

A Technology Entrepreneurship Programme for University students

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<p>Education in entrepreneurship is becoming a critical area of curricula for university students. Few faculties/ schools have a concentration in entrepreneurship in the computing curricula. This study attempts to increase an understanding of technology entrepreneurship phenomenon by presenting what has been written in the literature. The study investigates the development of Technology Entrepreneurship Programme in the curricula at a university, in which students are beginning to learn the theory and practice of skills needed to be business entrepreneurs or innovators, and not mere scientists. The study used literature review and qualitative research methods. The findings suggest that there are is a need to develop the programme that focus on the area of technology entrepreneurship at universities. The study presented proposals for the development of Technology Entrepreneurship that university should adopt and justify proposals based on an analysis of the research and development data. The study also proposed and describe two frameworks/models: a) Framework for Technology Entrepreneurship and b) Conceptual model for implementing the Technology Entrepreneurship Programme. This study will benefit universities or other institutions of higher learning in the process of developing and implementing entrepreneurship program into their curriculum. The study concluded with reflections on some of the strengths and weaknesses of the theoretical and methodological approaches taken. The study also focused on evaluating the outcomes of the development project and provide conclusions on its benefits to the organisation. It also provided recommendations for further research and highlighted the limitations of the study.</p>	
Keywords Entrepreneurship, innovation, education, curricula, technology	

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Abbreviations and Acronyms

AI	Artificial Intelligence
DTU	Delhi Technological University
EE	Economic Empowerment
ESD	Economic Supplier Development
IOT	Internet of Things
ITTO	Innovation and Technology Transfer Office
MBA	Masters in Business Administration
PPP	The Public Private Partnerships
SaaS	Software-as-a-Service
TEP	Technology Entrepreneurship Programme
TUT	Tshwane University of Technology
STEM	Science, Technology, Engineering and Mathematics

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1.BACKGROUND AND INTRODUCTION

1.1 Introduction

Companies aim for university graduates with analytical, business and communication skills. To compete globally, businesses require creative and innovative graduates. The business sector requires graduates with entrepreneurial ideas for processes, goods and services that are enhanced by computation- and information technology. Entrepreneurial graduates can create new products, services and technology (Wei; Liu & Sha, 2019).

Education in entrepreneurship promotes innovative talent which drives future expansion. The majority of current research and discourse in this field focuses on teaching staff construction in the entrepreneurial education ecosystem (Ruskovaara & Pihkala, 2015), curriculum development (Falck; Gold & Heblich, 2016) and whether entrepreneurship education can influence entrepreneurship intention (Ruskovaara & Pihkala, 2015) and (Martin et al., 2013; Pittaway & Cope, 2016).

Entrepreneurship fuels innovation, resulting in the introduction of new products and market penetration (Miller, 1983; Covin & Slevin, 1989). By combining information and values, entrepreneurship education assists entrepreneurs in acquiring resources, cultivating inventive skills and personalities and establishing multi-level learning channels. Entrepreneurship education includes information, skills and professional development. In addition to technical, financial and legal skills, entrepreneurial talent is essential for success (Arthurs & Busenitz, 2006; Kettunen; Mertanen & Penttila, 2013) (Kuratko, 2005).

Education in entrepreneurship cultivates innovative abilities for innovation-supporting activities, education and surrounds (Binks; Starkey & Mahon, 2006; Gundry; Ofstein & Kickul, 2014). Environment, organisation and student entrepreneurs interact during the invention process (Anderson; Potonik & Zhou, 2014).

Technological entrepreneurship is becoming increasingly popular among researchers, politicians, government officials, academics and businesses (Siyambola; Aderemi; Agbetokun & Sanni 2011,10). Literature emphasised technology opportunities with high potential, technical systems, invention, production and commercialisation. Consequently, poorer nations lack technical enterprise. Most entrepreneurial endeavours are non-technological. Imported technologies are constantly improved and innovated by their nations of origin, rendering them obsolete. Before analysing the framework and policy orientations, this chapter addresses technical entrepreneurship, its role in innovation and economic development, its features, and its current situation in South Africa. Entrepreneurship in the technological sector contributes to the development of regional economies. A region with several technology companies and significant technical entrepreneurship advantages (Kordel & Wolniak, 2021, 1).

1.2 The concept of Technological Entrepreneurship

Numerous definitions of technology entrepreneurship exist in the literature. When a new scientific or engineering invention presents an opportunity to build a new market, cluster, venture, or industry, this is known as technology entrepreneurship (Kordel & Wolniak, 2021, 1). First-mover advantages, network effects, technical standards, and falling costs may all contribute to the development of a new business model. Technological entrepreneurship benefits individuals, organisations, regions and nations (Bailetti, 2012,5). Consequently, the study of technological entrepreneurship provides benefits that extend beyond intellectual curiosity. Earlier definitions of technological entrepreneurship, according to Bailetti (2012,5), did not address the end consequence, target, mechanism, or connection between scientific

and technical discoveries. According to Bailetti, technology entrepreneurship entails project investment (2012). This investment collects and uses diverse assets and individuals closely related with innovative scientific and technological concepts. This action generates and seizes company value. A new definition should explicitly link technical entrepreneurship to theories of business, entrepreneurship, and management.

Badziska (2016,59) regard technological entrepreneurship as complicated. Petti (2012) defines technological entrepreneurship as inventing new technologies or recognising undeveloped ones, identifying and matching opportunities from applying these technologies to emerging market needs, technology development/application, and business creation (2009). Technological entrepreneurship examines tiny technology enterprises' external variables (Bailetti, 2012).

Engineering and technology-based business have other effects (Nicholas & Armstrong, 2003). Small businesses power science and technology. These systems launch new tech start-ups and entrepreneurs (Jones-Evans, 1995). Liu, Chu, Hung, and Wu (2005) show how entrepreneurs leverage new technologies with resources and organisations. Other topics include university and business incubators, firm spin-off and technology transfer procedures, government technical entrepreneurship programmes, and entrepreneurship education. Bailetti claims few scholars examine technological entrepreneurship (2012).

Literature interchanges technological, technical, and techno-entrepreneurship (Petti, 2012). Bailetti (2012) defines and describes technology entrepreneurship. The author says "technology entrepreneurship is an investment in a project that assembles and deploys specialised employees and various assets that are directly tied to advancements in scientific and technological knowledge" (Bailetti, 2012, 9).

On the project's deliverables, external and internal parties collaborate. "Technology entrepreneurship is characterised by the collaborative experimentation and development of new products, assets, and their attributes, which are linked to advances in scientific and technology knowledge and the firm's asset ownership rights" (Bailetti, 2012,5). Coordinating exploration and exploitation to meet shared objectives is an element of technological entrepreneurship (Lindenberg & Foss, 2011). It invests in and implements the firms' concepts, not just their technologies or commercial prospects. Thus, technological entrepreneurship is a phenomenon of collaborative creation involving a team of specialists from several domains, some of whom become embedded in the technology route they attempt to alter in real time (Garud & Karne, 2003).

The company's owners and staff are unable to predict or understand all asset characteristics. Teams must develop asset characteristics. Technological entrepreneurship identifies, chooses, and develops new characteristics that provide value for the organisation and its customers. Polish literature describes technical entrepreneurship as the connection between universities, research institutions, and capital market organisations (Flaszewska & Lachiewicz, 2013). To commercialise research results and incorporate them into new products and services, collaboration between research centres and businesses is crucial. According to Poznaska, technological entrepreneurship permits science, technology, and business to use research outputs (2010). Inventions, discoveries, and new technologies produce technological innovations that shape product and process development as the commercial market evolves. Innovative technology entrepreneurship demands resource efficiency. Collaboration with commercial organisations, especially funding sources, is necessary for innovation. "Technological entrepreneurship is related to the fundamental pillars of the knowledge-based economy, which include the following: innovativeness systems, education, information and communication, knowledge management processes at the organisational level, regional considerations, and the institutional and business environment" (Lachiewicz & Matejun, 2010, 189).

There are interactions between science, technology, and business in all forms of technological entrepreneurship. In this situation, pilot projects, market research, and education on how to incorporate new technology into the economy are crucial. These elements and institutions constitute a system for technology entrepreneurship. The corporate ecosystem plays a particular function in this situation. This encompasses anything from consortia or research centres to consulting, organisational, financial, and infrastructure services, as well as institutions that assist with the launch of new companies (Badziska, 2014).

Technological entrepreneurship is a combination of academic and intellectual entrepreneurship. This perspective encompasses spin-offs, academic or professorial firms, industrial and technological parks, company incubators, and other early phases of technological entrepreneurship. Academic entrepreneurship produces new jobs in higher education and research and development. Kwiatkowski (2000) described intellectual entrepreneurship as the utilisation of intangible knowledge to generate profit for individuals, communities, and nations. The vast majority of academic entrepreneurship and commercialisation of academic research is conducted by technology businesses. Multiple writers define technical entrepreneurship as a process that combines academic and intellectual entrepreneurship with business owners, managers, and employees marketing new technology and innovative commercial solutions. Collaboration between businesses and academic institutions is essential for technological entrepreneurship.

According to Siyambola; Aderemi; Agbetokun & Sanni (2011,10), technology entrepreneurship is the establishment of new firms that utilise technological innovation. It also includes the commercialization of breakthrough technologies.

According to Abdullah and Ahcene, technology entrepreneurship blends technology with entrepreneurship (2011). According to Beckman, Eisenhardt, Kotha, Meyer, and Rajagopalan, technological entrepreneurship emerges when science and

engineering generate a crucial part of an entrepreneurial opportunity, hence enabling the establishment of a business, market, or industry (2012).

According to Dorf and Byers (2005), technological entrepreneurship improves human resource capitalisation, identification, management of fast growth, technology-intensive commercial prospects, and substantial risk-taking.

According to the aforementioned definitions, entrepreneurship technology focuses on the launch of new enterprises, products, and apps. Using the above definitions, the study may characterise technological entrepreneurship. Emerging technologies are the focus of technological entrepreneurship's strategy and structure. In reaction to unanticipated environmental changes, the organisational architecture of technological entrepreneurship permits dynamic resource allocation within a constantly developing portfolio of business models.

1.3 Features of Technological Entrepreneurship

Technology entrepreneurship was examined by Siyambola, Aderemi, Agbetokun, and Sanni (2011,10). The definition of technological entrepreneurship is provided by the authors. Explanation:

- a) **High Potential Opportunity:** A new technology-based venture has high potential if it can create new value for its customers, has a substantial level of technology knowledge that is difficult to replicate and frequently patentable, has a significant first mover advantage, is scalable, creates a barrier to entry, and has a high initial risk that can be translated into a high return.
- b) **Technology-Intensive Opportunity:** Problem-solving, enhancing and safeguarding quality of life, finding future markets, enhancing product quality to increase business competitiveness, and reducing process costs are all elements of technological entrepreneurship. Significant inventions must be

commercialised through technological entrepreneurship in order to obtain material suppliers, company stability and production.

- c) **Unique Technology Capable of Driving a New Business:** The degree to which a company's profitability depends on meeting customer expectations can be used to evaluate markets. Entrepreneurship in technology can generate new technologies to institutionalise consumer-focused businesses while expanding market share via aesthetic alterations, price reductions, improved performance, etc.

1.4 The role of Technological Entrepreneurship in innovation and economic development

Extensive research indicates that technological entrepreneurship helps to job creation, economic and social development, and growth. Entrepreneurship in the technological sector generates economic and social progress. Entrepreneurs and corporations establish new businesses to capitalise on technical breakthroughs. New enterprises generate employment, enhance communities, and benefit their owners. These companies provide new technological paradigms that impact competition and rivalry in their field. Both slow and sudden breakthroughs have a favourable impact on the economy and alter consumer behaviour, usually for the better.

Innovation in technology demands technical entrepreneurship. Research and development achievements. Without technical entrepreneurship, technological advances would remain in the lab. Many research advances remain in the lab due to a lack of technology entrepreneurs. Industrialization cannot occur prior to the commercialization of technological innovation or research and development outcomes.

Entrepreneurship in technology can improve a nation's technology. Since technical endeavours impart knowledge. This enhances the technological capacity of the endeavours through doing or observing.

By commercialising research outputs, technical entrepreneurship accelerates the dissemination of successful technological discoveries. Patents are an international indicator of technological progress and industrialization.

The primary objective of universities is to foster creativity through entrepreneurship education, which influences students' perspectives. Innovative awareness, aptitude, and personality motivate the innovative activities of students. Higher education must encourage high-tech start-up companies (Franke and Lüthje, 2004). Students' cognitive capacities will be pushed to the limit by content-knowledge challenges (Bandura, 1999). By imparting business skills, entrepreneurs are developed. Student entrepreneurs get knowledge through participation in or observation of entrepreneurship courses. In this process, new knowledge is produced via experience and application.

Entrepreneurship education has the potential to alter students' perspectives on entrepreneurship (Galloway & Brown, 2002). Students' perspectives on entrepreneurship education may influence their creativity and self-assessment of their potential to generate new ideas (Brown & Ulijn, 2004; Beghetto & Kaufman, 2010), fostering the development of an internal, enduring, and stable inventive personality. Student entrepreneurs are provided with the necessary knowledge, skills, and resources to foster creativity, entrepreneurship, innovation and environmental sustainability. Entrepreneurship education helps aspiring entrepreneurs form appropriate beliefs and cognitive processes, improve their

perspectives on innovation, integrate new knowledge and develop innovative abilities and personality.

1.5 Technological Entrepreneurship development in South Africa

South Africa is devoid of both technical entrepreneurs and writers. The 2018 technology entrepreneurship ecosystem analysis conducted by OC&C Strategy Consultants revealed that South Africa has made tremendous social progress since the end of apartheid. To combat poverty, the new government development policy emphasises economic inclusion and job creation. Rarely observed in mature ecosystems, supportive criteria have fostered investment and private-sector initiatives. South Africa may become a global innovator if it increases its inhabitants' access to education, employment, and ICTs.

Changing the focus from the quantity of entrepreneurship initiatives to their efficacy would ensure that their objectives are met and permit the type of evaluation that finds truly effective job creation interventions. The government may aid in the creation of more sustainable jobs by addressing gaps in business and IT skills. Entrepreneurs change markets. Innovation is essential to entrepreneurial success. By creating new jobs, high levels of entrepreneurship in underdeveloped nations, particularly Africa, mitigate negative socioeconomic consequences. A robust entrepreneurial culture promotes the formation, survival, and expansion of new businesses, as well as the future of current businesses. Innovation, the application of knowledge to production, is fuelled by entrepreneurial activity.

1.5.1 South Africa at a glance

The South African economy ranks 40th worldwide and 3rd in Africa. The economy expanded 1.6% in the third quarter of 2022, following a 0.7% decline in the second

quarter. Agriculture, banking, transportation, and industry drove the expansion of the supply side. Exports and government spending boosted demand (Statistic South Africa, 2022).

Economic expansion pre-pandemic has restored. In the third quarter, production-based real GDP reached R1 161 billion (constant 2015 prices), exceeding the previous peak of R1 152 billion in the fourth quarter of 2018.

Gauteng accounts for 35% of the nation's gross domestic product and 42% of employment. Western Cape Province accounts for 14% of South Africa's GDP, and Cape Town is the country's most entrepreneurial city. Persistent global income disparity. The PPP-adjusted average income of USD 13,000 conceals economic inequality despite 78% poverty. In the third quarter of 2022, the unemployment rate for South Africans aged 35 to 44 was 27.9%. (<https://www.statssa.gov.za/?p=15991>).

The National Development Plan prioritises economic inclusion and increasing the standard of living for the typical South African. The government is enhancing healthcare, infrastructure, and transportation in order to generate 11 million additional jobs by 2030. As a destination for living, tourism and business, South Africa can attract regional and international talent.

South Africa rates lower than several major nations for technological entrepreneurship, but higher than its contemporaries in developing markets. In South Africa, OC&C Strategy Consultants (2018) analysed economic contribution criteria such as technical start-ups, exits above \$100 million, "unicorns," entrepreneurs' growth objectives, and contributions to the knowledge industry. In

terms of innovation production, South Africa surpasses many developing market competitors, but still falls behind the best.

1.5.2 The South African technology entrepreneurship ecosystem

Government support and entrepreneurship characterise South African technology. The government profits from the EDS project because it encourages private firms that invest in smaller suppliers. Thus, government and private efforts encourage entrepreneurs, particularly those from historically disadvantaged neighbourhoods, with incubation, mentoring, office space, coaching, money and other assistance to grow SME capacity and create jobs. The 2018 OC&C Strategy Consultants study of digital entrepreneurship ecosystems in South Africa with key participants identified three crucial development areas: • South Africa's education system cannot nurture digital entrepreneurship on a wide scale. • The rich network of support services supplied to nascent enterprises is not yet supervised and has not yet had maximum impact on entrepreneurs.

The majority of assistance has focused on start-ups and entrepreneurs, rather than discussing the entrepreneurial process and helping. One of Africa's most robust start-up ecosystems, South Africa attracts entrepreneurs and new enterprises. The government has developed a sophisticated ecosystem for start-ups and SMMEs in order to reduce unemployment and inequality through wealth creation. SMMEs contribute 35% of South Africa's gross domestic product. Job creation decreases unemployment and economic imbalance. South Africa has two tech entrepreneurship ecosystems with different drivers and markets. The Johannesburg/Pretoria ecosystem in Gauteng is bolstered by government and private sector entrepreneurial efforts. In 2016, Johannesburg held 180 start-up

events. 2017 International Entrepreneurship Conference. Pretoria is the national centre of economic expansion fuelled by entrepreneurship.

In the Western Cape, Cape Town and Stellenbosch are innovative cities. Cape Town's environment is double Gauteng's. Western Cape businesses are funded by angel investors, family offices, and venture capitalists, not governments. The ecosystem of Gauteng is studied with government funding. The Cape Town ecosystem anticipates more start-ups but is less dependent on the government.

The government of South Africa prioritises jobs, debt, and governance. The administration also prioritises the economic inclusion of the downtrodden. This agenda is supported by BEE and ESD. These programmes are advantageous to Gauteng IT start-ups. BEE is altering the economy, business, and government. Using a point system, it prioritises government contracts for formerly disadvantaged South African businesses (called "black," though not necessarily African). No other programme had a comparable impact on the South African economy. Improved point assignment and precedence could redistribute wealth to South Africa's poorest. The Enterprise and Supplier Development (ESD) project encourages large enterprises to directly or indirectly teach their smaller supply chain partners. Large enterprises must provide programme suppliers 3% of their annual income. This initiative grants ZAR 12 billion (USD 900 million) to a number of innovation hubs and incubators.

Numerous well-funded innovation centres, co-working spaces, incubators, and accelerators are located throughout Gauteng. The majority of these locations provide high-speed Internet, office space, and mentoring, occasionally in three-year programmes. Acceleration programmes typically last three to twelve months. Numerous entrepreneurs utilise incubators, yet their performance and monitoring are deficient, rendering their impact uncertain and possibly limited. Most programmes evaluate performance based on the number of supported

entrepreneurs and the scope of assistance provided, rather than impact or return on investment.

The University of South Africa, Tshwane University of Technology, Sefako Makgato University of Health Sciences, and University of Pretoria are close Johannesburg, South Africa's economic centre. Government programmes assist the ecosystem commercialise innovation. Support is provided for market-ready research, smaller businesses, and innovation skills. Due to IP restrictions, a specialised organisation oversees the creation and transfer of publicly funded IP and provides guidance on best practises. In Gauteng, sustainable employment development, socially responsible businesses, and social enterprises improve the lives of South Africans.

South Africa lacks unicorns worth a billion dollars. A unicorn's pipeline may lack innovative, scalable firms. Thawte, GetSmarter, Fundamo, Nimbula, and Gyft were among the greatest exits (FinTech, exceeding USD 54 million) (FinTech, above USD 54 million).

1.6 Purpose and benefits of the study

This project develops a university programme for technological entrepreneurship. Universities in South Africa are examining the possibility of introducing technology entrepreneurship into undergraduate programmes. Few institutions teach entrepreneurial skills. Thus, this study/project provides a framework for the technology entrepreneurship programmes and policy objectives of university students.

The proposed project for the development of a Technology Entrepreneurship Programme provides students with the exciting opportunity to establish new businesses to exploit technological innovation or commercialise it, to investigate

market potential, and to enhance their entrepreneurial thinking and skills. Students will learn about corporate leadership, which requires the identification of high-potential, technology-intensive commercial prospects, the acquisition of personnel and finance, and the disciplined management of rapid development and significant risk. Customers' purchases and markets can be evaluated based on the extent to which a company's profitability depends on satisfying customers' requests more effectively than its competitors. Thus, cosmetic modifications, price reductions and performance enhancements boost market share. Technological entrepreneurship develops innovative technology to institutionalise new customer-focused businesses.

The programme teaches theory and practise to commercial opportunists, not scientists or technicians. The concentration cultivates innovative concepts for commercially viable processes, products, or services, or seedlings, infused with entrepreneurial imagination if not invention. Entrepreneurial skills are also stressed. This programme is applicable to various industries.

Students enrolled in Technology Entrepreneurship Programme have the following goals: Define a commercial opportunity in a process, product, or service that could be enhanced by technology or the discovery of new technology. By integrating or developing solution technologies, design and construct a process, product, or service, or a prototype, that provides a competitive advantage in business possibilities. Learn the function and application of Intellectual Property (IP) (Bailetti, 2012).

Technology Entrepreneurial provides project-based entrepreneurial skills such as analytical, business, communication, and innovative thinking. The application and theory of technology will instruct students in creative problem-solving and entrepreneurship.

1.6.1 Division of chapters

The study will be consisting of the following chapters

1. Background and Introduction: The first chapter introduces the research. This chapter provides a concise summary of technological entrepreneurship, its characteristics, its role in innovation and economic development, and its growth in South Africa. The chapter also describe the purpose of the study.

2. Objectives: explains the objectives and scope of the thesis project. Objectives and scope are related. The anticipated outcomes of the development project will also be discussed. In addition, the chapter will provide research topics to support the anticipated outcomes. The chapter will conclude with the thesis's scope.

3. Theoretical framework: covers the theoretical framework. This chapter demonstrates an in-depth study of the topic and the use of key sources to construct a theoretical framework for the development project.

4. Methodology: this chapter explains the methodology, research method, demographic, data collection techniques, case study and data analysis.

5. Implementations and outcomes: implementation and results to describe the research and development methodology and outcomes are discussed in this chapter.

6. Conclusions and recommendations: conclusions to the results of the development project and the university's benefits will be evaluated in the concluding chapter. In addition, the chapter will examine potential research areas, recommendations, and study limitations.

References: This section provides an alphabetical index of all scholarly sources.

Appendices: Interview schedule (questions).

2.OBJECTIVES

2.1. Introduction

This thesis studies the growth of South African technology entrepreneurship programmes. This chapter details the aims, research topics and scope of the study.

2.2. Expected outcomes

The thesis will conduct a literature assessment of the ecosystem and programme for technology entrepreneurship in South Africa. In addition to study themes, scope, theoretical framework, methodologies, and outcomes, the thesis will also include these elements:

The anticipated outcomes of this study/project are:

- a) a theoretical foundation for a university student technology entrepreneurship programme. The framework will provide impetus to each step of the innovation process.
- b) Plan for implementing the full-fledged Technology Entrepreneurship Programme, based on a framework that any university can adopt. The dissertation will propose TEP modules.
- c) Create success measures for the TEP. Presentation and evaluation processes will be demonstrated.
- d) Plan research on technology entrepreneurship. On the basis of existing literature and research findings, this study will propose numerous research avenues for advancing our knowledge of technological entrepreneurship.
- e) Discussion of the findings.

2.3. Research questions

In this process, the problem statement and research questions are refined. Based on the research questions, it describes the variables or groups and their hypothesised relationship for quantitative studies, or the phenomena under examination for qualitative investigations. Research questions and hypotheses should be informed by problem and goal statements, research methodology, and data analysis. The Research Questions or Hypotheses portion will be repeated in Chapter 4 to provide continuity and structure the data analysis.

Grounded theory questions should "represent a problem-centered perspective of individuals experiencing a phenomenon and be sufficiently broad to accommodate the adaptability of the research approach" (Birks & Mills, 2011, 21). The following qualitative research questions were posed:

1. What is the theoretical basis for a programme in technology entrepreneurship?
2. How do universities establish a comprehensive technological entrepreneurship programme? TEP content or modules.
3. How can technology-based entrepreneurship be successful? Methods?

Since the end of apartheid, there has been a significant development in South Africa's society. To combat poverty, the new government development policy emphasises economic inclusion and job creation. Rarely observed in mature ecosystems, supportive criteria have fostered investment and private-sector initiatives. South Africa may become a global innovator if it increases its inhabitants' access to education, employment, and ICTs. Changing the focus from the quantity of entrepreneurship initiatives to their efficacy would ensure that their objectives are met and permit the type of evaluation that finds truly effective job creation

interventions. The government may aid in the creation of more sustainable jobs by addressing gaps in business and IT skills.

2.4. Scope

This thesis explains the breadth and difficulty of the research problem. This section defines the extent to which this study will address the research question, as well as its population and time frame requirements.

This section describes the study's hypotheses, limits, and restrictions. Assumptions are obvious. This section contains the data assumptions for the investigation. Identify the methodological, theoretical, or topical assumptions underlying the study. Clarify each presumption. When applicable, justify each assumption with many perspectives. This study assumed:

- a) This study appropriately reflects technological entrepreneurship in South Africa. To cover all the fundamentals, a comprehensive literature review was conducted.
- b) The researcher has no control over restrictions such as bias. The researcher has control over limitations such as the study site. This research had some limitations: This investigation was financially constrained. Due to time and financial constraints, the research was limited to one institution as case study, resulting in a small demographic sample. If this study had included all several universities, it would have taken longer and cost more.

2.5. Conclusion

Additionally, the thesis includes the desired outcome, research questions, scope, and restrictions that define the research problem to be investigated.

The next chapter will examine the investigation's use of the theoretical framework.

3.THEORETICAL FRAMEWORK

3.1. Introduction

This section covers the theoretical basis and application to this inquiry. Literature review and guiding theories establish the research hypotheses. Theoretical frameworks bind dissertations together. The planned research should be grounded in a theory or hypotheses. Researchers typically incorporate their findings into established hypotheses. This section should describe the relationship between the methodology of this investigation and existing theories. Is the theory credible? Visible theoretical sources? Are they pertinent? Need additional explanation? In addition to situating the project, the theoretical framework shows why it is worth researching. The theoretical framework describes the research approaches and demonstrates how they will contribute to the advancement of knowledge and practise. In addition, it describes the project's setting and why it warrants research.

3.2. Existing theories on technology entrepreneurship

The following section will look at framing different theories and also presented the theory that that inform or underpin this study:

Following are the different theories of entrepreneurship:

- Innovation Entrepreneurship theory
- Economic Entrepreneurship theory
- Sociological Entrepreneurship theory
- Psychological Entrepreneurship theory
- Opportunity based Entrepreneurship theory
- Resource-based Entrepreneurship theory
- Anthropological Entrepreneurship theory

- Process of stage Entrepreneurship theory

The next section will provide a brief description of each theory.

3.2.1. Innovation Entrepreneurship theory

Joseph Alois Schumpeter was a prominent economist throughout the first fifty years of the twentieth century (Sledzik, 2013, 89). He participated in the most prominent economic discussions. He was forgotten for thirty years following his demise. After traditional economic approaches were severely questioned in the early 1980s, Schumpeterian economics became highly popular. Innovation and entrepreneurship were Schumpeter's chief economic contributions. Schumpeter frequently discussed how innovation ("new combinations") and entrepreneurship propel economic growth.

Schumpeter was among the first to characterise innovation, but his perspectives evolved through time (Sledzik, 2013, 89). The theory of Economic Development, published by Schumpeter in 1912, emphasised the importance of entrepreneurs in generating new combinations. He viewed discontinuous and "revolutionary" change as the basis of "economic growth" that takes the economy out of its static state ("circular flow") and sets it on a dynamic path of lurches and stops. After thirty years, Schumpeter believed in dynamic capital. Since capitalist efficiency would produce monopolies and kill entrepreneurs, Schumpeter's position on innovation and entrepreneurship was doomed to fail. Schumpeter's words have never been more applicable than during the subprime and euro-debt crises. Entrepreneurs invent and anticipate.

(Block; Fisch & van Praag 2016, 61) concurred with Sledzik, 2013 that Joseph Alois Schumpeter's theory of creativity altered the perspective of the entrepreneur. Schumpeter believed that businesses develop and produce in order to stimulate the stagnating economy. Schumpeter also stated that entrepreneurs promote innovation in two ways, namely:

- a) By reducing the cost of production.
- b) By increasing the demand for certain products.

3.2.2. Economic Entrepreneurship theory

This concept was offered by Richard Cantillon (Thornton 1998, 61) because entrepreneurship affects the economy. Cantillon calls entrepreneurs "producers" and "exchangers." Entrepreneurs have a substantial effect on the supply chain from raw materials to finished goods. Cantillon believed that everyone, from beggars to restaurant proprietors, was an entrepreneur due to their variable income. This made his idea distinctive.

3.2.3. Sociological Entrepreneurship theory

This theory addresses social enterprise. An entrepreneur who considers society taboos, norms, culture, and religious beliefs may be able to establish a profitable firm that matches consumer expectations. According to Max Weber's sociological entrepreneurship theory, entrepreneurs must accept society's framework in order to better themselves and their business (Ruef & Lounsbury 2007, 2).

3.2.4. Psychological Entrepreneurship theory

Psychological theories consist of three components that are considered classic entrepreneur characteristics (Baron 2000, 15):

- a) **Locus of control:** An entrepreneur's success can be ascribed to both his or her inner abilities and external support.
- b) **Personality trait theory:** entrepreneurial behaviour is intrinsic.
- c) **Need for achievement:** entrepreneurs are successful due to their need for accomplishment.

Psychological theories of entrepreneurship categorise entrepreneurs based on these three characteristics.

3.2.5. Opportunity based Entrepreneurship theory

According to the ideology of Peter Drucker, the entrepreneur "constantly seeks change, responds to it, and exploits it as an opportunity." He; Nazari; Zhang & Cai (2020, 1) Drucker and Stevenson's expansive conceptual framework contradicted Schumpeter's view of entrepreneurship as change.

3.2.6. Resource-based Entrepreneurship theory

According to this principle, entrepreneurs need resources to develop and operate their businesses (Alvarez & Barney 2017, 1). Successful entrepreneurs require resources. The notion emphasises the importance of financial, social, and human resources for enhancing an individual's abilities.

3.2.7. Anthropological Entrepreneurship theory

Stewart (1992, 1) relates this concept to the cultural paradigm of entrepreneurs. Anthropologists investigate the past and present of people. Entrepreneurs are keen observers of society; thus, they must examine social and cultural factors to succeed. Social issues in business can present entrepreneurs with challenges (social or environmental). It challenges them to create innovative solutions or contribute to their development.

3.2.8. Process of stage Entrepreneurship theory

This theory also depicts an entrepreneur's evolution in five stages (Bhave 1994, 223). The theory of Venkat Rao is popular. The five steps of entrepreneurship development according to this theory are: -

- a) Simulation for stimulation of entrepreneurship.
- b) Identifying abilities and capacities of entrepreneurship.
- c) Expansion and development stage.
- d) Publicity foundation/Promotion.
- e) Feedback.

This study examined entrepreneurial theories and their results. Therefore, these theories are intriguing and essential to this thesis.

The research uses the EntreComp framework of the European Commission that defines an entrepreneurial mindset. The knowledge, abilities and attitudes required for entrepreneurs to create commercial, cultural, or societal value are described by EntreComp.

EntreComp is:

- a free, customisable framework for developing and analysing entrepreneurial competence in any circumstance.
- a framework comprising 15 entrepreneurial skills, each with a thread outlining its applicability in the real world. The learning outcomes outline this. Eight levels map learning objectives from beginner to expert.
- consists of definition, areas, competencies, threads, and advancement levels.

a) **Definition:** putting opportunities and ideas into action to create value for others. The creation of economic, cultural, or societal value.

b) **Areas:** EntreComp possesses three areas of competence: ideas and possibilities, resources, and action.

c) **Competencies:** Each area has five competencies: opportunity creation, creativity, vision, idea evaluation, and ethical and sustainable thinking. 15 competencies build an entrepreneurial approach. From hints and brief descriptions of each ability, thematic themes and learning objectives are derived.

d) **Threads:** Each of the 15 competencies is accompanied by a number of threads that describe its practical significance. Three competency strands are collaboration, creativity, and mobility.

e) **Progression levels:** Each competency thread has learning objectives tied to eight progression levels, ranging from foundation to intermediate, to advanced, to

expert. Evaluation of a learner's development over time, their starting positions, or a cohesive entrepreneurship skills journey requires mapping progression.

This study employs Joseph Alois Schumpeter's Innovation Entrepreneurship theory and the EntreComp framework. This paradigm is beneficial for formal education, non-formal education, inclusion, and all types of organisations and businesses. In this Technology Entrepreneurship Programme, EntreComp will be utilised to tailor entrepreneurial learning objectives to a specific context, create new or improve existing teaching and learning activities to gain entrepreneurial skills, and develop entrepreneurial learning assessment.

Schumpeter thought profit-seekers must innovate. This will alter the manner in which the economy employs its productive resources (Sledzik, 2013,89). Schumpeter believed that innovation fosters economic competitiveness and dynamics. Schumpeter described "creative destruction" in Capitalism, Socialism, and Democracy as economic change driven by innovation. Schumpeter defined innovation as "a process of industrial mutation that constantly revolutionises the economic structure from within, ceaselessly destroying the old one and ceaselessly building a new one." Schumpeter characterised development as structural shifts prompted by innovation. He divided innovation into the categories of invention, innovation, diffusion and imitation and provides an analysis of the dynamic business owner. According to Schumpeter, entrepreneurs that utilise the findings of scientists and inventors generate fresh investment, growth and employment opportunities.

Schumpeter argued that dissemination and imitation influenced an economy more than creation or fundamental innovation. For years, fundamental advances have little macroeconomic influence (Sledzik, 2013, 89). The transmission of fundamental innovation fosters economic growth, investment, and employment when imitators recognise the commercial potential of the new product or method and invest heavily in that technology.

Innovation and implementation, according to Schumpeter, were "two very separate things." A fresh concept cannot be realised on its own. It must be led by a businessperson (Sledzik, 2013, p. 91). It is power, not ideas, that is decisive. Schumpeter identifies "creative destruction" as the essence of capitalism. A stagnant economy is one in which economic activity continues at constant rates and merely reproduces itself. Capitalism, unlike feudalism and socialism, cannot be stationary. Schumpeter adds, "capitalist reality is first and foremost a process of transformation," emphasising change. Without destructive innovation, capitalism is merely a copy. Schumpeter argued that the innovations of "entrepreneurs" fuelled economic growth. According to Schumpeter's Theory of Economic Development, the entrepreneur directs resources toward "new applications and new combinations."

His most enduring contribution was the notion that entrepreneurship is both a singular component of production and a rare social input that alters the course of economic history. Innovation drives economic growth through "creative destruction," whereas entrepreneurs effect change. Innovation, according to Schumpeter, is the sole fundamental task in history. Entrepreneurs are smart, alert, enthusiastic, and determined. Innovation and implementation are examples of entrepreneurial behaviour. The four complementing activities of invention, namely risk-taking, error correction, management, and administration, are distinct from entrepreneurship.

Complexity of contemporary economies needs more economic interaction. Economy based on knowledge is driven by technology. Currently, innovation involves collaboration between numerous parties. Entrepreneurship results from cognitive traits that allow innovation distribution and comprehension. In Neo-Schumpeterian economics, innovation and entrepreneurship are universal and always evolving. Today, when modern capitalism is in crisis and has lost strength during the subprime mortgage and euro-debt crises, Schumpeter's remarks are more pertinent than ever before (Sledzik, 2013, 94).

3.3. Conclusion

This chapter provided support for literary theories. The study's hypotheses were also presented. The context of the study is essential for comprehending technological entrepreneurship. It clarifies the complexity of the phenomenon and how theories have shaped it. This chapter provides a theoretical foundation for the subsequent empirical study. The idea of Peter Drucker also describes how entrepreneurs seek, respond to, and profit from change. According to Max Weber's sociological theory of entrepreneurship, entrepreneurs should accept society's system in order to expand themselves and their start-up.

Schumpeter's Development Entrepreneurship theory and EntreComp serve as the theoretical foundation for this study. Schumpeter described development as the historical structural changes resulting from five types of innovation [4].

- a) launching a brand-new product or version;
- b) applying new methods of production or sales of a product (not yet proven in the industry);
- c) opening a new market (a market for which a branch of the industry was not yet represented);
- d) acquiring new sources of raw material or semi-finished goods; and
- e) establishing or dismantling a monopoly position.

This section covers all theories of literature. This section outlines the research's hypotheses. Multiple theories are demonstrated in the section and includes theories. The researcher will detail the technique, paradigm and design of this study in the following chapter.

4.METHODOLOGY

4.1. Introduction

The approach, paradigm, and design of this study are discussed here. The chapter also addresses data collection and coding for thematic data analysis. This chapter defines the validity and dependability of the study design and methods.

4.2. Research methodology

This chapter outlines the research project's methodology. According to Schwardt (2007,195), research methodology is an inquiry theory. It examines a method's assumptions, concepts, and procedures. Methodologies, according to Schwardt (2007), Creswell and Tashakkori (2007), and Teddlie and Tashakkori (2007), explain and describe the types of problems worth exploring, what constitutes a relevant research problem, hypotheses that can be tested, how to frame a problem so that it can be investigated using specific designs and processes and how to select and develop appropriate data collection methods. Desk-based research for the thesis position. According to Bassot (2022, 7), desk-based research is a broad classification of studies that utilise current data. There are two desk research methods:

a) Internal Desk Research: Every company should begin with internal desk research. Internal procedures can generate a substantial amount of data. Account data including sold products, quantities, pricing, customers, and locations. Internal desk research utilises organisational resources to efficiently and effectively organise data. Internal desk research is inexpensive and efficient due to the use of internal resources and the lower cost of external data.

b) External Desk Research – Gathering pertinent information from sources outside the organisation. The following are external links:

- Online Desk Research—Internet data is abundant. Since the internet contains billions of pages, businesses must be information-specific while collecting this data.
- The extraction of information from industrial, marketing and corporate websites is one method for locating important online information. Secondly, using the various search engines like www.google.com, www.yahoo.com, www.infoseek.go.com etc, for modulated searching.
- Refine search techniques to produce promising and pertinent results. To save time and effort, the researcher must comprehend the significance of the investigation and mentally adhere to the criteria.
- Government data – the government publishes a wealth of data for research online. This information is economic, monetary, and societal. Typically, access to government websites is free.

This research procedure demonstrated how the research was conducted and how the methodology was developed to gain a complex understanding of the hypotheses formulated inside the study's chosen constrained framework.

4.2.1. Deductive qualitative research

Qualitative research uses participant perceptions to understand social issues (de Vos et al, 2011). Qualitative research explores how participants perceive a social issue to assess its complexity (de Vos et al, 2011). The researcher learns about the historical or situational context via participants' subjective experiences. Qualitative social science research focuses on "their views, behaviour, interactions, and institutions" (de Vos et al., 2011, 5).

4.2.1.1. Deductive qualitative research steps

According to Pearse (2019), deductive qualitative research applies theoretical ideas, which are typically discovered in a literature study, to the collecting and interpretation of data in order to gain a comprehensive knowledge of a phenomenon in its context.

To do this deductive qualitative research, the researcher followed the advice of Pearse (2019):

a) A conceptual framework assisted the researcher in illustrating key concepts, "factors, variables, and structures," and "the supposed interrelationships" between them in a narrative or diagrammatic format (Miles and Huberman 1994, 37). The theory framework assisted the researcher in determining the relationship between the most significant aspects and the investigation. The conceptual framework assisted the researcher in data identification and analysis (Miles and Huberman 1994, 38). The conceptual framework presented in Chapter 2 drove data gathering and analysis.

b) Propositions were presented in the form of a qualitative statement to demonstrate how theoretical concepts from the literature fit together (Pearse, 2019). The selected propositions were compiled using the literature reviewed in Chapter 2.

c) A Codebook was created to describe the key concepts derived from the conceptual model and the literature review. Each concept was assigned an abbreviation or code, which was subsequently matched to the appropriate text or data source (Pearse, 2019).

4.3. Advantages and disadvantages of Desk-Based research

Every research method has pros and cons. Table 4.1 presents the advantages and disadvantages of the Desk-Based research method as discussed by (Bassot, 2022, 11).

Table 4.1. Advantages and Disadvantages of a Desk-Based research method

Advantages	Disadvantages
Easier to manage because it is usually more predictable, so lower risk	It can still be unpredictable for an example data disappearing from the Internet
Relatively inexpensive	May be out of date
Open up areas that it would not be possible to research otherwise	May contain bias
Easy to control the volume of data	Data might not be as relevant as it could be to the project
Saves time	There could be so many areas that it become vast and daunting
Low risk of harm because data is gathered directly	Data gathered might be of poor quality

4.4. Research design

Empirical data answers research questions. Research design is a data gathering plan, according to Leedy (1997,195). MacMillan and Schumacher say it chooses people, study settings, and data gathering methods to answer the research topic (2001,166). They also think a reliable study design delivers reliable outcomes. Durrheim says research design links strategy to research questions (2004,29). Study design entails determining research goals and methods.

This research will apply a phenomenological lens to comprehend individuals and their activities empathically or by evaluating their unique conditions (Mouton and Babbie 2001,28). (Mouton and Babbie 2001,28). Both the participants' subjective interpretation of their own experience and the researcher's subjective judgement of the content have significance. All humans, according to this interpretation, produce meaning. By analysing, developing, defining and defending daily experiences, researchers can comprehend certain occurrences (de Vos et al., 2011). Actual meaning is elusive, as proved by qualitative research and the interpretive method. This can only be appreciated through the study of text and other sources and the identification of linkages, analogies, and contrasts between segments (Neuman & Kreuger, 2003). This approach's ontology reveals that an interactive and methodical process can help us comprehend the symbols and meanings of a reality (de Vos et al, 2011).

4.5. The research process

After determining the subject of study or area of interest, the researcher must select a methodology. This work was guided by the onion model of (Saunders et al, 2003, 83). This onion illustrates researchers' concepts, strategies, and procedures.

The research onion developed by Saunders streamlines the choices one must make while planning a research strategy for a dissertation, thesis, or other formal research effort. From the onion's outside inward, one is presented with a spectrum of options ranging from high-level and philosophical to tactical and practical. This resembles the structure of the methods chapter. Although flawed, Saunders' research onion facilitates a thorough examination of methods. It clarifies options for research design. The study selects a method after selecting a topic. The Saunders et al. onion model guided this effort (2003, 83). This onion shows researchers' methods.

Saunders' research onion simplifies dissertation, thesis, and other formal research strategy choices. From the onion's exterior in, options range from high-level and philosophical to tactical and practical. The approaches chapter is similar. Saunders'

research onion helps examine methodologies, despite its flaws. It simplifies research design.

Figure 4.1 shows Saunders' onion, which has six layers to peel back to systematically reveal the research approach.

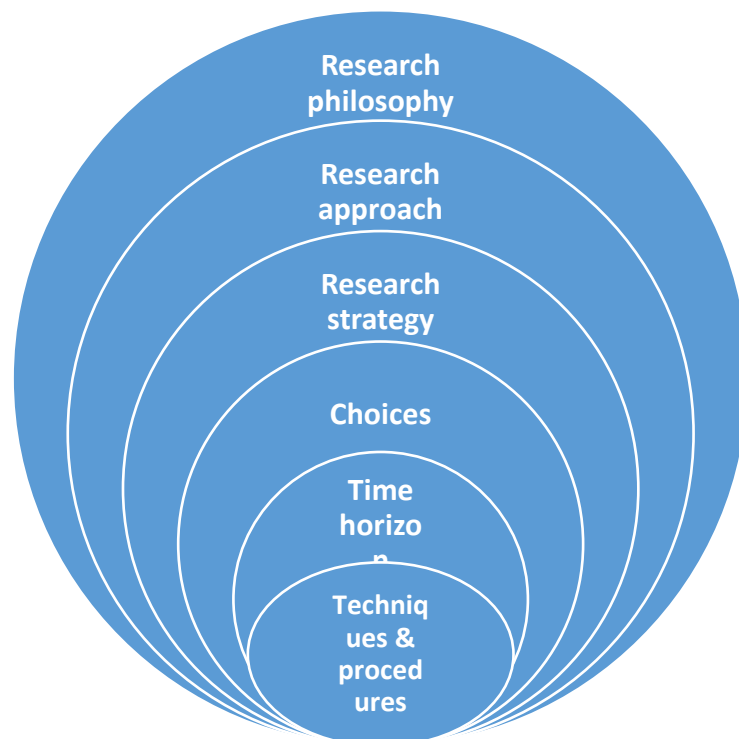


Figure 4.1: The layers of Saunders onion

Onion Layer 1: Research Philosophy

The onion is used to clarify the research philosophy. The research philosophy guides the study.

a) Ontological or epistemological philosophy inquiry

- Ontology is the "what" and "how" of reality and what we can genuinely understand. The researcher's ontological beliefs about reality are explored by answering questions about the nature of the world, including social phenomena; if reality is orderly or lawful; the existence of the natural social order; if reality is fixed and stable or constantly changing, unitary or multiple; and if reality can be constructed by the people involved in the research situation (Creswell, 1998, 76).
- Epistemology addresses "how" we learn about reality and its limits. This oversimplification is a good starting place (ontology and epistemology will be discussed later).

At this juncture, let us analyse three important research philosophies based on diverse ontological and epistemological assumptions:

- Positivism: Positivist study implies knowledge resides outside the subject. Thus, the researcher must watch without interpreting the phenomenon. Positivism claims a single reality and consistent meanings across fields. Positivists can only learn by observation and measurement. Thus, all knowledge is a posteriori—based on study, not reasoning. Positivists believe knowledge is true, false, or worthless. Discard anything unproven. For instance, God's existence. Positivism disregards God since knowledge must be factual. This issue is unresolvable.
- Interpretivism emphasises social and cultural impacts on individuals. This perspective examines society's views. Interpretivism allows researchers to evaluate participant behaviour, thoughts, and meanings holistically. Example. Psychologists can use schizophrenia case studies. Interpretivism applies because social and cultural factors may alter this diagnostic. Like the functionalist paradigm, the interpretive paradigm of sociology of regulation focuses on the individual. It is subjective, antipositivist, voluntarist, and ideographic (Karnevio, 2007). This paradigm studies human behaviour and the universe's spirituality (Burrell & Morgan, 1979).

- Pragmatism: uses the best methods to study phenomena. Pragmatism questions, interprets, and inquires. Pragmatism requires researcher participation and subjectivity, especially when inferring from participant replies and judgements. Pragmatism encompasses many philosophical positions. The trolley dilemma tests morality and psychology. Participants must choose between murdering one to save several or letting several die to prevent killing one. Include family or close friends in this experiment. The thought experiment's adaptability shows pragmatism.

4.6. Research method – a case study

As it "involves the investigation of a "bounded system" (bounded by time, context, and/or place)," a single case study was utilised to extend and validate theories Creswell and Poth (2007), (de Vos et al, 2011, 73). According to Van der Merwe, theoretical studies use existing facts or knowledge to support assertions (1996, 290). This limited circumstance is located at a University of Technology in Pretoria, South Africa.

The case study design "provides academics with tools to investigate complex phenomena inside their contexts" (Baxter and Jack 2008, 544). This demonstrates that a single instance was chosen to extend and validate views regarding a phenomenon (de Vos et al, 2011). Case studies aid in the development of hypotheses and the evaluation of programmes that may lead to context-specific solutions. A descriptive case study describes the context of a phenomena (Yin, 2003).

This methodology ensured that occurrences were thoroughly explored and examined from multiple perspectives, resulting in a more comprehensive understanding of the phenomenon. According to Yin (2003) and Baxter and Jack (2008), contextual elements are vital to the design of case studies because they

explain "how" and "why" the phenomenon is occurring. The phenomenon-context boundary is hence causal. Thus, the purpose of the case study is to comprehend how and why context forms and influences participant behaviour, as opposed to changing it (Baxter & Jack, 2008).

In this study, the research followed the following five steps:

- a) Clearly defined the research topic. Identified topic and its purpose, then list any relevant research attributes and theories.
- b) Selected appropriate resources.
- c) Looked for existing data.
- d) Collate, compare & assemble.
- e) Data analysis.

4.6.1. Literature review

Technology entrepreneurship in South Africa is examined in this study. The study was based on a comprehensive literature review. The literature review gave a scholarly description of the research question(s) and allowed the researcher to check and compare findings with other technology entrepreneurship researchers.

Literature reviews believe knowledge builds on previous research, according to Neuman (1997,89). Contextual, historical, theoretical, integrative, methodological, and meta-analytic literature reviews exist. Evaluations have goals. Neuman (1997,89) states that a literature review should demonstrate the researcher's familiarity with a body of knowledge about the subjects of research and establish its credibility; show the path of prior research and how the current project is linked to previously completed research; integrate and summarise what is known in and about the researcher's area of research; learn from others; and stimulate new ideas.

This study examined technological entrepreneurship and pertinent ideas using standard models, language, and concepts, following Neuman (1997).

4.6.2. Sampling method and techniques

Desk-Based research was conducted without sampling. Sampling provides "an idea of what can be anticipated from the entire research population" (Royse 2004, 189-190). A diverse sample will broaden the scope of the investigation.

4.6.3. Data collection

a) Desktop research

The first technique for data collection in this study was desktop research. Desk research consists primarily of collecting data from existing resources; hence, it is typically viewed as a low-cost technique compared to field research, since the primary costs are the researcher's time, telephone rates, and directories, etc. In this study the following sources were consulted and analysed:

- Government reports and presentations.
- Case studies from different universities in and out of South Africa
- Podcasts and blogs.
- Press releases.
- Websites and social media.
- Company databases and data sets.

By using categorisation and deductive thematic analysis, data was reduced.

a) Internal Desk Research: every company should begin with internal desk research. Internal procedures can generate a substantial amount of data. Account data including sold products, quantities, pricing, customers, and locations.

Internal desk research utilises organisational resources to efficiently and effectively organise data. Internal desk research is inexpensive and efficient due to the use of internal resources and the lower cost of external data.

b) External Desk Research – Gathering pertinent information from sources outside the organisation.

c) Online Desk Research—Internet data is abundant. Since the internet contains billions of pages, businesses must be information-specific while collecting this data.

The extraction of information from industrial, marketing, and corporate websites is one method for locating important online information. Second, modulated Google, Yahoo, Infoseek, Altavista, and other search engine queries.

Refine search techniques to produce promising and pertinent results. To save time and effort, the researcher must comprehend the significance of the investigation and mentally adhere to the criteria.

- **Government data** - Online government research data is abundant. Economic, financial, and social information. Most government websites provide crucial information for free. This may be the cheapest way to get information.

- **Customer desk research** - Research is most effectively done by talking to customers.

Customers know market trends best since they use products and services. Thus, client comments and data are most reliable for study purposes.

b) Interviews

The second technique for data collection for this study is interviews. Interviews with participant was conducted in a one-to-one, semi-structured manner. This allowed the researcher the ability to gain an understanding of their experiences

of entrepreneurship programme. The interview was conducted online with the representative from university in Finland who had vast experience in business entrepreneurship through Microsoft Teams due to the distance between both researcher and participant.

Interviews are the predominant mode of data collection for qualitative research (de Vos et al, 2011), as it allows for a straightforward means of obtaining information from participants (DePoy & Gilson ,2012). Interviews can be seen as a social relationship maintained by the researcher to gain information about their respective topic from the participants chosen for their placement within a particular setting or with the knowledge base required (de Vos et al, 2011). Interviews were conducted to understand the experiences of the participants.

This research predominantly uses semi-structured one-to-one interviews, as they are more organised than unstructured interviews. The structure is organised around specific topics of interest, whereas the flexibility allows the stories and information collected to become deep and nuanced (de Vos et al, 2011). Guided interviews, or open-ended interviews, was utilised as the act of guiding from the structured questions allows for the information to remain generally around the topic being researched (Morse & Field, 1995). The same set of questions asked to all participants allows the data to be comprehensive and comparable (de Vos et al, 2011). Interview questions were formulated using an question matrix (known as an interview schedule) as a tool to assist in ensuring that the interview questions will cover all the relevant areas pertaining to the prepositions of the study (Pearse, 2019).

Semi-structured interviews, once transcribed, were considered the primary data source; however, other data were also considered, such as notes, pamphlets, websites, blogs or other noteworthy articles on the hub or research propositions in question.

As discussions were done online on the application Microsoft Teams Meeting, recordings were stored on a physical hard drive and backed up on the Microsoft one drive cloud facility. The application, known as otter.ai, was used to assist in transcribing the interviews and adjusted manually for abnormality or errors.

4.6.4. Data analysis

- Analysing data implies understanding it (Merriam & Tisdell, 2015).
- To determine meaning, qualitative data analysis is "the classification and interpretation of linguistic (or visual) information" (Flick ,2013)
- Using both implicit and explicit references.
- Data analysis is understanding data (Merriam & Tisdell ,2015).

This will be accomplished via deductive thematic analysis (Pearse, 2019). The data was compiled and adjusted to ensure correct spelling and grammar. Themes then manifested. The theories of this investigation will be documented initially. Reporting demonstrates if data support or refute the claim. After reporting each assertion, the researcher evaluates whether the findings support the chapter three theory (Pearse, 2019).

4.6.5. Reliability and validity

Reliability and validity assist establish the strength of study data (Ritchie et al, 2013). Qualitative inquiry employs more innovative and adaptable research designs and methods, rendering the qualitative research paradigm less rigorous or even incomplete (Sinkovics; Penz & Ghauri, 2008). It is recommended that researchers utilise terminology that acknowledges the subjectivity of analysis and promotes a more controlled, regulated, and coordinated approach to data collection and analysis. (Sinkovics; Penz & Ghauri, 2008) suggest employing credibility to enhance the "credibility, reliability, transferability, and confirmability" of qualitative research.

The researcher used credible sources to build credibility. The researcher avoided online predatory publications and misleading news. The development of dependability was facilitated by highlighting the socially constructed reality of the technology entrepreneurship programme for different cohorts at various periods and in various circumstances. These modifications were utilised to compare and analyse data from various sources. Comparable to transferability and generalizability (Elo et al, 2014). This research was transferrable because, due to context and experiences, significant scenarios either overlapped or matched. The presentation of findings in a logical manner validated them.

4.7. Ethical considerations and compliance

The researcher submitted study proposal for approval to the Haaga-Helia University of Applied Sciences. Research Ethics was unnecessary as Haaga-Helia did not require such ethics approval for the study. Researchers must anticipate and address ethical difficulties (Creswell & Creswell 2017,88).

4.8. Conclusion

This chapter includes the study's research methodology and case study. This chapter detailed the desk-based research methods utilised for the study. This important study utilised a case study methodology. Consequently, the chapter explored case study research methods, including their advantages, disadvantages, and applications. The research utilised both internal and external desk research. The study also used journal, technical, government, and website articles. The chapter discussed data collection, analysis, and validity and dependability. The chapter continued with an examination of data. It was essential to note that there were no ethical issues with this study because there were no human participants. This was done to ensure that the study's findings would not have an impact on the institution's personnel and that they were presented in an honest and objective manner. The following chapter will discuss the research and development procedure and the findings of the investigation.

5. IMPLEMENTATIONS AND OUTCOMES

5.1. Introduction

This chapter discusses the process of research and development and the findings of the investigation. The data analysis will follow the conclusions of the research. The implementation of the theoretical framework will also be discussed (e.g. how data was classified according to a specific theoretical model). The section will also propose technological entrepreneurship development for universities and provide research and development-based justifications for them. This chapter will summarise the effects of development measures.

The initiative examined the feasibility of establishing a university technology entrepreneurship programme. The findings of Chapter 5 accomplish this. As indicated previously, Chapter 5 demonstrates how students evaluate their group learning experience in a technology entrepreneurship programme. Included among these are critical thinking, group learning, conflict, answer accuracy, and motivation. The theoretical approach of the study emphasises the complexity of learning, group learning, and the learner as an individual. This research contributes to theory, empirical literature, and academic contexts seeking to implement technology entrepreneurship programmes. This chapter begins with a discussion of the study's findings. This section describes project results, implementations, and contributions to the thesis. This chapter summarises the conclusions of the study/project. The sixth chapter provides research proposals (6).

5.2. Discussion of findings

The first part of the findings are from the desktop research. The study synthesises "new" and "elaborated" challenges in light of current literature and real examples, particularly in contrast to university technology entrepreneurship programmes in

industrialised and emerging nations. The study was anticipated to demonstrate that students in higher education require technology entrepreneurship programmes. All stakeholders should recognise the significance of technology entrepreneurship and encourage interaction between institutions and local communities, not merely as a formality but as a platform for networking and developing a vibrant ecosystem for entrepreneurship. This report should stimulate other research and development initiatives.

5.3. Findings from literature

The research reveals the existence of numerous technology entrepreneurship programmes. To prosper in today's dynamic business environment, organisations must rigorously question presumptions, find hidden opportunities, and devise alternative strategies.

These programmes addressed:

- How can one foster entrepreneurialism?
- What organisational structures and practises foster sustainable growth?
- How can you achieve strategic goals like a start-up?

Most of the programmes offer actionable answers to these questions.

5.3.1. Overview of the TEP

According to the research, the Technology Entrepreneurship course examines innovation, technology, and business, provides insight into bringing a new idea to market, and allows entrepreneurs to present their idea to a panel of venture capitalists or investors.

They teach innovators from any industry or those planning to enter any field the fundamentals of venture formation, test their own ideas, and commercialise technological advances. The programme at Johns Hopkins University was

recognised (USA). The world-class curriculum instructs pupils in pitching. Then, they will develop their ideas with the assistance of business mentors, classroom discussions, and hands-on initiatives. Students present their products or services to a panel of venture capitalists, industry experts, and seasoned entrepreneurs.

Johns Hopkins teaches technical entrepreneurship, which was pioneered in Silicon Valley. Students examined how tech entrepreneurs establish businesses. It includes identifying a high-potential commercial opportunity for a technical concept, recruiting personnel and securing funding, selling and marketing the concept, and managing rapid expansion. Teams of students work on start-up businesses to apply theory. Class #2. Approximately 40,000 international students participated in teams, according to the university. At the conclusion of the programme, the top teams were matched with Silicon Valley mentors and presented to investors. Alumni from the previous class will mentor this time. Students will be able to do the following by the end of the course: 1) explain a strategy for identifying a high-potential commercial opportunity for a technology idea (high performing students were able to discuss the pros and cons of alternative theoretical models). 2) create and test a plan for acquiring talent and capital. 3) Create and evaluate a business plan for marketing an entrepreneurial concept. 4) Apply an entrepreneurial mindset to transform challenges into opportunities in larger businesses and other contexts.

5.3.2. What does it mean to be entrepreneurial?

This study also explored the definition of entrepreneurship. Entrepreneurship is enjoyable and will assist in realising a technological concept.

The entrepreneurial programme at the University of Twente in Netherlands is famous for their free online course, students learned from seasoned technology entrepreneurs and professors from the University of Twente how to recognise, analyse, and exploit entrepreneurial possibilities. Entrepreneurship based on

technology is accessible to students of all majors and especially enticing to STEM (Science, Technology, Engineering and Mathematics) students.

According to the University of Twente, this innovative course examines the financial viability of breakthroughs and significant discoveries for new and established businesses. Master's in Business Administration (MBA) and graduate-level technical students participate in practicum courses that cover the whole commercialization cycle.

North Carolina State University in the United States ranks among the top ten institutions for patent production, although the majority of its patents are underutilised. Students and instructors with an emphasis on commercialization bring patents to new companies as products, goods, and services.

This curriculum guarantees students will create new businesses. Students will learn about technical opportunity analysis, the construction of innovations from authentic intellectual property, idea generation, and the exploration of high-growth business chances.

5.3.3. Duration of TEP

The study indicated that university technology entrepreneurship programmes vary in duration. Several business schools provide a six-month to one-year Technology Entrepreneurship Programme to maximise young students' access to information. As stated earlier, these entrepreneurial programmes bring together students from a number of fields - humanities, business, engineering, and the social sciences - to produce innovative solutions.

Students will engage in experiential learning throughout this enterprise. Their progress as technology entrepreneurs is aided by academic and practical training.

They collaborate on a campus with world-class research facilities and a start-up lab for groups.

In a challenging but supportive environment, students collaborate with others to solve problems and create something new, push boundaries, experience discomfort, recognise that control is an illusion, and pick themselves up each time they fall until they are standing tall with their team on a socially and economically viable business idea.

After studying disruptive technologies such as Artificial Intelligence (AI) machine learning, Internet of Things (IoT), and blockchain, students will obtain a Master of Science in Technology Entrepreneurship regardless of their academic background.

According to the report, during the two-year graduate programme, students will pick and evaluate concepts, build technical solutions, research and define their position inside a company, and spend a semester abroad at a premier school of entrepreneurship. Their team launches a start-up over the course of the programme.

The Delhi Technological University (DTU) offers a 120-credit MSc in Technology Entrepreneurship over the course of two years. This initiative provides technological solutions to social issues by combining old "for profit" and innovative "for purpose" business models. Each team that participates in the entrepreneurship programme will be provided with a space at DTU Skylab, a cutting-edge innovation hub.

MSc students are trained to become flexible entrepreneurs in the field of technology. They will collaborate in diverse teams with DTU researchers and businesses to transform a concept or technology into a commercially viable technology start-up.

The curriculum helps students deal with uncertainty, improve problem-solving, project management, interpersonal, and communication skills, and become

effective entrepreneurs, intrapreneurs, innovation managers, and social entrepreneurs.

Beyond information acquisition and coursework, the two-year graduate programme at DTU develops students' entrepreneurial skills. Through performance, production, contemplation, and adaptation, students will gain skills applicable to the future.

Alongside real-world start-up concepts and technology, entrepreneurship, ethics, personal development, and sustainability are taught. Entrepreneurs, start-up coaches, and entrepreneurial educators direct cross-curricular multidisciplinary teams. Start-up ideas and technologies may come from various sources:

- Students start-up team
- DTU inventions or patents
- Industry or big science facilities

Pace University's Bachelor of Arts in Computer Science programme is adding a Technology Entrepreneurship focus. Instead of scientists or technicians, this specialisation teaches business opportunists. The specialisation produces cutting-edge concepts for marketable processes, products, or services, or seedlings, imbued by entrepreneurial innovation if not invention of computational or informational technologies, in a pseudo-commercial organisation or, if possible, a legitimate firm. Wall Street financial organisations invest more in IT than other businesses, thus the current model programme analyses their techniques (Schumpeter, 2009). NYC challenges Silicon Valley in innovation. Computer science students often lack financial literacy (McEachern, 2008).

Technology Entrepreneurship creates a fictional business using entrepreneurship, interdisciplinarity, and technology. Computer science majors can learn technology

entrepreneurship in these ways. Define a business opportunity in a process, product, or service that could benefit from new or existing technologies; Create a process, product, service, or prototype with creativity and innovation to give a business opportunity a competitive advantage by integrating or developing solution technologies; Design and develop a business plan to communicate the process, product, or service, infused by technology, and the potential for profitability as a new department of a pseudo firm or as a new pseudo business, for desired investment by potential investors; and design and develop a customised plan for marketing the process, product, or service, infused by technologies, to targeted customers or companies in the Software-as-a-Service (SaaS) industry. Participation is open to majors in finance, management science, and mathematics.

Technological Entrepreneurship teaches project-based business, communication, creative, and innovation skills. The Bachelor of Arts in Computer Science curriculum develops entrepreneurial abilities in creative problem-solving and critical thinking through technological practise and theory. Business opportunists will learn, not technologists. "Concentration: the blending of components... assists to imbue [skills] with meaningful relationships and improved cohesion"(Nissani, 1995). Business requires theoretical and practical students (Berryman and Bailey, 1992 & Olssen and Peters, 2005). Technology Entrepreneurship majors at the Seidenberg School will apply theory and practise to technology (Bransford, Brown, Cocking, Donovan and Pellegrino, 2000). Entrepreneurship and interdisciplinarity teach students independence (Bradbeer, 1999).

5.3.4. Contents of the TEP program

The analysis demonstrates that technology entrepreneurship programmes at various colleges have varying foci. Comparable academic materials exist at other institutions. Numerous TEPs investigate the impact of technology on markets, society, and the environment.

These courses address internet and artificial intelligence technologies, as well as leadership and business styles. This concentration equips students with the knowledge, critical thinking, and technology skills necessary to start a business, consult and support consumers, assist an established company in launching a product, or enter the fast-paced start-up industry.

Analysis revealed that the majority of TEP participants are: (This is not an exhaustive list):

a) Opportunity recognition:

- What is entrepreneurship?
- What is Lean Start-up?
- How to recognise opportunities
- How to evaluate opportunities

b) Opportunity development:

- On customer value-driven market segmentation
- Customer research in the lean start-up
- Targeting and positioning
- Does your product fit the market?

c) Opportunity exploitation:

- From idea to implementation
- Identifying your network
- Network management
- What about business models and financing?

The topics covered in these programmes included:

- Understand what makes companies entrepreneurial.
- What obstacles prevent entrepreneurialism? How do entrepreneurial benefits compare?
- How can an organisation overcome inertia and view opportunities differently?

- How can organisations evaluate and adjust their corporate culture to emulate emerging ventures?
- How can the business ecosystem help agile and effective organisations?
- How can organisations recognise and adapt strategically?
- How can they change strategy?
- Systematic technology entrepreneurship.
- Matching consumer needs with promising technology to create new useful scenarios.
- Business-operating model alignment.
- How to assess technology maturity and market fit.
- How to pitch funding opportunities.
- Problem-solving and Systematic Innovation.
- Create a new product or service idea.
- Assess market viability of product or service ideas.
- Create a pitch.

5.3.5. Benefits of TEP

The study finds that the TEP has tangible benefits in most institutions. Some of the benefits identified included:

- Innovation problem-solving.
- A robust management toolset to identify performance issues and business opportunities, scope them, and implement creative and successful solutions.
- Combine strategic leadership with bottom-up discovery.
- Concept, organisation, and ecosystem collaborative innovation frameworks.
- Business experimentation and strategic pivoting.
- A host university digital completion certificate
- Turn a technology-based idea into a profitable business.

- Lean Start-up new venture development.
- Understand how marketing and networks affect new venture development.
- Use new venture revenue analysis tools.

After TEP, participants join the business school's global alumni network.

5.3.6. Who should attend this programme?

According to the survey, the majority of TEP specify eligibility. The majority of programmes are designed for students, academic scientists, selected industry experts, corporate venture officers, start-ups, communities, and individuals who wish to develop entrepreneurship inside an organisation or begin a technical product or service business. Typically, entrepreneurs are encouraged to collaborate. Most of the programmes indicated the eligible to participate in the programme. The following lists the most eligible criteria:

- Senior managers of established companies seeking to (re)ignite the company's entrepreneurial spirit.
- Entrepreneurial managers of fast-growing companies.
- R&D directors, students, academics, start-ups and seasoned enterprises.

Examples:

Elon Musk, Tesla, PayPal, and SpaceX CEO and “tech nerd” is another globally impactful technopreneur. Bill Gates, Sergey Brin, Larry Page, Jack Dorsey, Steve Jobs and Kevin Systrom are also noteworthy examples.

5.4. Findings from semi-structured interviews

The second findings that will be presented in this section are from the interview with a representative of a university in Finland. The researcher indicated the purpose of the interview and assured the participant that the presentation will be anonymous

and that he will not mention the name of the participant and the institution where the participant is from. The questions are found in interview schedule as appendices one. The researcher asked the participant the following questions:

a) The concept Entrepreneurship programme?

The participant was asked about their understanding of the concept Entrepreneurship programme. The participant indicate they have been teaching entrepreneurship. The participant has been a researcher in the field of entrepreneurship, have family background in entrepreneurship and has managed family business. The participant views the first the entrepreneur as someone who is very business oriented.

The participant was asked if they are involved in entrepreneurship in their organisation. Below is verbatim response:

Yes, because of course in university where we teach business, we approach entrepreneurship from business perspective as you were mentioning here...
However, entrepreneurship is much broader concept and it's also involves entrepreneurial behaviour.

The participant has been involved in creating entrepreneurship programme at the university where they work. The verbatim response to elucidated the statement is as follows:

I have been myself involved in creating an entrepreneurship program, in international business degree programmes and what is important there is for students to understand what entrepreneurs do.

The participants went further by explaining that students need to understand what's lead the decision lead one to become an entrepreneur. According to the participant, students need to know that they need to have a realistic understanding of what it is to be an entrepreneur.

The participant was also asked if their university is collaborating with any external stakeholders/partners in the region to support regional innovation?

The participant responded that their programme belongs to the university and they main stakeholders are students who are in entrepreneurship programme. These students are mainly trying to develop their own business idea and usually plan to launch their business ideas to the market. In this process networking is essential. They participant responded that one need to understand the importance of relationships and opportunities that networking can offer. In a nutshell, they work with industry and government in implementing their programmes.

b) Strengths, weaknesses, opportunities and threats

The participant was asked about their understanding based on the experience as to what are key strength, weaknesses, threats and opportunities of the entrepreneurship programme?

The participant responded that students first need to understand their own strengths and weaknesses as what sort of entrepreneurial competencies they have. They need to learn more and more on how entrepreneurship programme works.

The verbatim response is as follows:

I think one of the strengths of our entrepreneurship programme here in Finland is that we create a career path in entrepreneurship...

Our programme is one of its kind on general understanding of what entrepreneurship is all about...

The participant also added that their entrepreneurship programme is more about new business creation and has more information on business development processes.

The participant also responded added the following verbatim responses:

...And if your students have no have no prior experience in entrepreneurship, it's essential that they get an in depth understanding.

... they can also learn more about entrepreneurship on social media etc., because in media you can often read and media often presents entrepreneurs some something you know quick, you know successful a lot of money. Or then they make people afraid of bankruptcy but the conventional teaching of entrepreneurship is stronger than one just watching videos or lessons on social media...

Lastly the participant emphasised that in order for students to become entrepreneurial, having entrepreneurial mindset, they need to work entrepreneurially in their own life. Even if they work in another organization, they work there entrepreneurially and become business minded. When they are creating a business or they are entrepreneurs they need to work entrepreneurially in Finland.

c)Policies

The participant was asked about what policies, strategies and policy instruments they have put in place to support or enable entrepreneurship?

The participant responded as follows on the verbatim:

We have Ministry of Education that have kind of an entrepreneurship education, guidelines or so... Our Education Ministry from government level already have

some plans or some guidelines for educational institutions the to stress the importance of entrepreneurship education that we teach here in Finland.

The participant also added that the Minister of Education in Finland said some guidelines included the promotion of entrepreneurship in different ways and also in different context in Finland when it comes to running a business, they have supporting organizations for entrepreneurs. They have lot services for supporting potential entrepreneurs.

The participant also provided the additional verbatim response:

You know, if you want to start a business that you can get free services that are paid by the city or the government in Finland to help you out with funding and consulting services.

The consultants advise you about taxes and they give you the big picture so that you, you know it all, what you need to be tax compliance...

The participant also responded that the Finnish government try to make entrepreneurship attractive by providing various services and support structures...These instruments are attractive for people to become entrepreneurs. The is also a kind of family or friendly environment for entrepreneurship in Finland.

d) *Contents of the programme*

The participant was asked to indicate which modules they think should be included in an entrepreneurship programme?

The participant responded that it is important to ensure that a person need to be developed before they can be entrepreneurs. The participant's view is that a person needs to understand their competencies. In fact, one need to understand what is

lacking or not. They need to understand the realistically of what it is to be an entrepreneur.

The participants added the following verbatim response:

When you teach entrepreneurship, one should not only to focus on business theories, but equally or more importantly, develop a person, a coaching, the person providing possibilities for potential new entrepreneurs to network, talk to each other...

Maybe participants need to learn from a best practice in the industry.

The participants added that there is no entrepreneurship without an entrepreneur. It was also added that the programme needs to teach participants to work as a team and not only focus on them as individuals. And be able to bring together people from different backgrounds.

The participants also added on verbatim that:

Of course, it depends on the idea, course in Finland we also have a lot of entrepreneurs who works. But it's it's good to have team that share experiences and problems together...

d)Measuring success

The participant was also asked on what do they measure the performance of the programme?

The participant responded that success in not about numbers but the of new businesses created. The participant indicated that university entrepreneurship programmes should not be measures about the business created though. The participant added in verbatim that:

OK, in Finland in my understanding or based on my knowledge, higher education institutions are not responsible for creating new businesses... they generate knowledge...

But so, when we talk about the university it's an educational institution not the machine to create new businesses.

Of course, we can create new businesses, but they most likely will fail quite soon if people who operate these businesses they do not have the competencies, you know they will not succeed.

The participant responded that in measuring success in entrepreneurship programme is of course about what students learned. The participant can be provided with learning assignments to assess how learning outcomes are such that they develop themselves as honest entrepreneurs, as a person and also create business knowledge of course, and learn to work in a team.

When asked about the advise they can provide for the university that is in the process of implementing such a programme?. This is what the participant responded:

They should visit Finland and learn from others about some best practices...

The participant added that Entrepreneurship is about creating new projects or programs and implementing them and if one is planning to create the new program, it's is crucial to understand the integral part of entrepreneurship. When the institution wants to be an entrepreneurially university, it is essential to learn from best practices of other countries. In conclusion the participant shared the view about Slush. Slush is a not-for-profit building the world's leading startup event and the largest gathering of venture capital— delivering actionable company-building advice which takes place in Finland every year. The view is that it is a small form of

entrepreneurship. Most businesses are small in Finland but the country boost a huge start-up ecosystem.

5.4. Proposed TEP for a university

As indicated as one of the purposes of the study, the study proposes the Technology Entrepreneurship Program for a university. This section describes the propose TEP.

5.4.1. Preamble

The Technology Entrepreneurship Programme (TEP) offers an excellent opportunity for students to build new companies to exploit technological innovation or commercialise it, investigate market possibilities, and develop entrepreneurial thinking and skills. Students learn about corporate leadership, which requires the identification of high-potential, technology-intensive commercial prospects, the acquisition of personnel and finance, and the disciplined management of rapid development and significant risk.

a) Technology Entrepreneurship Programme details:

- The programme extends for seven (7) months and pairs students with technologies and mentors from industries/academia to develop strategies for commercialisation.
- Students undergo intensive training to understand advanced, cutting-edge technologies that enhance the market.
- Parallel to this technical training, the students also undergo intensive training in Intellectual Property and commercialisation through asynchronous IP clinics sessions.
- The program benefits participants by enhancing their education and training in entrepreneurship and commercialisation of technologies in any related fields, thereby increasing their future marketability in respective disciplines.
- At the end of the programme, students present their individual work and also pair into teams to create and deliver investor pitches judged by a panel of experts in technology commercialisation, entrepreneurship and venture capital.

The Technology Entrepreneurship Program distinguishes itself among vocational entrepreneurship programmes (Start-Up business, which emphasises the creation of small businesses) and general entrepreneurship programmes across the nation (which usually include one or two law courses). With the popularity of apps such as Shopify, GoDaddy, Freelancer, and Uber, entrepreneurship is currently fashionable. Consider the success of earlier models such as Facebook, Twitter, and YouTube, among others. It is an entrepreneurial and management programme that teaches students how to discover and implement new ideas and technology, including in emerging industries.

5.4.2. Objectives of the TEP

The objectives of the program are presented in here in two categories: encouraging technology entrepreneurship and entrepreneurship skills.

a) Why encourage technology entrepreneurship?

The recent increase in student demand for entrepreneurship courses reflects their disillusionment with a society established by others. To shape their jobs, Millennials want entrepreneurial abilities. Through decades of innovation and transfer of information, the demand for training in technology entrepreneurship has increased.

Teaching entrepreneurship exposes students to real-world problems, cultivates critical thinking, and expands life skills. Entrepreneurship advances the economic and social agendas of universities. The curriculum emphasises entrepreneurship, problem-based learning, interdisciplinarity, and networking with regional, national, and international partners. Faculty members who wish to start a business or coach entrepreneurs can join the TEP. The programme targets students in biotechnology, medical technology, health, science, engineering, information and communications technology, and design, among other subjects. The Open Mask Innovation Challenge is an exclusively female initiative.

b) Entrepreneurship skills

Entrepreneurship fosters leadership, networking, analytical, organisational, and interpersonal competencies. Students are taught to solve problems, work in teams,

assess risks, and engage with investors and professionals from various professions. It facilitates problem-solving and creativity. It facilitates creative thought, the adoption of strategic tactics, and the establishment of organisational mechanisms for testing and implementing effective ideas. It educates the intellect to recognise problems and devise solutions. Students are prepared for the uncertain and unpredictable world to which they will contribute by studying entrepreneurship.

In summary the objective of the programme is to:

- Develop and empower entrepreneurs by equipping them with the skills, business knowledge, sector information and a mind-set to begin successful small businesses.
- Assist in building a culture of entrepreneurship among course participants.
- Expose participants to entrepreneurship networks, have access to markets and mentorship opportunities.
- Empower participants are d with best practice tools and knowledge to grow their businesses.
- Demonstrate participants valuable insights into leadership in the entrepreneurial context.

5.4.3. Programme focus

Before enrolling in the programme, students with technology or early proof of concept undergo comprehensive and practical training. The programme demands technology or an early proof of concept, as opposed to merely an idea. In-person or blended instruction is preferred (both in-person and online).

5.4.4. Methodology

The programme consists of two (2) phases:

Phase 1: Comprises training with seven modules delivered within seven (7) months (virtual/Hybrid) by facilitators with vast experience in their respective field.

Phase 2: Entails mentorship & business coaching by mentors from business and academia etc.

NB: Once the participant is accepted, they must attend all modules.

The methods of delivering the programme can further be presented in the following manner:

a) Online Live Activities



The Programme is delivered through online sessions/classes by different facilitators and through group live activities around challenges.

b) Winter Innovation Bootcamp

Participants will attend a three-day bootcamp to work on individual and group projects, pitching dens and lots of activities.

c) One-On-One Mentoring



Individual guidance from worldwide industry experts, mentors, and investors.

Successful Phase 2 applicants will receive expertly tailored solutions to accelerate their enterprise, such as individual mentoring from experienced, skilled mentors, powerful peer networks, targeted introductions to potential partners and financiers, and investment readiness support to build healthy resilience and lasting scale.

d) Prizes Pre-Seed Funding



The programme will award the best pitch, technology, and participation. The end-of-year networking event will award prizes.

5.4.5. Modules

The Technology Entrepreneurship Programme offers module that teaches students to:

- Look for and evaluate project ideas
- Develop business plans
- Design Thinking
- Make a financial package;
- Partnering with key partners
- Getting the resources they need
- Understand Intellectual Property Rights
- Negotiation skills

- Legislative Compliance
- Pitching their technology/product (Pitching Master Classes)
- Marketing: Promote their technology/product, company, and its brand.

The following modules will be offered:

a) Design Thinking

- Introduction to design thinking and the tools
- How to harness the power of design thinking
- Learn to develop creativity and incorporate innovation

b) Developing & Presenting a Business Plan

- Business plan development
- Elements of a business plan
- The art and antique of presenting
- Dealing with stage fright

c) Technology Development and Management

Learn how to develop, evaluate project ideas

d) Funding & Entrepreneurial Finance

- Revenue model
- Funding model for innovation
- Understanding pricing/costing models
- Investment frameworks
- Compliance requirements: Tax etc
- How to analyse financial statement

e) Intellectual Property and Commercialisation

- Introduction to the concept of Intellectual Property (IP)
- Different forms of IP
- How to protect IP (process of patenting and patent strategies)
- Commercialisation of IP (routes to market)
- How to develop commercialisation strategies etc.
- How IP can help a business to flourish.

f) Marketing Strategies

- Identification of the market (segmentation, positioning and targeting).
- How to build your brand.
- Marketing the product.
- How to design and implement successful marketing strategies.

g) Pitching Masterclasses

- Effective communication through pitching.

5.4.6. Eligibility

Admission requirements. Participants must:

- Be a registered TUT student (fulltime or part-time).
- Complete application form (online form) in full.
- Have proof of existing technology/product or early proof of concept.

5.4.7. Prizes/Incentives

At the end of the programme the followings will be presented:

- Certificates of attendance for all participants.
- 1st prize for the best pitch.
- Prize for the best technology.
- Prize for the most consistent participant.

5.5. Conceptual model for implementing a Technology Entrepreneurship

As indicated in Chapter 1 of this thesis: the paper presents a conceptual framework or paradigm for the university's implementation of technological entrepreneurship. The Technology Entrepreneurship Development approach will be presented initially.

5.5.1. Framework for Technology Entrepreneurship development

Figure 5.1 will present the conceptual framework for Technology Entrepreneurship as proposed by this study. Each elements of the framework will be discussed.

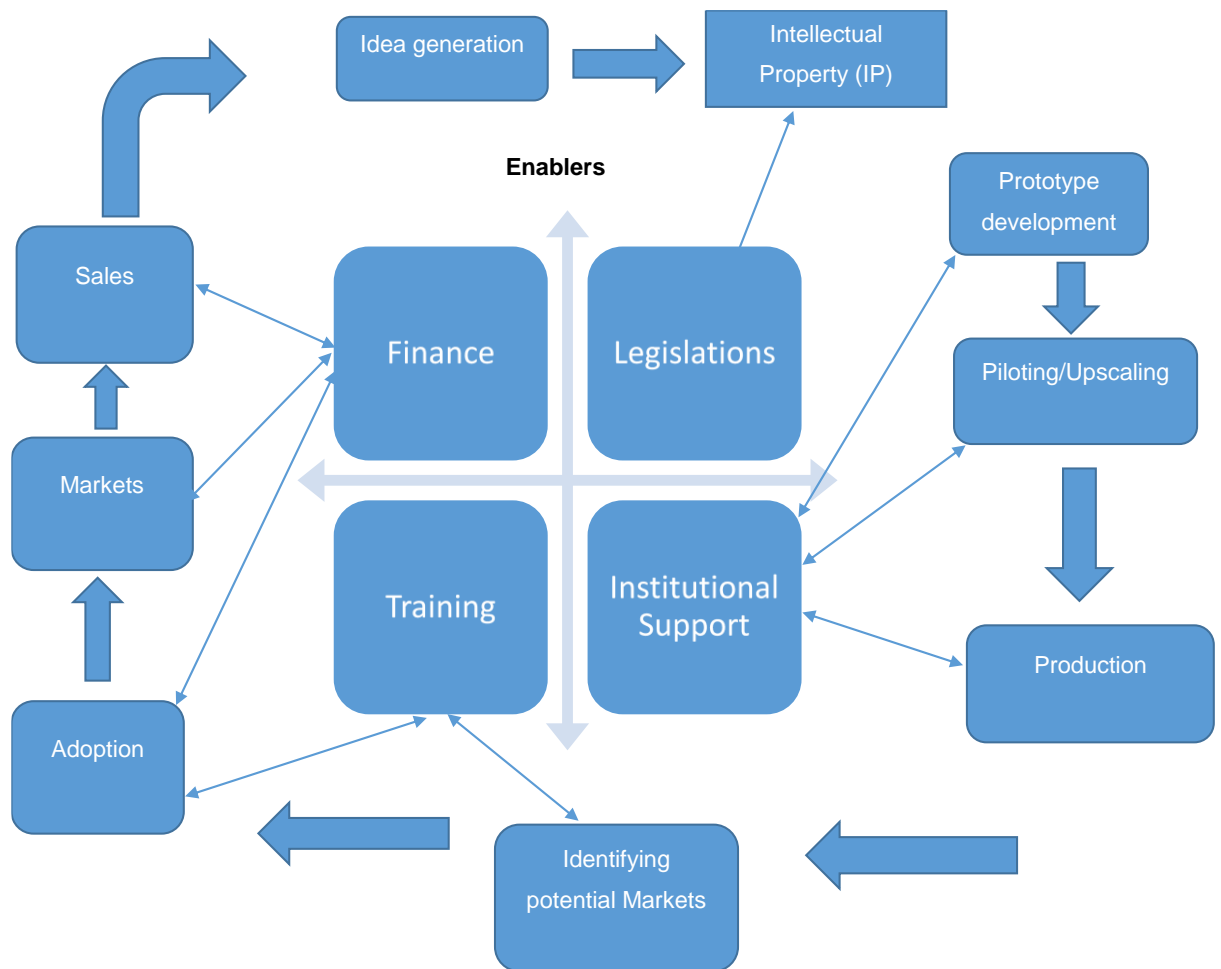


Figure 5.1: Framework for Technology Entrepreneurship

The elements of the framework: this section will describe each element of the framework.

- a) **Idea generation:** the process starts with the inventor/innovator generating an idea that can be novel based on the prior art.
- b) **Intellectual Property:** depending on whether the idea is novel. The IP can be registered after the search for some possible similar IP existing. If there is no prior art destroying the novelty of the idea, an IP application may be files.
- c) **Prototype development:** prototype may be developed to proof the concept. More than one prototype can be developed until such time that the innovator is satisfied that the technology does work and solve some technical problem.

- d) **Piloting/upscaling:** Pilot studies can indicate where the main technology/product may succeed or fail. Technology must be tested in its environment.
- e) **Production:** Manufacturing technology and products from raw materials or components follows technology's validation and procedure development. Thus, production employs inputs to create an end-user-valued good or product.
- f) **Identifying markets:** At this stage, the potential markets should be identified to ensure that the route to marketing can move swiftly.
- g) **Adoption:** Accepting, integrating and employing new technologies in society. Stages are frequently grouped by technology users.
- h) **Markets:** it is important to monitor the markets and ensure that there is enough supply of technology based on the demand.
- i) **Sales:** sales here refer to the process of selling technology as a product or service. It's also important to have pricing strategies at this stage.

The framework also depicts some enablers to the Technology Entrepreneurship process. They are as follows:

- a) **Finance:** grants/subsidies, individual investors, crowdfunding, angel investors, venture capital, governmental funding, corporate investment and private funding like bank institutions.
- b) **Legislations:** refers to government laws, policies affecting doing business. They have impact on compliance and standards, etc.
- c) **Training:** the type of training that the innovator get is crucial for being engaged in the technology development process and business development.
- d) **Institutional support:** this is the type of support that the Technology Transfer Office of a particular institution will provide to the innovators such as IP searches & registrations, seed funding, technical support, etc.

5.6. Conceptual model for implementing the Technology Entrepreneurship programme

The Technology Entrepreneurship programme conceptual model is depicted in Figure 5.2. Conceptual models are fundamental to programme implementation. It helps execute, comprehend, or imitate the subject of the model. This conceptual model can be used by TEP implementers to operate a successful programme. Adopting the model and reading about it allows implementers to visualise its operation. Implementers' mental models must be based on verified models.

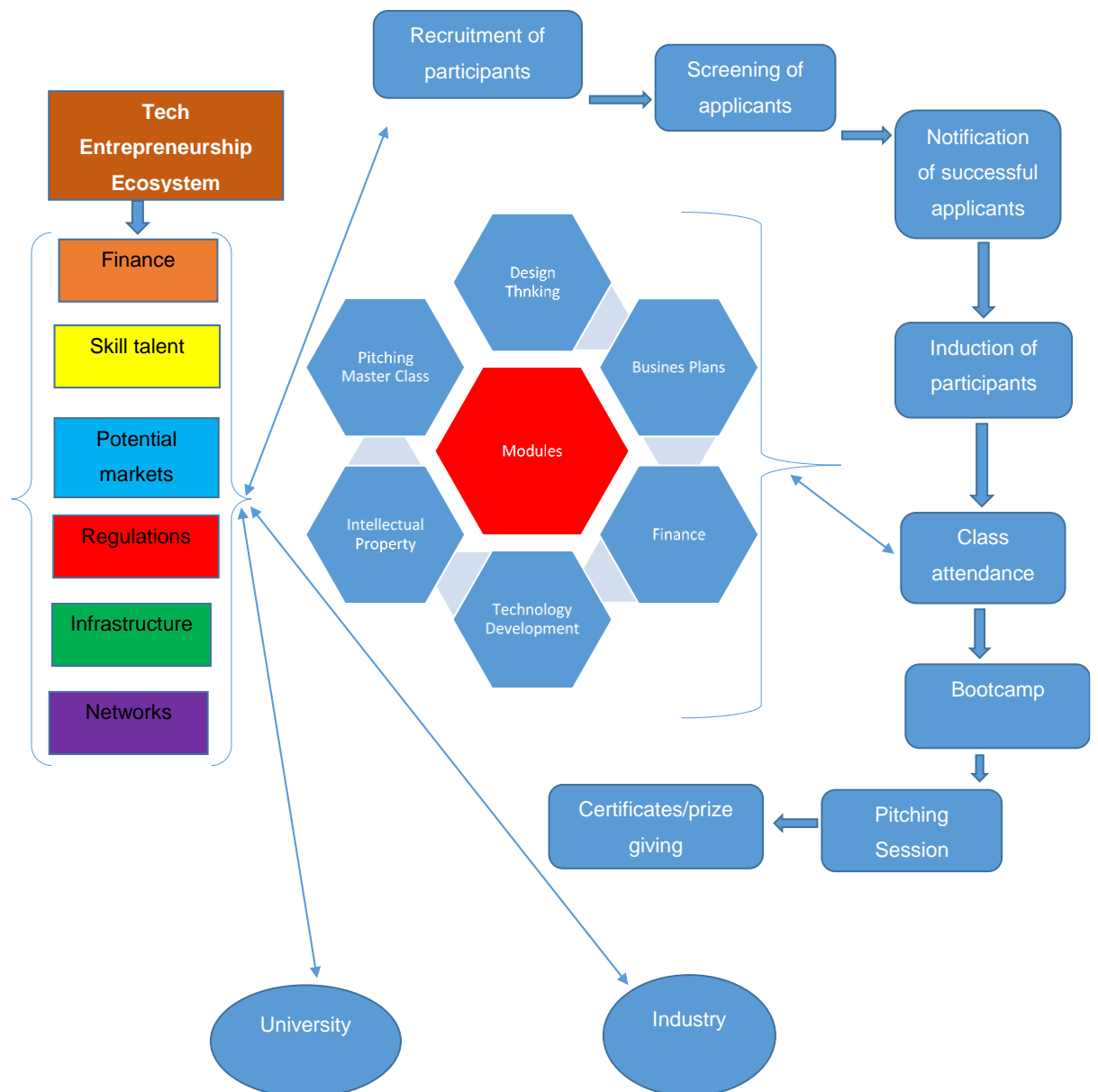


Figure 5.2: Conceptual Model for implementing Technology Entrepreneurship Programme

Each element of the model is now described in detail:

- a) **Recruitment of participants:** The process starts with the call for applications by potential participants. The call is distributed widely and eligible or interested participants apply.
- b) **Screening of applicants:** This is done by the ad hoc committee to determine which candidates will be considered for admission to the program. These screenings are based on the minimum requirements and preferred criteria as advertised for call for applications.
- c) **Notification of applications:** successful applicants are notified of the outcome of their applications through an email.
- d) **Induction of the applicants:** an information session is held for successful applicants to explain in full detail on how the program will run.
- e) **Class attendance:** after the induction, the participants start attending the classes which should be implemented in a preferred platform e.g. face-to-face, online or hybrid.
- f) **Bootcamp:** in the middle of the program, the participants are invited to a bootcamp, whereby they interact with their teams and facilitators.
- g) **Pitching session:** participants are given platform to pitch their technology or business based on their learnings from the program. They pitch before the panel of judges which is composed of academics, inventors, entrepreneurs etc.
- h) **Certificates & Prize giving session:** at the end of the programme, a networking event is arranged for the presentation of completion certificates and prize-giving for the best pitches, etc

The model also depicts three main stakeholders. The role of each stakeholder is as follows:

- a) **Academia:** provides comprehensive learning management for student entrepreneurs, enabling them to develop proper beliefs and cognitive systems, enhance their perspectives on invention, and integrate and accumulate new information to shape their innovative talents and personality. Academics can support entrepreneurs.
- b) **Government:** Establishing an environment for new businesses to start up and flourish, and assisting existing businesses in expanding by producing new goods and services in new markets, with the aid of appropriate tax policies, physical infrastructure, training and information, incubation facilities, research, and funding.
- c) **Industry:** They aid in commercialisation, performing an industry structure analysis. They absorb discoveries and provide commercial advice to inventors. They can also serve as mentors for inventors and entrepreneurs.

Based on the demands of innovators and entrepreneurs, the model encompasses various topics. 5.4.5 elaborated on the modules.

The model also depicts the technology entrepreneurship ecosystem and provide impacts of each factors:

- a) **Finance:** this may include grants/subsidies, individual investors, crowdfunding, angel investors, personal networks, venture capital, public funding, corporate funding.
- b) **Skill/Talent:** this might include skills needed, educational foundations, skills development centres, schools, courses, programs or on the job training, Research & Development and innovative skills. It can also refer to attracting local talent to tech entrepreneurship and acquiring international talent.
- c) **Potential markets:** this may refer to determining technology and market readiness. Determining the target markets and market segmentation.
- d) **Regulations:** may refers to government laws, policies and regulations. This enables compliance by innovators/entrepreneurs.

- e) **Infrastructure:** this may involve the fundamental physical systems of a company, region, or country and frequently involves the generation of public goods or production processes. Infrastructure examples include transportation systems, communication networks, sewage, water, and school systems, accessibility and cost of Internet (mobile / fixed), and Cloud & data experience.
- f) **Networks:** A "network of entrepreneurs" is a group of entrepreneurs organised formally or informally to enhance their enterprises.

5.7. Conclusion

This chapter described the methodology and outcomes of this study's research and development. The chapter offered the findings, data, and analysis of the research. On the basis of research and development data, this chapter presented recommendations for university technology entrepreneurship development. In addition, the chapter described two frameworks/models:

- a) Technology Entrepreneurship Framework and b) Conceptual Model of Technology Entrepreneurship Programme.

The following chapter will summarise the findings of the study and contains research recommendations.

6.CONCLUSIONS AND RECOMMENDATIONS

6.1. Introduction

This final chapter summarises the conclusions of the research. The theoretical and methodological advantages and disadvantages. The chapter will:

- evaluate the development project's outcomes and organisational benefits;
- compare the outcomes to the goals (chapter 2.1);
- evaluate client or stakeholder feedback objectively, and
- finish with recommendations and study limitations.

The social cognition theory was utilised to investigate the relationship between perceived entrepreneurship education and innovation. The structural equation model was utilised to assess and validate the political abilities and business opportunity recognition of student entrepreneurs. The chain-based multi-mediating function in innovative connections provides a fresh method for examining the impact of entrepreneurial education on the inventiveness of intermediary mechanisms. empirical findings: significant effect Innovation and perceptions of entrepreneurial education are positively associated. Test of intermediate effect. According to test results, political skills and perception of entrepreneurial opportunities affect perceived entrepreneurship education and creativity. Political abilities facilitate the identification of business opportunities and moderate the impact of entrepreneurship education on creativity.

6.2. Summary of the findings

The findings of the study are summarised. These findings are summarised as follows:

6.2.1. Findings of the objective of the TEP

The research uncovers numerous technology entrepreneurship programmes. In today's volatile business climate, organisations must question presumptions, uncover hidden opportunities, and develop innovative methods.

The main issue that these programmes try to address were:

- How to foster entrepreneurship?
- What organisational structures and practises foster sustainable growth?
- How can you achieve strategic goals like a startup?

6.2.2. Findings on the overview of TEP

Students were able to:

- 1) Create a plan for taking a technology innovation and finding a high-potential commercial opportunity.
- 2) Evaluate their strategy at the end of each session (high performing students were able to discuss the pros and cons of alternative theoretical models)
- 3) Test a talent and resource acquisition strategy.
- 4) Develop and assess a marketing plan for an entrepreneurial idea.
- 5) Use an entrepreneurial attitude to solve problems in larger companies and other settings.

6.2.3. Findings on the duration of TEP

The study revealed that the duration of university technology entrepreneurship programmes varies. Several business schools provide a six-month to one-year Technology Entrepreneurship Programme to assist young students in maximising their access to knowledge. This entrepreneurial programme brings together students from a variety of disciplines, including the humanities, business, engineering, and social sciences, to develop meaningful solutions.

6.2.4. Findings on the contents of the TEP programme

The study shows that technology entrepreneurship programmes vary by university. Similar university content exists. These programmes examined what makes organisations entrepreneurial and what hinders it; how they compare to entrepreneurialism; how to overcome inertia and past success to see opportunities differently; how to review and adjust corporate culture to demonstrate the flexibility of new ventures; how the larger business ecosystem can help organisations be nimble and effective and how to recognise the need for entrepreneurialism. A systematic approach to technology entrepreneurship; building new, useful scenarios by aligning consumer demands with promising technological seeds; assessing technology maturity and market fit; positioning chances to seek investment; problem solving and systematic innovation; designing a new product or service idea; evaluating market viability and pitching master class to express the idea.

6.2.5. Findings on the benefits of TEP

The study finds that the TEP has tangible benefits in most institutions. Some of the benefits identified included:

- Diagnosis of innovation issues and opportunities.
- Top-down strategic guidance and bottom-up exploration framework.
- Collaboration frameworks for ideas, organisations, and ecosystems.

- The ability to plan, execute, and evaluate business experiments and strategically pivot.
- The host university provide the participants a digital completion certificate.
- Ability to turn a technology-based business idea into a profitable business.
- Use Lean Startup to establish new ventures.
- Understand how marketing and networks affect new venture development.
- Use new venture revenue analysis tools.

6.2.6. Findings on eligibility of programme?

According to the poll, the majority of TEP specify eligibility. The majority of programmes are designed for students, academic scientists, selected sector experts, corporate venture officers, start-ups, communities, and individuals who wish to foster entrepreneurship in their organisation or establish their own company based on a technology product or service idea.

6.3. Proposed TEP for a university

The study proposed a framework for the Technology Entrepreneurship Program. The Technology Entrepreneurship Program (TEP) is an excellent opportunity for students to build new companies to exploit technological innovation or commercialise it, investigate market possibilities, and develop entrepreneurial thinking and skills. Students learn about corporate leadership, which requires the identification of high-potential, technology-intensive commercial prospects, the acquisition of personnel and finance, and the disciplined management of rapid development and significant risk.

6.4. Framework models for Technology Entrepreneurship program

The study proposed the following frameworks: a) Frameworks for Technology Entrepreneurship and b) Conceptual model for implementing Technology Entrepreneurship program.

6.5. Theoretical Implications

The findings illustrate the relationship between entrepreneurship education skills and innovative awareness, talent, and personality, as well as the observability of entrepreneurship and innovation. Entrepreneurship education can alter the attitudes and behaviours of pupils. The environmental consequences of entrepreneurship education on attitudes have been disregarded (Baron, 2006; Medvedeva, 2011). Social cognitive theory asserts that external variables and the distinction between possessing and believing in talents influence human behaviour. If they believe they can achieve their objectives, they will.

Social cognitive theory says people can imagine their futures through cognitive and motivational processes. Entrepreneurial education affects innovation differently. Social cognition theory says entrepreneurship education immerses students in the entrepreneurial environment, helping them spot actual business prospects. Entrepreneurship evolves (Zahra et al., 2006). Entrepreneurship requires talent and foresight.

Entrepreneurs need political skills like persuasion, inflection, and attractiveness to evaluate business prospects. Structural equation modelling shows that political skills and entrepreneurship opportunity perception affect perceived entrepreneurship education and creativity and indicates the path and internal mechanism of entrepreneurial competence. The research shows that an individual's perspective of their entrepreneurial education affects their general and professional entrepreneurial abilities, revealing the main sources of creativity.

Schumpeter's philosophy of innovation-driven entrepreneurship and EntreComp. Schumpeter described development as the historical structural changes resulting from five types of innovation [4].

a) launching a brand-new product or version. Design thinking will aid participants in creating and releasing new products.

b) testing new production or sales tactics for a product. In the marketing strategies module, participants explore product marketing techniques. The inclusion of entrepreneurial finance helped participants comprehend pricing strategies and financial statements.

c) establishing a new market for an underserved industry segment. This was included in marketing plans.

d) adding suppliers of raw materials and semi-finished products. Participants in the Technology Development course learned about prototyping and raw material dynamics.

e) new industry structure, such as the establishment or abolition of monopolies.

This section covers all theories of literature. This section outlined the research's hypotheses. Multiple theories were demonstrated in the section. The list included included theorists. It also detailed numerous theories. The researcher will detail the technique, paradigm, and design of this study in the following chapter.

6.5. Recommendations

In light of the objective of this study, “Investing a Technology Entrepreneurship Programme for university” and on the basis of the above findings and conclusions, the following recommendations are made:

- Focus: the program should have a clear focus and should not confuse the innovators/entrepreneurs.
- Free programme: the program should be free of charge to innovators/entrepreneurs. Although one will need undertaking from the participants that they will attend all the modules. Look to create something important, not money.

- Reach out to your potential entrepreneurs: for the program to succeed, it is vital to recruit and select innovators/entrepreneurs that has potential to complete the program. It might be valuable to select innovators who already have the technology/product or early proven concept.
- Address a need: it is crucial for the program to address the skills or training needed by the innovators/entrepreneurs.
- Differentiate the programme: it is essential to develop a program that is unique and differentiate itself to other programmes such as one offered at incubators or accelerators.

6.6. Further research

It is advised that further study with a representative sample of participants be conducted to establish which South African Higher Education Institutions provide a Technology Entrepreneurship Programme. The findings of this study are congruent with those found in the literature; hence, additional empirical representative studies are necessary.

6.7. Limitations of the study

This study focuses on student entrepreneurs rather than entrepreneurial education managers due to research object restrictions. Secondly, because perception at different times influences human behaviour and choices, future research could investigate dynamic monitoring from an organisational management approach. The research methodologies favour static analysis and lack dynamic monitoring. The perception of entrepreneurial education influences innovation in numerous ways. Future research on entrepreneurship education can broaden research variables and enhance research models and outcomes. This study focuses solely on mediating components involved in the development of a university technology entrepreneurship programme. Consequently, future research should incorporate intermediaries and regulatory concerns such as laws and rules.

This study has limitations, which are acknowledged as follows:

- a) The findings can only be generalised to a factor (perspective) and not to all universities.
- b) The findings reflect literature trends and one interview due to budget- and timing constraints.

6.8. Conclusion

This chapter outlined the conclusions of the study and the theoretical and methodological advantages and disadvantages. The chapter also evaluated the development project's outcomes and business benefits. It suggests further research and conclude with recommendations and study limitations.

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APPENDICES: INTERVIEW SCHEDULE

Research title: *A Technology Entrepreneurship Programme for University students*

Primary researcher: Dr Hamilton Mphidi

Date of interview: _____

Interview No: _____

Concept Technology Entrepreneurship Programme

1. What your understanding of the term Entrepreneurship programme?

Fill here

2. Are you involved in any entrepreneurship activities in your organisation? Please elaborate.
3. Are you collaborating with any external stakeholders/partners in the region to support regional innovation ?

Strengths, weaknesses, opportunities and threats

4. According to your experience, what are key strength, weaknesses, threats and opportunities of the entrepreneurship programme?

Fill here

Policies

5. What policies, strategies and policy instruments have you put in place to support or enable entrepreneurship?

Fill here

Contents of the programme

6. In your experience what modules should be included in an entrepreneurship programme?

7. How do you measure the performance of the programme?

8. How can a university implement such a programme?

9. Any additional comments?

