life.

I extend my heartfelt gratitude to the NWU Business School team for their support and resources, which made this journey possible. Thank you to my study leader, Dr. Johann Landsberg, for your invaluable advice, guidance, and patience. Your expertise and support were instrumental in navigating the complexities of this research.

I am also deeply grateful to my MBA team, the Magnificent 7. Your camaraderie, collaboration, and shared determination made this journey more manageable and enriching. Thank you for your friendship and collective spirit.

To all the participants who agreed to participate in this study, your willingness to share your experiences and insights was crucial to the success of this research. Your contributions are deeply appreciated, and this work would not have been possible without your input.

Finally, thank you to everyone who believed in me and offered support in various ways. This accomplishment is as much yours as it is mine.

ABSTRACT

This dissertation critically examines the barriers that impede spin-out companies' successful establishment and growth within South African universities. The study's primary objective is to identify and analyse these barriers and propose actionable strategies to enhance the commercialisation outcomes of university-based research. Through a qualitative research approach, semi-structured interviews were conducted with key stakeholders, including TTO representatives and university staff, to gain deep insights into the challenges faced by spin-out companies.

Five key barriers emerged from the analysis: financial constraints and funding limitations, organisational and bureaucratic inefficiencies, inadequate leadership and entrepreneurial culture, limited adoption of technological tools and digital transformation, and misalignment with the United Nations Sustainable Development Goals (SDGs). These barriers are critically analysed using theoretical models such as SWOT analysis and the Business Model Canvas, providing a structured understanding of the complexities within the commercialisation ecosystem.

The study also examines the impact of leadership styles within TTOs, explores the potential of digital transformation and artificial intelligence (AI) to enhance commercialisation processes, and investigates how spinouts can contribute to SDGs. Findings reveal that ineffective leadership and complex regulatory environments exacerbate the challenges faced by spinouts. At the same time, the absence of a robust ecosystem and limited industry partnerships further hinder their success.

Based on these findings, the study presents strategic recommendations to address each identified barrier. These include establishing university-linked seed funds, simplifying bureaucratic processes, fostering an entrepreneurial culture through training and mentorship, leveraging digital tools for efficiency, and advocating for policy reforms that support spin-out development. Additionally, aligning spin-out activities with SDGs is proposed to enhance societal impact and attract sustainability-focused investments.

The study’s conclusions emphasise the need for a holistic approach that integrates leadership, policy, technology, and sustainability considerations to create a conducive environment for spin-out companies. The recommendations will guide university administrators, policymakers, and TTO leaders in fostering a vibrant and sustainable spin-out ecosystem within the South African higher education sector. Future research directions are suggested to explore external stakeholders' perspectives, conduct comparative studies with international contexts, and quantitatively assess the impact of digital transformation initiatives on spin-out success.

This dissertation contributes to the growing body of knowledge on academic entrepreneurship. It provides practical insights for enhancing the commercialisation of university research in South Africa, ultimately supporting national innovation and economic development goals.

KEYWORDS AND CORE CONCEPTS

Academic Entrepreneurship

Academic-Industry Collaboration

Commercialisation Challenges

Digital Transformation in Higher Education

Funding and Venture Capital Constraints

Innovation Barriers in South Africa

Intellectual Property (IP) Management

Leadership in Technology Transfer

Organisational and Bureaucratic Barriers

Publicly Funded Research

Regulatory and Policy Barriers

Sustainable Development Goals (SDGs) Alignment

Technology Transfer Offices (TTOs)

University Spin-out Companies

LIST OF ABBREVIATIONS

ABBREVIATIONS	DESCRIPTION
AI	Artificial Intelligence
HEI	Higher Education Institution
IPR Act	Intellectual Property Rights from Publicly Financed Research and Development Act No 51 of 2008
IP	Intellectual Property
MBA	Master in Business Administration
NIPMO	National Intellectual Property Management Office
NWU	North-West University
POPIA	Protection of Personal Information Act
R&D	Research and Development
SDGs	Sustainable Development Goals
TTO	Technology Transfer Office
TT	Technology Transfer
UK	United Kingdom
US	United States
USP	Unique Selling Proposition

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CHAPTER 1 INTRODUCTION AND BACKGROUND

1.1 Introduction

This study scrutinises the underutilised potential of university spinouts in South Africa, entities borne from academic innovation capable of fostering economic and technological development. Globally, spin-out companies have emerged as key drivers of innovation, particularly in economies where university-industry partnerships and investment ecosystems are well-established (Siegel *et al*., 2007:111-133). Despite their promise, South African universities often encounter barriers in realising the full potential of these ventures, necessitating an urgent re-examination of the establishment and nurturing processes.

This investigation seeks to unearth the obstacles that Technology Transfer Offices (TTOs) face, ranging from skill gaps among researchers to intricate equity allocation debates that may dampen entrepreneurial zeal. Unlike in more mature innovation ecosystems, South African spinouts contend with structural barriers such as limited venture capital, complex regulatory frameworks, and weak commercialisation pathways (Kruss, 2015:397-415). By dissecting these challenges, the research aims to bolster existing knowledge and provide actionable strategies to enhance the efficacy of TTOs in launching and sustaining spin-out companies. The study's findings will offer invaluable guidance to stakeholders within the South African academic landscape, propelling the nation's economic growth and fortifying its innovation framework.

1.2 Background to the study

There is widespread recognition of universities' potential to drive economic growth and technological advancement (Etzkowitz, 2003:293-337; Klofsten *et al.*, 2019:149-159). By transitioning academic research into commercial ventures, universities play an important role in fostering innovation and entrepreneurial development. Spin-out companies serve as a critical conduit for this transition, effectively bridging the gap between academic research and industry (Hayter *et al.*, 2018; Shane, 2004:115).

The South African context presents a unique set of challenges that have limited the creation and success of university spinouts. Despite the high-quality research output and innovative potential, South African universities, including universities of

technologies, have been unable to create as many spin-out companies as their global counterparts (Kruss, 2015:397-415). Several barriers have been identified, ranging from leadership issues in TTOs to academic inventors' reluctance to take active ownership of the spin-out process (Bolzani *et al.*, 2015; Wright *et al.*, 2007:481-501).

There is an opportunity for in-depth exploration and contribution to fostering better strategies and policies for spin-out companies in South Africa. The study investigates the intricacies of these barriers and how they affect the successful creation of spin-out companies, thus serving as an invaluable resource for university administrators, policymakers, and researchers seeking to drive technological transfer and economic growth.

1.3 Problem statement

Despite the recognised potential of university spin-out companies in stimulating economic development, fostering innovation, and generating third-stream income, South African universities have struggled to establish these entities through their TTOs successfully (Etzkowitz, 2003:293-337; Tengeh & Rorwana, 2017:140-155). Despite the well-recognised potential of university spinouts in stimulating economic development, fostering innovation, and generating third-stream income, South African universities have not yet succeeded in this area (Crawley *et al.*, 2020; Meyer, 2003; Neves & Brito, 2020).

Several factors contribute to this problem, including:

- **Lack of empowerment in TTOs** slows down the effective creation of successful spinouts (Cunningham *et al.*, 2020; Siegel *et al.*, 2007:111-133), TTOs in South African universities often lack the autonomy and resources to make strategic commercialisation decisions efficiently. This results in delays in securing industry partnerships, negotiating intellectual property (IP) rights, and facilitating the transition of research into viable commercial ventures. Participants in Chapter 4 noted that bureaucratic constraints within universities create bottlenecks that slow down the spin-out process, discouraging entrepreneurial initiatives (4.3.2).
- **Insufficient funding and financing**, limiting the ability to support spin-out ventures from inception to market entry (Wright *et al.*, 2004). A critical limitation

for spin-outs is the lack of access to early-stage funding. Unlike developed markets with robust venture capital ecosystems, South African spin-outs struggle to secure private-sector investment, leaving them dependent on slow and restrictive public funding mechanisms. Interview findings (Chapter 4.3.1) highlight that the scarcity of local venture capital and restrictive grant conditions often result in promising innovations failing before reaching commercial viability.

- **Ineffective leadership within the TTO**, characterised by a lack of strategic vision and inadequate management skills, impeding the TTO's capacity to facilitate technology transfer and support spin-out companies (Huyghe *et al.*, 2014:289-307; Sonmezturk Bolatan *et al.*, 2022:101909). Strong leadership is essential in fostering an entrepreneurial culture within universities, yet many TTOs suffer from passive or authoritarian leadership styles that stifle innovation. Thematic analysis (Chapter 4.3.3) identified that hands-on, transformational leadership significantly enhances spin-out success, while rigid bureaucratic leadership approaches hinder commercialisation efforts. Participants highlighted that ineffective leadership leads to missed opportunities for market entry and weak industry engagement.
- **Deficiencies in the entrepreneurial knowledge**, **skills and experience of academic researchers**, affecting their capacity to commercialise research effectively (Krabel & Mueller, 2009:947-956). Many academic researchers lack the business acumen, industry networks, and commercialisation experience needed to develop spin-outs successfully. The findings (Chapter 4.3.3) indicate that a lack of structured entrepreneurship training and mentorship within universities prevents researchers from effectively navigating the business aspects of commercialisation. Without such support, spin-out ventures struggle to establish sustainable business models.
- **A concerning trend of inventors avoiding taking ownership and accountability in the commercialisation process**, which undermines the sustainability and success of spin-out companies (Lockett *et al.*, 2003:185-200). Weak university-industry linkages further exacerbate the challenges faced by spin-out companies. Participants (Chapter 4.3.2) reported that many TTOs struggle to establish partnerships with industry due to restrictive policies, lack of funding incentives, and bureaucratic complexities. Furthermore, South African

regulatory frameworks, including the Intellectual Property Rights from Publicly Financed Research Act (IPR Act 51 of 2008), add additional layers of complexity, making the commercialisation process more cumbersome compared to global counterparts.

There is a lack of empirical research focusing on these specific barriers within South African universities, particularly concerning the roles of TTO leadership and the integration of digital transformation and artificial intelligence (AI) in overcoming these challenges. This gap in the literature hinders the development of targeted strategies to enhance the effectiveness of TTOs and the success of spin-out companies in South Africa.

Therefore, it is critical to investigate these barriers within the South African context to develop practical and actionable solutions tailored to this unique environment (Franklin *et al.*, 2001:127-141; Kaushik *et al.*, 2014:133-159). This research fills a gap in academic knowledge and has significant managerial implications. (Siegel & Wright, 2015:582-595). By addressing this gap, the study aims to contribute new insights to the literature and provide university administrators and TTO managers with evidence-based recommendations. A better understanding of these barriers will enable them to make informed decisions that promote the successful establishment of spin-out companies, thereby increasing wealth creation, accelerating innovation, and fostering socio-economic development (Lockett *et al.*, 2003:185-200; Siegel & Wright, 2015).

This research study seeks to answer the question: "Why have South African universities not been able to establish more spin-out companies successfully, and how can they overcome the barriers that have hindered their efforts?" (Harlow, 2021:285-303; Mustar *et al.*, 2006:289-308).

1.4 Research objectives

For clarity, the research objectives are categorised as follows: The primary objective defines the central aim of the study. The theoretical objectives focus on engaging with existing literature and conceptual models related to spin-out companies. The empirical objectives guide data collection and analysis to address real-world challenges faced by TTOs in South African universities.

1.4.1 Primary objectives/Research aim

The primary objective (empirical focus) of this study is to identify and analyse the barriers preventing South African universities from successfully establishing more spin-out companies through their TTOs.

1.4.2 Secondary objectives

The secondary objectives are:

- To evaluate the influence of leadership effectiveness within TTOs on the successful creation and management of spin-out companies in South African universities.
  Explanation: This objective delves into how leadership qualities and management practices within TTOs affect the establishment and sustainability of spinouts, addressing a critical and underexplored barrier.
- To assess the role of artificial intelligence (AI) and digital transformation in enhancing the commercialisation process of university research within South African TTOs.
  Explanation: This objective explores the impact of modern technologies on commercialisation, offering insights into how digital tools can overcome existing barriers and streamline operations.
- To analyse the contribution of university spin-out companies to the United Nations Sustainable Development Goals (SDGs) within the South African context.
  Explanation: This objective links spin-out activities to global sustainability goals, highlighting their broader societal impact and providing a unique angle to the research.

1.5 Primary research question

What are the primary barriers universities in South Africa face in establishing spin-out companies?

1.6 Scope of the study

1.6.1 Field of the study

General Management, Entrepreneurship and Innovation.

The scope of this study is positioned at the intersection of General Management and Entrepreneurship. In General Management, the research delves into the principles, practices, and strategies organisations employ to achieve their objectives, specifically focusing on how they navigate the complexities of spin-out company formation at South African universities. This encompasses understanding organisational structures, resource allocation, leadership styles within the TTO, and decision-making processes that foster innovation and growth within the spin-out ecosystem. It underscores organisational culture's pivotal role in shaping innovation dynamics and the successful development of spinouts, highlighting how cultural elements can significantly influence the efficiency and effectiveness of technology transfer and commercialisation activities.

Simultaneously, the entrepreneurship and innovation facet of the study sheds light on the entrepreneurial journey, from the inception of an innovation or research idea to its transformation into a viable business venture. By integrating general management and entrepreneurship principles, the research seeks to elucidate the challenges faced during the spin-out process and the entrepreneurial strategies employed to overcome them. This dual focus allows for a comprehensive exploration, ensuring that the managerial and entrepreneurial nuances of spin-out company formation at universities in South Africa are captured in depth.

1.6.2 Sector/industry/business under investigation

The field of this study lies at the intersection of Entrepreneurship, TT, and the broader scope of Business Management and Innovation Studies. The focus is on the commercialisation process of university research by creating spin-out companies. This involves a deep dive into the management of TTOs in South African universities, leadership dynamics, academic entrepreneurship, and the role of these elements in influencing the success of spin-out companies. It explores these issues from a business research perspective, considering organisational and managerial factors that affect the successful conversion of academic knowledge into commercial enterprises.

1.7 Geographical demarcation

The geographical demarcation of this study is firmly rooted within the vibrant and diverse boundaries of South Africa.

1.8 Research design and methodology summary

1.8.1 Literature review

The literature review forms the foundation of this study, critically evaluating and synthesising relevant studies, theories, and findings related to university spin-out companies and their formation through TTOs (Snyder, 2019:333-339). Key topics include the role and challenges of TTOs in South African universities, barriers to successful spin-out formation, and the influence of leadership, Digitalisation, and SDGs.

1.8.2 Empirical study

A qualitative research approach was used to explore the barriers South African universities face in establishing spin-out companies. Data was collected through semi-structured interviews with key stakeholders, including TTO professionals, researchers, and experts. This approach allowed for an in-depth understanding of the experiences and perspectives of individuals directly involved in this field (Saunders *et al.*, 2003).

1.8.3 Research paradigm

This study aligns with the interpretivist paradigm, focusing on understanding individuals' subjective experiences and interpretations. This paradigm supports the qualitative approach, aiming to uncover the complexities of human sense-making within the context of TTO activities (Bryman *et al.*, 2014:20).

1.8.4 Research approach

An inductive methodology guided this investigation, allowing for the development of theories and identifying patterns based on the data collected. This approach was suitable for exploring the challenges and barriers in the spin-out company creation process without being constrained by pre-existing theories (Bryman *et al.*, 2014:4-12).

1.8.5 Methodological choice

The study employed a qualitative methodological choice, emphasising depth over breadth. This choice is aligned with the research paradigm and approach, aiming to capture the complex challenges and subjective experiences of key stakeholders in South African universities (Antwi & Hamza, 2015:217-225).

1.8.6 Research strategy

Semi-structured interviews were the primary strategy for data collection. This method allows participants to express their perspectives and experiences in their own words, providing richer, more detailed data (Bell *et al.*, 2022).

1.8.7 Time horizon

The research was conducted cross-sectionally, with data collected over several months, allowing for in-depth data collection and analysis (Saunders *et al.*, 2016). This approach provided a comprehensive snapshot of the current situation within South African universities' TTOs.

1.8.8 Study population and sampling

The study population comprised of TTO professionals, researchers, and experts in the technology transfer setting within five different South African universities. A purposive sampling technique was employed to select participants with rich knowledge and experience related to the research topic.

1.8.9 Designing the measuring instrument

Semi-structured interviews were the primary measuring instrument, using a guide to facilitate discussions about the barriers to establishing spin-out companies. This flexible approach allowed for the exploration of unexpected themes (Merriam & Tisdell, 2015:1-2).

1.8.10 Collection of data

Data was collected through personalised, semi-structured interviews, either in-person or via digital platforms. This method ensured meaningful interactions and quality data,

capturing participants' unique insights and experiences from five different South African universities (Bryman & Bell, 2015).

1.8.11 Data analysis

Thematic analysis was used to examine the interview data systematically. Manual coding identified key patterns, themes, and relationships within the responses, allowing for a thorough and insightful analysis aligned with the study's objectives.

1.8.12 Trustworthiness

Ensuring the trustworthiness of this study involved a comprehensive strategy that includes reliability, validity, credibility, transferability, dependability, and confirmability. Implementing a clear research design guarantees transparency and reproducibility, enhancing reliability. Data triangulation improved validity by verifying findings from multiple sources and reducing bias.

Credibility is emphasised through prolonged engagement with the data and member checks, where participants validate the accuracy of their interpreted responses. Detailed descriptions of the research context and methodology support transferability, making the findings applicable to other universities and their TTOs in South Africa and potentially beyond.

Dependability was ensured by maintaining an audit trail of all research processes, adjustments, and decisions, reflecting the dynamic research context. Confirmability was achieved through an objective stance in data analysis and rigorous reflexivity to minimise biases.

A representative sample from South African universities and their TTOs ensured the generalizability of the findings. These strategies aim to provide a thorough and unbiased exploration of the research topic, ensuring the integrity of the findings and their meaningful contribution to the field.

1.9 Ethical considerations

Ethical considerations are paramount in any research project and form the backbone of the study's integrity. Ensuring that the research is conducted responsibly and with

respect for all participants is an obligation that cannot be overlooked (Bryman & Bell, 2015).

For this investigation, strict adherence to the principles outlined in the Protection of Personal Information Act (POPIA, 2019) was maintained. This legislation provides guidelines on handling participants' contact details ethically and lawfully, safeguarding the integrity and confidentiality of participants' information, and ensuring its use exclusively for legitimate and lawful research purposes.

Explicit, informed consent was obtained from each participant through consent forms that clearly communicate the study's purpose, nature of involvement, and assurances of confidentiality (Creswell & Creswell, 2017). Participants will be informed that their involvement is entirely voluntary and that they may withdraw from the study at any point without repercussions (Merriam & Tisdell, 2015).

During data analysis, impartiality was maintained to avoid any biases that might skew the results. Confidentiality in reporting findings was ensured, with no identifying features linked to participants' responses in any resulting publications or presentations.

Strict adherence to these ethical guidelines was maintained throughout the research process. Ethical protocols have been duly observed and adhered to. Participants were informed about the study's objectives and ensured confidentiality and anonymity, with their consent documented in the Informed Consent Form.

1.10 Contribution of the study

This study explores the barriers South African universities face in establishing spin-out companies, highlighting their evolving role in driving economic contributions to society amidst decreasing government funding (Audretsch *et al.*, 2014:301-312).

Theoretical Contribution: Enhances the literature on academic innovation and entrepreneurship in South Africa by bridging the gap between theoretical understanding and practical challenges in establishing university spin-out companies (Mosey & Wright, 2007:909-935).

Practical Contribution: Provides a practical framework for Technology Transfer Offices (TTOs), policymakers, academic leaders, and industry stakeholders to refine

processes and foster an environment conducive to spin-out companies' growth (Lockett & Wright, 2005:1043-1057).

Industry Contribution: Informs industry best practices and offers strategies and recommendations tailored to the South African context, serving as a reference for TTOs to systematically address barriers and fully realise spin-out companies' potential (Clarysse, Tartari*, et al.*, 2011:1084-1093).

1.11 Limitations of the study

This study acknowledges several limitations. Sampling bias may arise due to purposive sampling, potentially limiting the generalizability of the findings (Etikan *et al.*, 2016:1-4). The scope of the study is confined to South African universities, which may not be directly applicable to other settings (Bryman, 2016:158). The reliance on self-reported data through semi-structured interviews can introduce biases such as recall and social desirability biases (Merriam & Tisdell, 2015:187; Podsakoff *et al.*, 2003:879). Qualitative methods provide depth but may lack statistical generalisability (Creswell & Miller, 2000:124-130). Data triangulation can introduce complexity and potential biases if different data sources contradict each other (Creswell & Creswell, 2017:150). Technological barriers in digital interviews might lead to data loss or misinterpretations (Drabble *et al.*, 2015:118-133). Temporal limitations mean the findings capture a specific moment in time, which may evolve (Blagoev *et al.*, 2024:2152-2196). Geographical constraints focus on South African universities, limiting their applicability to other regions (Miles, 2011:105). Dependence on participant recollection and potential confirmation bias are also acknowledged (Podsakoff *et al.*, 2003:879). Despite these limitations, the study offers valuable insights to achieve its research objectives.

1.12 Layout of the study

This dissertation was structured methodically to provide readers with a coherent understanding of the research journey. The layout ensures a progressive information flow, from the foundational elements to the culminating insights (Williams *et al.*, 1995). Each chapter was designed with a specific purpose, building upon the preceding sections and setting the stage for the subsequent ones. The following provides a

concise overview of the layout, offering a glimpse into the key components, the logical sequencing of the study, and ease of understanding.

Chapter 1: Introduction

The Introduction serves as the gateway to the dissertation, providing a concise overview of the research topic and its significance. This chapter introduces readers to the research problem, its context, and the overarching objectives guiding the study. Moreover, it delineates the scope and boundaries of the investigation, establishes its relevance in the current academic and practical landscape, and previews the structure of subsequent chapters. This chapter aims to engage readers and establish a foundation for the rest of the dissertation.

Chapter 2: Literature review

This chapter delves deep into the vast body of literature concerning university spin-out companies. The objective was to encapsulate prior academic discussions, empirical findings, and theoretical frameworks that underpin the commercialisation of academic research through the formation of spin-out companies.

Drawing from the foundational work of scholars, it situates spinouts within the larger context of academic entrepreneurship and innovation. A key focal point is the introduction to university spin-out companies, emphasising their significance and transformative power in both academic and commercial sectors. A deeper look into the role of TTOs was also presented. These entities are instrumental in bridging the gap between academic research and commercial implementation, and the literature uncovers their contributions, challenges, and evolving dynamics in this journey. The literature review explores the potential risks and barriers university spinouts may face, offering a holistic understanding of the barriers South African universities face in establishing spin-out companies.

Chapter 3: Research methodology

The Research Methodology chapter describes the research design, and the methods employed to collect and analyse data. It serves as a roadmap, guiding the reader through the research process and providing the rationale for the chosen methodologies.

- **Research Design**: This section explains the overall approach and design of the research. Whether it's quantitative, qualitative, or mixed methods, the choice often depends on the research questions and objectives (Creswell & Creswell, 2017)
    - **Population and Sample**: The researcher defines the population under study and the criteria used to select participants. Sampling techniques, whether random, stratified, or purposive, are elaborated upon to justify the sample's representativeness (Bryman, 2016:190-210).
    - **Data Collection Methods**: This section outlines the tools or instruments used to gather data. Standard tools include questionnaires, interviews, observations, and archival research. These instruments' development, pilot-testing, and reliability and validity are discussed (Saunders *et al.*, 2019).
    - **Data Analysis**: Once data is collected, it needs to be analysed. The procedures for data processing, coding, and the statistical or thematic methods used for analysis are detailed in this section.
    - **Research Ethics**: All research involving human participants should adhere to ethical guidelines. This section emphasises informed consent, confidentiality, and the ethical considerations upheld during the study (Bryman *et al.*, 2014).
    - **Limitations**: Every research method has its constraints. This section acknowledges the limitations of the chosen methods and potential biases that might influence the results (Creswell & Creswell, 2017:110-130).

Chapter 4: Empirical study

The Empirical Study chapter forms the crux of the research, presenting the raw data gathered and showcasing the practical application of the research methodology delineated in the preceding chapter. The primary aim of this chapter is to convey the results coherently and understandably. In this chapter, data visualisation tools such as tables, charts, and graphs often become indispensable in presenting findings

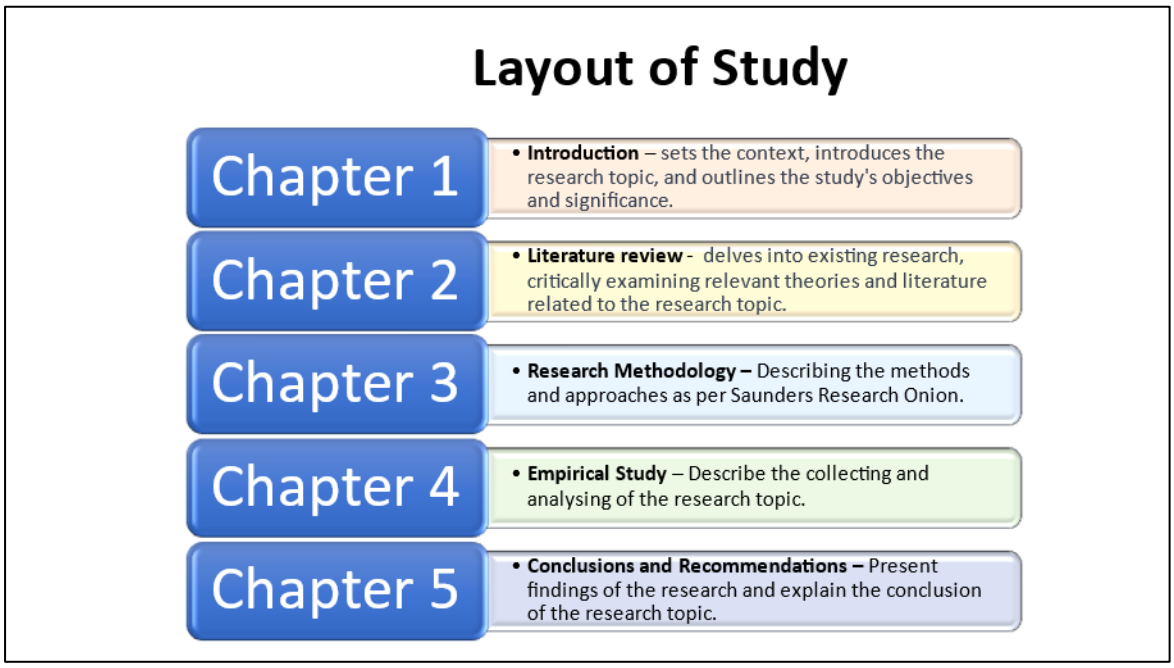
concisely. Moreover, the chapter typically contrasts the empirical results with existing literature, preliminary analysing how the findings align or deviate from prior research. This initial interpretation paves the way for a more in-depth discussion and analysis in the subsequent chapter. While presenting empirical findings, it's pivotal for researchers to remain unbiased, refraining from overinterpreting results and ensuring that the data speaks for itself.

Chapter 5: Conclusions and recommendations

This Chapter is the culminating segment of a dissertation where the researcher synthesises the entire research journey, drawing meaningful inferences from the empirical findings. As Saunders *et al*. (2018:610-630) noted, this chapter primarily strives to answer the research questions posited at the onset, ensuring that the study's objectives are sufficiently addressed. Apart from encapsulating the significant findings, this chapter also delineates practical implications for practitioners and policy-makers grounded in empirical evidence (Bryman & Bell, 2015:690-710). Additionally, recommendations for future research are often enumerated, highlighting potential avenues for scholars to further the discourse in the domain. Lastly, the limitations of the present study are candidly presented, ensuring that the research's scope and potential caveats are transparent to readers.

The layout of the study is presented in Figure 1 below.

Figure 1: The layout of the study



1.13 Summary

Overall, Chapter 1 provides a comprehensive introduction and background to the study, focusing on the barriers South African universities face in establishing spin-out companies. The chapter presents the problem statement, research objectives, and primary research question guiding the study. It also offers a brief overview of the research design and methodology, including the theoretical and practical contributions anticipated from the study. Additionally, the chapter outlines the scope, geographical demarcation, and limitations of the study. Ethical considerations and the importance of trustworthiness are addressed to ensure rigorous and responsible research. Finally, the chapter provides a layout of the dissertation, setting the stage for the detailed exploration in the following chapters.

Chapter 2 will review the relevant literature on university spin-out companies, focusing on the challenges and opportunities in the South African context.

CHAPTER 2 LITERATURE REVIEW

2.1 Introduction to literature review

University spin-out companies serve as a critical bridge between academic research and industry, fostering innovation and contributing to economic development. Despite their potential, South African universities encounter unique challenges in establishing successful spin-outs. This literature review examines these barriers and situates them within the broader context of commercialisation, leadership in Technology Transfer Offices (TTOs), funding limitations, digital transformation, and alignment with Sustainable Development Goals (SDGs).

This chapter will explore the following themes: financial constraints, organisational and bureaucratic barriers, leadership within TTOs, the impact of digital transformation and AI, and the alignment of spin-out companies with SDGs. Through this structure, the literature review aims to provide a comprehensive foundation for the thematic analysis of barriers and enablers of spin-outs within South African universities.

The intention is to give the reader an understanding of the background surrounding the formation of spin-out companies from universities through the university's TTO and how commercialisation occurs through them.

2.2 University spin-out companies: Global perspective

University spin-out companies have emerged as a pivotal mechanism for translating academic research into marketable innovations, acting as a bridge between academia and industry. Globally, these entities harness university research to create groundbreaking products and services, thereby driving economic development and technological advancement. The phenomenon of spinouts is widely recognised for its ability to convert scientific discoveries into commercial successes, contributing significantly to both local and global economies (Etzkowitz, 2003:293-337).

The global landscape of university spinouts is marked by numerous success stories that highlight the potential of these ventures. For instance, Silicon Valley in the United States (US) exemplifies the success of spinouts, with Stanford University and the University of California, Berkeley, being notable contributors to the region’s innovation

ecosystem (Sturgeon, 2000). Companies like Google, Genentech, and Hewlett-Packard originated as university spinouts and have since grown into industry giants, showcasing the transformative impact of academic entrepreneurship (Lécuyer, 2007:89-103).

In the United Kingdom (UK), university spinouts demonstrated significant success over the past decade. The combined value of equity investment deals into companies spun off from UK universities has risen by 527%, totalling £11 billion in funding (Roth, 2022). This success is largely attributed to institutions within the "golden triangle" of British academia, which consists of Oxford University, the University of Cambridge, Imperial College London, and University College London, which account for a significant portion of spin-out activity. These universities have established robust frameworks for fostering spinouts, with dedicated offices like Cambridge Enterprise and Oxford University Innovation supporting the creation and growth of these companies (Wright *et al.*, 2004:481-501).

These institutions have successfully commercialised numerous technologies, contributing to a wide range of sectors, from biotechnology to information technology. Notable examples include ARM Holdings, a semiconductor company, and Oxford Nanopore Technologies, a leader in DNA sequencing technology, as well as companies like Sage Group PLC (SGE) and Kainos Group PLC (KNOS) (Roth, 2022).

Comparatively, South African universities have made strides in establishing spin-out companies, but they face unique challenges that hinder their growth. While global trends show a high level of support and infrastructure for spinouts, South African institutions often struggle with limited resources, insufficient funding, and a lack of robust TTOs (Kruss, 2015:297-415). Additionally, socio-economic factors and policy constraints further complicate the landscape, making it difficult for spinouts to achieve the same level of success seen in more developed regions.

Key factors contributing to successful spinouts internationally include strong institutional support, access to funding, and a culture of entrepreneurship. Effective TTOs play a crucial role in identifying commercial opportunities, securing intellectual property rights, and facilitating industry partnerships (Debackere, 2000:47-55). Moreover, policies that encourage innovation and provide financial incentives for

research commercialisation are critical. For example, the Bayh-Dole Act in the US allows universities to retain IP rights to inventions made under federally funded research programs, significantly boosting the commercialisation potential of academic research (Mowery *et al.*, 2001:99-119).

A collaborative ecosystem involving universities, industry, and government agencies enhances the success of spinouts. Programs that provided mentorship, incubation, and acceleration services were vital in guiding spinouts through the early stages of development. In countries like Israel, the synergy between academic institutions and the vibrant start-up ecosystem resulted in numerous successful spinouts, making it a global leader in innovation (Senor & Singer, 2011:57-68).

While the global perspective on university spin-out companies showcased their potential as engines of innovation and economic growth, the success of these ventures depends on various factors, including institutional support, funding availability, and a conducive policy environment. By understanding these elements and adapting them to the South African context, universities can better navigate the challenges and enhance the success of their spin-out companies.

Critical Reflection

The success of spin-outs in developed economies underscores the importance of systemic support, particularly policy incentives and funding mechanisms. South African universities can learn from these ecosystems by adopting similar support structures tailored to local needs. The challenge lies in creating a favourable policy environment within a developing economy, requiring government and institutional collaboration to balance policy and resource constraints effectively.

2.3 University spin-out companies in South Africa

In South Africa, university spin-out companies are established to commercialise intellectual property (IP) developed within higher education institutions (HEIs). These spin-out companies are owned by their founder(s), and the university or other higher educational institution (HEI) will have a portion of the shareholding in the company (Rasmussen *et al.*, 2014; Wright *et al.*, 2008:1205-1223). Spin-out companies arise when the university or HEI transfers its intellectual property, an asset, into the new

company (Langa, Edoun*, et al.*, 2018:113-118; Meyer, 2003:107-115). This spin-out company creates a separate legal entity under the Companies Act No. 71 of 2008.

Spin-out companies are crucial in bridging the gap between academic research and industry, facilitating the commercialisation of innovative technologies, and contributing to economic development. These entities enable universities to translate their research outputs into market-ready products and services, generating third-stream income and fostering entrepreneurial ecosystems within academic institutions. Through this process, spin-out companies not only enhance the practical application of research but also contribute to the region's broader economic and technological advancement (Breznitz, 2017; Debackere, 2012:47-55).

Despite their potential, South African university spinouts faced several challenges that impeded their success. Limited access to funding is a significant barrier. Unlike their counterparts in more developed regions, South African spinouts often struggle to secure the necessary capital to advance their innovations from the lab to the market (Kruss, 2015:397-415). The venture capital landscape in South Africa was less developed, which restricts the growth potential of these spinouts (Langa et al., 2018:113-128).

There was often a gap in academic researchers' entrepreneurial skills and experience. Many researchers possess the technical knowledge required to develop innovative technologies but lack the business acumen needed to commercialise these innovations effectively (Wright *et al.*, 2004:236-245). This skills gap can hinder spinouts' ability to navigate the complexities of market entry, scaling operations, and sustaining growth.

Leadership within TTOs also played a crucial role in the success of spin-out companies. Effective TTO leadership could provide the strategic vision and support necessary for spinouts to thrive. However, TTOs in South Africa often face challenges related to limited resources, inadequate staffing, and insufficient training, which can impede their ability to support spinouts effectively (Debackere, 2012:47-55)Strong leadership within TTOs is essential for driving the commercialisation process, building industry partnerships, and securing funding opportunities.

Digital transformation and the integration of AI offer significant potential to enhance the success of university spinouts (Rippa & Secundo, 2019:900-911). Digital tools and AI could streamline operations, improve decision-making, and provide valuable insights into market trends and opportunities (Mühlroth & Grottke, 2020:493-510). AI can assist in identifying potential commercial applications of research, optimising business processes, and predicting market demand (Soni *et al.*, 2020:2200-2210). By leveraging digital technologies, TTOs can enhance their support for spinouts, making the commercialisation process more efficient and effective.

Aligning spin-out activities with SDGs could also enhance their impact. Spinouts can contribute to SDG 8 (Decent Work and Economic Growth) by creating jobs and fostering economic development. They can also support SDG 9 (Industry, Innovation, and Infrastructure) by promoting industrial innovation and building resilient infrastructure. By developing technologies that address social and environmental challenges, spinouts can contribute to SDG 3 (Good Health and Well-Being), SDG 6 (Clean Water and Sanitation), and SDG 7 (Affordable and Clean Energy) (United Nations, 2024).

The regulatory environment in South Africa can pose challenges. While the Companies Act No. 71 of 2008 provides a legal framework for the establishment of spinouts, navigating the regulatory requirements can be complex and time-consuming (Nieuwenhuizen, 2019:666-677). This can delay the commercialisation process and increase the costs of bringing new technologies to market.

Targeted interventions and support mechanisms were needed to enhance the success of university spinouts. These include improving access to funding through venture capital and government grants, providing training and mentorship to develop entrepreneurial skills among researchers, and strengthening the capacity and resources of TTOs (Pacheco & Franco, 2023; Rasmussen *et al.*, 2014). Additionally, fostering a supportive regulatory environment that facilitates the commercialisation process was crucial.

University spin-out companies in South Africa held significant potential for driving innovation and economic development. These entities can better bridge the gap between academic research and industry by addressing the challenges and translating

groundbreaking research into market-ready products and services. Aligning spin-out activities with SDGs can enhance their impact, contributing to sustainable development and societal well-being.

University spin-out companies in South Africa possess substantial potential to drive innovation and spur economic growth. By overcoming existing challenges, these entities can more effectively bridge the gap between academic research and industry, transforming cutting-edge research into viable market products and services. Additionally, aligning spin-out activities with the SDGs can amplify their impact, fostering sustainable development and enhancing societal well-being.

Critical Reflection

The South African context reveals significant structural and financial limitations that differ from the global spin-out landscape. While spin-outs elsewhere benefit from extensive support, local ventures are hindered by restrictive economic and organisational factors. Addressing these challenges necessitates both institutional reform within TTOs and systemic changes in policy and funding availability to create a more conducive environment for spin-outs.

2.4 Commercialisation and Technology Transfer

Commercialisation is the process of introducing a new product or idea into the market and making it available to consumers (Kenton, 2020). This occurs through developing a new product or service, licensing the new idea or creating a spin-out company to commercialise it (Breznitz, 2017).

Commercialisation includes identifying the potential of a new product or idea. This requires thorough market research to understand consumer needs, competitive landscape, and potential barriers to entry. Once the potential is established, protecting the intellectual property (IP) becomes crucial. IP protection ensures the innovation is legally safeguarded, providing a competitive advantage and attracting potential investors and partners.

The next step is to develop a viable business model for the commercialisation strategy. This might involve direct market entry through product development and sales or indirect approaches such as licensing the technology to other companies. Licensing

can be particularly advantageous as it allows the innovator to benefit from the partner's established market presence and distribution networks, accelerating commercialisation.

Creating spin-out companies was another effective commercialisation pathway, especially within the context of universities and research institutions. Spinouts enable the dedicated focus and resources needed to bring innovative technologies to market. These entities often benefited from the continued support of their parent institutions, including access to research facilities, funding opportunities, and business mentorship (Rasmussen *et al.*, 2014:62-106; Wright *et al.*, 2004:235-246).

The commercialisation process also included scaling the innovation to meet market demand. This involved manufacturing, marketing, and distribution planning to ensure the product or service can reach consumers effectively and efficiently. Throughout this process, continuous feedback loops with early adopters and stakeholders were essential to refine the product and business model, ensuring market fit and long-term success (Debackere, 2012:323-328).

Commercialisation is a multifaceted process that transforms research innovations into marketable products and services. By identifying market potential, protecting IP, developing strategic business models, and leveraging pathways such as licensing and spin-out companies, innovators can effectively bring their ideas to market, driving economic and societal advancements.

Critical Reflection

While commercialisation and technology transfer present promising avenues for academic research to impact the market, the literature highlights a number of critical gaps that hinder this process, particularly in university settings. Although market research, IP protection, and strategic business models are essential to effective commercialisation, universities often struggle with insufficient funding, limited industry connections, and an academic culture that doesn't always prioritise market application. The use of spin-out companies helps bridge some of these gaps by creating dedicated channels for research to enter the market. Spinouts may face considerable challenges without robust institutional support, external partnerships, and a regulatory framework conducive to rapid commercialisation. This reflection suggests that a more integrated

and supportive ecosystem is needed for universities, especially in developing contexts—one that aligns with both academic goals and market demands.

2.5 Intellectual Property and its management

Intellectual Property (IP) refers to creations of the mind, including inventions, literary and artistic works, symbols, names, images, and designs used in commerce (NIPMO, 2021). According to the Intellectual Property Rights from Publicly Financed Research and Development Act No 51 of 2008 (IPR Act), IP is legally protected to encourage and safeguard the innovator's creative efforts and investments. The IPR Act specifically aims to ensure that IP arising from publicly funded research is identified, protected, utilised, and commercialised for the benefit of society (Walwyn, 2018:20-26).

Under this Act, various forms of IP, such as patents, trademarks, and industrial designs, are protected by law, ensuring that the creators can control and benefit from their inventions. Copyrighted works like theses, dissertations, and other academic publications are generally excluded from the IP protection scope defined by the IPR Act. These works are typically governed by copyright laws, which grant authors exclusive rights to their literary and scholarly outputs.

Effective IP management involves several key activities: identifying potential IP, securing legal protection, and managing the commercialisation process. This included conducting IP audits to identify valuable assets, filing for patents or other protections, and developing strategies for licensing or creating spin-off companies to exploit the IP. The goal is to maximise the economic and societal impact of the research while ensuring compliance with legal and ethical standards.

The management of IP within higher education institutions was particularly crucial, as it not only protects the rights of researchers but also fosters innovation and collaboration between academia and industry. By effectively managing IP, universities can enhance their research capabilities, attract funding, and contribute significantly to economic development.

Critical Reflection

Effective IP management is essential for transforming academic research into market-ready products, yet challenges arise within universities due to limited IP expertise and bureaucratic hurdles. While the IPR Act in South Africa aims to protect IP from publicly funded research, its focus on compliance can sometimes overshadow the entrepreneurial drive needed for commercialisation. A balanced approach is required, enabling researchers and TTOs to navigate regulatory requirements while fostering an innovative, market-oriented IP strategy.

2.6 Technology Transfer

Technology Transfer (TT) translates new ideas or intellectual property developed under research and development public funding into products, processes and services (NIPMO, 2021). More specifically, in a South African university context, the IPR Act outline the process. TT involves commercialising promising technology and IP concepts emanating from publicly financed research activities for the benefit of society (Walwyn, 2018:5-35).

The IPR Act mandates that universities and other public research institutions identify, protect, and manage IP derived from their research activities. This includes assessing the commercial potential of new technologies, securing appropriate IP protection such as patents, and negotiating licensing agreements or creating spin-off companies to bring these innovations to market. Effective TT drove economic growth and fostered a culture of innovation and entrepreneurship within academic institutions (Rogers *et al.*, 2001:253-261).

TT encompassed various activities, including identifying research outcomes with commercial potential, the protection of these outcomes through patents or other IP rights, and their subsequent utilisation through licensing or the formation of spin-off companies. These activities required collaboration between academia, industry, and government to ensure that research outputs met market needs and were effectively commercialised (Rogers *et al.*, 2001:253-261).

Successful TT can significantly impact economic development by facilitating the translation of research into market-ready products and services. It also helps universities generate third-stream income, thereby enhancing their financial

sustainability and contributing to the broader economic and technological advancement of the region (Breznitz, 2017; Debackere, 2012). However, challenges such as limited funding, insufficient entrepreneurial skills among researchers, and regulatory complexities must be addressed to fully realise TT's potential in South Africa.

Critical Reflection

TT is pivotal in bridging the gap between academia and industry, transforming university research into market-driven innovations with broad societal benefits. While the IPR Act in South Africa lays a foundational framework for TT, it often focuses on compliance rather than fostering a proactive, entrepreneurial approach. Effective TT relies on substantial funding, industry partnerships, and entrepreneurial skills, which are frequently limited within South African institutions. To unlock TT's full potential, universities must cultivate an agile and collaborative TT environment, addressing funding constraints, building business acumen among researchers, and streamlining regulatory processes to create a stronger impact on both economic growth and regional innovation.

2.7 Role of Technology Transfer Offices

Following the enactment of the IPR Act, the National Intellectual Property Management Office (NIPMO) initiated the establishment of Technology Transfer Offices (TTOs) within universities to streamline and enhance intellectual property management arising from publicly funded research. These offices are critical in transforming research outputs into viable products, services, and processes that benefit society (NIPMO, 2021).

The TTO is a dedicated department within a university or HEI responsible for knowledge exchange or the TT (Walwyn, 2018:3-13). The TTO represent the university in managing IP emanating from publicly financed research and development output.

TTO helps researchers to identify and register IP and commercialise the IP or technologies. One way to do this is through spin-out companies. The TTO facilitates the process of spin-out creation and acts as a dual intermediary between the university

and researchers on the one end and between the university and industry on the other (Breznitz, 2017).

By fostering a culture of innovation and entrepreneurship, TTOs contribute significantly to the economic and technological development of the region. They help HEI's leverage their research outputs to generate third-stream income, enhance their financial sustainability, and promote broader socio-economic benefits (Breznitz, 2021; Walwyn, 2018:7-38).

Critical Reflection

TTOs are integral to bridging the gap between academic research and market application, yet their effectiveness in South Africa is often limited by structural and resource constraints. While TTOs provide essential services such as IP management, spin-out facilitation, and partnership mediation, their success depends heavily on adequate funding, skilled personnel, and supportive policy environments. Despite their potential to drive economic development and societal impact, TTOs can struggle to foster a true culture of innovation and entrepreneurship without stronger institutional and industry support. For TTOs to fully realise their transformative role, universities must prioritise capacity building and establish more robust industry linkages to empower these offices beyond basic administrative functions.

2.8 Importance of leadership in Technology Transfer Offices

Effective leadership within TTOs was critical for successfully commercialising university research and establishing spin-out companies. Leadership in TTOs involved not only the strategic management of IP but also the facilitation of relationships between academia and industry (Siegel, Waldman & Link, 2003:27-48). Strong leadership ensured that TTOs could navigate the complex processes of patenting, licensing, and funding acquisition, thereby enhancing the commercial potential of university innovations (Markman *et al.*, 2005:241-263).

In the South African context, where resources and support structures may be limited, the role of visionary and competent leaders in TTOs becomes even more crucial. Effective TTO leaders were instrumental in driving the commercialisation process, building industry partnerships, and securing necessary funding opportunities, which

was essential for the growth and sustainability of spin-out companies (Kruss *et al.*, 2016:1-8).

Transformative leadership, which involves inspiring and motivating staff and researchers to achieve their highest potential and think beyond conventional boundaries, was particularly effective in TTOs (Nuel *et al.*, 2021:169-182). Transformative leaders are adept at creating a shared vision and fostering a culture of innovation and entrepreneurship within academic institutions (Nuel *et al.*, 2021).

Leadership within TTOs must be adept at managing the unique challenges associated with the South African higher education landscape, including bureaucratic hurdles, limited financial resources, and the need for capacity building among researchers and staff (Walwyn, 2018:19-48). Such leaders must blend technical knowledge, business acumen, and interpersonal skills to translate academic research into market-ready products and services (Debackere & Veugelers, 2005:321-342). They must be capable of building and nurturing strong relationships with industry stakeholders, providing access to essential resources such as venture capital, mentorship, and market insights (Clarysse, Wright*, et al.*, 2011:1420-1442). By leveraging these relationships, TTO leaders can facilitate smoother transitions from research to commercialisation, ensuring that promising technologies reach the market more efficiently (Markman *et al.*, 2005:241-263).

Balancing risk aversion with risk-taking was another critical aspect of effective leadership in TTOs. While it is important to adhere to policies and procedures to protect intellectual property and manage resources responsibly, leaders must also be willing to take calculated risks to capitalise on innovative opportunities (Woodell, 2016). This involves having the discernment to know when to be flexible with policies and procedures to foster creativity and encourage entrepreneurial initiatives (Rogers *et al.*, 2001:253-261).

TTO leaders must have strong people skills to manage diverse teams of researchers, industry partners, and administrative staff. They must be adept at conflict resolution, negotiation, and collaboration, ensuring that all parties are aligned with the strategic goals of the TTO and the university (Siegel, Waldman & Link, 2003) (Correia *et al.*, 2024:1-31). Building trust and maintaining open lines of communication is essential

for fostering a collaborative environment where innovation can thrive (Debackere & Veugelers, 2005:321-342).

The importance of leadership in TTOs cannot be overstated. Effective leadership drives the commercialisation process and fosters an environment where innovation and entrepreneurship can thrive. In the context of South African universities, where challenges are more pronounced, the role of TTO leaders is even more significant in bridging the gap between academic research and industry, ultimately contributing to economic development and societal well-being.

Critical Reflection

Leadership challenges in South African TTOs indicate a need for skills diversification and empowerment. TTO leaders should not only be technically proficient but should also possess business acumen and interpersonal skills to navigate the commercialisation landscape. Universities could enhance TTO leadership by investing in management training and promoting leaders with entrepreneurial backgrounds, thereby aligning organisational goals with commercial success.

2.9 Importance of university spin-out companies

University spin-out companies are pivotal in facilitating TT and commercialisation, significantly contributing to economic development, generating third-stream income for universities, and creating employment opportunities (Tengeh & Rorwana, 2017). Assessing the contribution of spin-offs necessitates longitudinal data from specific universities, tracking the economic impact of these entities through metrics such as creation rates, survival rates, revenue, employment generation, and overall valuation over time. This inherently complex analysis demands a collaborative research endeavour among universities, industry partners, and economic development agencies (Hayter, 2016:475-490).

Spin-out companies served as conduits for TT and its commercialisation (Chi & Hanh, 2023:39-45). By offering shareholding to inventors, these entities attract talent and align the inventors' interests with the company's growth, fostering their continuous involvement and contribution to the spin-out's success (Di Gregorio & Shane, 2003:209-227; Franklin et al., 2001). These companies emerge with a focus on

research and development to enhance performance and revenue, underscoring the commercialisation of university intellectual property and technology.

Critical Reflection

University spin-out companies are essential for converting academic research into economic value, yet assessing their impact demands extensive data and collaboration across sectors. While they align inventors with commercial outcomes, long-term growth and funding challenges can limit their potential. Strengthening industry partnerships and adopting clear performance metrics are vital to maximising their regional and national impact.

2.10 The measurement of a successful spin-out company

Measuring a successful spin-out company can vary between South African universities and even within the same institution. Traditional metrics for gauging the success of spin-out companies, such as financial indicators like dividends, revenue, profit, or return on investment, are predominant in some South African universities; an evolving perspective posits that these metrics, although important, are perhaps too narrow in scope (Smith & Thompson, 2017:120-129). Several universities are broadening their horizon, recognising the pivotal role of job creation, local economic enhancement, social impact, and, most significantly, the real-world translation of academic research as crucial parameters for success (Mathisen & Rasmussen, 2019:1891-1938; Sorensen & Chambers, 2008:534-547). This shift reflects a growing awareness that the accurate measure of a spin-out's success lies in its ability to create value beyond mere financial returns.

Defining success becomes more complex when acknowledging the unique sectoral differences of each spin-out, highlighting the necessity for a range of metrics customised to the specific characteristics of different industries (Langa, Edoun, et al., 2018:113-128). While the National Intellectual Property Management Office (NIPMO) revealed that most South African TTOs quantify success merely by counting new spin-out firms (NIPMO, 2021), such an approach is arguably reductionist. A more nuanced understanding necessitates the incorporation of multifaceted metrics, fostering a holistic assessment of the achievements of university spinouts.

Universities should use metrics that include not only financial performance such as dividends, revenue, profit, or return on investment but also contributions to job creation, economic impact, social benefits, and the practical application of academic research into real-world applications (Odei & Novak, 2023:1279-1298; Sorensen & Chambers, 2008:534-547). The definition of success can also differ depending on the specific industry or sector in which the spin-out operates. Most South African TTOs measure successful spin-out companies through the number of new companies (NIPMO, 2021).

To better establish the success of university spin-out companies, it is crucial to define clear and comprehensive metrics that go beyond mere company count. This will ensure a more accurate and holistic evaluation of their impact and achievements.

Critical Reflection

The criteria for measuring spin-out success are expanding beyond financial metrics to encompass broader societal impacts like job creation and economic enhancement. Relying solely on spin-out counts, as some South African universities do, oversimplifies their contributions. A more holistic approach, using diverse and industry-specific metrics, would better capture these companies' true impact and sustainability.

2.11 Commercialisation revenue and economic impact from spin-out companies in South Africa

Like any other company formed in South Africa, a spin-out company pays dividends to its shareholders. A university may, therefore, earn dividends through its shareholding in the spin-off company or earn revenue by selling the shares that it holds in the company (Hockaday, 2020:15-176; Minshall & Wicksteed, 2005:22).

However, the revenues that universities receive can be affected by many factors, such as the spinout's success, the company's market, and the general economic environment (Investments, 2023; Wright *et al.*, 2006). The lack of a vibrant venture capital industry in South Africa influenced the potential for spin-out company creation and success (Langa, Edoun*, et al.*, 2018:113-128).

Internationally, publicly supported research and development institutes demonstrated the viability of technology commercialisation utilising spin-out companies. This trend of forming a spin-out company to commercialise IP and technology was expected to

increase in South Africa because of the introduction of the IPR Act (Langa *et al*., 2018:113-128).

A recurring challenge for South African university spinouts is the lack of funding. Unlike the U.S. and U.K., which have mature venture capital landscapes, South Africa lacks a robust network of investors willing to support early-stage, high-risk university spin-outs (Kruss, 2015:397-415). Local TTOs often rely on limited public funding, which has restrictive and lengthy approval processes, hindering timely access to resources (Langa et al., 2018:113-128).

Critical Reflection

The funding limitations in South Africa reflect a broader issue of risk aversion and a nascent investment culture. While public funding plays a role, it is insufficient for the high-risk nature of spin-out ventures. Creating university-linked seed funds or public-private partnerships could bridge this gap, fostering a more supportive financial ecosystem for early-stage spin-outs. Targeted policy reforms and incentives are necessary to attract private investment and mitigate the high perceived risks.

2.12 Digital transformation and AI in technology transfer

Digital transformation and artificial intelligence (AI) are significantly reshaping the TT landscape, enhancing the efficiency and effectiveness of commercialisation processes in universities. Integrating digital tools and AI technologies is pivotal in improving data management, predictive analytics, and process automation, crucial elements in the TT ecosystem.

Digital transformation involves leveraging technologies such as cloud computing, big data analytics, and blockchain to streamline the TT process. These tools enabled better management of IP, more efficient handling of licensing agreements, and improved communication with industry partners (Correia *et al.*, 2024:1-31; Rippa & Secundo, 2019:900-911). For instance, cloud-based platforms allowed for centralised storage and access to research data, enhancing collaboration among researchers and industry stakeholders (Rippa & Secundo, 2019:900-911).

AI technologies, particularly machine learning and predictive analytics, played a significant role in identifying potential commercial opportunities from university

research. By analysing vast amounts of data, AI can predict market trends, assess the commercial viability of research projects, and identify potential industry partners (Markman *et al.*, 2005:241-263). This predictive capability reduces uncertainty and risk in TT, making it easier for universities to bring their innovations to market (Tanwar & Poply, 2024).

Automating administrative tasks in the TT process can lead to significant time and cost savings. AI-powered automation tools can handle routine tasks such as patent filing, contract management, and compliance monitoring, freeing up human resources to focus on more strategic activities (Song *et al.*, 2024). This sped up the TT process and ensured higher accuracy and consistency in administrative operations (Ndlovu, 2021).

Internationally, universities have begun to adopt these technologies with promising results. Stanford University uses AI to manage its patent portfolio, and this has significantly increased the efficiency of its TT office (Liang *et al.*, 2022). Similarly, the Massachusetts Institute of Technology (MIT) leverages big data analytics to track and forecast the commercial impact of its research projects (Minh & Van, 2022:256-266).

Not all TTOs have incorporated AI into their operations. Those who have not adopted these technologies may struggle to keep pace with the efficiencies and competitive advantages offered by digital transformation. This lack of adoption can result in slower commercialisation processes, less effective IP management, and reduced ability to identify and capitalise on market opportunities.

Despite the benefits, the adoption of digital transformation and AI in TT also presents challenges. Issues such as data privacy, cybersecurity, and the need for substantial initial investment can hinder the widespread adoption of these technologies (Langa, E.i*, et al.*, 2018:113-128). Additionally, there was a need for specialised skills to manage and operate these advanced systems, which can be a barrier for resource-constrained institutions (Breznitz, 2021).

Digital transformation and AI are powerful enablers of technology transfer, offering significant potential to enhance the commercialisation of university research. By improving efficiency, enabling predictive insights, and automating processes, these

technologies can help universities overcome some of the traditional barriers to TT. Addressing the associated challenges will be crucial to realising their full potential.

Critical Reflection

The limited digital adoption in South African TTOs highlights a significant gap in efficiency and scalability. Investing in digital infrastructure and staff training in AI and data analytics could offer South African TTOs a competitive edge, improving operational efficiency and market insights. Collaboration with private-sector technology providers may offer a feasible approach to overcome resource limitations and promote digital innovation in TTOs.

2.13 Sustainable Development Goals and spin-out companies

The alignment of university spin-out companies with the United Nations Sustainable Development Goals (SDGs) presents a unique opportunity for higher education institutions to contribute to global sustainability efforts while fostering innovation and economic growth. Spin-out companies, often born from university research, have the potential to address critical societal challenges outlined in the SDGs, such as climate change, clean energy, health and well-being, quality education, and sustainable cities.

Universities are pivotal in advancing the SDGs by creating spin-out companies that commercialise research innovations. These companies can develop new technologies and solutions directly contributing to sustainable development. For instance, spinouts focused on renewable energy technologies can help achieve SDG 7 (Affordable and Clean Energy) by developing more efficient solar panels or energy storage solutions (Hall, 2008:1-20) . Companies innovating in the field of biotechnology can contribute to SDG 3 (Good Health and Well-being) by developing new medical treatments and diagnostic tools (Rasool *et al.*, 2024:118-128). Additionally, spinouts working on sustainable agricultural practices can address SDG 2 (Zero Hunger), while those focusing on water purification technologies can help achieve SDG 6 (Clean Water and Sanitation).

To maximise the impact of spin-out companies on sustainable development, universities need to foster an entrepreneurial ecosystem that encourages the commercialisation of research aligned with the SDGs. This involved providing support through incubators and accelerators, offering access to funding opportunities, and

facilitating industry partnerships (Hruskova, 2024:39-66) (Horan, 2019:1-22). Integrating sustainability into the university's research agenda and incentivising researchers to focus on projects that address the SDGs can further enhance the creation of impactful spin-out companies (Karahan, 2024:1-35).

The success of spin-out companies in contributing to the SDGs requires a long-term commitment to sustainability. This includes not only developing products and services that address specific SDGs but also adopting sustainable practices within the company itself. By embedding sustainability principles in their operations, spin-out companies can set an example for the wider business community and contribute to a more sustainable economy (Thompson *et al.*, 2022:144-162).

Aligning university spin-out companies with the SDGs represents a strategic approach to leveraging academic research for societal benefit. By fostering an environment that supports sustainable innovation, universities can play a crucial role in advancing global sustainability goals while driving economic growth and technological progress.

Critical Reflection

While SDG-aligned spin-outs offer significant potential for positive societal impact, South African universities face a trade-off between social impact and commercial viability. Integrating SDG goals into the university's commercialisation strategy is complex, as it requires balancing long-term sustainability objectives with immediate profitability. Developing a structured approach to sustainability in spin-outs could increase the appeal to investors and enhance societal relevance.

2.14 Organisational and bureaucratic barriers

Effective TTOs are crucial to managing IP, supporting commercialisation, and guiding researchers through complex processes. Developed countries exhibit streamlined TTO operations, as seen in the U.K., where universities like Cambridge and Oxford provide dedicated commercialisation offices with experienced staff and resources (Wright *et al.*, 2004:235-246). In contrast, South African TTOs often operate with limited resources and complex bureaucratic processes, slowing decision-making and delaying commercialisation (Walwyn, 2018:89).

Critical Reflection

South African TTOs lack the streamlined structures and processes seen in developed countries. The complexity and rigidity of local TTO operations highlight the need for organisational reforms to reduce bureaucratic bottlenecks. Simplifying processes and enhancing training for TTO staff could significantly improve operational efficiency and allow TTOs to function more effectively in supporting spin-out initiatives.

2.15 Identifying key barriers to South African spin-out success

Several barriers affect the formation of spin-out companies by South African universities. Ample studies internationally identified barriers that spin-out companies face, but more research must be done to understand the barriers within a South African context (Langa *et al*., 2018:113-128). This is due to unique socio-economic factors, policy implications, and the state of South Africa's innovation system.

A significant barrier for South African university spinouts is limited access to funding. Unlike their counterparts in more developed regions, South African spinouts often struggle to secure the necessary capital to advance their innovations from the lab to the market. The venture capital landscape in South Africa is less developed, which restricts the growth potential of these spinouts (Kruss, 2015:297-415). This lack of funding can be attributed to a risk-averse investment culture and a limited pool of venture capitalists willing to invest in early-stage, high-risk ventures (Langa *et al*., 2018:113-128).

Academic researchers often possess the technical knowledge required to develop innovative technologies but lack the business acumen to commercialise these innovations effectively. This skills gap can hinder spinouts ability to navigate the complexities of market entry, scaling operations, and sustaining growth (Wright *et al.*, 2008:1205-1223). Furthermore, there is often a lack of entrepreneurial training and support for researchers, which can impede the development of viable business models and strategies (Debackere, 2012).

Effective leadership within TTOs is crucial for the success of spin-out companies. TTOs in South Africa often face challenges related to limited resources, inadequate staffing, and insufficient training, which can impede their ability to support spinouts effectively (Walwyn, 2018:14-45). Leadership dynamics within TTOs can also

influence spin-out companies' strategic direction and operational efficiency. Strong leadership is essential to drive the commercialisation process, build industry partnerships, and secure funding opportunities (Kruss *et al.*, 2016).

A prominent yet understated barrier in the spin-out company creation process is the quality and capacity of leadership within TTOs. The effectiveness of TTOs is significantly influenced by their leadership, which can substantially affect the commercialisation of IP and the creation of spin-out companies. Leaders in TTOs are expected to bridge the gap between academic research and business worlds, promoting the translation of research into commercial opportunities (Siegel, Waldman, Atwater*, et al.*, 2003:111-133). However, leading a TTO requires unique skills and experiences, including academic understanding, business acumen, and negotiation capabilities (Debackere, 2012; Wright et al., 2008:1205-1223). A lack of these skills may result in inefficiencies in the operation of TTOs, subsequently hindering the creation and success of spin-out companies.

A leader's role in shaping a supportive culture for entrepreneurship within the university context must not be underestimated. A lack of entrepreneurial leadership can stifle innovative potential and discourage researchers from pursuing commercialisation (Huyghe *et al.*, 2014:289-307). Therefore, leadership within TTOs is crucial for creating and succeeding with university spin-out companies, and inadequacies in this area can present a significant barrier (Debackere, 2012:534-547; Sorensen & Chambers, 2008).

Navigating the regulatory environment in South Africa can be complex and time-consuming, posing a significant barrier to the commercialisation of university research. The Companies Act No. 71 of 2008 provides a legal framework for establishing spinouts, but compliance with regulatory requirements can delay the commercialisation process and increase the costs associated with bringing new technologies to market (Nieuwenhuizen, 2019:666-677). Additionally, policies that support innovation and provide financial incentives for research commercialisation are not always effectively implemented or accessible (NIPMO, 2021).

Socioeconomic factors, including wealth and education disparities, can impact spin-out companies' success in South Africa. These factors affected the availability of

skilled labour, market demand for innovative products, and the overall entrepreneurial ecosystem (Breznitz, 2017:25-35). Institutional factors, such as the level of support and infrastructure universities provide, also played a critical role. Universities with well-established TTOs and strong industry connections were better positioned to support the creation and growth of spin-out companies (Rasmussen *et al.*, 2014:92-106).

Cultural attitudes towards entrepreneurship and innovation also posed challenges. There may be a lack of entrepreneurial culture within academic institutions, where the focus is often on academic achievements rather than commercial success. Encouraging a culture of entrepreneurship and risk-taking within universities is essential for fostering successful spin-out companies (Etzkowitz, 2003:293-337).

Digital transformation and the integration of AI offer significant potential to enhance the success of university spinouts, but their adoption still needs to be improved. Issues such as data privacy, cybersecurity, and the need for substantial initial investment can hinder the widespread adoption of these technologies (Mühlroth & Grottke, 2020:493-510). Specialised skills are needed to manage and operate these advanced systems, which can be a barrier for resource-constrained institutions (Breznitz, 2021:5-9).

According to NIPMO's national survey for 2014-2018, the three most critical barriers to creating spin-out companies are the lack of TTO's empowerment, the development of incubators and access to incubation space (NIPMO, 2021). This can be influenced by factors such as TTO's resources, knowledge, and network connections. The empowerment of TTOs is paramount for the successful creation and nurturing of spinouts (Soliman, 2020). The Southern African Research and Innovation Management Association (SARIMA) is conducting its third National Survey on Intellectual Property and Technology Transfer at Publicly Funded Research Institutions, which aims to investigate these challenges further and provide updated insights.

Literature reviews find that universities' non-exclusive license policies prohibit the formation of spin-out companies (Shen *et al.*, 2022:1-19). Investors and academic researchers prefer exclusive rights to the IP and technology they commercialise. A non-exclusive licensing policy allows competitors outside the university to

commercialise the IP quicker and obtain revenue before the university's spin-out. The university is also less likely to invest capital in developing the new spin-out company.

A further critical barrier South African universities face in establishing spin-out companies pertains to the academic inventors themselves, who often need more commitment to engage in and lead the commercialisation process actively (Lam, 2010:307-340). Researchers and academic inventors primarily work in an academic environment, where the pursuit of knowledge and publication of research takes precedence over commercial activities. As such, they might be more interested in the research and discovery aspects of the project rather than its commercial exploitation (Clarysse, Tartari*, et al.*, 2011; Hockaday, 2020:316). This lack of entrepreneurial drive and assuming accountability hampered the effective translation of their IP into a commercially viable product or service, as they lacked the necessary business skills or motivation to successfully navigate the complexities of business operations, management and marketing (Bushe, 2019; Siegel, Waldman, Atwater*, et al.*, 2003). University policies may discourage inventors from actively participating in the spin-out company due to potential conflicts of interest. As a result, the successful transition from an academic environment to a commercial venture can be challenging, and this barrier often limits the growth and potential of spin-out companies in South Africa.

Research identifies several critical barriers specific to the South African context, including limited TTO resources, underdeveloped venture capital support, and regulatory challenges (Langa et al., 2018). The need for a supportive regulatory environment, accessible funding, and entrepreneurial training for researchers is evident. Additionally, cultural barriers—wherein academic achievements are prioritised over commercial success—hinder the development of a strong entrepreneurial culture within universities.

Critical Reflection

Addressing these barriers requires a multi-faceted approach. While local socio-economic factors and policy constraints are challenging, incremental changes in TTO management, funding structures, and cultural attitudes could significantly improve outcomes for spin-outs. Collaborative partnerships with industry and government

agencies could play a crucial role in fostering a more robust entrepreneurial environment within South African universities.

2.16 Summary

This literature review critically examines the dynamics of university spin-out companies, emphasising their role as catalysts for economic growth, innovation, and societal advancement. Beginning with a global perspective, it showcases how regions such as Silicon Valley and the UK have successfully cultivated spin-out ecosystems through robust institutional support, ample funding, and an entrepreneurial culture embedded within academia. These international models provide valuable insights for South African universities, highlighting adaptable frameworks to address local challenges.

In the South African context, the literature identifies unique socio-economic and regulatory barriers that hinder spin-out formation and sustainability, including limited access to venture capital, regulatory complexities, and a gap in entrepreneurial skills among researchers. These constraints are further compounded by under-resourced TTOs that often lack strategic leadership. Strong, visionary leadership within TTOs is highlighted as critical for advancing commercialisation, securing funding, and building industry partnerships essential for spin-out success.

The review also explores the transformative potential of digital tools and AI in enhancing TTO performance, which could drive efficiencies in IP management, predictive analytics, and market alignment. South African universities face significant challenges in adopting these technologies due to resource constraints, limited digital expertise, and high initial costs. Addressing these barriers will require targeted investment and skill development initiatives to leverage digital transformation fully.

Aligning spin-out activities with the United Nations SDGs is presented as a strategic opportunity, positioning spin-outs as contributors to both economic growth and societal impact. However, the literature indicates that achieving this alignment in South Africa will require substantial support, including dedicated funding for SDG-focused projects, policy incentives, and the integration of sustainability goals within university research agendas.

In conclusion, the literature advocates for a comprehensive, collaborative approach to addressing these barriers, calling for enhanced funding mechanisms, tailored entrepreneurial training, supportive regulatory reforms, and strategic partnerships. By implementing these measures and aligning with SDGs, South African universities can improve spin-out companies' sustainability and impact, thereby advancing economic and social development.

Future research is recommended further to explore these barriers within the South African context and to develop actionable insights for strengthening the commercialisation ecosystem. This research should prioritise policy adjustments, innovative funding structures, and enhanced institutional support mechanisms to establish a sustainable framework for spin-out growth and success.

CHAPTER 3 RESEARCH METHODOLOGY

3.1 Introduction

The purpose of this chapter is to outline the research methodology employed in this study, providing a detailed account of the approach used to explore the barriers faced by South African universities in establishing spin-out companies.

This study adopts a qualitative research approach, rooted in the interpretivist paradigm, to gain an in-depth understanding of the perspectives of key stakeholders involved in university spin-out companies. A qualitative methodology was deemed most appropriate, as it allows for a rich, contextual exploration of experiences and challenges faced within Technology Transfer Offices (TTOs) and the broader university commercialisation ecosystem.

To collect data, semi-structured interviews were conducted with participants from five South African universities and other key stakeholders, including TTO professionals, researchers, and industry experts. This approach enabled the researcher to gather nuanced insights while allowing participants to elaborate on their perspectives. Thematic analysis was employed to identify key patterns and recurring themes in the data, ensuring a structured interpretation aligned with the study's objectives.

This chapter addresses ethical considerations, ensuring compliance with research ethics and participant confidentiality. Measures undertaken to enhance trustworthiness, including credibility, transferability, dependability, and confirmability, are also discussed.

By detailing the research methodology, this chapter provides a comprehensive roadmap for how the study was conducted, ensuring transparency and rigor in addressing the research objectives.

3.2 Empirical study

This empirical study utilised a qualitative research approach to explore South African universities' barriers to establishing spin-out companies. This method was selected as it offers an in-depth understanding of the experiences and perspectives of individuals directly involved in this field.

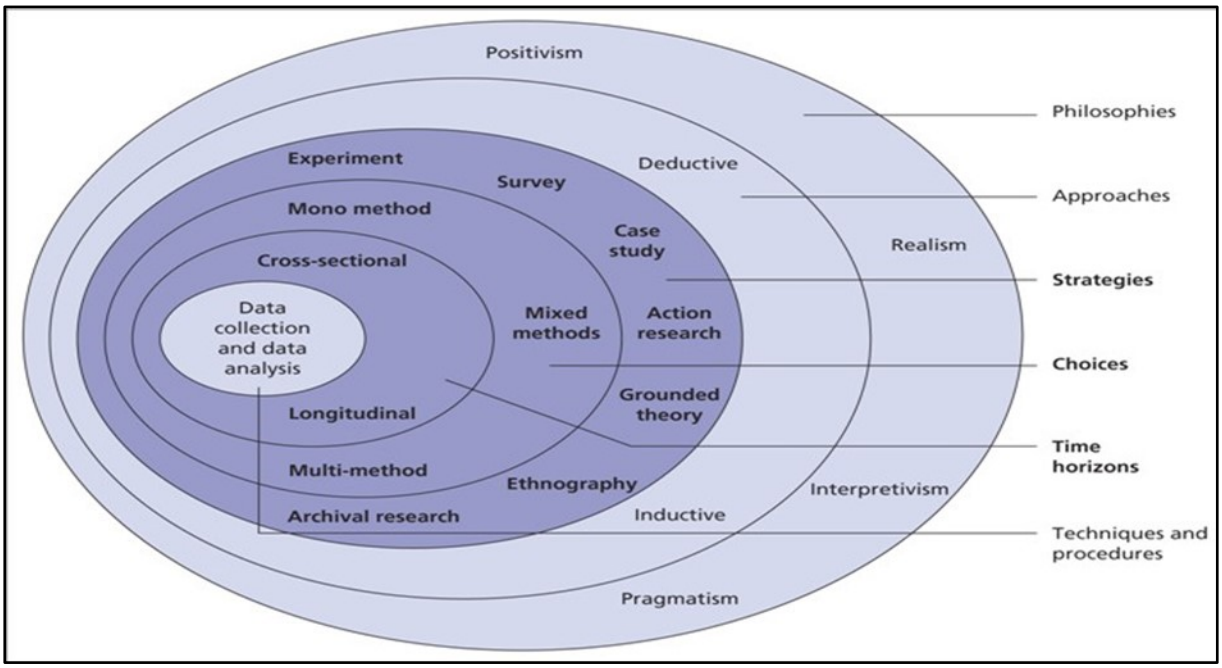
Data was collected through semi-structured interviews completed by key stakeholders such as TTO professionals, researchers involved in spin-out company formation, and experts in the TT landscape. Semi-structured interviews. in qualitative research can be a powerful way to gain deep insights into a participant's experiences and views on a particular subject (Saunders *et al.*, 2003).

Existing relationships within South African TTO offices were used to gather rich and contextual data from colleagues, researchers, and role players at other universities (Creswell & Creswell, 2017)The objective was to tap into a broad spectrum of experiences and views, thereby enhancing the study's validity and comprehensiveness.

In the empirical study, the research design and methodology were structured using the 'research onion' model proposed by Saunders, Lewis, and Thornhill (2019) (Saunders *et al.*, 2019:138). This model systematically peels away the layers of the research process, guiding the researcher from the outermost layer, which defines research philosophies, to the core, focusing on techniques and procedures. By adopting the 'research onion', this study aimed to ensure a thorough, systematic, and coherent approach to empirical investigation.

This framework, represented visually in Figure 2 below, delineates the various layers and stages researchers must peel away and navigate during the research process (Saunders *et al.*, 2019:138). Each layer of the onion is significant in guiding the researcher to make informed decisions and refine the research process to effectively meet the objectives. Figure 2 will provide a clear illustration and understanding of the methodological choices.

Figure 2: Saunders research onion



Source: Saunders *et al*., (2019:138)

3.2.1 Research paradigm

The research paradigm underpinning this study aligns with the interpretivist approach, stemming from the nature of qualitative research that tends to centre on individuals' subjective experiences and interpretations (Saunders *et al.*, 2019).

Interpretivism aligns with the understanding that reality is constructed through human activity and interaction, meaning that individuals subjectively interpret the world. This paradigm acknowledges the complexities of human sense-making, and that different people can understand the same phenomenon differently. The interpretivist paradigm aligned well with the qualitative research approach, which aimed to understand phenomena from the participants' perspectives and in a natural setting (Bryman *et al.*, 2014:19-21).

In the context of this study, the perceptions, and experiences of the TTO professionals and academic researchers involved were used to identify barriers to spin-out company formation.

This strategy gave rich, in-depth responses that revealed the underlying meanings and interpretations individuals attached to their experiences possible (Saunders *et al.*, 2019). It allowed participants to share their understanding of their environment within South African universities' TT activities, providing vital insights into the barriers to spin-out company formation.

3.2.2 Research approach

Research approaches are generally classified into three main types: inductive, deductive, and abductive approaches. Each approach differs in how it engages with theory and data.

Inductive Approach: This approach is commonly used in qualitative research and focuses on building theories based on observed data. Researchers collect and analyse data to identify patterns, themes, or relationships, which then inform the development of theoretical insights. It is exploratory in nature, allowing researchers to generate knowledge without being restricted by pre-existing theories (Bryman *et al*., 2014:4-12).

Deductive Approach: Unlike induction, the deductive approach follows a top-down process where research begins with a theory or hypothesis, which is then tested through data collection. This approach is more common in quantitative research, as it seeks to confirm or reject pre-existing assumptions through systematic testing (Saunders *et al*., 2019).

Abductive Approach: The abductive approach combines elements of both inductive and deductive reasoning. It begins with an unexpected observation that does not fit within an existing theoretical framework, prompting researchers to explore possible explanations. It allows for flexibility in refining theories while engaging with empirical data (Timmermans & Tavory, 2012).

The inductive methodology was used for this study's investigation. The inductive approach is often used in qualitative research, where the goal is to gain a deep understanding of a particular phenomenon from the perspective of the individuals who have encountered it (Bryman *et al.*, 2014:4-12).

In an inductive approach, data was collected and analysed to develop theories or identify patterns. This is opposed to the deductive approach, where a hypothesis is formed based on existing theory and then tested through data collection (Saunders *et al.*, 2019).

This approach was deemed appropriate for this study as it allows researchers to explore South African universities' challenges and barriers in establishing spin-out companies without being constrained by pre-existing theories or models. Through this approach, the complexities and nuances of this issue can be grasped, informed by the lived experiences and insights of key TTO professionals and academics.

The themes and patterns that emerge from the data will help us understand why South African universities struggle with establishing spin-out companies and guide us in suggesting strategies for improvement.

3.2.3 Methodological choice

The methodological choice refers to the data researchers collect and analyse to answer their research questions. Three methodological choices are quantitative, qualitative, and mixed methods.

Quantitative research, aligned with the positivistic paradigm, uses numerical data and statistical analyses to test hypothesised relationships between variables. It typically involves large samples and prioritises objectivity, generalisability, and statistical validity (Wiid & Diggines, 2009).

On the other hand, qualitative research, associated with the interpretivist paradigm, seeks to understand a smaller sample's subjective views, experiences, and beliefs. It delves into the intricacies of the subject matter, providing rich, detailed, and nuanced insights (Antwi & Hamza, 2015).

The mixed methods approach combines qualitative and quantitative methodologies to understand the research problem comprehensively (Saunders *et al.*, 2019). Given the objectives to explore South African universities' complex barriers to establishing spin-out companies, this study prefers a qualitative methodological choice. This choice aligns with the research paradigm of interpretivism and an inductive research

approach. It will allow for a deeper understanding of the subjective experiences and perceptions of key TTO professionals and academic stakeholders, thereby revealing the intricate dynamics of this phenomenon. The qualitative approach was chosen because it best captures South African universities' complex challenges and subjective experiences in their quest to establish successful spin-out companies.

3.2.4 Research strategy

In determining the research strategy for this study, one needs to consider the overarching research paradigm, approach, and choice, all of which have been established as interpretivist, inductive, and qualitative, respectively. Following these orientations, semi-structured interviews were selected as the appropriate methodological strategy (Bryman & Bell, 2015).

Semi-structured interviews are typically connected with qualitative research. These interviews allow participants to express their perspectives and experiences in their own words, resulting in richer, more complex data. When the semi-structured interviews include open-ended questions, respondents can express their views in their own words, thereby providing richer, more in-depth insights (Bell *et al.*, 2022).

This study will implement semi-structured interviews as a primary strategy for gathering data. The questionnaire was semi-structured, with questions that were predetermined by the researcher (Merriam & Tisdell, 2015). The questionnaire's semi-structured design offered some emphasis, direction and focus. Still, it also allowed for flexibility and adaptability, enabling the researcher to explore unexpected themes or ideas that emerged while gathering data.

This strategy aligned with the research's qualitative orientation of the research and the inductive approach, allowing a thorough exploration of the barriers South African universities face in establishing spin-out companies.

3.2.5 Time horizon

This research project was conducted cross-sectional. The timeframe for the study spanned over several months, allowing for in-depth data collection and analysis (Saunders *et al.*, 2016).

A cross-sectional time horizon allowed for an in-depth, qualitative exploration of South African universities' existing challenges in forming spin-out companies. While not capturing changes over time, this approach provided a rich snapshot of the current situation that can inform future research and policy. The time-constrained nature of the study also necessitated a focus on gathering meaningful, pertinent data efficiently.

Table 1 presents a comprehensive summary of the research methodology choices adopted for this study for ease of reference and clarity.

Table 1: Summary of the research choices

Research Category	Applied in the Study	Description
Research Paradigm	Interpretivist	The interpretivist paradigm posits that reality is socially constructed through subjective experiences and interactions. It emphasises understanding phenomena from the participants' perspectives, acknowledging that multiple realities exist based on individual perceptions and interpretations
Research Approach	Inductive	An inductive approach begins with collecting data, analysing patterns, and developing theories. Unlike a deductive approach, which starts with a hypothesis based on existing theory, the inductive method allows theories to emerge organically from the data gathered during the research
Research Strategy	Semi-structured Interviews	Semi-structured interviews offer flexibility and adaptability in data collection. This method combines predetermined questions with the opportunity to explore emerging themes or ideas, allowing the researcher to delve deeper into topics as they arise during the conversation with participants
Time Horizon	Cross-Sectional	A cross-sectional time horizon involves collecting data at a single point in time or over a specific, short period. In this study, data were collected over several months to provide an in-depth snapshot of the current situation within South African universities, capturing the state of affairs during that period
Research Design	Qualitative	A qualitative research design was employed to explore the experiences and perspectives of participants in depth. This approach is suited to gaining rich, detailed insights into complex issues, such as the barriers facing spin-out companies in South African universities

Source: Saunders *et al*. (2016:164)

3.2.6 Study population and sampling

- Study Population

The study population of this research was TTO professionals, researchers, and experts in the TT setting within South African universities with deep-seated experience in this domain, ensuring a rich and informed perspective on the subject matter (McMillan & Schumacher, 2014:31).

- Sample Frame: Inclusion and Exclusion Criteria

The inclusion criteria for the sample frame consisted of individuals who have direct involvement or tangible impact within the TT and spin-out company creation process. These were TTO professionals actively engaged in the process, researchers whose work contributed to the process, or experts who offered significant insights into this field.

Exclusion criteria included individuals who, despite being within the university setting, do not have a direct connection or influence on the technology transfer process or the creation of spin-out companies.

- Sample Technique

A purposive sampling approach was adopted to select participants with rich knowledge and experience related to the research topic (Merriam & Tisdell, 2015). This method allowed the researcher to understand the challenges and barriers in the spin-out company creation process from those directly involved or affected.

It is important to note that while this sampling approach may limit the generalizability of the findings to a larger population, it enhanced the depth and richness of the data, which was a key goal of the qualitative research (Merriam & Tisdell, 2015).

- Selection of Sample Technique

A purposive sampling technique was employed for this study, ensuring that the participants chosen possessed rich and nuanced knowledge of the research subject. This technique focuses on the quality and depth of data by including those with first-

hand experience or substantial knowledge of technology transfer processes (Merriam & Tisdell, 2015).

- Determination of Sample Size

The sample size for this study was designed to balance the depth of data with the feasibility of research execution. The concept of “information power” posits that the size of the sample is inversely proportional to the quality and relevance of the information held by each participant (Malterud *et al.*, 2016). A total of 10 semi-structured interviews were conducted to gather diverse perspectives. This number was selected to ensure comprehensive insights while maintaining a balance between depth and breadth of analysis. The research approach remained flexible, allowing for adjustments based on data saturation. If saturation had been reached with fewer interviews or if more were required, the number would have been adjusted accordingly to ensure a thorough exploration of the research objectives.

- Execution of the Sampling (Recruitment) Process

To execute the recruitment process for this study, a systematic approach was employed to identify and engage potential participants. As the study population comprises TTO professionals, researchers, and experts immersed in the TT fraternity within South African universities, the recruitment strategy was to capitalise on these specific institutional networks.

Contact was initiated via professional platforms, university channels, or TT communities. Each participant was chosen for their unique insights from extensive experience and deep knowledge of the spin-out company creation process. Upon agreement to participate, interviews were scheduled at the participants' convenience in a manner that respects their time commitments and professional responsibilities.

While recognising that the purposive sampling strategy may constrain the generalizability of the findings to broader populations, it was suitable for the study's qualitative nature. The strategy aligned with the principal research objective: to obtain a rich, detailed, and in-depth understanding of the phenomenon under investigation (Merriam & Tisdell, 2015).

- Designing the Measuring Instrument

The primary measuring instrument for this study was semi-structured interviews. The semi-structured interview guide, as per Annexure “B” facilitated rich discussions about South African universities' barriers and challenges in establishing spin-out companies (Bryman & Bell, 2015; Bryman *et al.*, 2014).

The interview questions were developed in line with the main research question, allowing room for exploration. Structured questions addressed the core topics related to the barriers to establishing spin-out companies. Several open-ended questions in the questionnaire allowed participants to express their unique insights and experiences. This flexible approach aligned with the inherent dynamism of qualitative research, allowing for the possible uncovering of unexpected yet potentially illuminating information (Merriam & Tisdell, 2015:1-2).

3.2.7 Collection of data

Data collection in this study was executed via personalised, semi-structured interviews. This method was chosen as part of a qualitative research approach to offer richer and more in-depth insights (Bryman *et al.*, 2014).

Interviews, whether in-person or through digital platforms such as Zoom or Teams, ensured more meaningful participant interactions and quality data. This approach provided an increased capacity for exploratory discussions and aligns better with the need for fewer yet more targeted and comprehensive responses (Saunders *et al.*, 2019).

Participants were engaged through an interview guide strategically designed to explore the challenges South African universities confront while creating spin-out companies. This guide combined structured inquiries focused on the central research theme with open-ended questions for participants to voice unique insights, experiences, and perceptions (Merriam & Tisdell, 2015).

This combination of specificity and flexibility is a hallmark of qualitative research and facilitates the collection of rich, detailed data. Confidentiality and ethical considerations

will be rigorously maintained throughout the data collection process (Creswell & Creswell, 2017).

3.2.8 Qualitative data analysis

Capitalising on the insights provided in the thematic analysis method, the researcher systematically examined the data collected from the interviews. The process begun with transcribing interview responses, converting spoken words into a textual format, and obtaining the participants' written consent (Bryman *et al.*, 2014).

The coded data was thoroughly examined to identify patterns, themes, and underlying relationships, aiding in a deeper comprehension of the research question (Saunders *et al.*, 2019). Recurring topics and concepts were identified and highlighted. This analysis was conducted manually, ensuring an in-depth understanding and interpretation of the data (Braun & Clarke, 2006).

This process of encoding and categorising the data assisted the researcher in deciphering the collected information. By transcending mere coding and investigating the qualitative data for similarities among categories, themes, and dimensions of information, the researcher gained a more profound understanding of the topic (Saldaña, 2021).

The researcher systematically documented and recorded participants' responses during the interviews. Noting any recurring patterns, similarities, or themes. These observations were used for subsequent analysis (Merriam & Tisdell, 2015).

Although qualitative data management software such as ATLAS.ti is often used to support detailed thematic analysis and facilitate data organisation, this study employed a manual approach. By manually coding and organising the qualitative data, the researcher ensured a deeper engagement with the content, enabling a comprehensive identification of recurring themes and nuanced insights. This hands-on method maintained the study's methodological rigour and allowed for a thorough exploration of the complex relationships and themes that emerged from the interviews.

3.3 Trustworthiness

To ensure the trustworthiness of this study, a holistic strategy that encompasses reliability, validity, credibility, transferability, dependability, and confirmability was employed. This comprehensive approach begins with implementing a clear and comprehensive research design to guarantee transparency and reproducibility, thereby enhancing the study's reliability. The principle of data triangulation was utilised to improve validity, employing multiple data sources to verify findings and reduce bias, thus ensuring a more robust examination of the research questions.

The study emphasised credibility through methods such as prolonged engagement with the data and member checks, where participants validated the accuracy of their interpreted responses. This enhances the authenticity of the data and ensures that the findings genuinely reflect the perspectives of those being studied. Transferability will be addressed by providing rich, detailed descriptions of the research context and methodology, allowing for the applicability of findings across similar contexts or settings. This ensured that the insights gained from this study were relevant to other universities and their TTOs in South Africa and potentially beyond.

To assure dependability, an audit trail documenting all research processes, adjustments, and decision-making was maintained, reflecting the dynamic nature of the research context and the iterative process of understanding it. This level of documentation ensured that the research process was transparent and could be evaluated by others for its consistency over time. Confirmability was achieved by maintaining an objective stance throughout data analysis and interpretation, supported by a rigorous process of reflexivity. This involved a continuous reflection upon and critique of the researcher's own biases, assumptions, and preconceptions to minimise their influence on the findings.

A careful selection of a representative sample from the larger population of universities and their TTOs in South Africa was undertaken to ensure the generalizability and applicability of the study's findings to the broader community under investigation. By adopting these strategies, the study aimed to provide a thorough and unbiased exploration of the research topic, ensuring the integrity of the findings and their meaningful contribution to the field of study.

3.4 Ethical considerations

Ethical considerations are paramount in any research project and are the backbone of the study's integrity. Ensuring the research was conducted responsibly and with respect for all participants involved is an obligation that cannot be overlooked (Bryman & Bell, 2015).

For this investigation, the researcher adhered strictly to the principles outlined in the Protection of Personal Information Act (POPIA, 2019). This legislation provides guidelines on handling participants' contact details ethically and lawfully. Compliance with the POPIA safeguards the integrity and confidentiality of participants' information, ensuring it is used exclusively for the research's legitimate and lawful purposes.

Consent forms were utilised to secure explicit permission from each participant, clearly communicating the study's purpose, nature of involvement, and assurances of confidentiality (Creswell & Creswell, 2017). Moreover, it was made clear to all participants that their involvement is entirely voluntary, and they are free to withdraw from the study at any point without any repercussions (Merriam & Tisdell, 2015).

To uphold ethical considerations during data analysis, the researcher remained impartial, avoiding any biases that might skew the results (Saunders *et al.*, 2019). Ensuring confidentiality when reporting findings is another important ethical responsibility. Therefore, no identifying features were linked to participants' responses in any resulting publications or presentations (Bryman & Bell, 2015).

The ethical guidelines outlined in this research are not just formalities but embody respect for participants and the principles of good research practice. Thus, strict adherence to these guidelines will be maintained throughout the research process.

For this study, ethical protocols have been duly observed. Participants were informed about the study's objectives and ensured confidentiality and anonymity, with their consent documented in the Informed Consent Form, Annexure A. The semi-structured interview questions used during the research process are presented in Annexure B

Table 2 below outlines the ethical considerations and provides ways to mitigate potential risks at each stage.

Table 2: Ethical considerations for the study

Phase	Ethical Issue	Description	Mitigation Strategy
Topic Selection	Worthy and Non-Intrusive Topic	Ensuring the research holds academic value without intruding on private or sensitive areas	Select a topic that is academically relevant while respecting individual rights and privacy
Recruitment & Site Access	Recruitment and Access to Sites	Ethical considerations when approaching institutions or participants for research	Obtain formal permission from institutions; ensure voluntary, non-coerced participation by informing participants clearly
Data Collection	Informed Consent	Ensuring participants are fully informed about the study and consent willingly	Provide comprehensive consent forms detailing the study's purpose, participation extent, and rights, including withdrawal
Data Analysis	Competence in Analysis	Avoiding biases and misrepresentation during data interpretation	Apply rigorous analytical methods, double-check interpretations, and seek peer review for accuracy
Reporting, Sharing, & Storing Data	Confidentiality & Data Accuracy	Protecting participant identity and ensuring accurate, responsible public dissemination of data	Anonymize data, use secure storage systems, and peer-review findings to ensure data integrity and confidentiality
POPIA Compliance	Adherence to POPIA	Compliance with the Protection of Personal Information Act (POPIA, 2019) concerning data privacy	Rigorously follow POPIA guidelines for data collection, storage, handling, and deletion to ensure legal compliance

3.5 Contribution of the study

This study offers significant insights into South African universities' barriers to establishing spin-out companies. Amidst the evolving landscape of higher education, the role of universities has shifted beyond traditional research and education, serving as pivotal agents in driving economic contributions to society. While the imperative for universities to bolster university-industry technology transfer is primarily government-driven, institutions themselves are motivated to seek economic returns, not merely for

societal benefit but also as a compensatory mechanism for dwindling government funding (Audretsch *et al.*, 2014:301-312).

Theoretical Contribution - The study on the barriers South African universities face in establishing spin-out companies will significantly enhance the existing literature on academic innovation and entrepreneurship in the South African context. Building upon the knowledge surrounding innovation and corporate entrepreneurship within specific sectors in South Africa, this research delves deeper into the academic sector, mainly focusing on universities. By identifying and analysing the barriers to establishing spin-out companies, the research seeks to bridge the gap between theoretical understanding and practical challenges faced by universities in South Africa. This endeavour will not only provide an academic lens to the issue but also underscore the nuances associated with the South African innovation and entrepreneurial ecosystem, enriching the broader discourse on university spinouts (Mosey & Wright, 2007:909-935)

Practical Contribution – Like many global counterparts, South African universities aim to commercialise their research findings for broader societal benefit. However, the unique challenges faced in this region make the process intricate. By comprehensively understanding these barriers, TTO's. Policymakers, academic leaders, and industry stakeholders can collaboratively devise strategies to overcome them. This research, therefore, offers a practical framework that universities in South Africa can employ. The insights derived will be instrumental in refining processes fostering a uniform and collective environment conducive to spin-out companies' establishment and growth. (Lockett & Wright, 2005: 1043-1057).

Industry Contribution – As universities in South Africa play a pivotal role in the knowledge economy, fostering spin-out companies becomes paramount. With its rich history and diverse economic landscape, South Africa can become a beacon for academic innovation and entrepreneurship. The findings from this research can inform industry best practices, culminating in a comprehensive document outlining strategies and recommendations specifically tailored for the South African context. Such a document can serve as a reference point for TTOs, ensuring that the barriers are

systematically addressed and the potential of spin-out companies is realised to its fullest (Clarysse, Tartari*, et al.*, 2011:1084-1093).

3.6 Limitations of the study

Every research endeavour is accompanied by certain constraints or limitations, which may arise from methodological decisions, practical considerations, or the intrinsic characteristics of the subject under investigation. This acknowledgement is essential in academic and scientific research documents that recognise these constraints. By transparently outlining these limitations, researchers demonstrate intellectual honesty and rigour and provide context for interpreting their findings (Bryman, 2016). This section offers readers a clear understanding of the potential boundaries or restrictions within which the study's outcomes should be interpreted, allowing for a more nuanced and informed assessment of the research. The main limitations of the study will be discussed below.

Sampling Bias: Even though purposive sampling can offer rich insights due to the selection of specific participants; it may introduce a bias as it doesn't capture the complete heterogeneity of the population. Purposive samples are not necessarily representative of the broader population, which may limit the findings' generalizability (Etikan *et al.*, 2016:1-4).

Scope of Study: Given that this research primarily focuses on South African universities, the findings might not be directly transferable or applicable to other State-funded institutions or TTOs outside South African university settings, limiting its external validity (Bryman, 2016:158). The participants selected for the qualitative study may not fully encapsulate the diverse perspectives of all stakeholders in South Africa's university TTO sector. Moreover, since certain institutions might not have been included, the results might not reflect the entirety of South African universities and may have limited generalizability across the broader academic landscape (Bezuidenhout, 2018:41).

Reliance on Self-reported Data: Since the study depends heavily on semi-structured interviews, it's contingent upon the accuracy and honesty of participants' responses. Self-reported data can sometimes suffer from recall bias or social desirability bias,

where participants may adjust their responses based on what they believe is socially acceptable or expected (Merriam & Tisdell, 2015:187; Podsakoff *et al.*, 2003:879).

Qualitative Limitations: While qualitative methods provide depth and context, they may not always yield statistically generalizable results to a broader population. Furthermore, qualitative data interpretation is often influenced by the researcher's perceptions and biases, which might affect the objective assessment of the data (Creswell & Miller, 2000:124-130).

Limitations of Data Triangulation: While using semi-structured interviews to research or investigate a particular phenomenon, the primary aim is to enhance the validity, credibility, and reliability of research findings (Denzin, 2017:120). By collecting data from various participants, researchers aim to cross-verify and validate their findings, thereby increasing confidence in the results (Yin Robert, 2017:98). Thus, Data Triangulation can enhance the validity of a study. Still, it can also introduce complexity, especially if the different data sources contradict each other (Creswell & Creswell, 2017:150). Resolving these discrepancies can be challenging and might lead to potential biases (Denzin, 2017:120-125).

Technological Barriers: Technological challenges might arise with interviews conducted through digital platforms like Zoom or Teams. There could be potential loss of data or misinterpretations due to technical glitches, leading to incomplete or fragmented insights (Drabble *et al.*, 2015:118-133)

Temporal Limitations: The study captures a snapshot in time. The findings may evolve as the landscape of technology transfer within universities changes over time, affecting the long-term relevance of the results (Saunders *et al*., 2018).

Geographical Constraints: The research focuses on South African universities and their TTOs. While these findings offer insights into the specific context of South African universities, their applicability to universities in other countries or regions may be limited due to potential differences in cultural, regulatory, or operational aspects (Bryman, 2016), which means the findings may not necessarily apply or be generalisable to TTOs in other geographical regions or countries with different cultural, economic, or regulatory landscapes (Miles, 2011:105).

Notably, the most expansive South African university TTOs is situated in the Cape province, which might further nuance the conclusions drawn from this study.

Dependence on Participant Recollection: As the research heavily relies on semi-structured interviews, there's a possibility that some participants might inadvertently omit or misremember details, leading to potential biases in the data. Participants might forget specific details, events, or influences that could be critical to the research. (Podsakoff *et al.*, 2003:879)

Depth vs. Breadth: The chosen qualitative approach offers depth but might limit the breadth of the study. Insights from a limited number of participants might not encompass the broader population's diverse range of experiences and perspectives.

Potential Confirmation Bias: The methodology relies on identifying and coding recurring themes and patterns in the interview data. While rigorous, this process could potentially overlook outliers or unique insights that don't fit into established themes. The interpretive nature of qualitative research may introduce researcher biases during data analysis, potentially affecting the study's objectivity and conclusions (Merriam & Tisdell, 2015:208). From an epistemological or theoretical standpoint, the researcher's personal beliefs and life experiences could potentially shape the interpretation of the data. (Merriam & Tisdell, 2015:208)

Although there are inherent limitations, the data garnered from this study, particularly through the structured face-to-face interviews, offers valuable supplementary insights that will successfully achieve the intended research objectives. (Bezuidenhout, 2018:41).

CHAPTER 4 ANALYSIS AND INTERPRETATIONS

4.1 Introduction

This chapter presents the findings derived from the qualitative analysis of interviews with key stakeholders involved in the TTO fraternity and commercialisation processes within South African universities. The primary objective is to identify barriers preventing the successful establishment of spin-out companies. The results are structured around five major themes that align with the research objectives: barriers to spin-out companies, leadership impact, digital transformation and artificial intelligence (AI) in commercialisation, alignment with Sustainable Development Goals (SDGs), and effective strategies for overcoming these obstacles. Each theme is critically analysed, and interpretations are provided to illustrate the insights gained from the participants' responses.

4.2 Gathering of data

The data for this study was collected through semi-structured interviews with 10 participants, each holding a strategic role within a university's TTO, Innovation Office or related commercialisation unit. The interviews focused on understanding the participants' perspectives regarding the barriers faced in establishing spin-out companies, the role of leadership, the influence of digital transformation and AI, and the alignment of spin-out activities with the SDGs.

The interviews were conducted via Microsoft Teams, a platform chosen for its reliability, ease of access, and built-in transcription feature. Microsoft Teams' automated transcription capability generated initial transcripts for each interview. These initial transcripts provided a foundation for further refinement but required careful manual review to correct inaccuracies and enhance the clarity of the content. This thorough review process ensured that the final transcripts accurately represented the participants' insights.

The transcribed data were systematically coded using a thematic analysis approach to facilitate a rigorous and structured analysis. The researcher engaged in an iterative coding process wherein significant phrases, patterns, and relevant terminologies were identified and categorised into preliminary codes. Each transcript was reviewed

multiple times to ensure consistency and comprehensive coverage of the key concepts. This iterative process allowed for identifying recurring themes and sub-themes, which were further refined and categorised.

The initial coding phase produced various codes that captured various aspects of the participants' responses. These codes were then reviewed and grouped into broader categories, which represented higher-level concepts related to the research objectives. The themes that emerged from these categories encapsulated the primary barriers, challenges, and opportunities associated with establishing spin-out companies in South African universities. The resulting themes were subsequently mapped back to the research questions and objectives to ensure that they aligned with the study's aims and provided meaningful insights.

Thematic analysis was selected as the most appropriate method for this study due to its robustness in identifying, analysing, and reporting patterns within qualitative data. This method enabled a structured and nuanced understanding of the complex barriers faced by South African universities in creating successful spin-out companies. By organising the data into distinct themes, the researcher could provide a clear and comprehensive interpretation of the findings, laying a solid foundation for the subsequent discussion and conclusions in the following chapters.

The comprehensive data analysis revealed five primary themes, which will be further explored and discussed in the next section. These themes form the core of the study's findings, offering valuable insights into the critical factors that influence the establishment and success of spin-out companies within South African universities.

4.3 Results and discussion

This section presents the study's findings, organised into five primary themes that emerged from the thematic analysis of the interview data. Each theme encapsulates key barriers impeding the establishment and success of spin-out companies within South African universities. The subsequent discussion critically examines these themes in the context of existing literature, highlighting their significance and implications for universities, TTOs, policymakers, and industry partners.

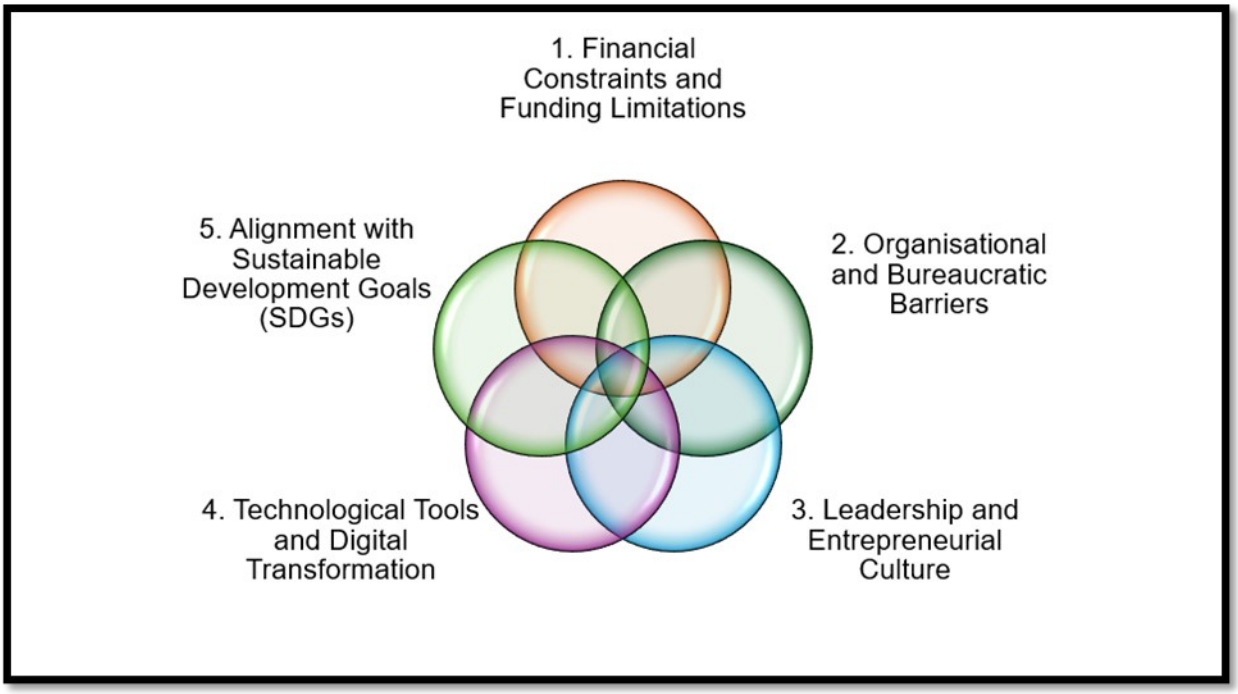
The five primary themes were identified through the following research questions:

a) What are the biggest barriers faced by universities in South Africa when trying to establish spin-out companies?
b) Are there specific hurdles unique to South Africa that hinder the establishment of these spin-out companies?
c) How does leadership within a university's TTO support spin-out companies?
d) Can you provide examples of leadership practices or styles within TTOs that have been particularly effective or ineffective in facilitating spin-out creation and growth?
e) In your experience, what are the primary weaknesses in the business model of the university TTOs and entrepreneurial skills of academics involved in spin-out companies?
f) How has the use of digital tools, including AI, affected the processes and success rates of spin-out companies at your university?
g) How do spin-out companies at your university align with and contribute to the United Nations Sustainable Development Goals (SDGs)?

Each theme encapsulates key barriers impeding the establishment and success of spin-out companies within South African universities. The subsequent discussion critically examines these themes in the context of existing literature, highlighting their significance and implications for universities, TTOs, policymakers, and industry partners.

Figure 3 below illustrates the five primary themes identified through the analysis, visually representing the critical barriers to spin-out success.

Figure 3: Themes identified as barriers to spin-out companies in South African universities



Following the thematic framework depicted in Figure 3 above, Table 3 below offers a comprehensive breakdown of each identified theme, detailing the specific categories and associated codes derived from the interview data. This table systematically organises the key barriers to spin-out success, providing clarity and depth to the overarching themes. By presenting the information in both visual and tabular formats, Table 3 enhances the understanding of the multifaceted challenges faced by South African universities in establishing and sustaining spin-out companies. The table's detailed categorisation underscores these barriers' complexity, facilitating a more nuanced discussion in the subsequent sections.

Table 3: Detailed breakdown of themes identified

Theme	Category	Codes
1. Financial Constraints and Funding Limitations	Funding Constraints	- Limited access to venture capital - Reliance on public funding - Difficulty securing early-stage funding
	Underdeveloped Venture Capital	- Fewer corporate venture capital firms compared to the UK/EU - Limited funding options
	Limited Access to Capital	- Difficulty obtaining early-stage investments from local and international investors
2. Organisational and Bureaucratic Barriers	Bureaucratic Decision-Making	- Lengthy and rigid internal processes delaying spin-out creation and funding approvals
	Complexity of Processes	- Complicated procedures within TTOs for managing IP and spinouts hinder efficient commercialisation
	Regulatory and Policy Hurdles	- External policies on tax, labour laws, and IP management complicate the commercialisation process
	Organisational Structure and Team Composition	- Hierarchical management styles can slow decision-making - Flat or collaborative structures promote flexibility
	Industry Partnerships	- Limited industry partnerships - Building industry partnerships
	Entrepreneurial Culture	- Absence of a mindset that supports innovation and business development among researchers and staff

Theme	Category	Codes
3. Leadership and Entrepreneurial Culture	Hands-On Leadership	- Leaders actively engage, mentor, and support researchers through the spin-out process
	Passive Leadership	- Leaders approve projects without active involvement, leading to delays and missed opportunities
	Emotional Intelligence (EQ)	- Leaders' ability to manage emotions and foster a positive organisational culture
	Authoritarian Leadership	- Rigid, controlling leadership styles that stifle innovation and discourage team collaboration
	Transformational Leadership	- Leaders inspire and motivate staff to innovate and pursue entrepreneurial ventures
	Focus on IP Over Business Models	- TTOs prioritise intellectual property protection at the expense of developing viable business strategies
4. Technological Tools and Digital Transformation	AI and Data-Driven Platforms	- Utilisation of AI to assess market potential, manage intellectual property, and match technologies with industry needs - Implementation of data-driven approaches to make informed decisions about commercialisation strategies - Specific instances where AI tools have significantly improved commercialisation outcomes
	Digital Transformation and Efficiency	- Adoption of digital tools and technologies to streamline TTO processes and enhance efficiency - Limited adoption of AI and digital tools comprehensively, affecting overall efficiency

Theme	Category	Codes
5. Alignment with Sustainable Development Goals (SDGs)	Direct Alignment with SDGs	- Spinouts explicitly designed to meet specific SDGs - Contributions to particular SDGs
	Indirect Alignment with SDGs	- Spinouts contribute to SDGs without a structured alignment process, aligning with SDG objectives over time - Commercialisation processes do not systematically align spinouts with SDG goals, focusing more on commercial potential

4.3.1 Theme 1: Financial constraints and funding limitations

Financial and funding limitations represent a critical barrier to the successful establishment and growth of spin-out companies within South African universities. This theme encompasses various challenges related to securing capital, including limited access to venture capital, reliance on public funding, and difficulties in obtaining early-stage investments. The financial ecosystem for university spinouts in South Africa is significantly underdeveloped compared to global standards, posing a considerable hurdle for TTOs and innovation centres in commercialising research outputs effectively.

- Funding Constraints

Participants frequently cited limited access to venture capital as a significant obstacle to the success of spinout companies. The lack of venture capital firms willing to invest in university spinouts forces TTOs to rely on a narrow pool of local investors, who often lack the capacity or interest to fund high-risk projects. This gap in funding options creates a bottleneck, restricting the ability of spinouts to move beyond the initial proof-of-concept stage. One participant noted, “The venture capital landscape in South Africa is not structured to support early-stage university spinouts, leaving many ventures without the financial resources they need to progress.”

Additionally, there was a notable emphasis on the reliance on public funding, which, while essential, involves lengthy approval processes, complex application requirements, and limited financial support. This dependency on a single funding source leaves spinouts vulnerable to changes in government policy and funding availability. Participants reported that the absence of diversified funding options sometimes results in promising projects being abandoned due to the inability to secure adequate financial backing.

- Underdeveloped Venture Capital Ecosystem

The underdeveloped venture capital ecosystem was highlighted as a significant barrier, with participants comparing the South African context to more developed markets such as the US and Europe. The findings indicate that spinouts in South Africa

lack access to a well-established network of corporate venture capital firms, making it difficult to obtain the necessary resources and expertise to support their growth. One participant expressed, “In more developed markets, spinouts benefit from robust corporate venture capital networks, but here, we struggle to find that kind of support.”

- Limited Access to Capital

Participants reported that limited access to local and international funding is a significant barrier. The perception of high risk associated with South African spinouts, coupled with limited local investment, makes it challenging for these entities to obtain the capital necessary to move beyond the seed stage. One participant summarised this issue: “Our spinouts are seen as too risky for investors.”

Correlation with Existing Literature

These findings align with existing literature, emphasising that limited venture capital availability and dependence on public funding hinder spin-out development in emerging markets. Previous studies have highlighted that high perceived risk and underdeveloped funding structures restrict early-stage investment opportunities (Kruss, 2015; Wright et al., 2006). Unlike in more developed ecosystems where early-stage investment is supported by private funds, South African spinouts face a particularly acute funding gap due to the absence of structured corporate venture capital networks.

Comparison and Unique Contributions

This study’s findings contribute uniquely by underscoring how South African spinouts are particularly vulnerable due to a lack of diversified funding sources and investor risk aversion. Unlike mature markets, South Africa’s venture ecosystem lacks robust corporate venture capital networks, deepening the financial gap university spinouts face.

4.3.2 Theme 2: Organisational and bureaucratic barriers

Organisational and bureaucratic barriers significantly hinder the successful commercialisation of research outputs and the establishment of spin-out companies within South African universities. These barriers include bureaucratic decision-making

processes, complex procedures within TTOs, regulatory and policy hurdles, organisational structure and team composition, limited industry partnerships, and the lack of an entrepreneurial culture. These elements create an environment that is often inflexible, slow to respond, and challenging to navigate, deterring potential spin-out ventures and stifling innovation.

- Bureaucratic Decision-Making

The bureaucratic nature of decision-making processes within universities and TTOs was identified as a major impediment to the efficient establishment of spin-out companies. Participants highlighted that lengthy and rigid internal procedures often delay spin-out creation and funding approvals, resulting in lost commercial opportunities. One participant noted, “The bureaucracy involved in approving a spin-out can take months, if not years.” This delay is exacerbated by the requirement for multiple layers of approval, which can hinder the responsiveness and adaptability needed to bring innovations to market.

Bureaucratic decision-making also manifests in the form of extensive documentation and the need for comprehensive justifications, which slow down the process further. As a result, many promising technologies remain stuck in the approval phase and are unable to progress to commercialisation.

- Complexity of Processes

Participants reported that navigating the complex procedures for managing intellectual property and establishing spinouts within TTOs is a significant challenge. These cumbersome processes often result in confusion, delays, and missed opportunities, limiting the potential for successful commercialisation. One participant remarked, “Navigating the IP management process is a maze, which delays our ability to move forward.”

- Regulatory and Policy Hurdles

External regulatory and policy hurdles, including compliance with tax laws, labour regulations, and intellectual property management, were also identified as significant barriers. These factors add layers of complexity that many TTOs are not equipped to

handle effectively, slowing down the commercialisation process. A participant noted, “Understanding and complying with tax laws while managing IP rights is a significant challenge.

- Organisational Structure and Team Composition

The organisational structure and team composition within universities and TTOs have a profound impact on the effectiveness of spin-out initiatives. Hierarchical management styles, characterised by centralised authority and multiple layers of oversight, were reported to slow down decision-making processes and reduce organisational agility. One participant expressed, “Our hierarchical structure means that every decision has to pass through multiple levels, causing delays.”

Conversely, participants noted that flat or collaborative management structures, which promote decentralised decision-making and open communication, enable greater flexibility and faster response times. These structures allow for more direct engagement with researchers and facilitate the quick resolution of issues, enhancing the overall efficiency of the spin-out process. Thus, adopting more collaborative management approaches within TTOs could significantly improve their ability to support spin-out companies.

- Industry Partnerships

Industry partnerships are essential for the success of spin-out companies, providing access to critical resources such as funding, mentorship, and market insights. Participants identified limited industry partnerships as a major barrier to spin-out development. The absence of strong industry linkages restricts the ability of spinouts to leverage external expertise and resources, thereby limiting their growth potential. One participant stated, “We struggle to find industry partners willing to collaborate.”

Despite these challenges, participants emphasised that building robust industry partnerships can substantially enhance the commercialisation process. Successful industry collaborations provide spinouts with access to specialised knowledge, networks, and funding, which are crucial for their sustainability and scalability.

Participants recommended that universities actively pursue industry engagement strategies to foster stronger partnerships and support the growth of spin-out ventures.

- Entrepreneurial Culture

The absence of an entrepreneurial culture within universities was cited as a significant barrier to spin-out success. Participants highlighted that many researchers and TTO staff lack the entrepreneurial mindset to drive innovation and business development. Academic environments often prioritise research and publications over commercialisation activities, resulting in a cultural disconnect that hinders the formation of spin-out companies. One participant observed, “Most researchers are focused solely on academic achievements, with little interest in commercial ventures.”

To cultivate a more entrepreneurial culture, participants suggested that universities implement training and mentorship programmes that equip researchers with business skills and foster a mindset that values commercialisation. Promoting entrepreneurship as an integral component of academic success would encourage more researchers to engage in spin-out activities and contribute to the growth of innovation-driven ventures within the university ecosystem.

Correlation with Existing Literature

These findings correspond with literature indicating that bureaucratic inefficiencies and complex internal procedures within TTOs are major barriers to spin-out success. Studies have shown that hierarchical structures slow down decision-making and prevent agile responses to market opportunities (Breznitz, 2021; Walwyn, 2018). US and UK university-industry partnerships mitigate such inefficiencies, whereas South African spin-outs often lack external support structures to expedite approvals.

Comparison and Unique Contributions

The study’s unique contribution details how South African TTOs are specifically hindered by layered approval systems and regulatory complexity, compounded by limited resources and industry partnerships. This context-specific insight provides a clearer view of the region’s challenges, distinguishing it from more agile environments found in the US or UK.

4.3.3 Theme 3: Leadership and entrepreneurial culture

Leadership and entrepreneurial culture are fundamental determinants of the success of spin-out companies within South African universities. This theme explores the diverse leadership styles, the role of emotional intelligence, and the prevailing cultural attitudes that either foster or impede entrepreneurial initiatives. Effective leadership not only guides spinouts through the complexities of commercialisation but also cultivates an environment conducive to innovation and business development. Conversely, inadequate leadership and a lack of entrepreneurial culture can stifle growth, hinder decision-making, and ultimately lead to the failure of spin-out ventures. Additionally, the prioritisation of IP over business model development within TTOs presents strategic challenges that impact the commercial viability of spinouts.

- Hands-On Leadership

Hands-on leadership is characterised by leaders who are actively involved in guiding, mentoring, and supporting researchers throughout the spin-out process. Participants emphasised that such leaders are instrumental in navigating the complexities of commercialisation and providing the necessary strategic direction for spinouts. One participant shared, “When leaders take an active role in mentoring researchers and connecting them with industry partners, it makes a huge difference in the spin-out’s success.”

Hands-on leaders offer guidance and advocate for the spin-out within the university and external networks, helping secure funding and strategic partnerships. Their proactive engagement accelerates decision-making, fosters a collaborative environment, and boosts team morale. Participants highlighted that hands-on leadership significantly reduces the uncertainty and risk associated with establishing new ventures, making it easier for spinouts to overcome early-stage challenges.

- Passive Leadership

In contrast to hands-on leadership, passive leadership was identified as a major barrier to spin-out development. Passive leaders are characterised by their lack of active involvement in the spin-out process, often approving projects without providing

meaningful guidance or support. Lack of engagement from leaders leads to delays, missed opportunities, and a general absence of clear direction within the spin-out team.

Passive leadership not only reduces the overall effectiveness of the TTO but also discourages researchers from pursuing commercial ventures, as they perceive a lack of institutional support. Participants reported that passive leadership leads to frustration among researchers, who often feel abandoned or overlooked, resulting in decreased motivation and a higher likelihood of project abandonment.

- Emotional Intelligence (EQ)

Emotional intelligence (EQ) is a critical attribute for leaders within TTOs. It enables them to effectively manage their own emotions and respond empathetically to the needs of their teams. Leaders with high EQ create a positive organisational culture, enhance team cohesion, and foster an environment conducive to innovation. Participants indicated that leaders who demonstrate high levels of emotional intelligence are better equipped to handle conflicts, reduce workplace stress, and motivate their teams.

Leaders with strong EQ are seen as approachable and supportive, making it easier for researchers to engage in open communication and share their ideas without fear of criticism. One participant mentioned, “Leaders with high emotional intelligence can create an atmosphere of trust and support, which is essential for fostering innovation and collaboration.” This capability is particularly important in the context of spin-out companies, where the stress and uncertainty associated with commercialisation can be high.

- Authoritarian Leadership

Authoritarian leadership, defined by rigid and controlling behaviours, was identified as a significant inhibitor of spin-out success. Participants described authoritarian leaders as centralising decision-making, limiting open communication, and discouraging collaboration. This leadership style stifles creativity and prevents researchers from

experimenting with new ideas, ultimately reducing the innovation potential of spin-out companies.

Participants reported that authoritarian leadership leads to a lack of flexibility and responsiveness, which are critical in the dynamic commercialisation environment. One participant shared, “Authoritarian leadership creates a culture of fear and conformity, where people are afraid to speak up or propose new ideas.” This rigidity can cause delays in decision-making, reduce team morale, and ultimately hinder the growth of spin-out companies.

- Transformational Leadership

Transformational leadership was highlighted as a highly effective style for promoting innovation and entrepreneurial ventures within universities. Transformational leaders inspire and motivate staff by fostering a shared vision, encouraging creative problem-solving, and promoting a culture of continuous improvement. Participants emphasised that transformational leaders could rally their teams around common goals, instilling a sense of purpose and enthusiasm for spin-out activities.

Transformational leaders also play a crucial role in creating a supportive environment for risk-taking and experimentation, which are essential for the success of spin-out companies. By empowering their teams and recognising individual contributions, transformational leaders enhance employee engagement and drive the overall performance of spinouts. One participant stated, “Transformational leaders make you feel like you’re part of something bigger, which motivates you to push boundaries and achieve more.”

- Focus on IP Over Business Models

Participants observed that many TTOs prioritise the legal aspects of IP protection over developing viable business strategies. This focus on IP often results in spin-out companies with a strong technical foundation but lack the business acumen to compete in the market. One participant noted.

This prioritisation creates a disconnect between protecting innovations and their practical application, making it difficult for spinouts to attract investment and establish

sustainable business models. Participants highlighted that while protecting IP is important, it should not overshadow the need to build a solid business foundation that addresses market needs and competitive dynamics. A lack of emphasis on business strategy development can leave spinouts vulnerable once they enter the competitive commercial landscape, reducing their chances of success.

Correlation with Existing Literature

This theme is consistent with the literature, which underscores the role of effective leadership styles—such as transformational and hands-on leadership—in fostering innovation and guiding spin-outs. High emotional intelligence in leaders has been linked to improved team cohesion and project outcomes (Siegel *et al.*, 2007:640-660).

Comparison and Unique Contributions

This study contributes by highlighting the distinct leadership gap in South African TTOs. Passive and authoritarian leadership approaches are more common, often stifling innovation and hindering the commercialisation process. It reveals a specific need for culturally attuned, entrepreneurial leadership to overcome the barriers faced by local spin-outs.

4.3.4 Theme 4: Technological tools and digital transformation

Integrating technological tools and digital transformation within TTOs plays a pivotal role in enhancing the efficiency and effectiveness of spin-out processes. This theme delves into using artificial intelligence (AI) and data-driven platforms, along with the broader adoption of digital transformation strategies, to streamline commercialisation activities, improve decision-making, and facilitate technology transfer. The findings reveal that while some progress has been made in adopting digital tools, significant gaps and inconsistencies remain in their application, affecting the overall success of spin-out companies.

- AI and Data-Driven Platforms

Using AI and data-driven platforms has emerged as a valuable tool for TTOs in assessing market potential, managing IP, and matching university technologies with industry needs. Participants highlighted that AI platforms provide actionable insights

that guide the commercialisation process, enabling TTOs to make data-driven decisions regarding which technologies have the highest potential for success.

AI-driven platforms offer several benefits, including the ability to quickly analyse large volumes of data, identify patterns, and predict outcomes, which are crucial for navigating the complex commercialisation landscape. These tools can also assist in managing IP by automating prior art searches and patent landscaping, freeing up resources for more strategic activities.

Despite these benefits, participants reported that AI and data-driven platforms are not yet fully integrated into TTO processes. Some TTOs still rely on traditional, manual technology assessment and market analysis methods, resulting in inefficiencies and missed opportunities. The limited adoption of AI tools can be attributed to a lack of digital expertise among staff, resistance to change, and the perceived high cost of implementing such technologies. One participant noted, “Our TTO does not use AI. It does not apply to us.”

- Digital Transformation and Efficiency

Digital transformation encompasses adopting digital tools and technologies to streamline TTO processes and enhance operational efficiency. Participants acknowledged that digital tools, such as project management software, CRM systems, and IP management platforms, have improved communication, tracking, and coordination of spin-out activities. These tools facilitate more efficient management of spin-out portfolios, help monitor project progress and enable better collaboration with external stakeholders.

The findings suggest that digital transformation has been implemented unevenly across TTOs, with some offices embracing these tools more comprehensively than others. While digital tools have streamlined certain processes, such as reporting and data management, their limited adoption in areas like AI-driven decision-making and advanced data analytics has constrained the full potential of digital transformation. As one participant remarked, “We’ve adopted digital tools for some tasks, but the integration is incomplete, and we still struggle with inefficiencies in our processes.”

The disparity in digital transformation adoption is largely due to budget constraints, varying levels of digital literacy among staff, and differing organisational priorities. This inconsistent application of digital tools hinders TTOs' ability to fully leverage technology to support the growth and development of spin-out companies. Participants suggested that increasing investment in digital training for TTO staff and adopting a more strategic approach to digital transformation could significantly enhance the effectiveness of commercialisation activities.

Correlation with Existing Literature

These findings align with the literature, which shows that AI and digital tools can streamline IP management and market analysis, improving operational efficiency and decision-making within TTOs (Rippa & Secundo, 2019:900-911).

Comparison and Unique Contributions

The study's contribution is notable in identifying South African TTOs' limited integration of AI and digital tools, largely due to budget constraints and a lack of digital skills. This analysis highlights how local barriers differ from more digitally advanced TTOs globally, suggesting an opportunity for targeted digital transformation initiatives.

4.3.5 Theme 5: Alignment with Sustainable Development Goals

The alignment of spin-out companies with the United Nations Sustainable Development Goals (SDGs) is increasingly becoming a priority for universities seeking to demonstrate the broader societal impact of their research outputs. This theme explores how spin-out companies established by South African universities align with specific SDGs, the challenges in achieving direct alignment, and the implications for technology transfer and commercialisation strategies. While some spinouts are explicitly designed to address particular SDGs, others indirectly contribute to these goals without a structured alignment process.

- Direct Alignment with Sustainable Development Goals

Direct alignment refers to spinouts specifically created to address one or more of the 17 SDGs outlined by the United Nations. These spinouts are intentionally structured to deliver social, environmental, and economic benefits that contribute to global

sustainability objectives. Participants noted that aligning spinouts with SDGs enhances their societal relevance and increases their attractiveness to socially conscious investors and stakeholders.

- Indirect Alignment with Sustainable Development Goals

Indirect alignment occurs when spinouts contribute to SDG objectives without being explicitly designed. These companies may engage in activities that support sustainable practices or produce technologies that have a positive environmental or social impact over time. However, this alignment is often unintentional and emerges as a by-product of the spinout's commercial activities rather than a core objective. One participant explained, "Our spinouts contribute to sustainable development without realising it." This finding mirrors findings by Hruskova (2024), who noted that many university spinouts lack structured sustainability frameworks.

In such cases, the lack of a structured alignment process means these spinouts do not always capitalise on opportunities to enhance their social impact or secure funding targeted at sustainability-driven initiatives. Participants acknowledged that greater emphasis on aligning spinouts with SDGs could create a strategic advantage by opening new avenues for investment and collaboration. Achieving this alignment requires a shift in the commercialisation approach, with TTOs and innovation offices adopting frameworks that prioritise both commercial and sustainability outcomes.

Correlation with Existing Literature

These findings resonate with existing studies that emphasise the value of aligning commercialisation efforts with SDGs, both for societal impact and to attract sustainability-focused investors (Hruskova, 2024:39-66).

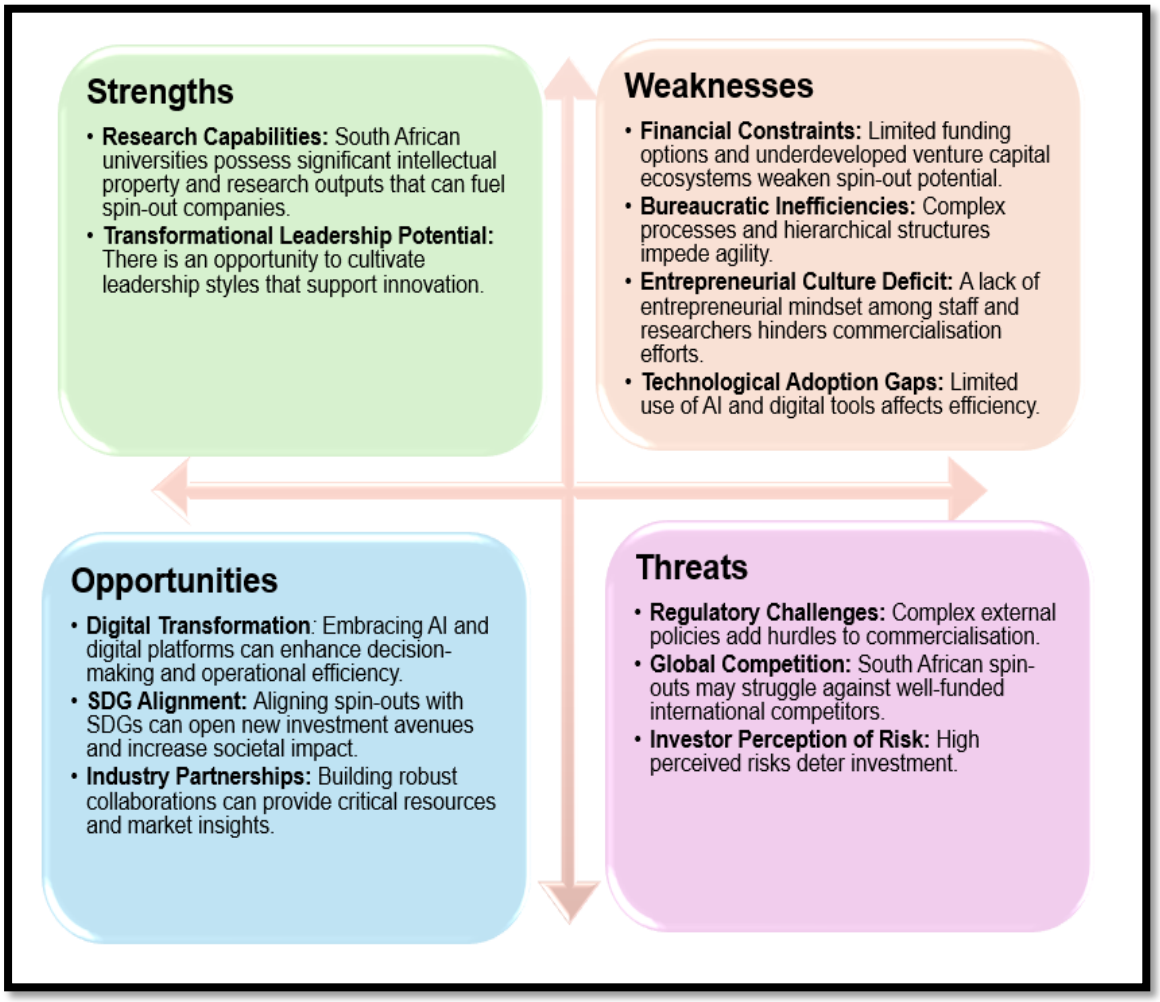
Comparison and Unique Contributions

The study uniquely identifies a lack of structured SDG alignment in South African spin-outs, where contributions to sustainability goals are often indirect. Unlike regions with prevalent SDG-aligned frameworks, this study underscores the potential benefits of adopting formal alignment processes to increase funding opportunities and societal impact.

4.4 Critical analysis of the findings of this study

A critical analysis of the research findings was conducted using a Strengths, Weaknesses, Opportunities, and Threats (SWOT) framework to assess the factors influencing the success of spin-out companies within South African universities. As illustrated in Figure 4, this SWOT analysis is directly derived from the results of this study, integrating the key barriers and enablers identified through thematic analysis. The strengths highlight robust research capabilities and the potential for transformational leadership within universities, as revealed by participants who emphasised the importance of hands-on and emotionally intelligent leadership styles. The weaknesses encompass financial constraints, bureaucratic inefficiencies, and a lack of entrepreneurial culture, which were significant themes in the findings. The opportunities include embracing digital transformation and aligning spin-out activities with SDGs, reflecting participants' insights on the benefits of adopting AI technologies and focusing on societal impact. Conversely, the threats consist of regulatory challenges, global competition, and high-risk perceptions among investors, which were consistently noted as external factors impeding spin-out success.

Figure 4: SWOT analysis based on the findings of this study

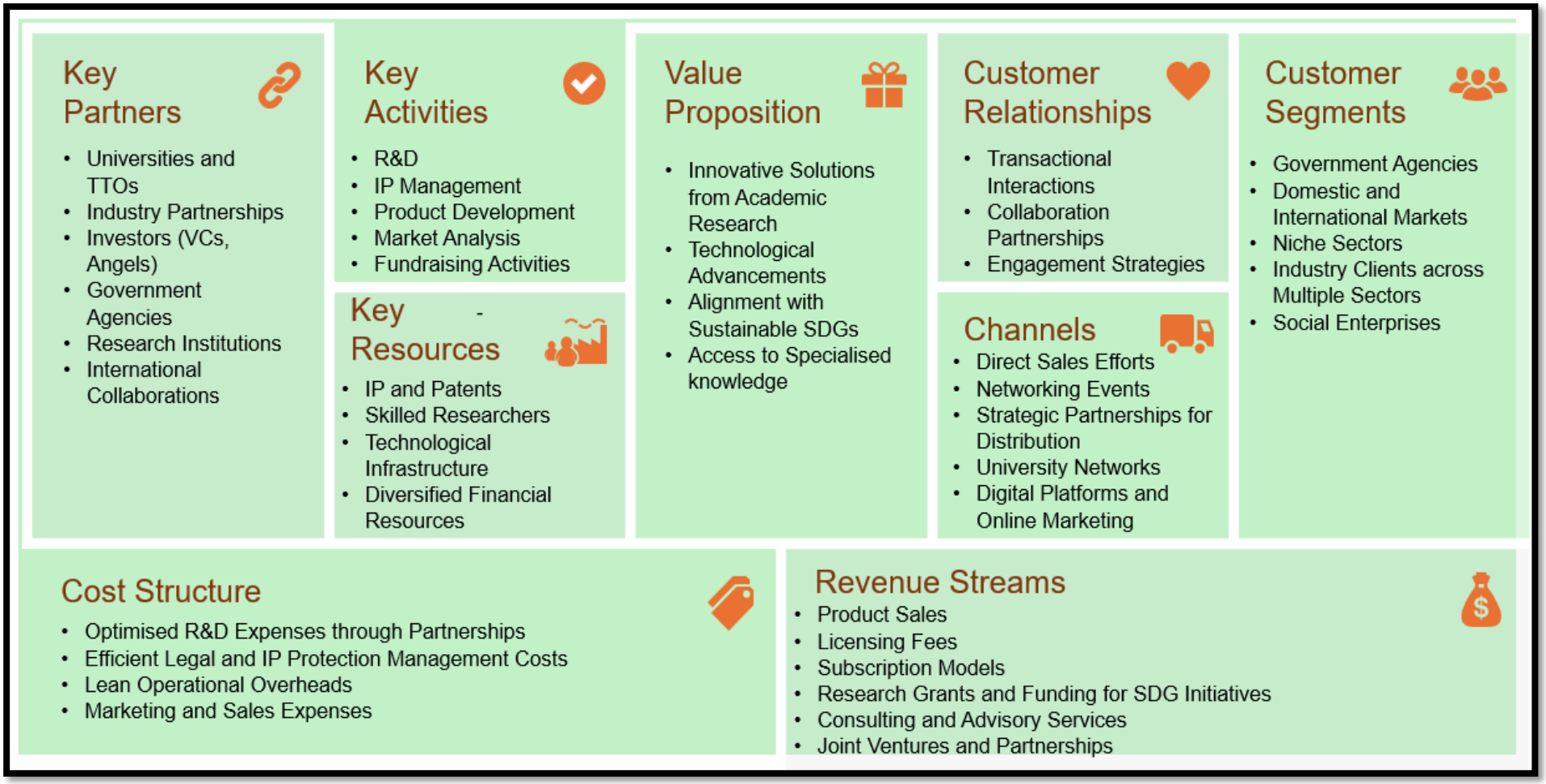


4.5 Applying the Business Model Canvas

The Business Model Canvas framework is applied to critically analyse how the barriers identified in this study affect the strategic development of spin-out companies within South African universities. The Business Model Canvas, developed by Osterwalder (2004), is a strategic management tool that provides a comprehensive overview of an organisation's business model through nine interconnected building blocks. This framework facilitates a holistic examination of how internal and external factors influence a business's value creation, delivery, and capture mechanisms. (Osterwalder, 2004)

Applying the research findings to the Business Model Canvas framework, as presented in Table 4, systematically identifies the areas where spin-out companies face significant challenges and opportunities for improvement.

Table 4: Business Model Canvas for South African university spin-out companies



Source: Osterwalder (2004)

4.6 Summary

Chapter 4 presents a comprehensive analysis of the key themes derived from interviews with stakeholders involved in the TTO and commercialisation processes within South African universities. The five primary themes identified include financial constraints and funding limitations, organisational and bureaucratic barriers, leadership and entrepreneurial culture, technological tools and digital transformation, and SDG alignment.

Financial Constraints and Funding Limitations emerged as a significant barrier, with limited access to venture capital and reliance on public funding hindering the growth and success of spinouts. The Organisational and Bureaucratic Barriers theme highlighted the challenges posed by complex internal processes, hierarchical structures, and the absence of a supportive entrepreneurial culture within universities.

The analysis of Leadership and Entrepreneurial Culture showed that effective leadership is crucial for driving spin-out success, with hands-on and transformational leadership styles particularly beneficial. In contrast, passive and authoritarian leadership were detrimental. The chapter also discussed the Technological Tools and digital Transformation theme, noting that while digital tools have been adopted in some areas, there still needs to be more consistent use of AI and data-driven platforms.

Lastly, the Alignment with the SDGs theme revealed that while some spinouts are explicitly aligned with sustainability goals, many contribute indirectly without a structured approach. This chapter establishes a clear understanding of the barriers and enablers for spin-out companies, setting the stage for the recommendations and conclusions in the following sections.

CHAPTER 5 CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter synthesises the research findings on the barriers preventing spin-out companies' successful establishment and growth within South African universities. By critically analysing these findings in relation to existing theories and models such as SWOT analysis, the Business Model Canvas, and relevant policies, the chapter provides actionable recommendations aimed at overcoming these challenges. It also evaluates the achievement of the research objectives, discusses the study's limitations, suggests areas for future research, and concludes with an executive summary that encapsulates the entire dissertation.

5.2 Research conclusions

Summary of Key Findings

The study identified five primary themes representing significant barriers to the success of spin-out companies in South African universities:

5.2.1 Financial Constraints and Funding Limitations

- **Funding Constraints:** Limited access to venture capital and reliance on public funding hinder spinouts' ability to secure necessary financial resources. The underdeveloped venture capital ecosystem in South Africa restricts early-stage investments, forcing spinouts to depend on a narrow pool of local investors.
- **Underdeveloped Venture Capital Ecosystem:** South Africa lacks a robust network of corporate venture capital firms willing to invest in university spinouts compared to global markets. This leads to difficulties in obtaining resources and expertise.
- **Limited Access to Capital:** High perceived risks associated with South African spinouts deter local and international investors, making it challenging to move beyond the seed stage.

5.2.2 Organisational and bureaucratic barriers

- **Bureaucratic Decision-Making:** Lengthy and rigid internal processes within universities and TTOs delay spin-out creation and funding approvals, resulting in lost commercial opportunities.
- **Complexity of Processes:** Complicated procedures for managing intellectual property and establishing spinouts lead to confusion, delays, and missed opportunities.
- **Regulatory and Policy Hurdles:** External policies on taxation, labour laws, and IP management add layers of complexity that TTOs struggle to navigate effectively.
- **Organisational Structure and Team Composition:** Hierarchical management styles slow decision-making and reduce agility, while flat or collaborative structures enhance flexibility.
- **Industry Partnerships:** Limited industry partnerships restrict access to critical resources, mentorship, and market insights necessary for spin-out development.
- **Entrepreneurial Culture:** Without a mindset supporting innovation and business development among researchers and staff, spin-out formation is impeded.

5.2.3 Leadership and entrepreneurial culture

- **Hands-On Leadership:** Active involvement of leaders in mentoring and supporting researchers significantly contributes to spin-out success.
- **Passive Leadership:** Leaders' lack of engagement leads to delays, missed opportunities, and decreased motivation among researchers.
- **Emotional Intelligence (EQ):** Leaders with high EQ foster positive organisational cultures, enhance team cohesion, and encourage innovation.

- **Authoritarian Leadership:** Rigid, controlling leadership styles stifle creativity, discourage collaboration, and hinder spin-out growth.
- **Transformational Leadership:** Leaders who inspire and motivate staff promote innovation and entrepreneurial ventures.
- **Focus on IP Over Business Models:** Prioritising legal aspects of IP protection over developing viable business strategies undermines the commercial viability of spinouts.

5.2.4 Technological tools and digital transformation

- **AI and Data-Driven Platforms:** Limited adoption of AI and data-driven platforms affects the ability to assess market potential, manage IP efficiently, and match technologies with industry needs.
- **Digital Transformation and Efficiency:** Inconsistent use of digital tools hinders the full potential of digital transformation, affecting operational efficiency and decision-making within TTOs.

5.2.5 Alignment with Sustainable Development Goals (SDGs)

- **Direct Alignment with SDGs:** Some spinouts are explicitly designed to address specific SDGs, enhancing their societal relevance and attractiveness to investors.
- **Indirect Alignment with SDGs:** Many spinouts unintentionally contribute to SDGs by lacking structured processes to capitalise on sustainability-driven opportunities.

5.3 Policy implications

The research reveals that policy-related barriers significantly hinder the successful commercialisation of university innovations through spin-out companies in South Africa. Although the Intellectual Property Rights from Publicly Financed Research and Development Act of 2008 (IPR Act) was enacted to facilitate the effective management and utilisation of IP from publicly funded research, its implementation has led to several

complexities. These challenges extend to IP management, taxation, and labour regulations, creating an environment that does not support spinouts' rapid development and growth. The following sections delve into these challenges and suggest potential policy reforms to address them.

5.3.1 Intellectual Property Rights Act

The IPR Act was introduced to ensure that IP emanating from publicly financed research is identified, protected, utilised, and commercialised for the benefit of the people of South Africa. The Act mandates that institutions establish TTOs and adhere to standardised processes for IP management. While the IPR Act aims to streamline policies, its implementation has revealed several challenges.

- **Administrative Complexity:** The Act introduces additional administrative requirements for disclosure, reporting, and compliance. Researchers and TTOs often face bureaucratic hurdles that delay the commercialisation process.
- **Ownership and Benefit-Sharing Ambiguities:** Despite the Act's guidelines, uncertainties remain regarding IP ownership, especially in collaborative projects involving multiple institutions or international partners. This ambiguity can lead to protracted negotiations and deter potential investors who seek clear IP rights.
- **Limited Flexibility in IP Transactions:** The IPR Act imposes restrictions on how institutions can transact IP. While these provisions aim to promote inclusivity, they may limit the institutions' ability to negotiate deals that maximise commercial potential.
- **Centralisation of Decision-Making:** The Act requires that certain transactions receive approval from the National Intellectual Property Management Office (NIPMO). This centralisation can cause delays and reduce the responsiveness of TTOs to market opportunities.

5.3.2 Taxation policies

The existing taxation policies in South Africa present challenges for spin-out companies, particularly in terms of high tax burdens and complex compliance requirements. The absence of targeted tax incentives for R&D activities diminishes the attractiveness of investing in early-stage, high-risk ventures typical of spinouts.

Compared to countries with thriving innovation ecosystems—such as the United States and the UK, where tax credits and deductions for R&D are prevalent—South African spinouts are at a competitive disadvantage. The lack of favourable tax policies reduces disposable income for reinvestment and hampers the ability to scale operations effectively.

5.3.3 Labour regulations

Rigid labour laws impose additional constraints on spin-out companies. Strict employment regulations, including inflexible labour contracts and high costs associated with hiring and terminating employees, limit the ability of these companies to adapt quickly to changing market conditions. Spinouts often require the flexibility to scale their workforce up or down in response to developmental stages or project demands. The current labour framework does not accommodate such agility, thereby increasing operational risks and discouraging entrepreneurial initiatives within universities.

5.3.4 Intellectual Property management

IP policies within universities and at the national level present significant hurdles. The complexity and lengthiness of IP negotiations, coupled with unclear ownership rights, delay the commercialisation process. The bureaucratic procedures associated with IP protection and licensing can deter potential investors and industry partners who seek clarity and expediency. Furthermore, the emphasis on stringent IP control by universities may overshadow the need for collaborative approaches that facilitate technology transfer and innovation diffusion.

5.3.5 Necessity for policy reforms

To address these challenges, there is a critical need for comprehensive policy reforms that align regulatory frameworks with the specific needs of spin-out companies. Such reforms should aim to simplify processes, reduce administrative burdens, and provide incentives that encourage investment and innovation. The following policy interventions are recommended:

- Simplification of Regulatory Procedures

Streamlining administrative processes related to business registration, taxation compliance, and labour regulations can significantly reduce time and resource expenditures for spinouts. Implementing one-stop-shop services or digital platforms for regulatory compliance can enhance efficiency and promote ease of doing business.

- Introduction of Tax Incentives

Establishing tax incentives specifically designed for spin-out companies can stimulate investment and reduce financial constraints. Examples include tax credits for R&D expenditures, reduced corporate tax rates for start-ups, and tax deductions for investors who provide capital to these ventures. Such incentives would align South Africa with international best practices and enhance the competitiveness of its innovation ecosystem.

- Flexibility in Labour Laws

Reforming labour regulations to provide greater flexibility in employment contracts would enable spin-out companies to manage their human resources effectively. Policies that allow for flexible working arrangements, short-term contracts, and simplified termination procedures can reduce operational risks and costs associated with workforce management.

- Standardisation and Clarity in Intellectual Property Policies

Developing clear, standardised IP policies across universities can expedite the commercialisation process. Establishing uniform guidelines for IP ownership, revenue sharing, and licensing agreements can reduce negotiation times and provide certainty to all parties involved. Policies that encourage collaborative IP management and open innovation models may further enhance technology transfer and commercialisation outcomes.

5.3.6 Enhancement of Innovation Support Mechanisms

Government policies should bolster support mechanisms such as innovation hubs, incubators, and accelerator programs that provide spin-out companies with access to

resources, mentorship, and networks. Additionally, increasing funding for grant programs targeting early-stage innovation can alleviate financial barriers.

5.4 Strategic alignment and collaborative policy development

Policy reforms should be strategically aligned with South Africa's broader economic and social development objectives, including the National Development Plan and the SDGs. By fostering an environment that supports spin-out companies, the government can stimulate job creation, promote technological advancement, and enhance the country's global competitiveness.

5.5 Conclusion

The current regulatory environment poses significant challenges to the agility and success of spin-out companies emerging from South African universities. Policy reforms are imperative to eliminate these systemic barriers and create a conducive ecosystem for innovation and commercialisation. By simplifying regulatory processes and introducing incentives for investment and innovation, policymakers can unlock the potential of spin-out companies to contribute meaningfully to economic growth, technological advancement, and societal well-being.

5.6 Recommendations

Based on the research findings, the following recommendations are proposed to address the barriers preventing the successful establishment and growth of spin-out companies within South African universities. These recommendations are designed to enhance commercialisation outcomes, foster an enabling environment for innovation, and align spin-out activities with both national development goals and global best practices.

5.6.1 Establish dedicated university-linked seed funds

The limited availability of venture capital and the reliance on public funding present a significant barrier to spin-out success. To address this, universities should establish dedicated seed funds to support early-stage spinouts. These funds can be designed to provide initial capital, bridging the gap between research output and commercial readiness. By leveraging internal resources, alumni networks, and government grants,

universities can create a sustainable funding mechanism that reduces dependence on external investors and accelerates the commercialisation process.

Action Plan:

- Identify potential funding sources, including university endowments, industry contributions, and government support.
- Develop criteria and processes for allocating seed funds to spinouts based on their commercial potential and alignment with strategic objectives.
- Implement governance structures to ensure transparency, accountability, and effective funds management.

Expected Impact:

- Improved access to capital for early-stage spinouts, reducing financial constraints.
- Accelerated development and scaling of promising ventures, increasing their chances of long-term success.

5.6.2 Streamline bureaucratic processes and decision-making

Bureaucratic inefficiencies, complex internal processes, and unclear IP management policies delay spin-out creation and hinder effective commercialisation. To mitigate these challenges, universities should focus on streamlining internal processes by simplifying IP management, accelerating decision-making timelines, and reducing administrative burdens.

Action Plan:

- Review and revise existing IP policies to clarify ownership rights, benefit-sharing mechanisms, and commercialisation pathways.
- Implement a centralised digital platform for managing IP disclosures, approvals, and licensing agreements.

- Establish clear decision-making frameworks with defined timelines to ensure agility and responsiveness.

Expected Impact:

- Reduced delays and increased efficiency in establishing and managing spin-out companies.
- Enhanced alignment between university administration, researchers, and TTOs, promoting a culture of innovation and collaboration.

5.6.3 Foster an entrepreneurial and innovation driven culture

A lack of entrepreneurial culture among researchers and TTO staff is a key barrier to successful commercialisation. Universities should cultivate a culture that values entrepreneurship and innovation by providing targeted training, mentorship, and incentives for engaging in spin-out activities.

Action Plan:

- Implement entrepreneurship training programs for researchers and TTO staff, focusing on business development, market analysis, and commercialisation strategies.
- Establish mentorship networks that connect spin-out founders with experienced entrepreneurs and industry experts.
- Develop reward systems that recognise and incentivise contributions to spin-out creation and commercialisation success.

Expected Impact:

- Increased participation of researchers and staff in entrepreneurial activities.
- Enhanced skills and capabilities for translating research into market-ready innovations.

5.6.4 Strengthen leadership capacities within Technology Transfer Offices

The effectiveness of spin-out companies is closely tied to the quality of leadership within TTOs. A hands-on and transformational leadership approach can significantly enhance the success of these ventures. Universities should invest in leadership development programs emphasising strategic thinking, emotional intelligence, and proactive engagement.

Action Plan:

- Provide leadership training focused on transformational and hands-on leadership styles, tailored to the unique challenges of technology transfer.
- Encourage TTO leaders to actively participate in the commercialisation journey of spinouts, providing guidance, mentorship, and strategic oversight.
- Facilitate peer learning opportunities and knowledge-sharing among TTO leaders to promote best practices.

Expected Impact:

- Improved leadership effectiveness and capacity within TTOs.
- Stronger support and strategic direction for spin-out companies.

5.6.5 Leverage Digital Transformation and AI Technologies

The limited adoption of digital tools and AI technologies within TTOs affects their ability to operate efficiently and effectively. To harness the benefits of digital transformation, universities should prioritise the integration of digital platforms and AI-driven solutions to support IP management, market analysis, and technology transfer activities.

Action Plan:

- Implement digital platforms to streamline IP management, from disclosure to licensing.

- Integrate AI tools for conducting market analysis, technology scouting, and opportunity assessments.
- Provide training and support for TTO staff to develop digital literacy and proficiency in using these technologies.

Expected Impact:

- Enhanced operational efficiency and decision-making within TTOs.
- Improved ability to identify and capitalise on commercialisation opportunities.

5.6.6 Align spin-out activities with Sustainable Development Goals

Aligning spin-out activities with the SDGs can increase societal impact and attract socially conscious investors. Universities should incorporate SDG considerations into their commercialisation strategies and ensure that spin-out companies contribute to sustainable development.

Action Plan:

- Develop structured frameworks for evaluating the alignment of spin-out activities with specific SDGs.
- Encourage spin-out companies to integrate sustainable practices and report on their social and environmental impact.
- Promote spin-out companies that address critical challenges such as climate change, health, and education, thereby enhancing their attractiveness to impact investors.

Expected Impact:

- Increased societal and environmental impact of spin-out companies.
- Enhanced visibility and attractiveness of spinouts to investors focused on sustainability.

5.6.7 Policy advocacy and collaboration with government and industry

The existing policy environment, including the implementation of the IPR Act, presents several challenges that limit the effectiveness of spin-out companies. Universities, TTOs, and spin-out stakeholders should actively engage with policymakers to advocate for reforms that address these barriers, such as simplifying regulatory processes and introducing targeted incentives for innovation.

Action Plan:

- Establish platforms for dialogue between universities, industry, and government agencies to address policy-related challenges.
- Advocate for revising the IPR Act to provide greater flexibility in IP transactions and expedite commercialisation processes.
- Collaborate with industry partners to develop policies that support innovation, investment, and the scaling of spin-out companies.

Expected Impact:

- A more supportive policy environment that fosters the growth of spin-out companies.
- Increased collaboration and alignment between academia, industry, and government, promoting a cohesive innovation ecosystem.

5.6.8 Facilitate access to local and international markets

Limited access to local and international markets restricts the growth potential of spin-out companies. Universities should support spinouts in expanding their market reach by providing access to networks, market intelligence, and export opportunities.

Action Plan:

- Leverage existing university and alumni networks to connect spin-out companies with potential partners and customers.

- Provide market research and analysis services to spin-out companies, helping them identify and enter new markets.
- Support spinouts in participating in international trade shows, industry events, and business missions to showcase their innovations.

Expected Impact:

- Enhanced market penetration and diversification of revenue streams for spin-out companies.
- Increased visibility and competitiveness of South African spinouts in the global marketplace.

5.7 Achievement of objectives

This section critically evaluates the extent to which the primary and secondary objectives of the study have been achieved. By systematically analysing the research findings in relation to the objectives outlined in Section 1.4, the study demonstrates a clear alignment between the research aims and the empirical outcomes.

5.7.1 Primary objective: Establishing the Barriers Preventing More Spin-Out Companies from South African Universities

The primary objective of this study was to identify and critically analyse the barriers that prevent more spin-out companies from being established in South African universities. This objective was fully achieved through a comprehensive thematic analysis of qualitative data collected from key stakeholders. The research identified five major barriers.

- **Financial Constraints and Funding Limitations**: Limited access to venture capital, an underdeveloped local investment ecosystem, and high-risk perceptions associated with spin-out companies were identified as key financial barriers hindering the establishment and growth of spinouts.
- **Organisational and Bureaucratic Barriers:** Lengthy decision-making processes, complex IP management procedures, and bureaucratic

inefficiencies within universities and Technology Transfer Offices (TTOs) were found to impede the commercialisation process.

- **Leadership and Entrepreneurial Culture:** Inadequate leadership engagement, a lack of entrepreneurial culture, and an overemphasis on IP protection at the expense of business model development were significant internal barriers.

- **Technological Tools and Digital Transformation:** Limited adoption of digital tools and AI technologies was identified as a barrier to efficiency and decision-making within TTOs.

- **Alignment with Sustainable Development Goals (SDGs):** The study found that many spinouts lack structured processes for aligning with SDGs, thereby missing opportunities to enhance their societal impact and attract sustainability-driven investments.

The identification and critical analysis of these barriers, supported by empirical evidence, confirm that the primary research objective has been comprehensively addressed.

5.7.2 Secondary objective one: Examining the impact of leadership within TTOs on the successful creation and management of spin-out companies

The study successfully examined the impact of leadership within TTOs on spin-out success. Key findings revealed that:

- **Transformational and Hands-On Leadership**: Leaders who engage actively with researchers and spin-out teams play a pivotal role in navigating the commercialisation process, securing resources, and fostering a positive culture of innovation.

- **Passive and Authoritarian Leadership Styles**: Leaders who demonstrate low engagement and rigid control hinder the potential for spin-out creation, reduce researcher motivation, and stifle the entrepreneurial environment within TTOs.

The study highlighted that leadership styles directly influence the commercialisation outcomes of university research. Effective leadership supports the spin-out process and aligns strategic objectives with broader institutional goals. The emphasis on the role of leadership provides a nuanced understanding of how leadership within TTOs impacts the successful creation and management of spin-out companies, thereby achieving this secondary objective.

5.7.3 Secondary objective two: Exploring how artificial intelligence and digital transformation can enhance the commercialisation process of university research

The research explored the role of AI and digital transformation in enhancing the commercialisation process and found that:

- **AI and Data-Driven Platforms**: AI has the potential to streamline market analysis, identify industry needs, and automate aspects of IP management. However, its adoption within TTOs is limited due to financial constraints, lack of digital expertise, and resistance to change.
- **Digital Transformation**: Digital platforms can improve operational efficiency, decision-making, and stakeholder collaboration. The study identified gaps in adopting these technologies, highlighting an opportunity to leverage digital tools for better commercialisation outcomes.

The findings provide a clear understanding of how digital transformation and AI can mitigate existing barriers in the commercialisation process, contributing valuable insights toward achieving this objective.

5.7.4 Secondary objective three: Investigating how university spin-out companies can contribute to the United Nations Sustainable Development Goals (SDGs)

The study investigated the alignment of spin-out activities with SDGs and found that:

- **Direct Contribution**: Some spin-out companies are explicitly designed to address specific SDGs, such as health, clean energy, and education. These spinouts contribute directly to achieving these goals and enhance their societal relevance.

- **Indirect Contribution**: Many spinouts contribute to SDGs unintentionally, with no structured processes to maximise their impact. This misalignment suggests untapped potential for spinouts to contribute more meaningfully to sustainable development.

The study concludes that aligning spin-out activities with SDGs can increase their societal value and attractiveness to investors focused on sustainability, thereby achieving this secondary objective.

5.7.5 Summary of achievement of objectives

The study successfully achieved its primary objective of identifying barriers to spin-out companies in South African universities. It met each secondary objective by examining the impact of leadership, exploring the role of digital transformation, and investigating the contribution of spinouts to SDGs. The alignment of findings with the stated objectives demonstrates the study's ability to address its research aims comprehensively, contributing valuable insights and practical recommendations for enhancing the commercialisation success of university spinouts.

5.8 Limitations of the study

This section critically evaluates the study's limitations to provide context for interpreting the findings and acknowledge factors that may have influenced the outcomes. Understanding these limitations is essential for delineating the scope of the research and guiding future studies on the commercialisation of university-based spin-out companies. The limitations identified include methodological constraints, contextual influences, data collection challenges, and broader regulatory and policy considerations.

5.10.1 Scope and contextual constraints

The study focused exclusively on spin-out companies within South African universities, which may limit the transferability of the findings to other contexts, such as different countries or types of academic entrepreneurship (e.g., start-ups or licensing activities). The specific economic, regulatory, and institutional environment

in South Africa introduces unique contextual factors that may not be present in other regions, potentially reducing the applicability of the findings beyond this context.

Furthermore, the study primarily explored internal university and TTO perspectives, excluding the views of external stakeholders such as private investors and industry partners. This exclusion may have resulted in an incomplete understanding of external factors that impact spin-out success, such as investor risk perceptions and market dynamics. Future research should broaden the scope to include diverse stakeholder perspectives, enabling a more holistic analysis of the commercialisation landscape.

Impact: The focus on a single country and stakeholder group may result in a narrow perspective, limiting the ability to make broader generalisations or recommendations for international contexts or diverse entrepreneurial activities.

5.10.2 Methodological constraints

The research employed a qualitative methodology, relying on semi-structured interviews with a small, purposive sample of participants. While this approach enabled in-depth exploration of complex issues, it also introduced limitations related to sample size and representativeness. The small number of participants may not fully capture the diverse experiences and views of all stakeholders involved in spin-out formation, and the findings may reflect subjective interpretations rather than objective realities.

Moreover, the absence of quantitative data restricts the ability to validate findings or draw statistically significant conclusions. Future studies should consider incorporating mixed-method approaches to triangulate qualitative insights with quantitative data, enhancing the robustness and validity of the findings.

Impact: The reliance on qualitative data limits the generalizability of the findings and may introduce subjectivity, which could influence the interpretation of barriers and recommendations.

5.10.3 Data collection and interview limitations

The data collection method, which primarily relied on virtual interviews via Microsoft Teams, posed challenges related to participant engagement and the depth of responses. Technical issues limited non-verbal communication, and potential participant distractions may have hindered the quality of the data collected. Moreover, the reliance on self-reported data introduces the possibility of response bias, where participants may provide socially desirable answers or refrain from critiquing their institutions.

Future research could consider conducting face-to-face interviews or using a combination of data collection methods, such as surveys and focus groups, to mitigate these limitations and enhance data richness.

Impact: Virtual interviews may have limited participant engagement and the depth of data collected, affecting the comprehensiveness of the findings.

5.10.4 Regulatory environment constraints and comparative analysis gap

The study highlighted the impact of South Africa's Intellectual Property Rights from Publicly Financed Research and Development Act (IPR Act) on spin-out companies. However, the complexity of regulatory frameworks and their nuanced influence on commercialisation activities may not have been fully captured. Additionally, the study did not perform a comparative analysis with other international regulatory environments, which could have provided valuable insights into the relative effectiveness of South Africa's policy landscape.

Future research should incorporate comparative studies to benchmark the South African regulatory environment against global best practices, enabling a deeper understanding of policy-related barriers and opportunities.

Impact: The absence of a comparative regulatory analysis limits the ability to evaluate the effectiveness of South Africa's IPR Act relative to international standards, potentially affecting the comprehensiveness of policy-related findings.

5.10.5 Generalizability and applicability of findings

The study's qualitative nature and focus on a specific type of academic entrepreneurship (spinouts) limit the generalizability of the findings to other contexts. Additionally, excluding broader ecosystem influences, such as national innovation policies, availability of skilled talent, and regional economic conditions, may restrict the findings' applicability to a wider set of entrepreneurial ventures.

Future research should explore how these broader ecosystem factors interact with university-based spin-out companies, providing a more nuanced understanding of the commercialisation landscape.

Impact: The study's specific focus may limit the findings' applicability to other types of academic entrepreneurship or international contexts, restricting the scope of recommendations.

- Conclusion of Limitations

Acknowledging these limitations provides a transparent view of the study's scope and applicability, guiding future research to address identified gaps. Despite these constraints, the study offers valuable insights into the barriers facing spin-out companies in South African universities and provides a foundation for further exploration and refinement of commercialisation strategies in similar contexts.

5.9 Recommendations for future research

This section outlines recommendations for future research to address the limitations identified in this study and to deepen the understanding of the barriers and enablers influencing the successful establishment and growth of university spin-out companies. Building on the insights derived from this research, future studies should adopt broader scopes, integrate diverse methodologies, and explore new dimensions of the commercialisation process. These recommendations are proposed to facilitate a more comprehensive understanding of spin-out dynamics and contribute to developing effective strategies for promoting university-based entrepreneurship.

5.11.1 Expanding the scope to include external stakeholders

Future research should broaden the scope to incorporate the perspectives of a wider range of stakeholders beyond university and TTO representatives. Including external stakeholders such as spin-out founders, entrepreneurial academics, private investors, industry partners, and government policymakers will provide a more holistic view of the commercialisation ecosystem. These perspectives can reveal additional barriers and opportunities that may not be visible within the university context alone.

Research Focus Areas:

- Investigate how investor risk perceptions impact the willingness to fund university spinouts.
- Explore the role of industry partnerships in facilitating access to resources, mentorship, and market opportunities.
- Examine the impact of government policies and incentives on the spin-out ecosystem from the perspectives of both policy implementers and beneficiaries.

Rationale: Incorporating diverse perspectives will enable a more comprehensive analysis of external factors influencing spin-out success and will support the formulation of strategies that are better aligned with the needs and expectations of all stakeholders involved in commercialisation.

5.11.2 Adopting mixed-method approaches

While this study utilised qualitative methods to gain deep insights into the barriers to spin-out success, future research should consider adopting mixed-method approaches that integrate both qualitative and quantitative data. This combination would allow for the triangulation of findings, enhancing the robustness and validity of the research outcomes. Quantitative data, such as survey results or financial performance metrics, can complement qualitative insights and provide a more comprehensive understanding of the factors influencing spin-out growth and sustainability.

Research Focus Areas:

- Conduct large-scale surveys to quantify the prevalence and impact of identified barriers (e.g., financial constraints, bureaucratic hurdles).

- Use financial performance data to assess the economic viability and growth trajectories of spin-out companies over time.
- Perform regression analyses to identify key predictors of spin-out success and determine the relative influence of different factors.

Rationale: Employing mixed methods will strengthen the empirical foundation of the research and provide more generalisable conclusions, allowing the researcher to draw statistically significant insights that complement qualitative findings.

5.11.3 Longitudinal studies to capture evolutionary dynamics

The current study provides a snapshot of the barriers spin-out companies face at a specific time. Future research should consider longitudinal designs to understand better how these barriers evolve and how spinouts navigate the commercialisation process over time. Longitudinal studies would track spin-out companies from inception through different stages of growth, allowing researchers to identify changing needs, emerging challenges, and effective strategies for overcoming obstacles at each stage.

Research Focus Areas:

- Examine the long-term impact of leadership styles and organisational changes within TTOs on spin-out success.
- Assess how changes in the regulatory environment or funding landscape influence spin-out trajectories over time.
- Monitor the effectiveness of digital transformation initiatives and their influence on the operational efficiency of TTOs and spin-out companies.

Rationale: Longitudinal studies will provide dynamic insights into the commercialisation process, capturing temporal trends and enabling researchers to identify causative relationships between interventions and outcomes.

5.11.4 Comparative studies with international contexts

Future research should undertake comparative studies that benchmark the South African spin-out landscape against other countries with more developed

commercialisation ecosystems. Understanding the similarities and differences in barriers and enabling factors across different regulatory, economic, and institutional contexts will provide valuable lessons for enhancing the local ecosystem. Comparative studies could focus on regions with robust venture capital ecosystems, established industry-university partnerships, or supportive policy frameworks.

Research Focus Areas:

- Compare the impact of varying IP policies on spin-out formation and growth in South Africa, the United States, and the UK.
- Analyse the effectiveness of tax incentives and government support programs in promoting spin-out success across different countries.
- Evaluate the role of cultural attitudes towards entrepreneurship in shaping the success of spinouts in different academic environments.

Rationale: Comparative research will highlight best practices from international contexts, enabling South African policymakers and university administrators to adopt and adapt successful strategies that have been proven to work elsewhere.

5.11.5 Exploring the Role of Technological Innovation and Digital Transformation

Although this study explored the role of digital transformation and AI in enhancing commercialisation processes, there is a need for further research that quantitatively assesses the impact of these technologies. Future studies should investigate how digital tools can be effectively integrated into TTO operations and spin-out activities to optimise processes, reduce costs, and improve decision-making. This research should include case studies, pilot projects, and empirical evaluations of digital tool adoption within TTOs.

Research Focus Areas:

- Assess the impact of AI-based market analysis tools on the commercialisation success rates of spinouts.

- Evaluate the effectiveness of digital platforms for managing intellectual property, licensing, and technology transfer activities.
- Investigate the role of digital literacy training in enhancing the capabilities of TTO staff and researchers.

Rationale: Quantifying the benefits of digital transformation initiatives will provide concrete evidence to support investments in technology and guide the digital evolution of TTOs and spin-out companies.

5.11.6 Investigating policy frameworks and reform implementation

The research findings highlight the need for policy reforms to support spin-out companies. Future studies should focus on evaluating the implementation and impact of these policy reforms, identifying gaps, and proposing targeted amendments to the existing regulatory frameworks. This could include examining the effectiveness of the IPR Act in achieving its intended objectives and exploring alternative models for IP management and commercialisation.

Research Focus Areas:

- Evaluate the IPR Act's impact on spin-out companies' commercialisation success and its alignment with national innovation goals.
- Investigate how policy changes in taxation, labour regulations, and IP management influence spin-out formation and sustainability.
- Propose and test new policy frameworks that offer greater flexibility and support for university spin-out companies.

Rationale: Research focused on policy evaluation and reform will provide actionable insights for policymakers and contribute to the development of a more supportive environment for university-based entrepreneurship.

5.11.7 Exploring sustainable development goals integration

Given the growing emphasis on sustainability, future research should investigate how spin-out companies can better align their activities with SDGs. Studies could explore

frameworks and strategies for optimising spinouts' social and environmental impact while maintaining commercial viability. This research would provide valuable guidance for universities and TTOs seeking to position their spinouts as drivers of positive societal change.

Research Focus Areas:

- Develop structured frameworks for integrating SDGs into spin-out business models and commercialisation strategies.
- Assess the impact of SDG alignment on spin-out success, including access to funding, investor attractiveness, and societal impact.
- Explore partnerships with NGOs, governmental organisations, and industry to enhance the sustainability impact of university spinouts.

Rationale: Focusing on SDG integration will enhance the societal value of spin-out companies, positioning them as contributors to broader global sustainability objectives and increasing their attractiveness to socially conscious investors.

5.9.1 Conclusion of recommendations for future research

The recommendations outlined above provide a strategic roadmap for future research to build on the current study's findings and address its limitations. By expanding the scope, adopting mixed-method approaches, conducting longitudinal and comparative studies, exploring digital transformation and policy impacts, and integrating SDGs, future research can deepen the understanding of spin-out dynamics and contribute to creating more effective commercialisation strategies. These research directions will enhance the academic discourse on university-based entrepreneurship and provide actionable insights for practitioners, policymakers, and stakeholders seeking to foster a vibrant and sustainable spin-out ecosystem.

5.10 Executive summary

This mini-dissertation investigates the challenges South African universities encounter in establishing spin-out companies, focusing on the barriers presented by TOs, leadership roles, and the integration of SDGs. Through qualitative research, including

semi-structured interviews with TTO professionals, academic researchers, and industry experts, this study analyses the multifaceted obstacles, such as financial limitations, organisational hurdles, and leadership dynamics that impede the successful creation and management of spinouts.

The findings underscore the significant impact of leadership quality within TTOs on the efficacy of spin-out initiatives and highlight the potential of digital transformation and SDGs to enhance the commercialisation process. The research reveals a critical gap between theoretical frameworks and practical implementation, specifically emphasising the need for strategic leadership and innovative management practices to navigate these challenges effectively.

Addressing these barriers, the dissertation aims to offer strategic insights and practical recommendations to foster an environment conducive to the growth and success of university-based spin-out companies, ultimately contributing to South Africa's economic and societal advancement. This work not only adds to the academic discourse on technology transfer and entrepreneurship but also serves as a valuable guide for policymakers, university administrators, and TTOs striving to optimise the commercial potential of academic research.

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Annexure A

NWU Business School
North-West University
Private Bag x6001
Potchefstroom, 2520
http://commerce.nwu.ac.za/business-school

07 October 2024

DEAR PARTICIPANT

INFORMED CONSENT TO COMPLETE SURVEY

You are invited to take part in a research study that forms part of a Master of Business Administration (MBA) degree. Please take some time to read the information presented here, which will explain the details of this study. Please ask the researcher or person explaining the research to you any questions about any part of this study that you do not fully understand. It is very important that you are fully satisfied that you clearly understand what this research is about and how you might be involved. Also, your participation is entirely voluntary, and you are free to say no to participating, this will not affect you negatively in any way whatsoever. You are also free to withdraw from the study at any point, even if you do agree to take part now.

This study has been approved by the NWU Economic and Management Sciences Research Ethics Committee (EMS-REC) and will be conducted according to the ethical guidelines and principles of the North-West University and other international ethical guidelines applicable to this study.

Title of the project: Exploring the barriers faced by South African universities in establishing spin-out companies

Institution: North-West University Business School
Ethics Reference Number: NWU-00608-24-A4

Names and contact details of project staff

	Supervisor	Researcher
Title, name & surname	Dr Johann Landsberg	Ms Gretha Duvenage
Full Names	Johann	Gretha
Function in Project	Principle Investigator	Researcher
Telephone	082 804 6950	082 464 0402

What is this research study all about?

This study aims to explore and understand the barriers faced by South African universities in establishing spin-out companies originating from academic research. By identifying these challenges, the study will enhance current knowledge and provide actionable recommendations to facilitate spin-out companies' successful formation and growth, thereby contributing to South Africa's economic development and innovation ecosystem.

What will be expected of you?

You will be expected to:

- Participate in the semi-structured interview, which should take approximately 30 minutes of your time.
- Respond to the questions in an open and honest manner.
- The interview will be recorded for accuracy, transcribed, and analysed as part of the research.

Please note that your responses are completely anonymous, and no personally identifiable data will be collected.

DECLARATION

Declaration by participant

By selecting the option below, I agree to take part in the research study titled: "***Exploring the barriers faced by South African universities in establishing spin-out companies".***

1. I confirm that I have read the information sheet for the above study. I have had the opportunity to consider the information, ask questions, and have these answered satisfactorily.

2. I understand that as I have completed the study anonymously, it will not be possible to remove any information I have provided, as you will not be able to identify me in any way.

3. I understand that individuals from the University may look at anonymous research data collected during the study, to ensure that the study is conducted appropriately.

4. I agree that my anonymous information can be shared with individuals from the project team detailed above.

I agree to take part in the above study.

Annexure B

SEMI-STRUCTURED INTERVIEW QUESTIONS

Semi-Structured Interview Questions

Introductory Questions:

1. Can you describe your role and responsibilities in the Technology Transfer Office (TTO)? How long have you been involved with technology transfer and commercialising spin-out companies at your university?
2. Could you describe the structure and size of your Technology Transfer Office or equivalent body? How does the management style of your TTO affect the creation and management of spin-out companies.?

Primary Objective - Barriers to Spin-Out Companies:

3. In your experience, what are the biggest barriers faced by universities in South Africa when trying to establish spin-out companies? Can you provide specific examples?
4. Are there specific hurdles unique to South Africa that hinder the establishment of these spin-out companies?

Secondary Objectives:

Leadership within TTOs and Business Strategies:

5. How does leadership within a university's TTO support spin-out companies?
6. Can you provide examples of leadership practices or styles within TTOs that have been particularly effective or ineffective in facilitating spin-out creation and growth?
7. In your experience, what are the primary weaknesses in the business model of the university TTO's and entrepreneurial skills of academics involved in spin-out companies?

Digital Transformation and Key Success Factors:

8. How has the use of digital tools, including AI, affected the processes and success rates of spin-out companies at your university?

Sustainable Development Goals (SDGs):

9. How do spin-out companies at your university align with and contribute to the United Nations Sustainable Development Goals (SDGs)?
10. Can you share specific examples of spin-out companies that have successfully addressed particular SDGs?

General Reflections:

11. Based on your experience, what advice would you offer to other universities in South Africa looking to establish or improve their spin-out company initiatives?