



BINDURA UNIVERSITY OF SCIENCE EDUCATION

**A WORKING MODEL TOWARDS THE COMMERCIALISATION OF
INNOVATION HUBS: A CASE OF BINDURA UNIVERSITY OF SCIENCE
EDUCATION INNOVATION HUB**

BY

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**A DISSERTATION SUBMITTED TO THE BINDURA UNIVERSITY OF SCIENCE
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MASTER OF SCIENCE DEGREE IN LEADERSHIP AND CORPORATE
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APPROVAL FORM

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DECLARATION

I, Calvin Penyani, do hereby declare that this dissertation is a result of my own investigation and research, except to the extent indicated in the acknowledgments, bibliography, references, and comments included in the body of the report, and that it has not been submitted in part or in full for any other degree to any other university.

DEDICATION

This dissertation is dedicated to the unwavering support system that has carried me through this journey.

To my wife, Nozipho, your love, understanding, and endless encouragement have been the bedrock upon which I have built. Thank you for shouldering the extra burden and creating a space for me to focus on this project.

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Thank you.

To God be the glory and honour

ABSTRACT

This study aims to develop a context-sensitive commercialization model for the Bindura University of Science Education (BUSE) Innovation Hub, directly confronting the “technology Death Valley” that persistently separates prototype creation from market adoption inside Zimbabwe’s Heritage-Based Education 5.0 framework. Heavy public investment in university innovation infrastructure contrasts starkly with the reality that African higher education institutions rarely succeed in turning research into commercial value. To close that gap, the work systematically unpacks the processes, barriers, enablers, and stakeholder expectations shaping technology transfer at BUSE. The study is grounded in an integrated framework that combines the Triple Helix, Innovation Systems, Technology Transfer, and the Resource-Based View with Dynamic Capabilities. A pragmatic mixed-methods case design was employed. Data sources included structured questionnaires (n=108, 83% response rate), 30 semi-structured interviews, document analysis, and non-participant observation, capturing perspectives from student innovators, alumni, faculty, hub management, and external stakeholders. Quantitative data were analysed using descriptive statistics, Pearson correlations, and Structural Equation Modelling (SEM), while qualitative data were examined thematically. The findings indicate that the hub is bifurcated: it demonstrates strength in physical infrastructure and prototyping support but remains critically weak in pre-commercialisation activities, funding, clear pathways, and stakeholder engagement. All barriers examined were rated as significant, with the most prominent being lack of early-stage funding, limited industry linkages, and insufficient business skills. Structural Equation Modelling (SEM) confirmed that stakeholder engagement is the strongest driver of commercialisation enablers ($\beta=0.72$, $p<0.01$), which in turn directly drive commercial outcomes ($\beta=0.78$, $p<0.01$), validating the interdependence of the conceptual dimensions. Document analysis revealed systemic gaps, including an intellectual property (IP) policy still in draft. The resulting five-phase working model integrates pre-commercialisation support, staged seed funding, structured industry and investor engagement, a Multi-Stakeholder Innovation Advisory Board, and continuous feedback loops. Key recommendations include establishing a BUSE Innovation Seed Fund, forming a BUSE-Industry Consortium with right-of-first-negotiation provisions, revising academic promotion criteria to value commercialisation outputs, and implementing a balanced scorecard for performance measurement. This study makes three distinctive contributions. Theoretically, it provides the first empirically validated structural model of commercialisation in a Zimbabwean university context, extending Triple Helix and Resource-Based View frameworks to resource-constrained, policy-driven environments. Methodologically, it demonstrates the effectiveness of a multi-stakeholder mixed-methods case design for identifying systemic barriers. Practically, it offers an actionable, contextually grounded model that transforms the BUSE Innovation Hub from a prototyping facility into a genuine engine for economic development and job creation under Education 5.0. The findings inform both institutional practice and national policy, offering a replicable framework for other African university innovation hubs facing analogous commercialisation challenges.

Keywords: Commercialisation model, BUSE Innovation Hub, technology transfer, stakeholder engagement, Education 5.0, technology Death Valley, Triple Helix, entrepreneurial university, Zimbabwe, university-industry collaboration, innovation ecosystem.

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LIST OF ABBREVIATION

- AMOS: Analysis of Moment Structures (software for SEM)
- BUSE: Bindura University of Science Education
- CFI: Comparative Fit Index (model fit index for SEM)
- CNC: Computer Numerical Control
- CMIN/DF: Chi-Square Minimum / Degrees of Freedom (model fit index for SEM)
- ENA (1-5): Commercialisation Enablers (specific survey items)
- ENG (1-5): Stakeholder Engagement (specific survey items)
- IP: Intellectual Property
- ICT: Information and Communications Technology
- NDS1: National Development Strategy One (2021-2025)
- NDS2: National Development Strategy Two (2026-2030)
- NVCCZ: National Venture Capital Company of Zimbabwe
- NVivo: Qualitative data analysis software
- OUT (1-4): Outcomes and Feedback (specific survey items)
- PRE (1-5): Pre-Commercialisation Support (specific survey items)
- PPP: Public-Private Partnership
- RBV: Resource-Based View
- RMSEA: Root Mean Square Error of Approximation (model fit index for SEM)
- SD: Standard Deviation
- SEM: Structural Equation Modelling
- SPSS: Statistical Package for the Social Sciences
- TTO: Technology Transfer Office
- UGX: Ugandan Shilling

- VRIO: Valuable, Rare, Imperfectly imitable, non-substitutable (framework)

CHAPTER 1

INTRODUCTION

1.0 Introduction

The study aims to establish a contextually relevant working model that can enable the commercialisation of innovations at Bindura University of Science Education (BUSE) Innovation Hub. It will initially discuss the context of the changing nature of universities as agents of innovation, entrepreneurship and economic growth. It will then explore problems and challenges facing commercialisation of research outputs in the university-based Innovation Hubs. Of specific interest is that there has been a persistent gap between the creation of innovations and successful commercialization at BUSE.

The study will have to produce a model of innovation commercialization relevant and viable at the BUSE Innovation hub. In order to achieve the primary objective, the study will review commercialisation processes, analyse obstacles to commercialisation and critically evaluate the role and expectation of stakeholders from the industry and investment. It will also design a step-by-step mechanism for the successful commercialisation of innovation and identify key performance indicators and establish some objectives for the same. It goes without saying that research questions will provide a clear direction of the research.

The research contributes by way of contributing to theory and practice within Zimbabwe's higher education system and the entire innovation ecosystem; moreover, the findings from BUSE will be generalizable to similar institutions. This study is focused on BUSE Innovation Hub and recognizes certain limitations of access to resources, time, and specific datasets. Chapter 1 concludes by identifying the organization of the study's dissertation structure.

1.1 Background of the Study

Over the past twenty years, global higher education has radically transformed. Universities are no longer regarded only as centres of knowledge creation, but also as catalysts for economic development and innovation-driven entrepreneurship (Etzkowitz, 2002). By following the "Triple Helix" model of collaboration between universities, industry and government, innovation hubs are becoming indispensable infrastructure to transfer knowledge research into concrete economic and social values. Evidence from institutions like Massachusetts Institute of Technology and Stanford University shows how integrated commercialization eco systems

in universities can generate billions in economic activity using innovation to translate knowledge and ideas into tangible value.

The African continent responded with universities on-boarding the “Triple Helix” model by increasing the proliferation of their university-based innovation hubs where young and innovative population could use their knowledge and ideas to generate business models. In Africa, the transfer of innovation through universities into markets has encountered a range of challenges. Science Granting Councils Initiative (2025) reports that a large part of innovation potential in Africa is still unused as there is limited private investment in research, weak university and industry links, insufficient commercialization infrastructure and information gap among different stakeholders in the innovation process. Also, United Nations Economic Commission for Africa (2025) indicate that almost 90 percent of small and medium-sized enterprises (SMEs) in Africa are disconnected to the research and innovation ecosystem which could have led to better economic growth.

Despite the system wide challenges in Africa, some successes have emerged: The Technology Innovation Agency (TIA) in South Africa has been innovative in financing the commercialisation process of university research and innovations. Makerere University Innovation Hub in Uganda has Developed a “Comprehensive approach to managing intellectual property, international partnerships, and has identified about forty promising innovative projects for commercialization, with roughly US\$2.7 million earmarked for them to access markets”. Afe Babalola University in Nigeria has successfully consolidated its various innovation initiatives, from agritech research, engineering projects to a structured venture-backed incubation programme. For Zimbabwe, the policy landscape on the utilization of university research and innovation has greatly improved with the National Development Strategy 1 (NDS1) which prescribed the establishing of 14 innovation hubs and industrial parks across the country’s higher learning institutions in a bid to maximize value addition for natural raw materials and promote inclusive development.

These innovation hubs have produced a variety of commercial products ranging from agricultural inputs, personal care products to cosmetics which are finding their way to both the local and export markets. Furthermore, His Excellency President Emmerson Mnangagwa has directed that “patents and prototypes being produced by our innovators must be commercialized, through effective monitoring of each innovation from prototype to the market”. This vision fits within Zimbabwe’s new Heritage-Based Education 5.0 Model, which

has shifted higher education towards a more developmental role focusing on industrialisation, innovation and job creation and thus, it is in this context that National Development Strategy Two (NDS2) has pushed for greater integration of research, innovation and production, and through the National Venture Capital Company of Zimbabwe (NVCC) has collaborated with institutions and is working closely with the Confederation of Zimbabwe Industries to foster commercialization and investment from incubation, venture funding to the market. As part of this agenda, the Bindura University of Science Education (BUSE) under National Development Strategy 1 has established an innovation hub which falls under the institution's industrial park.

BUSE as a science focused university produces innovations that range from AI integrated tablets (Palpo device), food production from the institution's Masawu processing plants to an innovative agro-park. However, there is a clear lack of a validated process and ecosystem that facilitates effective commercialization and productization for the innovations produced at BUSE's Innovation Hub to the market and to actual economic benefit for BUSE, the entrepreneurs and the wider economy. The BUSE Innovation Hub is part of the broader national initiative to bridge the gap between university research and the market but it seems it lacks the key elements of a strong and functional commercialisation ecosystem, thereby contributing to the underutilization of the nation's research potential. This study intends to explore the underlying reasons why the commercialisation potential at the BUSE Innovation Hub has remained largely under realized and explore what a working commercialisation ecosystem could look like at the institution level.

1.2 Statement of the Research Problem

The Bindura University of Science Education (BUSE) Innovation Hub, in line with many similar university innovation facilities across Zimbabwe and sub-Saharan Africa, has successfully nurtured and developed numerous innovative prototypes and research output from their respective students, faculty, researchers, and associated entrepreneurs. These have included technologies such as AI-integrated tablets (Palpo devices), natural product developments (Masawu processing), and specialized chemical formulations (Hi-Profile chemicals). However, a significant and pervasive challenge persists: a considerable disconnect between the initial development of these innovations and their successful transformation into market-ready products or sustainable business enterprises.

Research globally and within the African context underscores the severity of this challenge. For instance, studies indicate that among the best-performing universities globally, the rate of

licensing university technologies averages only around 3-5% (Startup Researcher, 2026), with a large proportion of research outputs never progressing beyond scholarly publication (United Nations Economic Commission for Africa, 2023). This pronounced gap between the generation of innovation and its entry into the market, often termed the “technology Death Valley,” stems from systemic obstacles, including inadequate funding opportunities, poor industry engagement, insufficient infrastructure dedicated to commercialization, and informational asymmetries among stakeholders (Science Granting Councils Initiative, 2025; Capacity4dev, 2025).

This failure in the commercialization pipeline represents a fundamental shortfall that undermines the development agenda outlined by Zimbabwe's Education 5.0 policy framework and limits the potential impact of university-based innovation on economic growth and employment creation.

While this challenge is not unique to BUSE, it mirrors widespread issues across the African continent where promising and scalable innovations are often confined to laboratories and innovation hubs due to multifaceted challenges. These include limited access to early-stage seed funding and venture capital, inadequate intellectual property rights management capacities, weak linkages with potential industry partners and investors, insufficient development of entrepreneurial skills among researchers and students, and a lack of structured processes and mechanisms for effective technology transfer and market access. Within the specific context of BUSE, it appears that although the Innovation Hub provides a space, basic infrastructure and some mentoring to its users, it lacks a systematic approach for rigorously evaluating the commercial viability of innovations, connecting entrepreneurs with industry stakeholders and investors, and supporting businesses through critical developmental stages to reach the market. The National Venture Capital Company of Zimbabwe (NVCC) has indeed characterized the country's entrepreneurial ecosystem as "historically fragmented, characterized by innovators often working in isolation despite the availability of institutional support structures" (NVCC, 2025).

The absence of a well-defined and operationalized commercialization pathway at BUSE leads to a situation where even the most promising innovations may fail to achieve market success, resulting in substantial economic potential being lost and the success of Zimbabwe's innovation policy framework not being demonstrated through concrete commercial outcomes.

The research problem is further compounded by the lack of empirical studies that investigate the specific factors constraining commercialization within Zimbabwean university innovation hubs. Furthermore, there is a dearth of contextually appropriate and empirically validated models to guide the development and improvement of commercialization processes at these institutions. While existing frameworks for technology transfer have been developed internationally, their direct applicability to the unique economic, policy, and market conditions of Zimbabwe requires careful consideration.

This study therefore addresses both an immediate, practical issue at the institutional level (BUSE Innovation Hub) and a significant knowledge gap concerning the successful establishment of commercialization pathways within university innovation hubs in Zimbabwe and similar developing country contexts.

1.3 Research Objectives

1.3.1 General Objective

To develop a contextually appropriate working model that facilitates the commercialization of innovations generated at the Bindura University of Science Education Innovation Hub.

1.3.2 Specific Objectives

1.3.3 To examine the current commercialization processes, resources, and practices employed by the BUSE Innovation Hub and identify the barriers perceived by key stakeholders that hinder effective commercialization.

1.3.4 To analyse the role, expectations, and potential contributions of stakeholders particularly industry partners and investors, in facilitating innovation commercialization within the BUSE ecosystem.

1.3.5 To synthesize stakeholder perspectives, evidence from practice, and relevant theoretical frameworks into a proposed working model for commercialization at BUSE.

1.4 Research Questions

1.4.1 What are the current commercialization processes, resources, and practices at the BUSE Innovation Hub, and what barriers do stakeholders perceive as hindering successful commercialization?

1.4.2 What are the expectations, needs, and potential contributions of industry partners and investors regarding engagement with the BUSE Innovation Hub and support for innovation commercialization?

1.4.3 What key elements, processes, and stakeholder roles should constitute a contextually appropriate working model for commercialization at the BUSE Innovation Hub?

1.4.3 What should be the fundamental elements, processes and stakeholder roles that should be in place to develop a working model for the commercialization of innovation at the BUSE Innovation Hub?

1.5 Proposition

In view of the qualitative and exploratory nature of this study aimed at developing a context-specific model rather than testing pre-existing causal relationship the study will be governed by proposition(s) rather than formal hypotheses. Such proposition(s) which arise from the literature review and Conceptual Frame Work will guide data collection and analysis and could be subject to revision in light of empirical findings. Proposition 1: Lack of a well-established pathway for commercialization at BUSE Innovation Hub is primarily due to systemic barriers including paucity of dedicated funding, weak capacity in intellectual property management and inadequate linkages with industry and investors rather than a lack of innovative prototypes or entrepreneurial zeal on the part of students.

Proposition 2: Strong Triple Helix (university-industry-government) interaction leads to positive impact on commercialization success and leadership and governance structures will act as a mediator in innovation prototypes' relationship with product to market.

Proposition 3: There is a difference in the perception of commercialization process among the stakeholders of the BUSE innovation ecosystem; where students' innovators emphasize on access to funding, mentoring while supervisors are more concerned about the quality of research and intellectual property. Management focuses on infrastructure and operations whereas external stakeholders stress on venture-readiness and viability issues. Proposition 4: The most viable commercialization model(s) for university innovation hubs like BUSE necessitates contextualization of existing global best practices to address limitations pertaining to local resources, policy landscape, markets and culture, instead of adopting models from Global North settings.

1.6 Research Assumptions

This study is predicated on several assumptions that underlie its design and implementation:

1.6.1 The selected key informants, representatives of the stakeholder's group in BUSE Innovation Hub ecosystem comprising hub management and staff, students' innovators and alumni, supervisors, industry partners, and investors will be willing to participate in the research and will respond truthfully and adequately.

1.6.2 BUSE Innovation Hub management will allow the researcher access to the relevant information, documents, facilities and stakeholders, which are essential for data collection in BUSE.

1.6.3 The obstacles to commercialisation, which have been observed in African and Zimbabwean literature, exist at BUSE in a certain degree to form the premise of the research inquiry.

1.6.4 A mixed methodology approach incorporating quantitative and qualitative methods is a suitable methodology to investigate the phenomenon of innovation commercialisation so as to develop models appropriate for BUSE. 1.6.5 The development of a systematically structured model for innovation commercialisation can enhance the success outcomes at BUSE and collaboration between various actors is crucial. 1.6.6 The developed working model will not be unique to BUSE as it can also apply to similar Zimbabwean and African university innovation hubs with similar challenges.

However, adaptiveness of the model would be a requirement to other contexts

1.7 Justification of the Study

This research is justified on theoretical, policy, practical, and developmental levels. Theory Justification: It seeks to contribute to the body of knowledge on university-based innovation and entrepreneurship in African context. There is a wealth of literature on innovation transfer and commercialisation, however application of such theories in African context needs to be explored for context specificity of such knowledge.

The context-specific analysis of the problem of innovation commercialization at BUSE can inform the development of more relevant theories of innovation intermediation in developing economies.

Policy Justification: Zimbabwe's National Development Strategies (NDS1, NDS2), and the Education 5.0 policy paradigm emphasize on the need to accelerate socio-economic development through innovation. The government has allocated substantial resources to establish innovation hubs throughout country and has time and again expressed that the success of these institutions lies in the effective commercialisation of the innovations generated. Ministers lament about great potential lying dormant in university prototypes awaiting transformation. The present research will provide empirical data and relevant recommendations for both institutional practices and national policy.

Practical Justification: the study addresses a pragmatic issue that is prevalent in BUSE as an innovation hub which require adequate solutions in order to function to full capacity.

Innovation hub at BUSE has attracted significant capitalisation and as such the need to demonstrate innovative products capable of being commercialised is vital for institution's sustainability and the continued interest of stakeholders. The working model will serve as an invaluable tool to hub managers on how best to achieve their mandate. Developmental justification: This research also addresses the overarching goals of employment creation, industrialisation, and economic diversification in Zimbabwe.

The successful translation of innovations into commercially viable products and ventures will enhance economic value creation, create jobs and address local challenges by generating home-grown solutions. To foster self-reliance in innovation, Zimbabwe requires an evidence-based approach for innovation hubs like BUSE where many prototypes remain commercialisation potential untapped. Methodology Justification: The study fills a critical need for the development of contextually grounded, empirical studies of innovation ecosystems in African contexts.

While much is written about African innovation, a lot is largely anecdotal or relies on frameworks and conceptual lenses from the Global North.

The research is designed using mixed methodology in an attempt to address the complexity inherent in the study of innovation commercialisation and its impacts in a real-world context

1.8 Purpose of the Study

The main purpose of this research study is to develop a contextually appropriate working model for the commercialisation of innovations originating from the Bindura University of Science

Education (BUSE) Innovation Hub. This broad purpose includes specific objectives designed to capture various facets of model development:

1.8.1 To establish a factual basis for model development through the acquisition of in-depth understanding of the current landscape for commercialisation within which the BUSE Innovation Hub operates, taking into account its institutional environment, its existing activities and processes, and the ecosystem's dynamics influencing potential for commercialisation.

1.8.2 To achieve contextual appropriateness and relevance for the proposed model by systematically incorporating the views, experiences, and needs of various stakeholders associated with the BUSE Innovation Hub who are actively engaged in or directly affected by innovation commercialisation. This focus will ensure the model reflects the specific contexts, limitations and opportunities at BUSE and in Zimbabwe as a whole.

1.8.3 To devise a practical and actionable framework to guide the transformation of innovative prototypes into market-ready products and sustainable ventures.

The working model is envisaged to function as a functional instrument for the hub's management, its innovators and other stakeholders, with clear processes and pathways being defined.

1.8.4 To contribute to the wider knowledge and practice in university innovation commercialisation by developing a model for the BUSE Innovation Hub, which can be adapted for other university innovation hubs in Zimbabwe and other African contexts facing similar challenges

1.9 Significance of the Study

The research has significance at a number of levels including at the institutional, student, national and global levels.

1.9.1 At the Institution Level:

For BUSE, the working model provides an empirically-based guidance on how to enhance the effectiveness and efficiency of the Innovation Hub in its pursuit of commercialisation efforts.

This framework allows for more strategic allocation of resources, better engagement of stakeholders and a clearer direction in commercialisation activities thereby positioning BUSE as a strong player in innovation landscape in Zimbabwe.

1.9.2 Student Level:

For the students and alumni, the study will be of benefit as the proposed working model would improve their prospects of transforming innovative prototypes into successful business ventures, generating employment opportunities and enhance their socio-economic status.

1.9.3 Significance for the Academy and Students

For academic mentors to students who are innovation driven, and for their own researches it will provide insight to commercialise academic endeavours. This research will serve to influence engagement with the innovation hub and curricula development to be innovation and entrepreneurship aligned.

1.9.4 Significance for the industry and investors

For outside world including businesses and financial partners, the research will help to identify how best to interface and integrate with innovation hubs so as to be linked with the innovations, talent and firms of interest to them. Financial partners would leverage reduced risk in collaborations with hubs in an understanding of the ecosystem.

1.9.5 Significance for national policymakers

The ministry of higher and tertiary education in Zimbabwe and its partners such as the National Venture Capital Company of Zimbabwe, this research would provide evidence of implementation of policy on innovation at individual institution level thereby informs policy decisions and framework design for innovation commercialisation at the national level.

1.9.6 Significance for regional and international discourse

This study contributes to existing discourse on university innovations and entrepreneurship in Africa by providing in-depth understanding of commercialisation activities at BUSE; an innovation and entrepreneurship in an African university that contributes to the literature at regional and international level.

1.10 Delimitations

1.10. Delimitation Geographical: The scope of this study is limited to the BUSE Innovation hub. Results cannot be considered representative or generalize able for other university innovation hubs beyond this.

Spatial: the study at one single university may not be statistically representative for other university innovation hubs throughout the nation but has the potential to inform for replication at regional level.

1.10.1. Temporal Delimitations: This study focus on current state of innovation commercialisation at BUSE innovation hub which spans over a period of approximately 3-4 months of its operations and may thus not represent the evolution of activities over time or future directions of the hub or projects running in the hub outside the designed working model.

1.10.2. Spatial Delimitations: Although many countries and regions have university innovation hubs, the present study will focus on Zimbabwe context specifically BUSE Innovation hub and will thus not allow for generalised inference at global level.

1.10.3. Topical delimitations: This study focus on the commercialization practices at the innovation hub, as such it does not cover other hub related activities that may be critical for overall hub functionality like intellectual property management not directly related to product commercialisation, student incubation, innovation pedagogy unless directly related to innovation commercialisation outcomes. The innovation projects considered for commercialisation are limited to those based within the BUSE Innovation hub.

1.10.4. Stakeholder delimitations: While various stakeholder categories will be considered for interviews, certain external groups like national policymakers are not targeted as direct participants in the interviews, though reference to their influence on commercialisation process will be made.

1.10.5. Methodological delimitations: The use of specific qualitative methods can influence the type and nature of data produced. For example, it is not practical to carry out a time-series analysis of the commercialisation process with the present resources.

1.11 Limitations

Access Limitations: Obtaining participation from all targeted individuals may prove challenging, especially among busy industry partners and investors. To address this,

collaboration with hub management will facilitate introductions, flexible scheduling including remote interview options will be offered, and the value of participation will be clearly communicated.

Response Bias: Participants may offer socially desirable responses or hesitate to disclose negative experiences, particularly students concerned about potential repercussions. To mitigate this, confidentiality will be ensured, rapport will be established, questions will be framed in non-judgmental terms, and findings will be triangulated across multiple sources.

Researcher Bias: The perspectives of the researcher may influence both data collection and interpretation. Mitigation strategies include maintaining a reflexive journal, engaging in peer debriefing, actively seeking disconfirming evidence, and conducting member checking.

Generalizability Limitations: As this is a single case study, findings cannot be statistically generalized to other settings. However, the study seeks analytical generalization by developing concepts and models that may be transferable to similar contexts, allowing readers to assess relevance based on detailed description.

Resource Limitations: The study is constrained by limited time, funding, and research assistance. All data collection and analysis will be conducted by a single researcher, which may restrict the volume of data collected. Mitigation strategies include prioritizing the most information-rich sources and employing efficient data collection methods.

Economic Instability: Zimbabwe's economic volatility may influence stakeholder availability and willingness to participate. Mitigation strategies include offering flexible scheduling and maintaining ongoing communication with potential participants.

Temporal Limitations: Collecting data at a single point in time does not capture dynamic processes of change and development. This limitation is addressed by incorporating retrospective accounts of participants' experiences and by developing a forward-looking model.

1.12 Definition of Terms

The following terms, which are used in this research and have significance in the study, are defined: “To facilitate understanding of conceptual consistency and specificity in this dissertation, crucial terms are defined and context-aligned to their employment in this particular study based upon relevant theoretical literature.

Commercialisation is the transformation of any scientific and technical output, idea or prototype into a product or service that can be commercially produced or delivered with economic value.” (Rasmussen, 2008, p.2). Within this research, it is conceptualised to span from innovation, product prototype through to marketable product and subsequent new business formation. Commercialisation refers to the act of selling of innovative products; technology transfer of innovation into practice with the creation of wealth and in other words it refers to the translation of research outcomes to products and services in order to produce economic impact (Nain, & K-E Kim, 2017). The commercialisation process may include intellectual property protection, product development, financing and market launch (Dutta, Monga, & Narayanan, 1999) whereas for innovation to achieve commercialisation it needs support system. However, Mian, Li & Lee, (2016) regard it as ‘moving innovations from ‘research to cash’.’ Hence this definition entails the entire process from the idea conception to actual selling to end-users.

Commercialisation Enablers These are the resources and structures that ‘enable a company to successfully exploit the innovation value’ (Mian et al, 2016, p.47). They facilitate and ‘ease the transition of inventions and innovations’ from research laboratories through to the commercial sphere (Suman, Kumar, V.L., & Srivastava, 2014, p.2). In this research, the enablers would cover diverse support structures including funding (both seed and venture capital), industry partnerships, technical and prototyping support, legal and advisory services and mentorship.

Entrepreneurship “We define entrepreneurship as the study of how opportunities to create something of value are organized.” (Shane & Venkataraman, 2000, p.217) In an academic context, the understanding of entrepreneurship involves understanding the entrepreneur as an opportunist and the entrepreneurial process, leading to the establishment of a new entity (venture). According to O’Hara and Martineau (2012), academic entrepreneurship within universities can manifest in diverse ways including, forming start-ups/ spin-off companies to bring university innovations to the market, licensing intellectual property generated by research. Entrepreneurship in this context relates to innovative individuals (students, alumni, staff) using university knowledge to pursue commercial opportunities.

Innovation Ecosystem Innovation ecosystem refers to the complex network of people, institutions, processes, policies and resources that shape innovation and entrepreneurial outcomes in a given region or sector (M.E. Porter, 1990). In this study the ecosystem involves

various stakeholders ranging from university level, to government (Ministry of Education) to industry partners and investors. As argued by Scharnitzky (2014), the innovation ecosystem fosters collaboration, co-creation and knowledge diffusion. In the study the BUSE Innovation Ecosystem as encompassing the broader socio-economic environment in which the BUSE hub operates includes all interactions, relationships, policies and resources that are conducive to or hinder commercialization of research innovation.

Innovation Hub “An innovation hub is a place (physical or virtual), which provides access to experts, investors, partners and a set of tools and resources, that enables individuals to explore, develop, pilot and scale their innovations, to make an impact and create their own ventures.” (Jimnez & Zheng, 2021, p.3)

A **University Innovation Hub** serves as an intermediary between the research produced within the institution and the outside market (Carayannop, L., & Cabalfin, J, 2018). In this dissertation, we are specifically concerned with innovation hubs based within universities, and will be using the Bindura University of Science Education (BUSE) Innovation Hub as the case study. Hence BUSE Hub will be referred to as BUSE Innovation Hub throughout the study.

Institutional Context “An institution is a complex set of formal and informal norms, rules of engagement, and practices that govern social and political behaviour.” (Scott, 2014). The term is broadly used here to capture the context in which the innovation hub operates which includes national and international policies on higher education and innovation (including Education 5.0 and SDGs), regulations guiding commercial activities of universities, university structures, governance and culture, and the national economic and political environment.

Pre-Commercialisation Support Pre-commercialisation support is defined as the “early stages of invention-led commercialisation, namely the translation and de-risking process whereby inventive conceptions are assessed for technical and commercial viability before seeking major commercial support, either in terms of capital investment or market partnerships.” (Rasmussen, 2008, p.1). Pre-commercialisation refers to measures put in place to ensure inventions are prepared to receive commercial attention. Examples include evaluation and due diligence on inventions, prototype development, IP strategy, and early market assessment (Phadke, 2008). These support mechanisms are primarily geared at assessing and reducing technical risk and ensuring intellectual and property rights.

Stakeholder Engagement Stakeholder engagement is concerned with all processes in an organization to communicate with interested people or organisations involved with the project

(Freeman, 1984). In the context of innovation commercialization, stakeholder engagement describes all the processes through which the BUSE Innovation hub interacts, communicates, and builds relationships with its numerous stakeholders such as students, alumni, academics, faculty, university management, government, industry, and investors, aiming to align expectations and objectives toward achieving effective commercialization of innovation.

Technology Transfer "The moving of technological knowledge from an academic institution to an industry partner. For technology transfer to be successful, it needs not only the movement of the technology itself, but also adequate support systems" (Hickin and Duxbury, 1998 p211.). "Technology transfer is one of the main drivers for industrial competitiveness as well as for university international ranking." (Sapsalis, et al, 2008, p 6) In the context of university-industry linkages, technology transfer covers a wide range of formal and informal mechanisms through which knowledge and innovations developed in universities are transmitted to society and the private sector for commercialisation and societal benefit. These can range from patent licensing and contract research to collaborative R & D and the formation of spin-offs or start-up companies. In this study we define it as "the overall mechanism for generating a significant economic or social return on investment from R&D by firms or other organisations that utilize the innovation, for instance, by producing goods, delivering services, or forming new organisations, to bring the innovation into wider social use." (OECD 2007).

Market-Ready Product A product that is adequately developed and validated for market launch, meeting required quality, functional and safety standards, and customer needs.

Spin-off or Start-up Venture A new company formed specifically to develop and commercialize an innovation stemming from an academic or research institution, or student project.

"Valley of Death" The critical stage between the initial stages of R&D and the point of market entry for an innovation, where many promising projects fail due to a lack of resources and support.

Funding Mechanisms Financial instruments and sources (e.g., venture capital, grants, government funding) available to support the development and commercialization of innovation.

Summary: This glossary has been designed to establish clarity and conceptual coherence across the entire research. These definitions, drawing upon relevant theoretical scholarship, are

strategically tailored to the specific investigative scope concerning the commercialisation of innovation at the BUSE Innovation Hub in Zimbabwe. By aligning these crucial terminologies with the conceptual model and guiding theoretical frameworks of this dissertation, this section lays the groundwork for an analytically rigorous and logically structured examination.

1.13 Dissertation Structure

The study is structured into five major chapters.

Chapter 1 provides an introduction that lays the foundation for the research study, giving background, the research problem, objectives, and questions, along with propositions, assumptions, justification, the purpose of the research, the significance of the research, and a preliminary introduction of the theoretical and empirical literature review, conceptual framework and research methodology used in the thesis.

Chapter 2 provides a review of relevant and existing research in the theory of knowledge and its empirically grounded findings to inform the study by creating a detailed conceptual and theoretical framework using the Triple Helix model, Innovation Systems, and Entrepreneurial Ecosystems theory to be used as the lens for analysing the process of commercialization of university-based innovation. The chapter covers theoretical views of how the role of universities in innovation has transformed over time; the role of innovation hubs in commercialization processes; the commercialisation of innovation and its potential inhibitors; and conceptual models of the commercialization of innovation hubs in Africa and Zimbabwe, respectively.

Chapter 3 details the research methodology and design. It outlines the philosophical underpinning of the research, mixed-methods case study approach that will be used, defines the target populations and sampling strategy/techniques, specifies the data collection tools used in the study. The chapter will present the approach to analysing quantitative and qualitative data, the reliability, validity and trustworthiness of the study, and ethical considerations for conducting this study.

Chapter 4 presents the research data and analyses, and discusses the results of the findings. The findings data that are presented here comprise of the empirical data from interviews, focus groups and document analysis along with quantitative data collected from various stakeholders in the innovation hubs to the BUSE Innovation Hub, and addresses each of the research

questions. The presentation and analysis of data are discussed in relation to existing theoretical studies, leading to the development of a working model.

Chapter 5 offers a conclusion and discussion of the study findings. The findings will be summarized and their implications for existing theories, policy and practice discussed, a final version of the working model of commercialization of innovation at the BUSE Innovation Hub presented in detail along with an outline of what the work has achieved, what are its limitations and recommended actions at BUSE level and directions for further research in innovation commercialisation.

1.14 Chapter Summary

The introductory Chapter of the thesis outlines the fundamental premise for understanding the Commercialisation of innovation at Bindura University of Science Education (BUSE) Innovation Hub, under the purview of Heritage-Based Education 5.0 framework. Situated within the global evolution where universities are repositioned as agents of economic development, this chapter subscribes to the global narrative on Triple Helix Model (Etzkowitz and Leydesdorff, 2000), while being mindful of the "technology Death Valley" of the African context which is characterised by lack of the bridge for innovation to reach the market (Science Granting Councils Initiative, 2025). The problem of research is clear: BUSE Innovation Hub fails to offer clear evidence-based and process-based pathways for the commercialization of innovation, despite providing platforms to foster several potential innovations, including innovative devices developed by Palpo Technologies, embedded with artificial intelligence capabilities, as well as masawu product development, posing an inherent paradox for Education 5.0 industrialization initiative. Three objectives guide the study: assessing current commercialization procedures and hindrances; evaluating roles and prospects for stakeholders; and synthesising these into a contextually sound working model for commercialisation of innovation at BUSE.

The four research propositions derived from theoretical literature are employed as sensitising tools to guide empirical investigation of the research phenomena. This study adds to theoretical knowledge in largely unexplored African contexts of innovation, as well as policy relevance for Zimbabwe's National Development Strategy, and offers potential practical contributions to BUSE as an institution and development contributions towards economic diversification and job creation in the country. The research framework integrates principles of Triple Helix, Innovation Systems and Entrepreneurial Ecosystems theories; viewing commercialisation of

innovation as an interactional process within specific national, institutional and Zimbabwean innovation system structures comprising pre-commercialization support; commercialization enablers; and stakeholder participation with feedbacks influencing system processes.

This thesis will adopt a pragmatic philosophical paradigm to inform the adoption of a mixed-methods approach employing a sequential explanatory design wherein quantitative surveys will be carried out first, followed by in-depth qualitative investigation through interviews, focus group discussions, and content analysis, covering approximately 130 participants. The thesis concludes by framing the organisation and anticipated limitations of this study.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter systematically reviews both theoretical and empirical literature that pertains to innovation commercialisation, particularly the intermediary role of university innovation hubs in the national innovation systems. The purpose of the chapter is to establish a sound theoretical and analytical foundation for developing a working model for the Bindura University of Science Education (BUSE) Innovation Hub, within the framework of Zimbabwe's Heritage-Based Education 5.0 policy. An integrated theory framework and conceptual framework of the study will be presented, along with discussion of shifting university roles, characteristics of innovation hubs, the pathway of innovation commercialisation, barriers, stakeholder, leadership, feedback mechanisms, finally identifying the critical gaps in the literature, and underpinning the case for a working model appropriate for the context.

2.2 Theoretical Framework

Because innovation commercialization is a complex, multifaceted phenomenon embedded in interlinked institutional, economic and social systems, it is inappropriate to approach this study with only one theoretical lens. Consequently, this study employs an integrated theory framework combining primary theoretical orientations of the Triple Helix Theory (Etzkowitz & Leydesdorff, 2000), Innovation Systems Theory (Lundvall, 1992; Nelson, 1993), Technology Transfer Theory (Bozeman, 2000), and the Resource-Based View and Dynamic Capabilities framework (Barney, 1991; Teece et al., 1997). While other perspectives, such as Entrepreneurial Ecosystems Theory (Isenberg, 2011) and the Quadruple Helix extension (Carayannis & Campbell, 2009), are recognised to add valuable nuance to this research, the above frameworks form the cornerstones of the integrated theoretical framework adopted in this study because they are highly complementary, and they each provide crucial analytical lenses.

2.2.1 Triple Helix Theory

The Triple Helix model of university-industry-government relations which is best represented by Henry Etzkowitz and Loet Leydesdorff (Etzkowitz & Leydesdorff, 2000; Etzkowitz, 2002; Leydesdorff & Etzkowitz, 1998), arose from research on the diverse innovative paths of leading industrialized economies throughout the second half of the 20th century. Unlike conventional

linear innovation theories that envisioned a unidirectional flow from research, development to application (where the university was seen as the primary provider of knowledge, industry the primary user, and government a regulator or funder of basic research), the Triple Helix suggests that innovation emerged from the blurring of boundaries and interpenetration of these three spheres of society, with each acquiring the characteristics of others.

The underlying propositions of the Triple Helix model are: first, there has been a fundamental broadening of university missions; a 'third mission' was added to teaching and research as economic development and an engine of commercialisation to serve national and regional growth; this 'entrepreneurial university' (Clark, 1998) pursues entrepreneurial aims like patenting and spin-off formation; second, as universities become more 'enterprising', industry becomes more knowledge intensive; engaging in research collaboration and seeking co-location and closeness to academia; and third, government has shifted from being an external controller of innovation to acting more as a facilitator and venture capitalist to create incentives and to support appropriate infrastructure for innovation. This interaction, especially from their respective 'borrowed' or newly adapted roles leads to triple helix spiral that generates more, faster knowledge commercialisation.

Triple Helix Configurations

There are three conceptual models or ideal-typical configurations of university-industry-government relations identified in the literature: the statist, the laissez-faire, and the triple helix models (Etzkowitz & Leydesdorff, 2000). The statist model is characterised by state dominance over both universities and industries; a central plan controls the research and innovation directions. The laissez-faire model, typical of many market economies, has strong borders among the three sectors; there is limited overlap or interaction. The triple helix model is described as having interpenetration with a blurring of borders among and between these spheres with hybrid organisations such as university incubators, technology parks and university-industry- government linkages formed at these intersections; this form represents the 'optimal' structure in the theory's view for knowledge-based development.

Critiques and Application to African Contexts

While the triple helix model has been influential in shaping discourse on university-industry-government relations, it has been subjected to strong critiques, particularly with respect to its relevance to developing countries. First, it assumes the presence of institutions of adequate capability, independent universities, well- developed industries and an effective public administration (Kruss et al., 2015). For example, the notion of the 'entrepreneurial university' is predicated on concepts of academic freedom and independence from external interference and is often challenging to envision in the Zimbabwean higher education system given the historical political context. Secondly, the theory is normative in its presentation and has been criticized for presenting a prescriptive prescription that can disregard developmental priorities and may promote a number of negative outcomes, such as the privatisation of academia or under-investment in basic research (Mirowski & Sent, 2008).

Third, the model is said to have an implicit understanding of power relations that are ignored. For instance, the assumption of equal footing among the three spheres of interaction may not be true if one sector dominates, e.g., a powerful industry partner or an overbearing government (Shinn, 2002). Given the government's overarching role in financing Zimbabwean state universities and controlling university policies, and the domination of some key industries by a few players, a mutually interactive, non-dominant partnership among the triple helix partners is difficult to imagine; perhaps there is even a tendency towards the statist model, but this time, but disguised as education 5.0 with unusual interventionist tendencies in some spheres. Fourth, the model is criticised for its 'lack of spatial context' where knowledge flow is treated as National or Regional rather than Global (Cooke, 2005), and there can be much higher engagement with international actors rather than within the domestic arena.

Application to BUSE

Within the context of this study, the Triple Helix Theory has considerable value, firstly by providing a useful perspective that attributes current innovation commercialisation challenges not just to internal limitations within the Hub, but as outcomes of deficits in the overall engagement with and interactions among the triple helix partners. Weak linkages between the university and industry, for example, are to be understood, from this theoretical perspective, as a symptom of the absence of strong triple helix ties. It directs researchers and policymakers to look critically at the structure of interaction among the three key agents for innovation – the university, the firm, and the government. In this framework, a key aspect of supporting

commercialisation through an innovation hub at the BUSE context lies in bolstering the bridging relationships among these key players. Secondly, the triple helix framework highlighted the significance of the government role, beyond funding and regulation; particularly its role as promoter of commercialisation, as expressed through mechanisms such as the National Venture Capital Company of Zimbabwe, the National Development Strategy framework and through Education 5.0 policy.

2.2.2 Innovation Systems Theory

Innovation Systems Theory (Lundvall, 1992; Nelson, 1993) views innovation as an interactive, learning process dependent on multiple factors operating in conjunction within an institutional and cultural context. The theory stresses that poor linkages between innovation agents, rather than the intrinsic capabilities of these agents, frequently underlie innovation bottlenecks. The approach to analysis operates at national, sector and regional levels of innovation systems, with this study focused on national and regional dynamics. It notes that developing countries tend to possess weaker formal institutions, inefficient capital markets, and limited corporate absorptive capacity (Oyelaran-Oyeyinka & Sampath, 2007). Education 5.0 policy represents a state led effort to reengineer Zimbabwe's national innovation system through strengthening of ties between the university and industry. From an Innovation Systems lens, for BUSE, the core problem is one of 'systemic coordination failures'.

2.2.3 Technology Transfer Theory

Theory examines the way technology transfers to commercialisation through Licensing, spin offs and research collaboration. [8,9]. T T theory modern views it as a mutually interactive between market and the research agenda. To be effective this requires appropriate technology transfer office, licensing know-how, IP management capability and professional staff. In case of BUSE the lack of a formal T T theory may be interpreted as an institutional deficit which warrants a functional model for T T to embed these facilities.

2.2.4 Resource-Based View and Dynamic Capabilities

Theoretical Foundations

RBV as developed originally by Barney [11] and thereafter refined by other researchers argue that competitive advantages accrue to organisations in possession of resources that are valuable, rare, imitable and inimitable and non- substitutable (VRINO). R B V has moved our focus from the industry the sector to the internal focus of organisation as factors that influence

performance difference amongst competitors. These resources vary; from the obvious ones like plant and financial resources to intangible ones like organisation reputation, knowledge and skills.

The application of RBV and dynamic capabilities in University Technology Transfer and Innovation Hub's research The RBV framework and the dynamic capability concept are increasingly applied to explain technology transfer and the performance of university innovation hubs [9, 15]. Following RBV logic, this perspective examines the resources of innovation hubs (physical and financial resources, funding, mentors) as well as its dynamic capability to sense market need opportunities, seize these opportunities and reconfigure resources and capabilities for these opportunities and respond to ongoing challenges, as supported by the VRIO logic. From an RBV and dynamic capabilities perspective, the key question about the BUSE innovation hub revolves around its resources.

Application to University Innovation Hubs

Which resources would be most valuable in translating innovations to market realities and where may significant resource gaps exist that could hinder these commercialization endeavours. From a dynamic capability perspective, we might also wonder whether the hub has developed a routines and processes for identifying promising technological innovation opportunities, sensing them and harnessing them through appropriate support mechanisms and transforming organizational operations in response to lessons learned in and feedback from market interactions. Proposition 2, which suggests a mediating effect of leadership and governance, can thus be seen through dynamic capabilities: effective leadership cultivates or leverages specific capabilities in sensing and seizing market opportunities, translating them to the market, and reconfiguring processes in light of new market conditions and feedback. But the lack of feedback mechanisms discussed in chapter 1 might constitute a deficient capability that will lead to persistent commercialization failures regardless of the present capabilities and resources.

2.2.5 Supplementary Perspectives

Additional Theoretical Perspectives Other frameworks can be used to enhance the depth of the study, for example; Entrepreneurial Ecosystems theory [16] provides a diagnostic framework of six component-driven ecosystem; policy; finance; culture; support; human capital and markets, as building blocks necessary to cultivate the development of successful entrepreneurs. Furthermore, the Triple Helix Model extended to include the Quadruple Helix Model

recognizes a fourth pillar of society; civil society and emphasizes social relevance while. The are not central to this study, but serve as supplementary to support it, if the need arise.

2. 2.6 Theoretical Framework Summary

Triple helix theory, as an over-arching perspective, explains and articulates the necessity of cooperation between university, industry and government domains. It provides an explanation for the stated effect of strong triple helix interaction for commercialization performance in proposition 2. • Innovation Systems theory is a tool which draws the attention to the broader institutional conditions (policies, culture, infra-structure, networks) surrounding such interaction; Technology Transfer Theory supplies concepts of licensing, spin-offs and collaborations used in the process of moving academic output to market, including considerations regarding potential lack of capability of the BUSE; The entrepreneurial ecosystem theory presents a tool to assess six domains relevant to stimulate or obstruct entrepreneurial activity, supporting the identification of the multi-factor nature of barrier formation.

•The RBV & DC theories focus upon internal hub resources and processes as being responsible for the variation in performance with regard to the commercialisation activities, thereby offering insight for leadership, governance of proposition 2 and a focus upon feedback loops built into the study's conceptual framework; Entrepreneurial Ecosystem Theory (EET): It is important to look for a holistic framework that analyses entrepreneurial activity, which is the topic for this thesis.

Entrepreneurial activity: In the present era of global innovation economy, it is vital that innovation transfer should be analysed on different level's where triple helix concept is important where as there are many innovation ecosystem that foster or hinder innovation commercialization

2.2.7 Synthesis: An Integrated Theoretical Framework

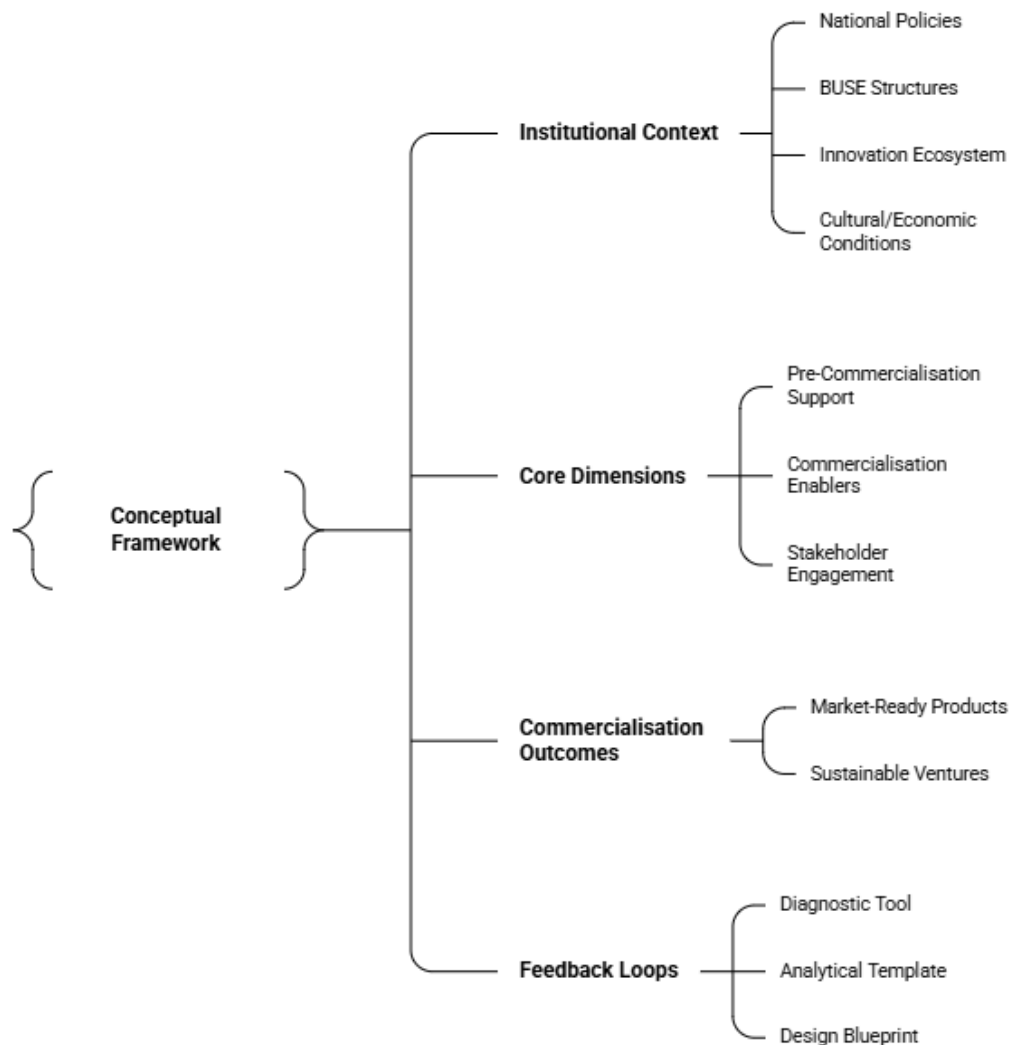
The three theoretical frameworks analysed provide useful concepts which helps to focus and analyse the innovation commercialization aspect of the BUSE Innovation hub. While this thesis relies heavily upon the combined theoretical concept no single theory provides answers all the question relating to BUSE Innovation Hub. Hence, as demonstrated by the confluence of these three perspectives; innovation commercialisation in the BUSE Innovation hub is envisioned as a systematic, multi-level activity supported by, and nested within, a combination of institutional

interactions, an organization's resources and competencies, an effective transfer mechanism and an entrepreneurial ecosystem.

2.3 Conceptual Framework

The framework, (Figure2.3.2.1), integrates the derived insights in a hierarchical form consisting of: the Institution-level context (policy, infrastructure, ecosystem, cultural/economic factors); the Core- Dimensions (pre- commercialisation support, commercialisation enablers, stake holders' engagement), the Commercialisation Outcomes (products available to markets, sustainable businesses) and; the Feedback mechanisms to improve/ refine continuously. The tool works as diagnostic, as template for the collection and analysis of information, as a structure for the development of working models of the Hub.

Conceptual Framework for Commercialisation



Source: Own Diagram (2026)

Fig 2.3.2.1 Conceptual Framework for Successful Innovation Commercialisation

2.3.1 Institutional Context

The institutional context establishes the “rules of the game” within which all commercialization activities operate. Drawing on innovation systems theory (Lundvall, 1992; Nelson, 1993), this pillar recognises that the performance of individual hubs is heavily influenced by their environment. At BUSE, there are four interconnected components of the institutional context.

Firstly, national policies in Zimbabwe, specifically the Heritage-Based Education 5.0 and National Development Strategies (NDS1 and NDS2) have provided a powerful policy mandate for industry development driven by universities.

These policies signal to higher education institutions that they must contribute to economic development by developing and commercialising new knowledge. They set expectations that patents and prototypes will progress to market. Secondly, the structure and mechanisms at BUSE itself - including resource allocation practices, academic reward and promotion criteria, and the place of the Innovation Hub within the overall university - affect whether the national policy mandate will be translated into practical commercialization activity. If publications continue to be the dominant indicator for faculty career progression, or if faculty workload cannot accommodate commercial activities, the policy will have little impact.

Thirdly, the overall innovation ecosystem surrounding BUSE - which comprises support organizations, the funding landscape, and the network of potential industry partners in Zimbabwe - will influence access to relevant resources and the opportunities available to innovation teams.

A fragmented and under-developed ecosystem will constrain the hub's potential. Fourthly, culture and economics play a role. For example, if society does not have a tolerance for risk-taking and failure (which is part of innovation), entrepreneurs will be dissuaded from venturing out.

Similarly, market size and economic instability will constrain the potential for long-term investment in innovation. Therefore, the institutional context can function both as a driver of, and a barrier to, innovation. Improving the performance of any individual innovation hub must take into account the external environment.

In particular, policy makers and the university need to recognise the extent to which enabling and disabling institutional conditions affect innovation in general and this Hub's capabilities in particular.

2.3.2 Pre-Commercialisation Support as the Preparatory Driver

Pre-commercialisation support describes the necessary first step in the commercialization pathway: identifying promising innovations and preparing them for their journey towards the market. This pillar essentially functions as an 'engine of readiness', transforming early-stage research into concepts that have a real chance of making commercial impact. Without these

preparatory activities, an innovation will never reach commercial viability. This pillar includes four main sub-components: • **Idea Validation:** The process by which potential market need is assessed and the potential of an innovation to succeed is confirmed through rigorous analysis of product-market fit, customer requirements, and competitive landscape.

This is crucial to ensure that resources are not wasted on innovations that lack any commercial potential.

Prototyping Assistance: The provision of access to physical space, tools, equipment, expertise and funding that allows the concepts to move to a tangible and testable prototype stage. Many investors will not consider an innovation until it is at least a working prototype. • **Intellectual Property Management (IPM):** Protection of innovations through patenting, trademark registration and trade secrets so that legal rights are established, underpinning subsequent commercial transaction processes such as licensing and technology transfer.

Market Research: Detailed analysis of potential markets, customers, market segmentation, distribution channels, regulatory environment, and pricing strategy that underpins the commercial plan for the innovation. From a Resource-Based View perspective (Barney, 1991), pre-commercialisation support represents the hub's core stock of valuable, rare, inimitable, and non-substitutable assets that will give innovators a competitive advantage. Lack of these capabilities at the Innovation Hub will determine the level of success with regards to innovation commercialisation and innovation entering commercialisation pathways.

This pillar would directly address the so-called “technology Death Valley” problem – the phenomenon by which innovations fail to transition from proof-of-concept into commercially viable products.

2.3.3 Commercialisation Enablers as the Translational Driver

The commercialisation enablers pillar acts as the “translational driver” for innovations emerging from the preparatory stage. Whereas pre-commercialisation support builds readiness, enablers are about “getting it done” by linking ready innovations to the resources and support they need to be commercialized. The four components of this pillar include: • **Funding Mechanisms:** Access to various sources of funding at different stages of the innovation process, such as seed funding, grants, angel investment and venture capital. Having access to appropriately staged funding has repeatedly been cited as the most critical single enabler for innovation commercialization (Science Granting Councils Initiative, 2025).

Industry Linkages: Active engagement and relationship building with existing businesses, potential customers, suppliers, distributors and research organizations that may translate into potential commercial partnerships, licensing agreements and markets for innovative products.

Entrepreneurial Capacity Building: Providing education, training, workshops, coaching and other resources that equip researchers and innovators with the necessary skills to manage a venture.

Mentorship Programs: Connecting innovators with experienced entrepreneurs, business leaders and investors to guide, advise and support them in developing their ventures. Each of these components is interconnected.

For example, good industry linkages can help to mobilize funding, while a strong ecosystem of experienced mentors can be a key attraction for angel investment. The lack of robust funding, strong linkages with industry, and a developed network of mentors at the Innovation Hub represent significant gaps that need to be addressed. Given the limitations of the Zimbabwe's ecosystem such as a underdeveloped venture capital industry, an underdeveloped venture philanthropy infrastructure, and weak interaction between academia and industry, a stronger emphasis needs to be placed on the development and managing of the 'enablers' element of the Hub's functions.

2.3.4 Stakeholder Engagement as the Integrative Driver

An Integrative Driving force: Stakeholder Engagement The triple helix approach (Etzkowitz & Leydesdorff, 2000) places an intersection of university, industry and government as critical to innovation-led growth. One dimension in the Stakeholder Engagement pillar reflects this idea. The processes of innovating commercialisation inherently involve multiple stakeholders who are likely to have divergent views and expectations from any engagement process with an innovation support organisation.

Five groups of stakeholders need to be engaged at BUSE: the hub management and staff who manage and provide services and infra-structure; students who create innovations and the graduates who start companies based on these; academic supervisor who provide academic content, industry contacts and expertise in specific areas; partners from industry who can commercialize innovation and provide with access to market and industry problems; and investors who provides financial resources, commercial discipline, advice, guidance and direction and an exit strategy.

Each stakeholder group has different motivations and contributions to make; and different expectations about commercialization. The stakeholder engagement pillar acts to bring in human agency to each other 3 pillars. Support for pre-commercialisation is by the staff; commercialization enablers come via partners and investors, and the institution context is made and influenced by the management and government actions and decisions. If no member of the stakeholder group engages meaningfully, no commercialization can occur; however great are the capabilities and resources within the other 3 pillars.

E.g., the hub might develop great pre-commercialization support processes, but without industry partners who wish to develop and commercialize products with their developed IP, this work is meaningless, likewise motivated students who create great ideas need academic support to turn these into actual product.

Divergent perceptions and conflicting expectations of the hub managers, innovators, academics, industry and investors have always been cited as a major barrier in innovation commercialisation (Siegel et al, 2003). BUSE's operational working model, thus, should include a system of co-ordination and communication for integrating stakeholder needs, and expectations into a working system that leads to commercialisation.

2.3.5 Synthesis: Interdependence and Systemic Driving Force

An interdependent system as a driving force of the four dimensions should not work as stand-alone but they have been conceived as an interdependent system.

A conducive institutional context should facilitate pre-commercialisation support. Good pre-commercialisation support shall attract potential commercialization enablers. Active participation and coherent engagement of stakeholder will ensure those enabling resources such as finance and industry linkages are used effectively in the innovation process.

Stakeholder engagement also provides feedback to the institution on the commercialisation strategy and direction.

Interdependences between the pillars have feedback loops which drives the sustained translation from initial innovation into commercial impact in an economic entity, shown in the conceptual model above. Therefore, in developing a working model, BUSE must also address each of the pillars and assure that one strength cannot compensate for another weakness

2.4 How the Framework Guides the Study

The conceptual framework provides direct guidance on the study's objectives in developing a fit-for-purpose operational framework for the commercialization process at BUSE. First, the framework provides a diagnostic framework to identify commercialization processes and barriers at BUSE across all relevant areas, focusing on all three core pillars and their systemic interaction with the institutional environment (Objective 4.2.1). Second, it identifies Stakeholder Engagement as a stand-alone dimension, thus permitting a focus on identifying the specific expectations, needs and capabilities of the stakeholders involved in the BUSE Innovation Hub's commercialization activities (Objective 4.2.2).

Third, the structure of the conceptual framework guarantees that any working model produced in this research (Objective 4.2.3) will address all dimensions of the commercialization process in an integrated fashion, include mechanisms for feedback and continuous improvement, and be situated within the unique socio-economic and political context of Zimbabwe and BUSE itself.

2.5 The Evolving Role of Universities in Innovation and Economic Development

Ching, K., & Sheng-Ju, C. (2018). In dialogue with science's social contract with society. *Asian Education and Development Studies*, 7(2), 127-143.

2.5.1 Zimbabwe's Heritage-Based Education 5.0 Model

Education 5.0 Model in Zimbabwe Zimbabwe's post- independence policy for higher education, since 1980 has had various developments, driven by shifting national agendas, changes in the economic climate, and growing international influences. The Education 3.0 model which emerged in the early part of the millennium, saw universities evolve from performing just teaching and research, adding community engagement as a 'third stream' or 'third leg' (Zhou, 2018). Higher education institutions were expected to go beyond the confines of the university walls, in terms of contributing to the development of local communities through community outreach activities, consultancy and participatory projects.

Education 3.0 although a step forward to have an engaged university, it was not sufficiently commercially oriented as to have direct impact on local economy; it also lacked clear pathways for innovation's translation to commercialization and economic impact.

This led to the emergence of Education 4.0 model following the introduction of the National Development Strategy One (NDS1, 2021-2025). It then added 'innovation' as the fourth dimension or pillar of the university's mission beyond the traditional teaching, research and community engagement, highlighting universities' roles in new knowledge generation, such as in applied research and innovation (Ministry of Higher and Tertiary Education, 2020). The framework recognized the crucial roles of universities in technological, process, product innovation aimed at facilitating industrialisation. The most recent evolution is Education 5.0, again guided by the Ministry of Higher and Tertiary Education, Innovation, Science and Technology Development. It has identified five areas of focus, adding 'Industrialization' as the fifth leg or pillar. It explicitly defines universities as industrializing agent' responsible for commercialization of innovations to result in the development of a wider range of new technologies, industrial products and sustainable enterprises. Education 5.0 model is different to previous ones because commercialisation is not only a potential product, but the final objective for the University's activities in relation to its economic contribution.

business. Education 5.0 is thus different from all the others in the sense that it is based on commercialization as a measure of university contribution to the national development.

2.5.2 Core Principles of Education 5.0

The heritage-based Education 5.0 is based on five interlinked pillars, which collectively contribute to the mission of the university; teaching, research, community service, innovation, and industrialisation. The five pillars are viewed as sequenced and cumulative since one complements another. Teaching produces graduands; the graduates generate the required body of knowledge; they engage with their immediate environment; their ideas are then commercialized at universities and brought to the market by industry (Ministry of Higher and Tertiary Education, 2021). The foundation of the policy is anchored on the principle of Heritage-Based Education in which Zimbabwe's development should be driven by indigenous knowledge systems, cultural attributes, and natural resources, instead of the implantation of foreign models of development. It is proposed that heritage-based education encourages self-reliance and national identity while at the same time engaging with the international knowledge pool on Zimbabwean own terms (Zhou, 2018). This concept translates to how innovations developed in Zimbabwean universities must endeavor to utilise the local resources, address the local problems and eventually contributing to local industries instead of generating mere knowledge intended for external exploitation.

2.5.3 Implementation Challenges

Much of commitment in as far as the implementation of Education 5.0 is concerned emanates from the government who has repeatedly stated their readiness and zeal to implement Education 5.0, the President and ministers are regularly visiting innovation hubs, endorsing policy and call for commercialization of patents and innovations by universities. Innovation hubs and centers of innovation have been launched and continue to be formed and adopted by higher and tertiary education institutions, including developing entrepreneurship curricula to prepare graduates with skills needed in an entrepreneurial economy. Universities continue to revise policy and support innovation commercialization and in the case of BUSE, the university's Innovation Hub, under the university's industrial park has innovated AI-based tablets, processed Masawu into various foods, and a variety of innovations in the Agro-park domain.

The however the implementation of Education 5.0 faces a variety of challenges that appear to resonate with the research problem in Chapter 1 of this study;

Firstly, despite the numerous innovation hubs launched throughout the university landscape in the country, there is lack of systematically defined innovation to market process pathways. While these hubs are present, they frequently face what researchers called the “technology Death Valley” which is characterised by a huge gap between the prototype generation and the ultimate commercial application; Secondly, financing mechanisms, while a national venture capital company is available for startups, have been limited in scope to support the kind of high-risk, early-stage innovation that are expected from research performed in the innovation hubs.

Thirdly, industry linkages although heavily promoted have been poor, owing to low absorptive capacity among most industries and lack of established formal channels to promote university-industry interaction, and also, poor university-industry collaboration in joint product development activities due to lack of demand from the private sector;

Fourthly, the intellectual property (IP) regime guiding innovation outputs from universities remain unclear to a lot of innovators, the policy is still underdeveloped and this leaves university-based innovations poorly protected; and • Lastly, incentive mechanisms for researchers for engaging in innovation and commercialisation of intellectual property is largely insufficient since research is still driven by number of research publication in highly rated journals, Teaching is still viewed superior to innovation.

2.6 An Examination of Current Innovation Hub Practices

2.6.1 Defining Innovation Hubs

A physical or virtual meeting space where entrepreneurs, innovators, investors, and support organizations meet to drive innovation and entrepreneurship is termed an innovation hub or incubator, accelerator, maker space, or living lab. This meeting space acts as a mediator that reduces costs, increases the knowledge exchange and provide resources which an innovator might not be able to get individually. The increase in such centres globally proves the idea that innovation should be a group, not individual activity and their need of facilities to conduct these group activities.

2.6.2 Typologies of Innovation Hubs

As discussed, all organisations that operate as innovation hubs don't have common functions and structure. Various researchers have come up with several typologies for classifying these entities. Incubators Are institutions that exist to help early-stage companies in their development process and assist them to grow and succeed with an array of services including mentorship, training, workspace and networking services for the limited period of time often a year or two. University-based incubators like BUSE Innovation Hub utilize existing resources from the university infrastructure and pool together academic, intellectual and professional resources for entrepreneurs. Mian et al. (2016) suggest a typical university-based incubator can utilize intellectual property rights. Accelerators Like incubators they aim to grow ventures through an intensive program but differ from incubators in the fixed-term duration, the cohort approach for program and the “demo day” as the final step of program with an aim to convince investors. Like in any typical accelerator, equity stake is provided in return of money received (Cohen and Hochberg, 2014). Makerspaces also called as fab labs, hackspaces, or creative spaces are spaces that typically provide access to prototyping and fabrication tools and equipment such as 3-D printers, laser cutters, NC machines, and electronics tools (Hatch, 2014). The prototyping facility provided by the Makerspaces facility is essential because this is the point where the innovative ideas often falter on the road to the commercialization. Makerspaces is the component in the BUSE Innovation hub that is most useful for those Innovators who is trying to create Physical innovations or Food-based products.

2.6.3 Core Functions of Innovation Hubs

The major roles played by these innovation hubs includes several. Providing physical facilities; such as office space, meeting rooms, etc. Offering business support such as professional mentoring, training and other business support services like professional assistance. Supporting access to Finance by direct investment and/or connecting start-ups with relevant investors and other capital sources. Developing networks and fostering a community amongst entrepreneurs, investors and other actors. Providing market access and industry links. Acting as a certification agency and legitimizing ventures in the eyes of investors, partners etc. Promoting a conducive ecosystem and advocating for entrepreneurial activity.

2.6.4 Innovation Hubs in African Contexts

The existence of high rate of unemployment amongst the African Youth; the high adoption of technologies and increasing need of innovative solutions to complex problems facing developing countries has necessitated the establishment of such innovation centres in Africa. These centres vary widely but a growing pattern has been observed and such centers are common in almost every part of continent and the number have been rapidly increasing. Some of the renowned centres in Africa include iHub in Nairobi; Co-Creation Hub (CcHub) in Lagos, Nigeria; and BongoHive in Zambia. (Ndemo and Weiss, 2017). African Innovation hubs also differ from those in developed world because they are acting as the bridge between formal and Informal innovation Eco-systems thereby, providing the former with insights from the latter and opportunities to linkup and access formal facilities and networks. African Innovation hubs are largely influenced by the need for socio-economic impact due to their developmental setting, often providing a mix of for-profit and not-for-profit models. Many are also funded externally, posing questions about long-term sustainability and their response to the localized innovation needs, though African hubs show more resilience and adaptable nature as they innovate unique operating models suited to the local circumstances (Friederici et al., 2020).

2.6.5 BUSE Innovation Hub: Positioning within Literature

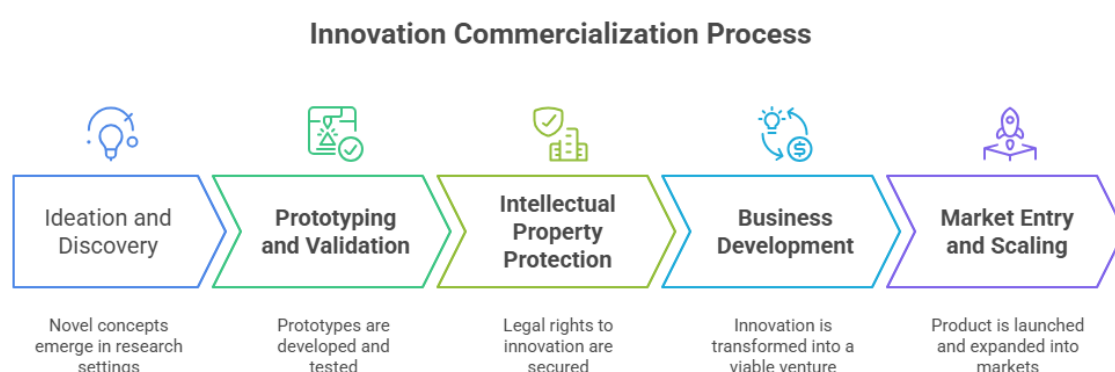
The BUSE Innovation Hub combines attributes of several typologies mentioned in literature. As a university-based initiative, it offers a physical hub, incubation services for students and alumni, and supports prototyping for software, electronic, and food products. It is part of the Education 5.0 framework, which mandates that innovation and commercialization are integral functions of the university. However, the hub faces some challenges compared to more established centres: lack of a formal Technology Transfer Office, reported weak connections

with industry and investors, and unclear business development support, training, mentorship, and professional services. The feedback and continuous improvement processes seen in mature hubs appear to be underdeveloped. Thus, the BUSE Innovation Hub can be described as an emerging university incubator with strengths in infrastructure and prototyping but areas for improvement in business development, finance access, and industry linkages.

2.6.6 The Commercialization Pathway

There is a body of literature that proposes the innovation process as consisting of stages, where specific sets of activities are performed at each stage, where each stage poses distinct resources, risks, etc. There are various stage models developed by researchers such as those of, Rasmussen (2008); Siegel et al. (2003); and Shane (2004). However, by considering them we identify 5 distinct stages to define Commercialisation Pathway:

Table 2.6.6.1: The Five-Stage Commercialization Pathway



Source Own Diagram (2026)

Stage 1: Ideation and Discovery when we conceive of new science. Science can appear as either pure scientific discoveries or technological advances and university level this usually involves either research laboratory breakthroughs, the classroom environment or student based innovative projects. Some of the challenges facing this stage involve identifying potential value or interest from existing research for commercial purposes; documenting discoveries in intellectual property terms; and identifying markets or opportunities in addition to original research for innovations. Often potentially very useful innovations are never commercialized because innovators do not understand the commercial potential or were unaware or unwilling to undertake the risk of seeking a commercialize path (Thursby & Thursby, 2002).

Stage 2: Prototyping and Validation It's from this abstract conception that tangible, working artifacts (products and or services) need to evolve. This involves turning conceptions of research discoveries into tangible and functional prototypes and then validating these through experimentation and testing (Rasmussen and Borch, 2010). It's this stage when many innovations simply fail as it often involves developing a demonstrable, and testable entity that is the prerequisite step to interesting anyone or for anyone to express any interest, i.e. Outside interest is rarely drawn to an idea.

Stage 3: Intellectual Property Protection and Management The innovation must be protected legally, via, patent, trademark, copyright or trade secret protection, to create something of value and protect from further duplication by others (Rasmussen, 2008). University innovation centers in developing countries are sometimes plagued by challenges including intellectual property issues, such as obtaining protection or due to weak enforce ability of patents and, or other legal instruments, as the international IP system is very expensive and complex (Kruss et al., 2015).

Stage 4: Business development This involves transforming the protected IP and prototypes into commercialized products, services or businesses through various modes such as licensing, spin-off firm and through commercialization contract of innovation (Shane, 2004). This can involve licensing (transfer of rights to operate business on the innovation, and receive payments for that), and Spin-off ventures (setting up of a new commercial firm by founders on a basis of university IP), this entails new business, with adequate capital, team, operations, etc. (Rasmussen and Borch, 2010).

Stage 5: Market Entry and Scale The last stage which involves planning and implementation of production, marketing, sales and distribution activities, for commercial success and scale, leading to substantial market penetration (Rasmussen and Borch, 2010).

2.5.7 The Technology Death Valley Phenomenon

This is a descriptive term to refer to the chasm which separates successful university patent commercialization from what is often research conducted at the university or a technology developed out of such research that does not meet success after the proof of concepts. Such phenomena occur around the world though more pronounced in Africa where several innovation challenges abound to cause these innovations to fail when crossing this valley (UNCA 2023) The metaphor of Death Valley highlights the challenges that any product is facing at this stage – lack of funding; insufficient resources; and no systematic ways and

process that can take a proven concept and make it a viable, scalable and marketable product and/or service.

2.6.7 Quantifying the Death Valley

Empirical evidence shows that the extent of this challenge are widespread. Some studies report that less than one hundred university patent produce any meaningful return to the university (Lemley, 2001). The estimated licensing of universities' technologies is typically between 3 and 5 per cent of all the research produced even by leading institutions (Startup Researcher, 2026). In Africa this challenge becomes more serious where it is reported that only less than 12% of tech- startups can make beyond pilot, with infrastructure, financing, and human resource capacity "locking innovations into pilot purgatory" (TechCabal 2025). Most academic outputs, that are published annually, just become part of public domain and are hardly commercialized (UNCA, 2023).

2.7 An Examination of Current Innovation Hub Practices

Hubs, incubators and makerspaces act as facilitators providing a low-transaction, collaborative and sharing economy model providing access to skills, capital, network, and infrastructure that innovators might not easily find (Jimnez and Zheng, 2021; Mian et al. 2016). Incubators provide a long-term framework to offer a holistic package of support; accelerators focus on short, focused programs with a clear goal of raising investment or gaining market traction through intensive support; makerspaces are collaborative environments geared towards prototyping, building, experimenting and fabrication of innovative ideas. The main function includes provision of infrastructure, support in business development; access to finance/funding, connections to industry/markets.

They often enhance informal innovation mechanisms through integrating them in more formal pathways; a focus on social impact and a strong dependency on international donors to finance most of their activities (Friederici et al. 2020; Ndemo and Weiss, 2017). The BUSE Innovation Hub can be regarded as an emergent innovation hub with existing strengths in infrastructure and prototyping but limitations in business development support; IP management; systematic approaches to innovation management and fundraising.

2.9 Key Factors Contributing to Successful Commercialisation

Commercialisation success occurs on several levels; institutional – technology transfer offices, intellectual property policies, incentives aligned with university faculty interests (Siegel et al.,

2004; Lach & Schankerman, 2008); innovation – technical maturity, strong IP position, clear market potential (Moore, 2000); entrepreneur – entrepreneurial background, entrepreneurial self-efficacy, availability of champion (Roper & Love, 2012); and ecosystem – access to seed and venture financing, industry absorption capacity and professional services. Successful commercialization will require simultaneous strengthening of all of these components within BUSE rather than in isolated elements.

2.10 The Commercialisation Process in University Settings

In University Settings “The process by which innovations move from the initial concept to a marketed product and commercial viability. The key stages and process of transferring University Innovation The multi-stage transformation of research results into marketable goods or services is known as the process of commercialisation” (Rasmussen, 2008). The identified commercialization pathway includes five stages as summarised above: (1) Ideation and Discovery; (2) Prototyping and Validation; (3) Intellectual Property Protection; (4) Business development (Licensing or Spin-offs) and (5) market Entry and Scaling. The central ‘technology Death Valley’ located between “proof of concept and proof of market,” is characterized by challenges associated with capital requirements, team composition shifts from technical to management and technical, cultural and institutional factors (R Rasmussen and Borch, 2010). This phenomenon is particularly pronounced in Africa with less than 12% of its tech startups making beyond the pilot stage (TechCabal 2025). While there are number of ways for technology transfer such as licensing, spin-offs, and co-operation for joint product development, each mode requires different institutional capacity and network linkage, which are scarce at BUSE. Overcoming these deficits can be a major objective of the framework working model.

2.11 Current Challenges in Implementing Innovation Commercialisation

2.11.1 Macro-Level Barriers

It has been recognised that innovation hubs do not operate in a policy vacuum. Macro level policy may significantly determine the potential of innovation commercialization. In Zimbabwe, while government has adopted policies such as Education 5.0, to support innovation and commercialization, and while there is growing enthusiasm, implementation is still lacking. The policy on intellectual property rights may be weak in protecting university generated intellectual property or enforcing intellectual property laws, weakening the utility of a patented innovation (Kruss et al. 2015) and there may be cumbersome regulatory frameworks

on registration of start-ups, licensing and taxation processes for new companies. For example, according to the Science Granting Councils Initiative (2015), one of the predominant factors impeding the commercialization of innovation in Africa was policy incoherence which resulted in different government ministries working at cross purposes. The prevailing economic conditions are also vital in influencing the chances of successful commercialisation.

Zimbabwe's volatile economy, characterised by currencies fluctuations, hyperinflation and a general shortage of liquid capital, presents a climate that discourages and discourages risk-taking which is vital in innovation.

For, if investors do not have confidence in the long-term future, investing in the development of new products is of necessity risky (Nhema, 2015). Markets, in a country experiencing economic crisis such as Zimbabwe, are likely to be small thereby making any potential large-scale, commercially successful products or services of extremely limited market size. Furthermore, the current weak industrial base of Zimbabwe results in fewer companies to partner with so that the innovations are produced in commercial quantities. Foreign currency constraints also limit the ability to purchase necessary imported machinery and equipment as well as to obtain external technical or legal assistance required during commercialization.

Table 2.11.1: Macro-Level Barriers to Commercialization in Zimbabwe



Source: Own Diagram (2026)

2.11.2 Institutional-Level Barriers

Adequate management of intellectual property, such as identifying patentable inventions, conducting prior art searches, filing applications, managing prosecution, and negotiating license agreements, is essential for successful commercialization of inventions. This capacity is widely missing in the majority of African universities (Kruss et al., 2015). In the case of BUSE, a dedicated Technology Transfer Office is still lacking, as stated earlier, making IP management a major institutional barrier.

Without the capacity to adequately protect commercially valuable innovations, they become unappealing to investors and commercial enterprises that often require exclusivity to engage.

University reward systems, on the other hand, typically focus on publications and teaching as more critical for career advancement and promotion, whereas the time and effort dedicated to commercialisation activities remain unrewarded and could risk the career of a researcher or academic (Siegel et al., 2003). It remains to be clarified if the existing incentive systems at BUSE would be aligned with Education 5.0 expectations for commercialization, such as formal valuing of contributions through IP, allocation of course load for such activities, acknowledging these in promotion criteria, or engaging in activities of the Innovation Hub.

2.11.3 Individual-Level Barriers

Technical expertise alone is not sufficient for commercialisation; it needs to be coupled with skills in business planning, financial management, marketing, fundraising, negotiation, and venture management. Student innovators and researchers might be proficient in their scientific discipline but lack the entrepreneurial competencies required (Rasmussen, 2008). The transition from being an expert to becoming an entrepreneur entail developing new skills, assuming new roles and navigating unfamiliar terrain.

Many innovators struggle with this shift in skills and identity without formal support and coaching. Arguably the most critical individual level barrier to university innovation commercialization is the unavailability of accessible, early-stage finance (Science Granting Councils Initiative, 2025). Ideas that are beyond the proof-of-concept stage but too early for venture capitalists and also unsuitable for standard bank loans or for grants for early stages development need seed funding to mature their inventions to commercial product stage. In the Zimbabwean context such seed capital, meant to enable small investments in validation of

proof-of-concept, testing market need and business formation is scarce, making it difficult to bridge the “technology Death Valley”

2.11.4 Interaction Effects and Systemic Barriers

Perhaps the most important aspect of the literature on barriers is the realization that barriers do not occur in isolation. Indeed, many barriers work together to create systemic effects that amplify the sum of the parts.

A lack of capacity for intellectual property management coupled with a lack of access to finance: potential investors are reluctant to invest if intellectual property rights are not well-protected, but intellectual property rights cannot be well-protected without financing; a lack of industry linkages coupled with a lack of information flow: innovators do not know what the industry needs; industry does not know of new innovations; faculty are unwilling to take risks with their careers or their institution by commercialising their research for which they lack relevant entrepreneurial skills, while the institutional incentives, which are likely misaligned with the pursuit of commercialisation activities, offer little or no recognition or reward for doing so.

Thus, for the BUSE Innovation Hub it would be crucial to be aware of interaction effects. Interventions will fail if they target a single barrier but do not adequately address other enabling or exacerbating conditions. Any work towards developing a working model should have a holistic, systems view in addressing multiple barriers simultaneously.

2.11 Stakeholder Perspectives on Commercialisation

Successful commercialisation requires aligning disparate interests between and among the five main stakeholders: the Hub management; the students (and their alumni); the academic Supervisors and other University Faculty Members; commercial enterprise (industry partners); and Investors; and Government. Failure to align their multiple interests with an agreed common objective would lead to co-ordination problems and conflict (Cohen & Hochberg, 2014; Shane, 2004).

Each stakeholder is engaged at different levels of innovation commercialisation activities and contributes with varied capabilities and interests. While the Hub management is concerned with operational sustainability and measurement of program metrics, the students expect access to direct support and funding, as well as mentorship and equipments. The academic Supervisors are generally interested in mentoring their students to become researchers while at the same

time protecting Ip, commercial opportunities while ensuring not to distort the research focus. Industry partners desire access to readily market-able products/services; while Investors are keen on return on investment, efficient management team, market-ready product with evidence of viability, and the University Government will take the national development goal as a motivation while promoting Education 5.0 goals in relation to the commercialization of innovations from Universities.

2.11.1 The Multi-Stakeholder Nature

The innovation commercialisation in a university setting is generally considered as a collaborative, multi-stakeholder venture, entailing interaction and collaboration between various actors, organizations, and individuals with varying perspectives, priorities, skills, and resources (Siegel et al., 2003; Perkmann et al., 2013). For any initiative, such as the BUSE Innovation Hub, to be effective in commercialising innovation output, it must engage with key stakeholders, whose cooperation and engagement are critical at different stages of the commercialization pathway.

2.11.2 Hub Management and Staff

Hub management, including various operational and administrative staff members, provides critical support functions and serves as a central facilitator in the university innovation ecosystem (Mian et al., 2016; Banks et al., 2019). The primary concern of hub managers is ensuring the operational and financial sustainability of the Hub and the effectiveness of its programmes. Their objectives include metrics such as the number of ventures initiated and supported by the Hub, the number of jobs created, the funding raised by the supported start-ups and their venture survival rates, among other similar quantitative indicators.

2.11.3 Student Innovators and Alumni

Students, including both present and former University students, often constitute the core entrepreneurial energy and talent that drive university-led innovation activities (Miller & Acs, 2017; Wright et al., 2017). Their key characteristic features in their entrepreneurial journey includes, among others; innovative flair, limited financial resources and entrepreneurial experience, and a pressing desire to commercialize their inventions. As research conducted across innovation hubs in African context has shown, these students express frustration with what they perceive to be; a slow administrative process, lack of capital, and inadequate support for bridging the gap from idea to market-ready product (Ng'ang'a, 2016; Friederici et al., 2020).

2.10.4 Academic Supervisors and Faculty

Academic supervisors and faculty offer technical expertise, research guidance, and the imprimatur of academic prestige to university commercialisation (Siegel et al., 2003; Perkmann et al., 2013). In commercialisation activities, academic supervisors and faculty were influenced by existing institutional incentive structures which typically valorised publications and teaching far above any commercial gains (Thursby & Thursby, 2002). Their views are commonly characterized by a tension between academic logic and commercial logic, as well as concerns about intellectual property protection, sharing of knowledge, whether it is appropriate to prioritise commercial applications and commercialisation distorting research agendas (Slaughter & Rhoades, 2004).

2.11.5 Industry Partners

Industry partners represented the market where innovation activity and university IP might be taken up, whether through licensing, research collaborations or via integration into supply chains (Perkmann et al., 2013; Bozeman, 2000). Industry partners focused on issues such as: commercial viability, ROI, and alignment to strategic objectives. For example, a study by Kruss and Visser (2017) in a cross-African study, found that industry partners, predominantly valued university interactions for accessing skilled labor and problem-solving capacities and placed little importance on licensing university early-stage IP that required substantial investment and market development effort.

2.11.6 Investors

Investors (e.g., angel investors, venture capital funds, development finance institutions) provide critical funds needed to enable innovation and to enable the scale of innovations (Cohen & Hochberg, 2014; Shane, 2004). Investor focus revolved around risk assessment, expected returns and the strength of the management team. There is a nascent understanding of African venture capital and a number of studies have highlighted its limitations for funding early-stage ventures such as university innovations due to, inter alia, weak capital markets, limited exit opportunities and high perceived risk (Ndemo & Weiss, 2017; World Bank, 2020b). Investors regularly claim university innovations lack commercial viability, venture-readiness, mature business models, management expertise and market strategy (Science Granting Councils Initiative, 2025).

2.11.7 Government Agencies

Government agencies set policy frameworks and fund and direct innovation activity (Etzkowitz & Leydesdorff, 2000; Lundvall, 1992). The Zimbabwean government, through the Ministry of Higher and Tertiary Education, Innovation, Science and Technology Development, has established the Education 5.0 policy agenda that mandates the creation of innovation hubs in all universities (Ministry of Higher and Tertiary Education, 2021). Government views focused on strategic developmental outcomes and measuring public expenditure.

2.11.8 Divergent Perceptions and Implications for Coordination

Evidence consistently identifies different stakeholder interests as a barrier to commercialisation (Siegel et al., 2003; Perkmann et al., 2013). In terms of innovation hubs, management have a focus on financial sustainability; students aim to get funding; supervisors worry about IP protection and reputation; industry partners seek profitable ventures; investors want to protect their capital by maximizing returns; while governments seek national economic and social development outcomes. This multiplicity of and divergence in interests requires careful management and alignment for commercialisation success.

2.12 Review of Empirical Literature

Research on university hub commercialization in Africa is still embryonic but consistent and often pessimistic themes emerge.

2.12.1 Empirical Evidence on Barriers to Commercialisation in University Innovation Hubs.

At the highest level of a cross-European survey on university innovativeness, adhocracy culture was associated with the highest levels of innovation though it was not the dominant organizational culture (Gorzalany et al., 2021). In sub-Saharan Africa, research by Kruss et al. (2015) demonstrated that poor institutional linkages and weak firm absorptive capacity are systematic inhibitors of commercialisation. More contextually relevant work in Zimbabwe by Mazorodze and Mkhize (2024) surveyed 240 Zimbabwean academics and identified lack of research funding (46%) and lack of incentive structures (21%) as the primary barriers. More generally across Africa, the Science Granting Councils Initiative (2025) in their review indicated that lack of private sector investment, weak IP management and a fragmented ecosystem were systemic challenges hindering commercialisation in African countries. However, a specific study providing a holistic account of commercialization barriers in a single

Zimbabwean university from all stakeholders had not been published at the time of this review. Turning specifically to Africa, one of the few comprehensive empirical studies of university-firm interactions in sub-Saharan Africa comes from Kruss, Adeoti, and Nabudere (2015). Using a multi-country comparison in Nigeria, Uganda and South Africa, they investigate how the interaction between weak institutional linkages, misalignment in reward structures and low firm absorptive capacity prevent the translation of academic knowledge into commercializable products. Their contribution is a cross-national, institutionally-grounded study. However, their research is broad on the knowledge transfer process and less focused on university-hub commercialisation process specifically, and the Zimbabwean context is not explicitly included. Locally, Mazorodze and Mkhize (2024) undertook a study of innovation in Zimbabwean higher education and found, among a sample of 240 academics in four Zimbabwean public universities, that funding (46%) and incentive issues (21%) were the principal hindrances. Their sample excluded non-academic stakeholders and was not focused on university innovation hubs per se. Looking regionally, Science Granting Councils Initiative (2025) provided a multi-country diagnosis of industry research linkages, noting that insufficient private sector investment, poor IP management and ecosystem fragmentation were systemic. It did not offer sufficient granular insights at an individual university innovation hub level to guide action. United Nations Economic Commission for Africa (2025) provides an indication of the scale of the disconnect between industry and universities but does not articulate the specific barriers within universities or hubs themselves.

2.12.2 Empirical Studies on Stakeholder Engagement in Innovation Commercialisation

Commercialisation Makumbe and Washaya (2022) have documented significant positive correlations between organisational culture and innovation in a developing-country university; but without external actors as they did not address the linkages of the firm to its environment. The study by Fischer et al. (2021) emphasised the importance of internally driven capacities and ecosystem embeddedness as key for frugal innovation, but their case study was situated outside the country, for example in Zimbabwe the literature is scarce in this research area regarding what the expectations of both industry and investment partners are which is the gap this research is aiming to address. In their study Fischer et al. (2021) used the methodology of a case study approach that included data collection via 14 key informant interviews that provided rich detail into how an entrepreneurial university in an emerging economy has fostered frugal innovations via strategic knowledge transfer, they revealed that internal capabilities, surrounding innovation ecosystem, and the institutional framework are the core

dimensions that have played a role in the development and commercialisation of innovations; which are in lines with our chosen theoretical framework, but the empirical context is not that of Zimbabwe and they focused solely on frugal innovation which as aforementioned doesn't account for all aspects of commercialisation that occur at a University Hub.

Empirical studies on industry and investor engagement with the innovation hubs at university level are virtually non-existent.

In this research proposal under the background the commercialisation success and funding that has been mobilised by BUSE's Innovation Hub for Market Entry UGX 2.7 billion and the fact that there are 40 innovative projects identified that can be brought to the market (Institutional reports, BUSE 2023a) are not derived from a systematic empirical enquiry of innovation hubs in Zimbabwe. Moreover, a practitioner-based explanation on the entrepreneurial ecosystem in Zimbabwe by The National Venture Capital Company of Zimbabwe (2025) noted that it had been and is, somewhat "fragmented" and innovators are 'building in isolation', but again this information cannot be viewed as a scholarly or systematic observation. Hence, no evidence or study exists which identifies what the industry partners and investors' expectations, needs, and potential contribution are with regards to university hubs and this becomes the second research question addressed in this proposal.

2.12.3 Empirical Studies on Commercialisation Models and Frameworks

To measure the impact and performance of innovation in higher education institutions (HEIs) across Europe Vidicki et al. (2023) advocated the need for a multi-perspective performance measurement framework rather than reliance on patent counts.

An innovation evaluation method of Chinese universities for its innovation education was presented by Lv et al.

(2022). Within Zimbabwe Garwe (2021) researched on the effectiveness of the national quality assurance framework for research and its impacts on the national research system and concluded that there had been significant advancements although deficits exist in postgraduate research training and the structures thereof. However, there were no empirically developed and contextualised working models tailored for a Zimbabwean University under Education 5.0 in this research.

Lv et al. (2022) came up with an evaluation method of innovation and entrepreneurship education quality in Chinese technical universities which he applied at Changzhou Institute of

Technology. They included performance measurement metrics that span the entire process of innovation and entrepreneurship education, including the number of patents applied/authorised, publications; competition awards obtained by the student and funding that was acquired. They also included organisational arrangements, organisational structures and levels of student satisfaction.

Despite that the study provides useful performance measurement perspectives but focused more on educational process and inputs rather than output commercialisation at university innovation hub, thereby is less applicable to our case.

Based on Garwe (2021) national quality assurance for research and innovation, the study identified various limitations using a combination of documentary analysis and in-depth interviews, the subsequent review by international peer researchers identified strengths but also the existence of serious limitations in PhD training and facilities that required improvement. However, the findings noted the urgent need to shift towards a performance-based research funding arrangement similar to the one practiced by the United Kingdom's Research Excellence Framework. Garwe's (2021) research provides valuable insights into the Zimbabwe's HE policy context, although its focus was on assessing the national quality assurance system and not a hub specific commercialisation model. This creates a void that requires study at the university innovation hub level by using contextually relevant variables and an integrated working model grounded in the university experience.

2.12.4 Synthesis and Identification of the Empirical Gap

Overall, the empirical evidence reviewed indicates that poor funding, lack of collaboration with industry, limited expertise and capacity, as well as organisational culture challenges exist as constraints to university innovation commercialisation.

Most importantly, this literature further implies that the involvement of external stakeholders such as the industry and investors is a vital aspect of innovation commercialisation in African universities. Nevertheless, despite the existence of research evidence on how innovation occurs, there is evidence on frameworks which were not developed based on an empirically situated case like ours and do not fully capture the unique context of the Zimbabwean innovation space and the influence of the Education 5.0 agenda. Thus, four important gaps were identified; The lack of a single-case, mixed-methods empirical research in African HE that addresses the views of multiple stakeholder groups (hub managers, student innovators, supervisors, and external partners) on the commercialisation barriers and enablers; The under-

researched and unaddressed issue of what exactly the expectation and contribution of both industry and investors can be in a Zimbabwean university innovation Hub; commercialisation models have mostly been adapted from resource rich contexts with no empirically-informed working models relevant for the Zimbabwe HE context given limited resources and policy directions; and finally the synergistic influence of our three identified key dimensions, which pre-commercialisation support, commercialisation enablers and stakeholders' involvement on the overall successful commercialisation of innovation from the University Hub, have not been empirically explored within one study at the Zimbabwe Higher Education level.

The current study endeavours to fill exactly these gaps. By undertaking a mixed-methods, single-case study of the BUSE Innovation Hub which involves all key stakeholders in collecting data from across all groups it will yield a working model specific for context.

2.13 Empirical Evidence from Existing Models

2.13.1 International Exemplars

International models like those at Massachusetts Institute of Technology (2020). Andorra: Gallardo meets with Spain's Minister of Industry, Trade and Tourism Reyes Maroto to discuss industry and trade collaboration agreements. MENA Report, and Stanford University show how mature and structured commercialisation ecosystems are capable of generating billions in economic activity through structured technology transfer (Etzkowitz & Leydesdorff, 2000). International exemplars boast high IP protection, mature VC ecosystems, institutional cultures supporting faculty entrepreneurship, and significant endowments, however, their environments differ markedly from the Zimbabwean landscape limiting direct transfer.

2.13.2 African University-Based Models

Makerere University Innovation Hub (Uganda) is one of Africa's most mature university-based commercialisation models (Ng'ang'a, 2016; Kruss et al., 2015). Bolstered by international funding support, the hub has implemented a robust system for intellectual property, international partnerships and venture development, the key features of which include a stringent vetting process of projects for commercial merit before investment; formal registration and management of IP; collaborative university links (e.g. UK counterparts providing technical support); structured venture incubators; international networks to assist market entry (Science Granting Councils Initiative, 2025); C4DLab has short-listed 40

innovative projects for commercialization and assigned some UGX2.7 billion (approx.. \$730,000) for their market entry (UPPC, 2025).

Afe Babalola University (Nigeria), a privately funded institution has integrated disparate, earlier innovation programmes into a consolidated framework focusing on commercial viability (Agboola & Oni, 2015). Key elements of the model are the holistic integration of innovation activities across all university departments instead of compartmentalizing them within a single unit; a firm emphasis on commercial viability in the design/conceptualisation phase; formal links with venture capital firms providing funding and expertise; and high engagement with alumni entrepreneurs providing mentorship and investment. The Afe Babalola model represents a successful approach to building commercialization expectations into the fabric of academic provision rather than treating it as a separate or niche function.

The University of Nairobi C4DLab (Kenya) is a venture that follows a model emphasizing technology and entrepreneurial solutions (Ndemo & Weiss, 2017). As a university/international technology company collaboration, it supports innovators with mentorship, training and linkages to venture capitalists. Key components of the model include: emphasis on digital technology-based solutions; partnerships with major international technology companies providing advice and access to market channels; promotion of idea development through pitch events, competitions and demo days; and cultivation of an entrepreneurial mindset within the university student population.

2.13.3 Zimbabwean Initiatives

The National Innovation Coordination Framework is developing under the Education 5.0 initiative that provides the policy rationale within which university-based hubs will operate (Ministry of Higher and Tertiary Education, 2021). The framework outlines: creation of 14 innovation hubs and industrial parks in tertiary institutions across the country; the Education 5.0 policy, which makes the commercialization imperative of university-based innovation; and government mandates on the commercialisation of inventions and prototypes (ZBC News, 2026).

The National Venture Capital Company of Zimbabwe, under a government mandate to address the funding deficit, is establishing formal partnerships with universities to create value chains from research through incubation, venture funding to market (Zimbabwe Independent, 2025). As it is relatively new, its model is still under development but involves working with

the Confederation of Zimbabwe Industries to provide mechanisms from research, through incubation and venture financing to market access.

2.14 Leadership and Governance of University Innovation Hubs

Innovation Hubs To ensure transition from prototype to market the leadership of university innovation hubs needs to be characterized by: vision; boundary-spanning behaviors; entrepreneurial mind-set; and enabling leadership behaviors (Guerrero & Urbano, 2012). The structure of the governance mechanism needs to balance autonomy and accountability, possibly using an external advisory board including members from industry and the investment community. The performance measurement framework should go beyond metrics simply measuring numbers of startups, to a more rounded balanced score card including financial, customer, process, and learning and growth indicators.

2.15 Feedback Loops and Continuous Improvement

Improvement The process of learning within dynamic organizations such as university innovation hubs must take the form of organizational learning which can be established through: the incorporation of Feedback; Outcome measurement; Stakeholder input; and Learning from failure which occurs on single and double loop levels (Argyris & Schn, 1978). A cyclical 'Plan-Do-Check-Act' approach would therefore form the bedrock for continuous learning.

2.16 Gaps in the Literature

2.16.1 Empirical Gaps

Limited African Context Research: While North American and European university technology transfer has been widely investigated, there's far less empirical research into commercialisation processes within African university contexts (Kruss et al., 2015). As a result, the Capacity4dev (2025) review states that "more in-country research should be pursued in order to better understand the mechanisms, policy processes, and the contexts influencing the transmission of results from African Higher Education Institutions to markets". A Scopus search for "Zimbabwe AND innovation commercialization" found fewer than 10 results, none relating to university innovation hubs.

Scarcity of Zimbabwean Studies: Our literature review revealed a lack of academic studies concerning the innovation and commercialization in Zimbabwean universities. Bajilla and

Saine (2025) explain that the structural, resource constraints, and fragmented governance challenges to implement Educations 5.0 are still to be addressed but this system approach study uses secondary data and there is very little in-depth primary research on how universities in Zimbabwe were implementing Education 5.0 policy and what barriers they had encountered to support implementation efforts.

Single-Stakeholder Focus: The majority of existing studies are based on single stakeholder perspectives, usually university administrators or professors (Siegel et al., 2003). Only a few studies have used multi-stakeholder designs in which the perceptions of hub managers, student innovators, their academic mentors/supervisors, industry actors, and investors were all explored. The discrepancy in perceptions can serve as a key hurdle to a synchronized implementation of innovation, as Proposition 3 suggests.

2.16.2 Contextual Gaps

Technology Death Valley in African Settings: The “technology Death Valley” is a globally recognized problem (Nwaka, 2021); however, research on how this problem manifested in African universities is very limited. TechCabal (2025) highlighted that fewer than 12% of AI start-up failures were due to market failure, however, African universities did not seem to explore how innovation hubs could assist them to mitigate the issue.

Education 5.0 Implementation: One of the key policy intervention for this study is Education 5.0, however little is known on how institutions implement Education 5.0 policy. To date, no peer-reviewed empirical study has investigated how universities have implement and managed the Education 5.0 at the institutional level since its implementation. Bajilla and Saine (2025) identify a “disconnection between the policy’s ambitious goals and the existing implementation system” and this provides further rationale for more empirical work.

2.16.3 Methodological Gaps

Descriptive vs. Prescriptive Research: The majority of research into university innovation hubs has been descriptive rather than prescriptive, focusing on what has been done in certain contexts rather than prescribing what should be done to improve the processes (Mian et al., 2016). This tendency means that hub managers and researchers will have to develop guidance as existing studies do not inform hub management on how best practices can improve outcomes.

Static vs. Dynamic Analyses: As explained above, existing research on university innovation hubs has mostly been descriptive rather than prescriptive (Mian et al., 2016). As a result, there are no models available that provide a framework that hubs can use as a guide for process improvement.

2.16.4 The Need for a Working Model

Although, the theoretical approaches discussed in this chapter provides valuable analytical leverage, each of these approaches suffers from shortcomings in adequately addressing the complex, multi- dimensional phenomenon of innovation commercialization within the university context in a developing country setting. The Triple Helix model elucidates required interactions between university, government, and industry but falls short in offering guidance for establishing these interactions in environments where institution capacity is often limited. The innovation systems approach emphasizes systemic conditions but does not provide practical recommendations for organisational interventions.

Technology transfer theory offers insight into mechanism but assumes the existence of a developed technology transfer office and a mature IP legal framework, elements that might not be available in many developing country contexts.

The Resource Based View and Dynamic capabilities framework highlight necessary resources and capacities but do not take into account of external institutional and political context which the hub must navigate to promote commercialization outcomes.

There is need for a comprehensive working model to manage the institutional, organisational and individual aspects of the commercialization process at the BUSE Innovation Hub. The working model must synthesise and adopt some strengths of the various theories, whilst ensuring that these are linked to the operational issues (i.e. Pre-commercialization support, commercialization enablers and stakeholder engagement) as espoused in the conceptual framework (Figure 2.8), as well as providing desired outcomes (market ready products/ services and sustainable commercialized ventures) that are driven by a robust feedback mechanism to ensures continuous learning. The model should take cognizance of the Heritage Based Education 5.0 policy context, and the specific characteristic of Zimbabwean innovation ecosystem such as financial constraints, weak industry linkages and immature intellectual property management regime.

A more adaptable and realistic working model can empower hub management, university authorities and policymakers to understand the barriers and driving factors of innovation commercialisation and to facilitate an informed decision making that will tailor interventions to the peculiar needs and conditions at BUSE. The working model is set not to be solely academic, but also a guiding framework to take BUSE Innovation hub from being a prototyping facility towards being an enabler for commercialization and an engine for sustainable economic development.

2.17 Chapter Summary

This chapter introduced the theoretical underpinnings and explored prior research on innovation commercialisation as part of the foundation building for research at the BUSE Innovation Hub. A synthesis of six theoretical frameworks (Triple Helix Theory, Innovation Systems Theory, Technology Transfer Theory, Entrepreneurial Ecosystems Theory, Resource-Based View and Dynamic Capabilities framework, and the Quadruple Helix extension) created an integrated theoretical frame. A hierarchical conceptual framework encompassing the institutional context, three critical dimensions of innovation commercialization (pre-commercialisation support, commercialization enablers and stakeholders' engagement), two core outputs (market-ready product and sustainable commercialised venture), and iterative feedback mechanisms, was proposed.

Our exploration has shown that universities globally are rapidly transforming from ivory towers to entrepreneurial hubs. Zimbabwe's Education 5.0 policy signals a unique version of this shift. Innovation hubs play vital mediating roles, though the study recognized persistent barriers across the micro-, meso-, and macro-level contexts including the complexity and misalignment of various stakeholders perspectives. The innovative hub literature identified several design principles from exemplar case studies (i.e. Makerere University Innovation Centre, Afe Babalola University, and University of Nairobi) as including context sensitivity, integration within the systemic context, stakeholders' consensus, institutional support professional capacity building, stable financing sources, continual progress, and alignment with university strategy. Gaps such as lack of studies in the African context, specifically Zimbabwe; over-focus on single-stakeholder perspective; minimal coverage on the implementation of the technology Death Valley and Education 5.0, and predominance of descriptive research on university innovation hubs informed the focus of this thesis. The conceptual framework and design principles developed in this chapter will be the foundation

for the empirical investigation in the following chapters and they are expected to be used in the development of a working model for the BUSE Innovation Hub.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter details the research methodology followed in conducting a study on the commercialisation of innovation at the BUSE Innovation Hub to develop a relevant working model within the context of Zimbabwean Heritage-Based Education 5.0. The chapter details the philosophy underpinning the research, approach taken, design applied, methods employed to collect data, sampling process, procedures undertaken to ensure data reliability and validity, presentation of data and methodology applied for data analysis, as well as issues of research ethics. The chapter also justifies the choices made regarding methodology and rationale of their suitability. In the conclusion the approach taken is summarised.

3.2 Research Philosophy

A research philosophy is a set of beliefs that shapes our understanding of what knowledge is and how it can be produced; and thus shapes our methodology and designs (Collis & Hussey, 2014). It also plays a significant role in identifying the research questions and how the design and data collection methods, including data analysis and interpretations are conducted (Saunders et al., 2019). Generally, four research philosophies include positivism (where truth can be discovered through objective and factual methods), interpretivism (concerned with understanding complex human behavior and motivations from the ‘actor’s point of view’; reality is subjectively constructed through interaction), realism (recognises that there is a real world independent of the observers, although our knowledge of it is flawed), and pragmatism (based on whatever method works best to answer a question).

This research is aligned to a pragmatic research philosophy. Through this study, the philosophy of pragmatism is relevant in that it encourages blending positivist and interpretivist epistemologies to a more pragmatic solution (Collis & Hussey, 2014). Since the aim is to develop a practical working model, there is need to blend qualitative, quantitative and also abduction and deduction to best serve the purpose of the study. Pragmatism is suitable for the following reasons: firstly, the study is interested in a practical working solution rather than an explanation or theory about the process of commercialisation. Pragmatism’s emphasis on practical solutions means that it fits well with a prescriptive goal.

Secondly, this research has to account for different stakeholders, including students, university management, industry, investors and government, whose interpretations of success and challenges surrounding commercialisation varies. The researcher needs to navigate this multiplicity of perspectives without necessarily embracing one 'truth'. Thirdly, given the exploratory nature and breadth of the research questions, both deep insights into the experience of stakeholders and analysis of cross-case patterns is needed, which a pragmatic approach allows to accommodate and combine qualitative richness with quantitative breadth. The research is thus pragmatic in its orientation.

3.3 Research Approach

This refers to how theory is related to data in your study (Saunders et al., 2019). This element in the research onion describes the way the other layers are linked together, that is the connection between design strategy and method. It helps us think logically about each layer within the design structure and how it helps you respond to your research question. Following the pragmatic stance we also adopt an abductive approach to theory development in a mixed methods study as laid out by Saunders et al., (2019). Abduction starts from observing a phenomenon (a puzzle about the innovation commercialisation process at BUSE Innovation Hub) and developing possible theories to explain the observation (Saunders et al., 2019).

It is unusual because it does not fit well with traditional induction (where one starts with an observed phenomenon and works towards a theory) or deduction (where one starts with a theory and works towards testing hypotheses with observable data) since it involves moving backward and forward between these two extremes. The use of the abductive approach is ideal in this study in the pragmatic tradition. This pragmatic tradition suggests that if there are multiple approaches or philosophies that can lead to the study's outcome, you should use them; the primary criterion for selecting the research strategy is utility-based (Collis & Hussey, 2014).

This argument underpins the use of mixed methods approach in our study as well. In the methodology choice layer of the research onion we choose mixed method research design, which is based on a combination of quantitative and qualitative approaches (Saunders et al., 2019). Mixed method design brings together various approaches of research; that is quantitative methods that collect data using survey questionnaires and qualitative methods, such as semi-structured interviews and document analysis and observation in this research, to help achieve this study's objectives (MacIntosh & O'Gorman, 2015).

Qualitative methods would bring depth to understand the underlying meaning behind students' experiences and attitudes toward innovation commercialisation and would allow observation of the process, while quantitative methods will ensure that the data obtained can be statistically generalised across the wider hub community to assess the prevalence of certain opinions and experiences, hence helping to establish reliable data to inform the working model (Bryman & Bell, 2015).

The different methods are thus integrated together with the aim of ensuring that the resulting model would be not just conceptually sound, but empirically validated and well rounded. As depicted by the research onion structure, the approach of the study involves pragmatic philosophy, followed by the process of abduction in developing theory and finally the methodological choices (using both qualitative and quantitative data collected through interviews, documents and observation as well as questionnaires) that provide flexibility in approach and guide the analysis process toward the achievement of the research objectives within BUSE. Thus, the research approach involves both abduction and mixed methods in order to produce a rich, valid, empirically supported and practical working model on the commercialisation of innovation in the BUSE Innovation Hub.

3.4 Research Design

Saunders et al. (2009) define research design as the method to be employed by the researcher to answer the research questions. Research design may also be referred as the methodology and framework in research that the investigator has chosen for study and therefore the method of study or mode of procedure employed when undertaking his research (Kumar, 2014). Bryman and Bell (2015) defined a research design as the overall plan for the investigation, indicating the structure that combines the diverse components of the study so as to facilitate the successful examination of the research question. According to Babbie and Mouton (2012), research design is concerned with how to design the researcher's proposed approach.

Research design facilitates communication to the others on the planned steps on conducting the study, data collection, selection of samples and above all, the outcome analysis (Babbie & Mouton, 2012). There are two key functions of research design; the establishment of an operational plan that directs how various tasks and steps should be implemented and that the prescribed procedures will provide adequate results, to achieve unclouded and precise answers (Kumar, 2014). In conducting this study, I opted for a case study research design. A case study approach is an in-depth exploration of a case that is complex, real-life and bound by context

and its setting (Yin, 2018). As a methodological approach to the study of complex phenomena, this type involves intensive, comprehensive and systematic examination of one or few case(s) so as to understand various variables that operate in that particular system (Stake, 2005). Case study approach in this research provides opportunity for exploration of institutional, policy and economic factors that drive the innovation commercialization process at the BUSE Innovation Hub and hence gain a deep contextual understanding, vital for providing possible tailored solutions. Second, the use of this research approach gives the chance to examine in details various aspects relating to the challenges, barriers, and opportunities of innovation commercialisation at BUSE and consequently aid in establishing a comprehensive working model, thus achieving the study's objective. Third, due to the dearth of previous literature about commercialization process at Zimbabwean Higher Education Institutions as shown in Chapter 2 of this study, an exploration of new and relevant variables would need such an approach, hence, the exploratory approach of a case study is suitable. Additionally, a case study allows close collaboration with key stakeholders at BUSE and this is imperative for problem definition, trust building and co-creation of solutions (Yin, 2018). Furthermore, a case study of BUSE's Innovation Hub can enrich the body of knowledge on university innovation commercialization, with particular relevance to the developing context of Zimbabwe. Finally, given the need for practical working solutions, the data generated will allow the development of a practical working model for innovation commercialization. In the endeavor to develop an ideal new working model for innovation commercialisation at BUSE Innovation Hub, my study is prone to investigate new research dimensions that call for the adoption of explanatory research design.

Explanatory research designs are best utilized for complex research areas with limited research information available as they seek to discover possible underlying reasons for existence of the event/ phenomenon. They also try to understand the relationships among variables as well as attempt to establish how specific factors explain those specific variations found within given information. According to Sekaran and Bougie (2016), "explanatory research design is a study conducted to find out the cause and effects relationship between variables by testing relationships between various constructs and looking for existing patterns in previous researches." The context of this research can effectively be illuminated by an explanatory design as it helps answer the 'why' questions regarding barriers to innovation commercialization and effective governance strategies at the hub.

3.5 Data Gathering Tools

The researcher embraced a pragmatic philosophy and an abductive research strategy, the choice of data gathering tools was inspired by these paradigms. The pragmatist perspective values practical solutions that are fit for the research question, and the abductive logic entails the researcher constantly shuttling between evidence and theory. Based on this pragmatic philosophy and abductive reasoning, several data collecting tools have been utilised. Four data sources have been employed to gather both primary and secondary data; face-to-face semi-structured interviews, structured questionnaires, document analysis and direct observation, this approach to data collection helps achieve triangulation of data.

The face-to-face semi-structured interviews will be the key source of primary data, providing the researcher with the opportunity to probe deeply into the attitudes and views of the key stakeholders on aspects of innovation commercialisation, barrier to the commercialization and the ways of doing so within the BUSE Innovation Hub. The structured questionnaires will represent the quantitative arm of this study. The sample of stakeholders that will participate will be broader, thus making the study's quantitative data reflect the entire Hub's environment on matters regarding stakeholder perspectives on issues concerning the commercialisation process. The closed items in the questionnaires will capture the measurable, factual data relating to aspects such as the level of understanding of the commercialization process and the perceived importance of key variables among others.

In addition, a documentary study including analysis of previous studies on innovation commercialisation will be performed. This approach is suitable because of its ability to generate additional in-depth relevant data as well as supplementary evidence to interviews, and questionnaires so as to complement the empirical data obtained from the surveys and interviews. Finally, observations of day-to-day activities will also be employed so as to gather relevant informal information on innovation commercialization processes. The systematic collection of these distinct types of information will allow for robust triangulation, and enhance the generalizability and validity of the proposed working model for the BUSE Innovation Hub.

3.5.1 Interviews

Face-to-face interviewing is one of the most widely used qualitative data collection methods, wherein there is direct verbal exchange between interviewer and respondent. The method is often used when the researchers want to explore in detail, the opinions, experiences and behavior of people and this technique lends itself very well to the study of innovative product commercialisation. A widely held view amongst authors writing on qualitative data methods, states that, face to face interviewing allows us to obtain rich, nuanced data that goes deep into the perspectives of stakeholders regarding innovation commercialisation challenges and strategies.

Interviewers may ask follow-up questions which help elicit finer distinctions, probe ambiguities, and encourage the participants to speak freely, building understanding along the process. For the purposes of this study, semi-structured interviews will be held with all the identified key stakeholders i.e. The hub management, student innovators, academic supervisors, industrial partners and government agencies representatives to collect primary data on their perceptions towards innovation commercialization within the hub, what can improve on innovation commercialisation and why, challenges that they face with respect to commercialization of innovations as well as expectations with regard to commercialisation strategies of innovation (per stakeholder group). All interviews will take approximately 45-60 minutes of time and will be audio recorded with the informant's permission.

3.5.2 Questionnaire

Questionnaire refers to a logical organized form, which contain all the data collection methods and present all participant with a predetermined list of question arranged in order and plan manner. A questionnaire consists of a series of structured question which they are to be given written responses and then be returned to the investigator. Researcher could gather amount of information easily through questionnaires at the lower costs from many individuals with much easier task. Through distribution of questionnaires the researchers are capable of collect quantitative information from many individuals efficiently and inexpensive as compare to interview and observation. For the sake of this research the researcher creates questionnaires based on concept frame work which developed in chapter two section two three. The questionnaire will be based on the concept and consist of demographic data, perceived barriers to commercialisation, rating on pre commercialisation support, commercialisation enablers, stakeholder support, and institutions and environmental variables that contribute to the

commercialisation process and final outcome. Questionnaire would be coded by the researcher using five-point scales. Using 1=strongly disagree to 5=strongly agree. When a person is asked a question regarding his feeling, it is imperative to use likert type scaled data collection approach so to make efficient response to a set of statement with range from strongly agree to strongly disagree. The use of this questionnaire is convenient for the researcher for few reasons like saving time, ease of data comparative process, ease of administration requires less skill, allow respondent to take sufficient time before responding, while the study questionnaire could obtain sufficient accurate data.

3.5.3 Questionnaire Design

The response by respondent(s) should be marked. A physical handing of the questionnaire by researchers were implemented to maximize response rate. There will be a pilot study conducted to about ten respondents in order to assure validity and reliability and determine the time taken for respondents to complete the Questionnaire. Besides, Questionnaire will be subjected to reliability test through using Cronbach's alpha test result showing the alpha coefficient of 0.70 confirming validity of questionnaire. The questionnaire was design with various segments, based on the concept framework; these segments cover demographic information, pre commercialisation support, commercialisation enablers, stakeholder support, institutional and environmental factor and commercialisation output. Both open-ended and closed-ended questions will be included in the survey; open-ended questions for elicit rich detailed information to participants whereas the close ended questions are aimed for simplified the information collected from participants to respond effectively.

3.5.4 Document Analysis

In relation to the study on the commercialisation of innovation, document analysis is paramount. Document analysis involves the systematic investigation, collection and examination of written, recorded and visual data that form a foundation for understanding of a phenomenon. In the study of the university's technology transfer processes and innovation hub performance, a variety of scholarly authors document analytical methods.

For the purposes of this study the various documents that would be examined include: BUSE Innovation Hub initial proposal, the BUSTECH strategic and annually planning reports, Education 5.0 policy guidelines and implementation document, National Development Strategy One (NDS1) and National Development Strategy Two (NDS2) key sections relating to innovation, National Venture Capital Company of Zimbabwe funding guidelines,

BUSTECH IP policies (where available), innovation hub reports on performance monitoring, records from BUSE Innovation Hub advisory board/management committee minutes (where available) and any media coverage about BUSTECH innovations.

3.5.5 Observation

In the study of commercialisation of innovations at BUSE Tech, direct observations of the operations of the hub will provide supplementary evidence on how commercialisation practices occur, as compared to information gathered retrospectively via interviews. Observation is a systematic method to gather direct evidence on behavior and activities as they actually unfold. The following will be observed: hub facilities (physical location, accessible equipment, how innovators make use of such facilities) and routine activities; mentor sessions, training workshops, or pitch events (with participation and organizer consent); and stakeholder meetings (with participant consent). Observations will record in field notes using a structured protocol that describes the setting, activity sequence, roles of participants, interesting moments or events, and researcher observations. This detailed record of events would then be written up within a maximum of 24 hours to enable in-depth analysis.

Direct observation of hub actions by researcher will give an idea of the process of commercialization in actual happenings instead of retrospect description provided during interview for analysis (Spradley,2016). There will be an observational period of observation by researcher which includes BUSE innovation hub facility and working processes and how innovation hub function in relation to stakeholder interaction and processes (physical layout, equipment access, innovators activity); mentor session;pitch;meeting with investors (with researcher consent for observation); stakeholders' meetings (with participant s' consent), all by a direct, systematic process. Recorded activities will have been in line with a structure that will capture details of setting description, actions, and researchers' thoughts. Fieldnotes shall be written up within 24 hours after each session.

3.5.6 Pilot Testing

To ascertain the clarity, validity and feasibility of the data collection instruments (as outlined in 3.2, 3.3 & 3.4 respectively) pilot tests shall be undertaken prior to the primary data collection. A pilot test, with representatives from two innovation hub members, one academic supervisor and one external stakeholder will be undertaken. The semi-structured interview guide shall be tested for readability, comprehensibility, logical flow and appropriate timing, and any resulting feedback will influence question amendments and ordering.

The structured questionnaire will be completed by pilot participants and analysed for ambiguity or redundancy and for completion duration, Cronbach's alpha will be utilised for any scaled items to determine internal consistency, whilst the observation tool will be used in a single innovation hub meeting session to test for operability. Pilot test findings shall be incorporated into the finalised versions of the survey instruments, improving their validity and reliability (van Teijlingen & Hundley, 2001; Creswell & Creswell, 2018).

3.6 Sampling Techniques

Sampling methods are largely categorised into probability and non-probability methods (Kothari, 2005) and both will be employed as part of this study due to the sequential explanatory mixed-methods approach.

For the quantitative data strand probability sampling will be used which will support the analysis and increase the credibility of overall stakeholder trends revealed through the survey methodology. Specifically, stratified random sampling will be applied where, for the purposes of ensuring each stakeholder cohort has fair representation in the sample size, the population has been segmented into the four predetermined strata (innovation hub management & staff; students & former students; academic staff and; external stakeholders) and random selection of respondents occurs from each cohort, in proportion to stratum size in the population. However, a census approach will be adopted for the innovation hub management sample stratum due to its relatively small size.

For the qualitative data strand non-probability purposive sampling techniques will be utilized. This is the preferred methodology when an organisation aims to explore a diverse group of people with particular attributes and insights into a specific phenomenon ((Etikan, Musa, et al., 2016), to gain meaningful insights into contextually specific results, rather than focusing on statistically representativeness. The purposive approach to innovation commercialization sampling will identify individuals whose experiences are critical for generating information that satisfies the research objectives by addressing the commercialization cycle, and encompassing a variety of institutional and individual contributions. Purposive selection is appropriate for this study which will target participants that have been identified as directly involved in the operations and success of the BUSE Innovation Hub to assist in elucidating innovation commercialization barriers, enablers and stakeholder involvement.

The qualitative sample was constructed according to the following inclusion criteria:

- **Hub management and staff:** employed within the BUSE Innovation Hub with operational or strategic responsibilities for at least six months.
- **Student innovators and alumni:** currently enrolled or graduated students who had developed or were actively developing an innovation with commercial potential through the Hub.
- **Academic supervisors:** faculty members who had supervised student innovators within the Hub or were themselves engaged in commercialization-related research.
- **External stakeholders:** representatives of industry partners, investors, or government agencies who had direct engagement with the BUSE Innovation Hub.

This purposeful design facilitated the in-depth interrogation of specific processes, relationships and contextual issues identified within the conceptual framework, specifically within the Triple Helix of interactions (Etzkowitz & Leydesdorff, 2000). Integrating stratified random sampling for width and generalizability with purposefully selected participants for depth and contextual depth resulted in an overall sampling methodology appropriate for developing a contextually sensitive working model.

3.6.1 Sample Size Determination

A sample is a fraction or group that is used to illustrate a general pattern (Pemecky, 2016) or to represent an entire population in a study (Etikan et al., 2017). For this dissertation that sought to explore a commercialization working model for Bindura University of Science Education (BUSE) Innovation Hub, the target population was a list of 150 key stakeholders from in the hub environment (see Table 3.1). Due to the research being mixed-methods, this Dissertation had to employ distinct but complementary methods of determining a sample.

A sample size was calculated for the quantitative survey using G*Power software (Faul et al., 2009) in order to provide adequate statistical power. A significance level of 0.05 with a 0.95 confidence level was used. Medium effect size ($f=0.15$), consistent with those often found in multiple regressions, was selected, which generated a minimum of 92 participants; 100 were targeted to account for non-responses and incomplete responses. A census of all 20 hub managers and staff was to be undertaken whereas stratified random sampling would be applied in order to determine proportions from other strata in the total survey sample.

For the qualitative data analysis for the study, the sample size was to be determined on the basis of the principle of data saturation (Patton, 2015) that is: the researcher to collect data until no new themes or data are obtained (Neuman, 2014). According to a number of sources (e.g., Yin, 2009; Creswell and Clark, 2007), based on the research being phenomenological and case study in approach, it is reasonable to aim for a sample of about 30 people in order to establish saturation. It was estimated that the samples to be drawn from the various stakeholder categories would be as follows: 5-8 hub managers/staff, 8-12 student innovators and alumni, 5-8 supervisors, and 6-10 external stakeholders. The actual sample size was to be confirmed at the saturation point where new participants added no new data or information (Guba & Lincoln, 1989). In addition, this means a total of about 130 participants were to be targeted between survey and interviews, whereby some may have participated in both.

3.7 Data Reliability and Validity

Reliability refers to the quality of measurement method that can be relied upon; data are Reliable if they have not been unnecessarily modified and reflect the truthfulness, completeness, accuracy, trustworthiness and completeness of what they represent. (Cozby, 2011). A five point Likert scale questionnaire was used to increase the reliability of the questionnaire part of the study. Reliability of the questionnaire was assessed by the use of Cronbach's alpha (≥ 0.70).

The ability of the method used to measure exactly what is intended to measure refers to validity (Bryman & Bell, 2015). In terms of methods for data validity, this research used Content Validity (Mugenda and Mugenda, 1999), which defines what degree study objectives and questions are actually represented by the study, the validity of an item and its contents represent what the researchers intended to discover (Mugenda and Mugenda, 1999). The use of a representative sample related to the research problem addressed helps a great extent to promote valid research outcomes (Etikan, et al., 2017; Wiersma, 2005) In qualitative data analysis the issue of Trustworthiness will be demonstrated through: Credibility (extended contact, triangulation, member checking, peer examination, self-monitoring/journal reflection); Transferability (thick, rich description); Dependability (clear description of audit process); Confirmability (creflexivity, triangulation, audit trail) (Lincoln and Guba, 1985).

3.8 Data Presentation and Analysis

Analysing data involves the process of examining the information and presenting comment and explanation upon the results (Turner, 2013). Data were collected by the researcher using:

questionnaires, interview guides, document analysis protocols, and observation schedules. Data collected from questionnaires (quantitative) will be analysed using the SPSS for Windows version 21.

SPSS has proved to be the statistical software commonly used to process and analyse complex datasets generally analysed in the innovation commercialisation research area (Smith et al., 2022).

Among the best aspects about the SPSS version 21 is the ability of the SPSS software to run complex operations such as, correlation analysis, descriptive statistics and factorial analysis which are the critical processes of determining the critical underlying drivers and relationships governing behaviours and outcomes of innovation commercialisation. It has simple interfaces making complex analyses and visualisation an easy task. The qualitative data were collected from interview scripts, unstructured open-ended responses on questionnaires, documents and notes from observations; they will be analysed using thematic analysis. Braun and Clarke's (2006, 2021) six phases will be adopted namely familiarisation with data; generating initial codes; searching for themes; reviewing themes; defining and naming themes and writing the report. Data will be managed in terms of their coding and thematic analysis by using NVivo qualitative data analysis software.

At analysis, two levels of investigation will be carried out: that within the specific groups of stakeholders (identifying themes specific to each group) and across groups of stakeholders (comparing and contrasting common themes identified within and between different stakeholder groups). The cross groups comparison has direct link to the third proposition, regarding different stakeholder perspectives as a hindrance to collective action. In relation to Chapter 2 (Section 2.3), the conceptual framework will guide the research through "sensitising" the researcher and direct attention to, for instance, relevant events or behaviors in data without establishing tight codings. The final working model derived at the end of analysis phase will be composed of synthesis of the existing models and that of conceptual framework with empirical and design principles

3.9 Ethical Considerations

Ethical considerations are the guiding principles guiding the study's operation based on norms, attitudes, and expectations in society (Burns & Grove, 2018). According to research ethics guideline, the questions designed the questionnaire were not infringing on personal privacy and they had minimal negative implications on the respondents.

BUEC will seek Approval. **Institutional permission** will be sort from BUSE Innovation Hub management. The approval will be documented before data collection begins.

All participants will be given **Informed consent**. Each participant will be given a participant information form detailing the purpose of the research, its procedures, any risks or benefits, confidentiality provisions, as well as outlining participants are able to withdraw their participation at any stage of the study up until the data collection process is completed by the latest 14days after your participation in the data collection, if applicable, for a minimum period until date analysis commences (and no penalty will apply, as per MDE ethical review standards),andareexpectedtodiscloseanythingtheymaybetoose,astheyareno longerdependentont he. Written informed consent forms will be sought from every participant in the study, before data collection begins.

Protection and control of participant identification and confidential and anonymous data. Each respondent will have their personal identity preserved via use of pseudonyms (e.g., Student Innovator 3, BUSE Innovation Hub Manager 2). Some organisations (e.g. BUSE Innovation Hub, National Venture Capital Company) would be referred by name because they are pertinent to case and case study approach ,but personal information will never be disclosed without permission ,no information obtained in this research will be shared with individuals or organisations not named in the study without the participant's prior expressed. All data obtained and collected during the research processes would be recorded, stored, and handled via secure data storage system to guard against unauthorized access; all collected data will be stored on password protected laptops.

Managing power differences: the researcher could come across power differences when interacting with the participants, particularly students since they may see the researcher as authoritative due to institutional belonging. This is to be avoided by clearly explaining that the researcher is Masters' student. All participants will be clearly assured that, the choice of participation, refusal, and withdrawal will neither be at the detriment of their academic standing nor impact on access of their facilities at BUSE. Researchers will try to reduce power differences and bias through the choice of meeting location, selecting neutral locations and privacy in private. Sensitivity of commercially valuable data, the researcher can meet participants from either private industry or government where by these persons might be asked to provide commercially sensible data.

All stakeholders interviewed during the research are requested to provide information that they are at their discretion to disclose. In a case where such information accidentally or deliberately provided; the researchers may be asked to delete it by the interviewee from the transcripts. The researchers shall seek permission prior to inclusion of any proprietary information. Dissemination of findings, data, and results Sharing results Researchers will disseminate the results and findings to BUSE Innovation Hub management and all relevant stakeholders in the form of a detailed report and a summary of the report as well as presentation as a form of sharing to all stakeholders for implementation on working model.

3.10 Chapter Summary

This chapter is an overview of the research Methodology that the study undertaken will followed for. This research study adopt the mixed methods approach, with particular emphasis on case study research methodology which seeks to develop an explanatory and working model to innovation commercialisation within a Heritage-Based Education 5.0 framework that are the subject of a case study approach which combines various methods for data collection such as non- participant observations, face to face semi-structured interviews, quantitative surveys (questionnaires) and document analyses. A case of the BUSE Innovation Hub in Zimbabwe will be examined. The study will employs purposive sampling technique, recruiting approximately 28- 35 stakeholders; including the Hub Management, students of innovation at BUSE, industry-based collaborators, the investors, government policy makers or agencies, and academic supervisory experts to work with in a case study with diverse perspectives on innovation commercialisation processes. In order to achieved reliability and validity in this case study research; Cronbach-alpha methodology and technique is used for questionnaires that collect quantitative data and trustworthiness measures such as triangulation is used in collected qualitative data with the usage of Lincoln & Guba methodology of trustworthiness as guided by Lincoln & Guba (1985), on reliability of study measures and credibility, transferability, confirmability. Quantitative data are analysed using statistical Package for social scientists (SPSS version 21), qualitative data are analysed using thematic analysis in cooperation with NVivo software. In addition to ethical requirements, ethical issues as discussed in this chapter namely Institutional approvals, Informed consent, Confidentiality, and anonymity, Managing power differences and Sensitivity of commercial and other types of data have been fully covered for and, will continue to govern the study as is seen above ,as well as its future endeavors and processes. This research methodology described below, should be sufficient to enable data collection of richer, trustworthy evidence to answer research questions.

The data that gathered are, when triangulated with research of literature covered in the chapter 2. Will give answer to research questions presented in Chapter One(1), and then they will culminate into a framework which would eventually develop a working model presented in Chapter 5 after the findings collected in Chapter 4 have been reported.

CHAPTER FOUR

DATA ANALYSIS, FINDINGS AND INTERPRETATION

4.0 Introduction

This chapter analyzes data collected to examine the commercialization of innovation at the Bindura University of Science Education (BUSE) Innovation Hub. The findings and their interpretation are presented. The chapter begins with an overview of the overall response rate in section 4.2, followed by demographic information of respondents in sections 4.2.1 through 4.2.5. Section 4.3 presents the data analysis, discussion of findings, and interpretation across the core dimensions of the conceptual framework: pre-commercialization support, commercialization enablers, stakeholder engagement, barriers to commercialization, and outcomes and feedback mechanisms.

4.2 Response Rate

108 out of the 130 distributed questionnaire were returned complete, giving a response rate of 83%. Out of the remaining, 22 were not completed, or they were severely incompletely. Hand-delivered the questionnaire on-site at the innovation hub of the BUSE, as well as follow-ups and liaison with hub administration might have aided in reducing the non-response. The chosen purposeful sampling methods, for example selecting student innovators, alumni innovators, faculty supervisors, hub staff, and any outsider business person who knows quite a bit with respect to innovation commercialization, might have supported in elevating the response rate of the hub respondents, the vast majority appeared excited and eager to fill out questionnaires and interview me. Most questions in the questionnaire applied the Likert Scale, ranging from 1 to 5, with a specific guideline in every section.

Table 4.1: Response Rate

Instrument	Target	Successful	Response Rate
Questionnaire	130	108	83.0%
Semi-Structured Interviews	30	30	100.0%
Overall	160	138	86.3%

Source: Primary Data (2026)

According to Table 4.1 the Questionnaire completion rate was 83% and the number of Targeted Interview completion rate was 100%. A response rate of 70% is high and provides a strong degree of representatives for the population sample (Babbie & Mouton, 2012). Response rates of 83% for the Questionnaire and 100% for the Targeted Interviews resulted in an overall response rate of 86.3%. High response rates increase the degree of representative nature for the studied population. In this study, this may be due to the nature of the sampling strategy in the purposive and stratified techniques whereby participation was not sought from unsuitable people. The response rate of 83% is quite high for this kind of survey and with direct scheduling the 100% of the Target Interviews indicate interest in professional and academic interests for participants.

4.2.1 Demographic Information of Respondents

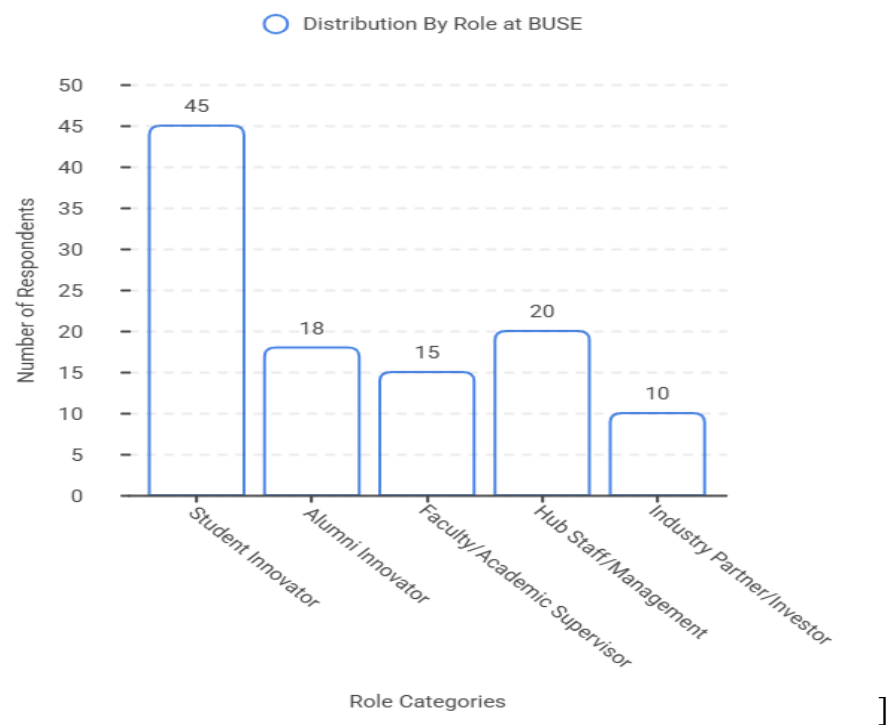
This Section captures demographic profiles of the participants that were relied upon for selection of the participants by utilizing the purposive sampling technique in the context of an explanatory case study. In particular, focus is put on their roles at BUSE, the length of their stay at the Innovation Hub and nature of innovation(s) at the hub.

4.2.2 Participants' Role at BUSE

Figure 4.1 illustrates the distribution of research participants and the roles they held in the innovation process. 108 responses to the research questionnaire were gathered. Student innovators was the largest type of participant at 41.7% (n=45). 16.7% of participants were alumni innovators (n=18). Faculty and academic supervision stakeholders represented 13.9% (n=15) of participants. 18.5% of participants were represented by the innovation hub staff and

management (n=20). 9.3% of research participants were external to the university such as industry partners and investors (n=10). Of the respondents, 90.7% were internal to the university while only 9.3% were external to the university, as was intended as a way of capturing the innovation ecosystem through the eyes of those most directly managing it while also managing to capture this hard-to-capture voice through the survey.

Figure 4.1: Distribution of Respondents by Role at BUSE



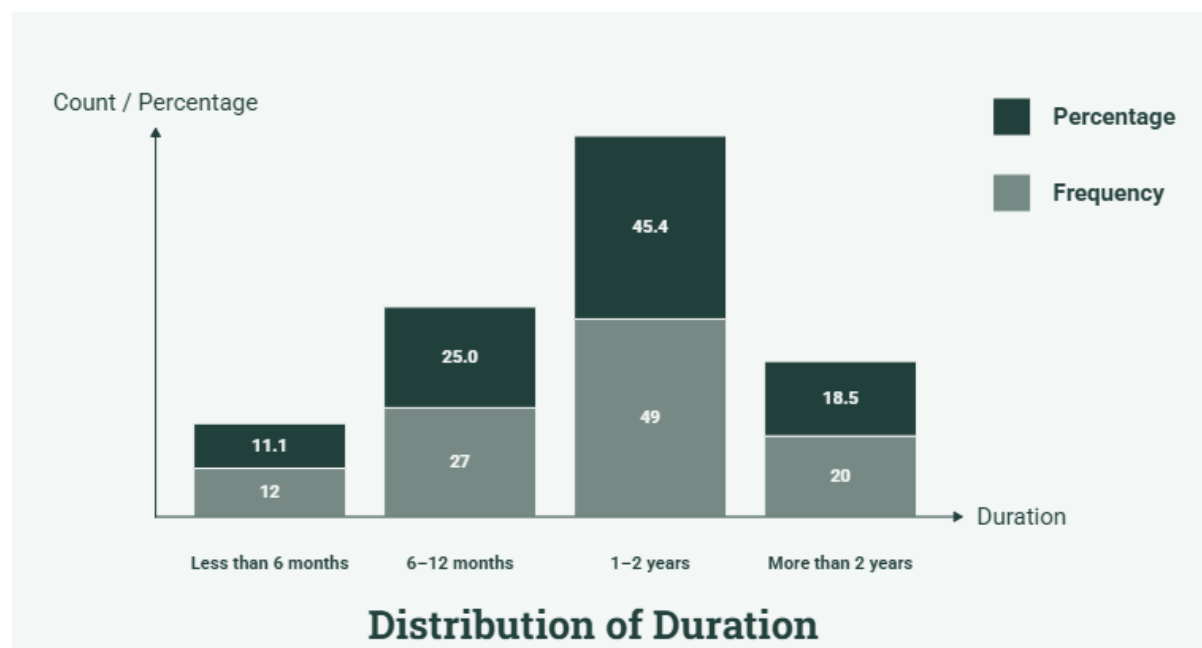
Source: Primary Data (2026)

4.2.3 Length of Involvement with BUSE Innovation Hub

Participants' association with the BUSE Innovation Hub over time is shown in Table 4.2 below. The results in this table illustrate that a significant 45.4% (n=49) of the participants had been engaged with the hub for a duration of 1-2 years. Another large proportion of the respondents, i.e., 25.0% (n=27) were with the hub for 6-12 months, followed by 18.5% (n=20) participants that have been engaging for over 2 years. 11.1% (n=12) had been engaging with the hub for less than 6 months. This indicates that the group of participants included in the research seems reasonably mature, in as far as it contains sufficient numbers of participants who are experienced enough with the commercialization processes of the hub and can offer some useful insights into the opportunities, challenges and future of the hub as regards commercialization.

Furthermore, having long term participant >2 years with the hub should bring in sufficient historic context as well as providing with fresh perspectives from newer participants <6 months with the hub and to have a broad range of participants to represent all aspects as shown in Table 4.2.

Table 4.2: Duration of Involvement with Innovation Hub

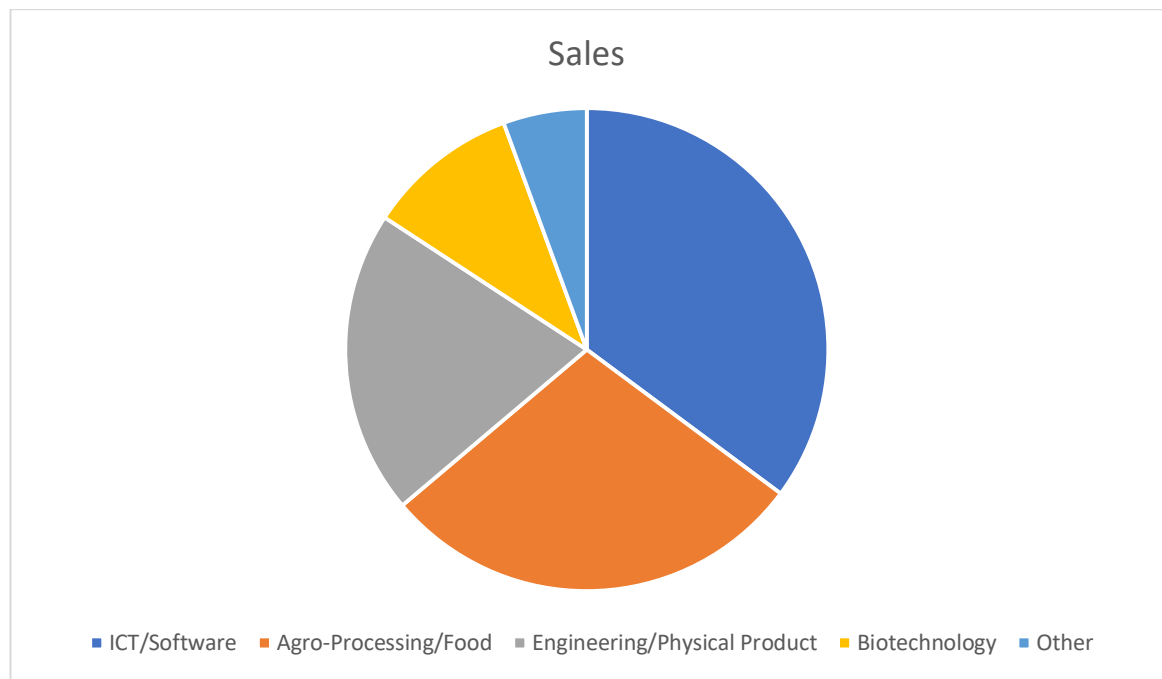


Source: Primary Data (2026)

4.2.4 Type of Innovation

Figure 4.2 shows the types of innovations developed by respondents. ICT/Software innovations were most common (35.2%, n=38), followed by agro-processing/food innovations (28.7%, n=31), engineering/physical products (20.4%, n=22), and biotechnology (10.2%, n=11) Other innovation types (e.g.,renewable energy solutions; educational technologies) constituted the least frequently cited cluster of innovations(5.6%, n=6). This shows the relevance of innovations in science and technology sectors in which BUSE is specialised, and is relevant for Zimbabwe's industrialization objectives within its Education 5.0 blueprint. The different innovation categories indicate a broadscope for the hub in cross-sectoral innovation as well as the different possible routes of innovation commercialisation.

Figure 4.2: Type of Innovation Being Developed

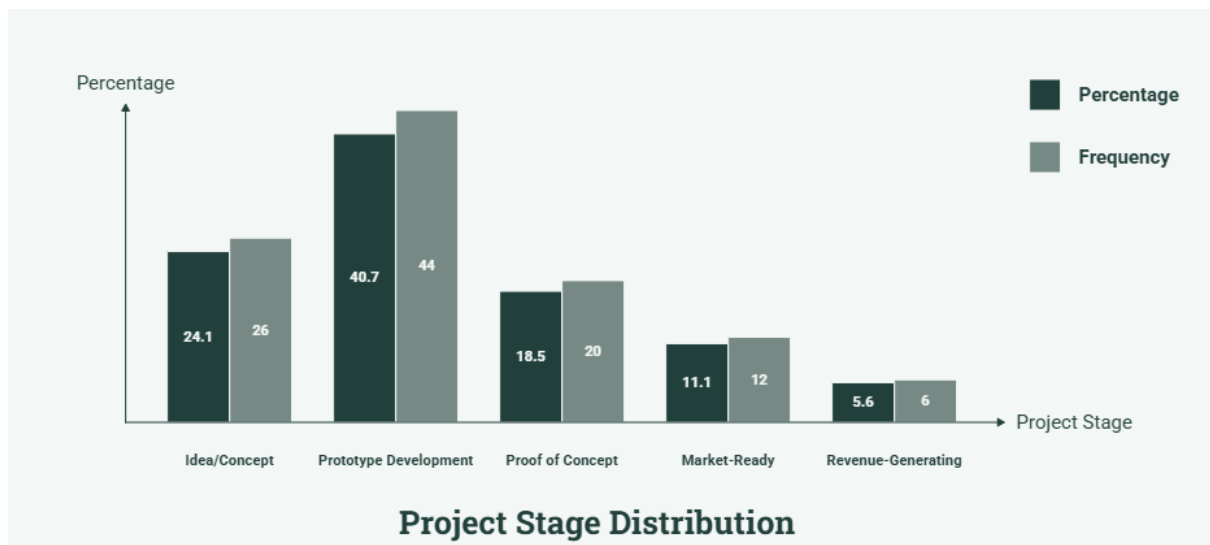


Source: Primary Data (2026)

4.2.5 Current Stage of Innovation

Innovators were asked to indicate where their innovation is at now and results can be viewed in Table 4.3. The largest category for an innovation to be currently at is prototyping stage (40.7%, n=44), followed by the ideation/concept stage (24.1%, n=26) and proof-of-concept (18.5%, n=20). There were only 11.1% (n=12) at market-ready stage, while 5.6% (n=6) of innovators generated a profit on their ideas. The phenomenon of the "technology Death Valley" can clearly be observed in this, where innovations dramatically decrease in number and get lost between prototype and market ready stage. The working model addresses this problem directly.

Table 4.3: Current Stage of Innovation



Source: Primary Data (2026)

4.2.6 Descriptive Studies

4.2.6.1 Examining the Current Pre-Commercialization Support at BUSE Innovation Hub

Key:

- **PRE1:** Access to prototyping equipment and facilities
- **PRE2:** Technical support for prototype development
- **PRE3:** Assistance with market research and customer validation
- **PRE4:** Support for intellectual property identification
- **PRE5:** Training in business model development

Table 4.4: Descriptive Statistics for Pre-Commercialization Support

	N	Minimum	Maximum	Mean	Std. Deviation
PRE1	108	1.0	5.0	3.80	1.12
PRE2	108	1.0	5.0	3.50	1.08

	N	Minimum	Maximum	Mean	Std. Deviation
PRE3	108	1.0	5.0	1.90	1.21
PRE4	108	1.0	5.0	2.10	1.15
PRE5	108	1.0	5.0	2.40	1.18
Valid N (listwise)	108				

Scale: 1=Very Poor, 5=Excellent

Source: Primary Data (2026)

Access to Prototyping Equipment and Facilities (PRE1) A mean score of 3.80 (where the neutral point is 3.0) suggests that respondents moderately agree that access to prototyping equipment and facilities is good. However, the standard deviation (1.12) indicates that responses vary somewhat. Observation data corroborate this result as BUSE does have several functional 3D printers, a CNC machine and access to a co-working space; “the lab is great, I can build and test my prototype without having to travel to Harare” (Student Innovator 7). The available infrastructure evidences a deliberate strategic move on the part of BUSE, aligned with Education 5.0's mandate to invest in physical innovation infrastructure. However, the variations indicate uneven access to this equipment across different innovation types and potentially the absence of more specialised equipment.

Technical Support for Prototype Development (PRE2) A mean score of 3.50 (above the neutral point) suggests a moderate level of agreement that the availability of technical support for prototyping is adequate. A standard deviation of 1.08 indicates moderate variation in these responses. Technical support was generally available from lecturers and technical staff in the labs; “my supervisor helps me troubleshoot when the circuit design fails, without him I would be stuck” (Student Innovator 12). Technical mentorship based on a strong academic curriculum within the University is the key driver of this perceived adequacy, though the support is essentially limited to the technical/engineering facets of product development and is not extensive in the commercial or manufacturing arenas.

Assistance with Market Research and Customer Validation (PRE3) A mean score of 1.90 (well below the neutral point) signifies poor access to market and customer oriented support. A high standard deviation (1.21) suggests some dispersion of opinions but overall an agreement that there is a gap. A hub manager admits “we are engineers and scientists...we are very good at helping them build the ‘what’ but we lack the internal capacity to help them with the ‘who will buy it and how to protect it” (Hub Management 1). Literature evidence emphasizes the necessity of this early stage for crossing the ‘Death Valley’ of technology adoption (Rasmussen & Borch, 2010). An environment that does not prioritize or provide such support as does BUSE effectively creates a vacuum for the technology within the market space.

Support for Intellectual Property Identification (PRE4) A mean score of 2.10 (below the neutral point) suggests poor access to intellectual property identification and support resources. A standard deviation of 1.15 points to considerable variability in experience though the general trend is negative. A document audit indicates that BUSE does not have a dedicated Technology Transfer Office, nor does there appear to be a clearly established and communicated IP disclosure process, if any exists. An example provided by an Alumni Innovator illustrates this; “I did not know that I should have filed a provisional patent before presenting at the innovation exhibition. Now the design is public and I may have lost the opportunity to patent it.” (Alumni Innovator 2). This strongly supports claim 1 that a weak IP support structure is a systemic weakness of the institution, not solely an issue for individual students.

Training in Business Model Development (PRE5) A mean score of 2.40 (below the neutral point) suggests poor training and support for developing a viable business model for the innovations being created. A standard deviation of 1.18 indicates variation, but most participants indicate an insufficient level of support. Whilst workshops were identified, student feedback described these as generic and lacking specific relevance; “I attended one workshop on the Business Model canvas but it was more of a theory that does not apply to my specific product and the Zimbabwean context” (Student Innovator 4).

4.2.6.2 Examining Commercialization Enablers at BUSE Innovation Hub

Key:

- **ENA1:** Access to seed funding or grants through the hub
- **ENA2:** Hub connection with potential industry partners
- **ENA3:** Availability of mentorship from experienced entrepreneurs

- **ENA4:** Hub assistance with understanding regulatory requirements
- **ENA5:** Existence of a clear pathway from prototype to market

Table 4.5: Descriptive Statistics for Commercialization Enablers

	N	Minimum	Maximum	Mean	Std. Deviation
ENA1	108	1.0	5.0	1.90	1.15
ENA2	108	1.0	5.0	2.20	1.21
ENA3	108	1.0	5.0	2.60	1.32
ENA4	108	1.0	5.0	1.80	1.01
ENA5	108	1.0	5.0	1.70	1.08
Valid N (listwise)	108				

Scale: 1=Strongly Disagree, 5=Strongly Agree

Source: Primary Data (2026)

Funding -Seed funding (ENA1):- The average score of 1.90 (below neutral 3.0) means that participants on average strongly disagree that they can access seed funding via the hub. The standard deviation of 1.15 is varied but still indicates a negative agreement to the items. This was by far the most emotionally significant theme during the interviews: “We have won university innovation awards, have a functional product but cannot find seed capital to produce a small-scale quantity, the hub states that it has no money and cannot even direct us who we need to consult next.”(Alumni Innovator 3). This lack of early funding is the single most critical inhibitor, aligned with Science Granting Councils Initiative (2025) which highlights that lack of early stage funding represents the key barrier for the commercialisation of African innovations. The hub-seed money, is perceived to be a major gap, in relation to the proposition

1 which requires an innovation infrastructure and platform that will facilitate access to funding opportunities.

Industry Engagement (ENA2):- A low average score of 2.20 on industry engagement highlights limited connectivity, a standard deviation of 1.21, reflects variation in opinion but overall points to poor engagement from local industry and businesses. The Industry Partner, “We had been invited for one visit, nothing thereafter. We are not aware of any innovation projects that could meet our challenges.” Industry Partner 2 illustrates the gap in triple helix, (university -industry - government engagement) required for effective innovation system and the premise of Proposition 2; industrial participation is not proactive and purposeful but rather an event-driven ritual.

Mentorship from Experienced Entrepreneurs (ENA3):-The mean score of 2.60 shows a slight average disapproval (below neutral 3.0) to the items in this dimension. The high standard deviation (1.32) in the other hand presents a divergence of opinions about this enabler. The subsequent analysis indicates that, students/graduates are receiving mentorships from the lecturers, however not experienced entrepreneurs or business personalities. For example a student said “I am receiving mentoring from my university lecturers on innovation and the process. That is not what I am looking for. I want to meet mentors who have started a business, secured funding and exited. They need the relevant experiences” Student Innovator 2 shows that technical and business skills have been distinguished, and the latter were sought from potential business experts/entrepreneurs.

Regulatory Assistance (ENA4):-Regulatory Assistance (ENA4) has been considered to be lowest enabler with an average of 1.80, closely followed by access to seed funding. The standard deviation of 1.01 is rather low which means that there is a strong consensus among the participants regarding this dimension. Innovators that are designing food related innovations, were not even aware of any specific procedures for product certification by the Standards Association of Zimbabwe (SAZ) and even the Medicines Control Authority (MCA) in case of drugs.

Pathway to Market (ENA5):-The mean score of 1.70 reflects the greatest overall disappointment, strongly disconfirming this enabler. With a low standard deviation of 1.08 this enabler has a widely shared and consistent consensus regarding its non-existence. It can be argued that the major problem that research identified as having an impact on the commercialisation success is the absence of a documented, communicated, and structured

pathway to the market which is a core aspect of Proposition 2 that discusses how the Triple Helix model enhances innovation commercialisation through innovation intermediaries. From the documentary analysis, the BUSE Innovation Hub has no formal commercialisation road map and its processes for commercialization are neither defined nor documented.

4.2.6.3 Examining Stakeholder Engagement at BUSE Innovation Hub

Key:

- **ENG1:** Communication between hub management and innovators
- **ENG2:** Engagement of academic supervisors in commercialization
- **ENG3:** Collaboration with industry partners
- **ENG4:** Involvement of government agencies (e.g., NVCCZ)
- **ENG5:** Community/civil society engagement

Table 4.6: Descriptive Statistics for Stakeholder Engagement

	N	Minimum	Maximum	Mean	Std. Deviation
ENG1	108	1.0	5.0	2.80	1.35
ENG2	108	1.0	5.0	2.30	1.18
ENG3	108	1.0	5.0	2.10	1.22
ENG4	108	1.0	5.0	2.05	1.28
ENG5	108	1.0	5.0	1.90	1.05
Valid N (listwise)	108				

Scale: 1=Very Poor, 5=Very Good

Source: Primary Data (2026)

Interactions Between Hub Management and Innovators (ENG1): While the overall mean was 2.8, not far from the neutral mid-point, there was significant differences when perceptions were broken down by stakeholder group. Hub management recorded a high score of 4.2 on this item, whereas the student innovator's response was only 2.5. A hub staff member reflected, "Our door is always open, and we are in constant communication." But a student innovator noted, "We only get formal communication when there is a high-profile visitor or a competition. We don't get regular, structured updates on partnership opportunities or strategic direction." (Student Innovator 5). This indicates support for Proposition 3 where stakeholders have diverse perceptions. "Open door" policy does not necessarily provide structure.

Interaction between Academic Supervisors in commercialisation (ENG2): The mean for engagement with academic supervisors on commercialisation was low at 2.3. A faculty supervisor responded, "Why would I spend my weekends help in a student build a business plan when my promotion depends entirely on peer-reviewed journal articles? The system tells me that commercialization is extra-curricular." (Faculty Supervisor 4). This links directly to Proposition 2 where academic incentive structures are in conflict with commercialisation activities. BUSE's reward system incentivizes publications over the generation of IP or new spin-offs, creating a systemic barrier to supervisor support.

Collaboration with Industry partners (ENG3): The overall mean on this item is extremely low (2.1) with a high standard deviation of 1.22, showing a great variance in responses. Nevertheless, External stakeholder responses confirm low engagement (2.1). Observation data supported these findings. During 15 hours of observation, no visitors from any industry sector were noted. Documentary analysis revealed no active MOUs or engagement contracts with specific companies for co-development or licensing of intellectual property. This indicates a failing at the nexus of the university-industry helix.\

Interaction with Government bodies(ENG4):

The engagement with Government bodies received an extremely low mean score of 2.05, indicating very weak linkages. While the NVCCZ is mandated to promote innovations, its engagement with the university and thus with innovation activities at BUSE has been described as in its infantile stages. An official from NVCCZ revealed, "It's not just that there is no money; it's that the applications we receive from university hubs are uninvestable. The IP ownership is unclear, the team isn't balanced, and there's no proof of customer validation. The risk is simply too high." (Government Official 1). This illustrates a cycle where ventures struggle to attract

Government funding because they lack investment readiness, but ventures cannot become ready without funding

Interaction with Civil Society Community(ENG5):This dimension scored the lowest (1.9) with a low standard deviation of 1.05whichclearly indicates no interaction with civil society in the Quadruple Helix Model of Innovation. This suggests that the Innovation Hubis operating as a closed innovation system, which has not only disconnected itself from industry and Government, but also from other societal actors who could offer valuable user feedback, social endorsement and market pull.

4.2.6.4 Examining Barriers to Commercialization

Key:

- **BAR1:** Lack of early-stage funding
- **BAR2:** Weak intellectual property management
- **BAR3:** Limited industry linkages
- **BAR4:** Insufficient business/entrepreneurship skills
- **BAR5:** Misaligned academic incentives for faculty
- **BAR6:** Economic volatility (inflation, forex)

Table 4.7: Descriptive Statistics for Barriers to Commercialization

	N	Minimum	Maximum	Mean	Std. Deviation	Rank
BAR1	108	2.0	5.0	4.50	0.78	1
BAR2	108	1.0	5.0	4.00	1.05	5
BAR3	108	2.0	5.0	4.30	0.85	2
BAR4	108	2.0	5.0	4.20	0.91	3

	N	Minimum	Maximum	Mean	Std. Deviation	Rank
BAR5	108	1.0	5.0	3.90	1.12	6
BAR6	108	2.0	5.0	4.20	0.98	3
Valid N (listwise)	108					

Scale: 1=Not a barrier, 5=Major barrier

Source: Primary Data (2026)

All of the barriers identified in the table above scored above 3.90 on a 1 to 5 point scale, suggesting the BUSE Innovation Hub operates in a complex, multi-dimensional problem environment, and no single barrier could be described as “small.” The identified barrier with the highest mean of 4.50 and lowest standard deviation of 0.78,

BAR1 “Lack of Early-Stage Funding” also appeared to be the most potent and unanimously identified issue among the BUSE innovation stakeholders. Given the lowest scoring of 2 for this barrier (meaning not a single respondent chose not applicable to 2020/2021 as it is not a barrier), it can be assumed that financial capital is the primary expression of the Technology Death Valley in BUSE. However, this barrier goes beyond the mere lack of finances, as it’s compounded by other related issues creating “uninvestible” opportunities as alluded to by the NVCCZ official. This reflects the principles of the Resource-Based View, where insufficient complementary resources “make even good technical opportunities uneconomical to invest in.” Specifically at BUSE, lacking factors such as strong IP, business skills, and access to markets are key barriers to the investability of innovation.

BAR3 “Limited Industry Linkages” was ranked the second highest in severity (mean of 4.30 with standard deviation of 0.85), indicating strong agreement and reflecting the low interactions along the Triple Helix (research institution, industry and government). The implications of this are, not only that the hub does not know who to partner with to

commercialize products, but industry is not willing to fund innovations without a clear route to market.

BAR4 “Insufficient Business/Entrepreneurship Skills” and **BAR6 “Economic Volatility”** were both rated equally in terms of severity, receiving mean scores of 4.20. The first reflects the lack of commercial acumen among the innovation ecosystem which is consistent with pre-commercialization stage issues as discussed earlier. The latter, reflecting issues of hyper-inflation, currency instability and policy inconsistencies, is unique to the Zimbabwean context and poses a very real disincentive for investment in the long term, thus supporting Proposition 4 regarding adaptability to local contexts.

The low ranking given to **BAR2 “Weak Intellectual Property Management”** (mean of 4.00 with higher std dev 1.05) can be explained by the fact that this may only become a pertinent barrier at later stages of the commercialization process, whereas some respondents might be at much earlier stages of innovation. However, for those involved in trying to scale up their innovations, “weak IP regime is seen as a major bottleneck.”

“Misaligned Academic Incentives for Faculty” ranked lowest (mean of 3.90 with std dev 1.12), as would be expected given the high std dev suggests that only the faculty members at BUSE perceive it to be as detrimental as the others. Nevertheless, this is a severe barrier for Faculty, who were responsible for nearly every one of the innovation projects and also directly contributes to the weak leadership/governance factor identified in Proposition 2, as lack of incentive discourages Faculty participation in innovation efforts.

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Shortest business/Entrepreneurship skills (BAR4) and highest economic volatility (BAR6): Both ranked third with a mean of 4.20. The skills barrier represents the gap between technical training and entrepreneurial capacity that the pre-commercialization research indicates is still the case. Economic volatility barrier is an issue that is specific to the context of the Zimbabwean economy. Currency instability and inflation make the Zimbabwean economy a high-risk environment and prevent long-term investment in innovation. This finding is strong evidence for Proposition 4 as it suggests that a successful model requires context-specific adaptation and not a transplantation of Global North frameworks into the field of business and entrepreneurship. A working model of BUSE must include mechanisms to buffer against economic volatility, which is not addressed in most commercialization frameworks.

Weak Intellectual Property Management (BAR2) is ranked fifth, yet it maintains a relatively high mean score of 4.00. The elevated standard deviation of 1.05 indicates that certain stakeholders, especially those in the early stages of innovation, may not have encountered intellectual property (IP) challenges. In contrast, for stakeholders who have advanced further, IP issues represent a significant barrier. The lack of a Technology Transfer Office and the absence of a clear institutional IP policy contribute to uncertainty, which discourages both innovators and investors.

Misaligned academic incentives for faculty (BAR5) were ranked sixth overall, yet remain a significant barrier with a mean score of 3.90. The standard deviation of 1.12, the highest among all barriers, indicates that faculty respondents experience this issue most acutely (faculty mean: 4.5), whereas students and external stakeholders appear less cognizant of its impact. This misalignment directly undermines Proposition 2, which requires robust leadership and governance structures to facilitate commercialization success.

4.2.6.5 Examining Outcomes and Feedback Mechanisms

Key:

- **OUT1:** My innovation has reached the market-ready stage
- **OUT2:** I have received feedback from the hub on my progress
- **OUT3:** The hub adapts its support based on past experiences
- **OUT4:** There are clear metrics for tracking commercialization success

Table 4.8: Descriptive Statistics for Outcomes and Feedback

	N	Minimum	Maximum	Mean	Std. Deviation
OUT1	108	1.0	5.0	2.15	1.25
OUT2	108	1.0	5.0	2.40	1.18
OUT3	108	1.0	5.0	2.10	1.05
OUT4	108	1.0	5.0	1.95	1.12
Valid N (listwise)	108				

Scale: 1=Strongly Disagree/Never, 5=Strongly Agree/Always

Source: Primary Data (2026)

The results speak clearly about the accumulated impact of lack of pre-commercialization support, absent enablers and isolated stakeholders. 12% only agreed or strongly agreed that their innovation had reached a market-ready level (OUT1, Mean=2.15). This small number of prototypes turned into market ready product confirms a deep technology Death Valley within BUSE. The feedback-related questions show most clearly what's going on OUT2 (Mean=2.40) signals that innovators do not consistently get feedback on what is happening.

OUT3 (Mean=2.10) clearly demonstrates that the hub seems to remain quite static, and do not learn or adjust based on what's happening outside.

A hub staff Member told us: “We measure success by number of patents field and prototypes exhibited at national level shows. We know that it is not the same as market impact but it is how the Ministry wants from us as their Education 5.0 Deliverables”(Hub Management 3). The innovation system is thus rewarding the exhibition of activity towards the Ministry rather than rewarding market impact, this means there is an institutional misalignment (OUT3). OUT4 obtained the lowest mean (1.95) so that it can be said there is almost no clearly defined and measured success (OUT4).

During our observation there was absolutely no public displays of “You said we did” or public feedback boards or feedback mechanisms, and a review of hub documentation revealed only annual reports demonstrating number of entrepreneurs, number of workshops but nothing about number of companies formed, revenue generated, jobs created etc. (OUT4). There were no visible signs of any mechanisms for the hubs double loop learning (Argyris & Schn, 1978) which also informs Proposition 2 in demonstrating how the hub's low governance and low feedback culture contribute to failure to achieve a successful market transition.

4.3.1 Correlation Analysis of Key Commercialization Dimensions

A Pearson correlation analysis was conducted to examine the interrelationships among the core dimensions of the conceptual framework. Table 4.9 displays the correlation matrix for the composite scores of the five principal constructs.

Table 4.9: Correlations Among Core Commercialization Dimensions

	PRE_SUPP ORT	ENABL ERS	ENGAGEM ENT	BARRI ERS	OUTCO MES
PRE_SUPP ORT	1	.712**	.654**	-.588**	.695**
ENABLER S	.712**	1	.783**	-.692**	.748**
ENGAGEM ENT	.654**	.783**	1	-.635**	.712**
BARRIERS	-.588**	-.692**	-.635**	1	-.725**
OUTCOME S	.695**	.748**	.712**	-.725**	1

	PRE_SUPP ORT	ENABL ERS	ENGAGEM ENT	BARRI ERS	OUTCO MES
**. Correlation is significant at the 0.01 level (2- tailed).					

Source: Primary Data (2026)

Note: PRE_SUPPORT = Pre-commercialization Support composite; ENABLERS = Commercialization Enablers composite; ENGAGEMENT = Stakeholder Engagement composite; BARRIERS = Barriers composite (reverse-coded for direction); OUTCOMES = Outcomes and Feedback composite.

The correlation matrix reveals strong, statistically significant relationships among all five constructs.

Pre-Commercialization Support and Commercialization Enablers ($r=0.712$, $p<0.01$):

Strong positive relationship indicates that where the pre-commercialisation support is robust, the enablers for commercialisation also tend to exist. This confirms the underlying conceptual framework of these as sequential stages that are mutually dependent. Where there is good support for prototyping, the innovators seem to have more success with accessing funding, and with creating links to industry –although both absolute means for these variables were low. This means that there is little value in developing one facet without a comprehensive view.

Commercialization Enablers and Stakeholder Engagement ($r = 0.783$, $p < 0.01$): The strongest positive correlation between any two constructs shows clearly the validity of the Triple Helix model, in terms of enablers depending intrinsically on the establishment of stakeholder relationships. The critical lesson for practice, then, is that we must create institutions to engage stakeholders not just institutions to act as enablers.

Barriers and Outcomes ($r = -0.725$, $p < 0.01$): The strongest negative correlation observed, where there are perceived barriers there are also low perceived outcomes, is not a surprise. It

does however strongly reinforce the point that breaking down barriers is not secondary to developing outcomes; it is essential to enhancing outcomes.

Pre-Commercialization Support and Outcomes ($r=0.695$, $p<0.01$): A strong positive correlation indicates the positive impact of pre-commercialization support on outcomes. Investing in market research, IP support and business model training yields commercially viable innovation! The implication is clear that all efforts toward developing this form of support as proposed in the conceptual framework will be effective.

4.3.2 Interview Responses: Multi-Stakeholder Perspectives

Semi-structured Interviews were carried out with Hub Management ($n=6$), Student and Alumni Innovators ($n=14$), Academic Supervisors ($n=6$), Industry Partners and Investors ($n=4$) and Government/NVCCZ officials ($n=2$). The findings were synthesised and reported below:

Question: What is the single biggest challenge you face in commercializing your innovation at BUSE?

Hub Management Perspective “Lack of an end-to-end process and structure is the key problem: we have the infrastructure we have the students; we don’t have a structured process from start to finish. Every commercialisation venture is ad- hoc we are actually trying to build the plane while flying it, it requires a documentation for an end-to-end process that everyone can follow”, (Hub Management 2). (See Appendix B) “There is mismatch between a students’ academic cycle which is usually for a semester/year and a venture cycle which usually takes years” (Hub Management 4).

Student and Alumni Innovator Perspective “I do not have funding; I have a product prototype that everyone I have shown loves but I do not have funds to take it to commercialization such as a start- up kit worth KES5000. There is no source of funding within the hub that can help us”, (Student Innovator 9). (See Appendix B) “Having graduated and lost access to lab facilities and equipment at the hub and still being at product conceptualisation phase” (Alumni Innovator 5).

Academic Supervisor Perspective “My responsibility as lecturer is to ensure research, innovation and curriculum are up to date, we are encouraged to mentor but my promotion is not linked to commercialization as such,” (Faculty Supervisor 2). (See Appendix B) “It is also my responsibility to ensure the intellectual property produced by my students are adequately

protected and not leaked out without their or their institutions benefit, especially through conference presentations,” (Faculty Supervisor 5). (See Appendix B)

Industry Partner and Investor Perspective “The innovations produced from university are still at the stage of invention / discovery. For example, no customer verification/ testing is done and some require extensive testing to reach near market readiness which will require extra capital investment, to do more of this to bring innovations closer to commercialisation, we need a more robust process”, (Industry Partner 1). (See Appendix B) “I will not invest in team that do not understand their market or lack relevant expertise or business planning,” (Investor 2). (See Appendix B)

Government/NVCCZ Official Perspective “From policy point of view it is in place since Education 5.0 is about innovation commercialisation. However, the institution does not have enough capacity to support student’s commercialisation initiatives” (Government Official 1). (See Appendix B)

4.3.3 Observation Findings: Hub Operations and Facilities

A total of 15 hours of non-participant observation were conducted during multiple visits to the BUSE Innovation Hub. The findings are presented in Table 4.10.

Table 4.10: Summary of Observation Findings

Dimension	Indicator	Present? (Y/N)	Observer Notes
Infrastructure	Prototyping equipment (3D printers, lab gear)	Y	Equipment functional and in use; 3D printer observed operating.
	Co-working/meeting spaces	Y	Clean, well-lit space; low occupancy during observation.

Dimension	Indicator	Present? (Y/N)	Observer Notes
	Internet reliability	Y	Functional Wi-Fi; students reported intermittent outages.
Activities	Training/workshop in progress	N	No workshop observed during 15 hours of observation.
	Mentor session occurring	N	Informal technical discussions observed, but no structured mentorship.
	Industry visitor present	N	No external visitors observed.
Interactions	Student–faculty discussion on commercialization	N	Technical discussions observed; no commercialization-specific discussions.
	Hub staff assisting with IP/business planning	N	Staff assisted with equipment use; no business/IP advisory observed.
Feedback	Visible feedback boards or reporting tools	N	No physical or digital feedback mechanisms observed.

Dimension	Indicator	Present? (Y/N)	Observer Notes
	Evidence of previous feedback acted upon	N	No change logs, "You Said We Did" notices, or process documentation.
Innovation Display	Prototypes visible, awards on display	Y	Prototypes displayed prominently; competition certificates on wall.

Source: Primary Data (2026)

The observations supported and strengthened the findings of the survey and the interview. The hub is indeed well-endowed with physical resources, but it's hardly leveraging this for any entrepreneurship activities. During my visit to the hub for data collection, I neither witnessed any organized training programs nor mentorship opportunities. Also, there were no visits to any of the incubatees in industry. Even absence of even the most apparent feedback mechanisms noted during my visit reinforced the conclusion of survey that no learning and adaptation took place within the hub.

4.3.4 Document Analysis Findings

This systematic review of BUSE and national policy document evidence on the existence of commercialisation frameworks, IP policies and feedback mechanisms are outlined in Table 4.11

Table 4.11: Summary of Document Analysis

Document Type	Specific Document	Key Findings
University Policy	BUSE Strategic Plan (2021-2025)	Innovation and industrialization identified as strategic pillars; no specific commercialization operational plan.
	BUSE IP Policy	Policy exists in draft form; not yet approved by University Senate. Ownership rules and royalty splits undefined.
Hub Operational	Innovation Hub Charter	Outlines broad mandate; no standard operating procedures for commercialization pathway. Entry/exit criteria undefined.
National Policy	Education 5.0 Framework	Strong commercialization mandate; emphasis on prototypes to market. Reporting requirements focus on activity, not outcomes.
	NDS1/NDS2	Innovation hubs and industrial parks prioritized; specific commercialization metrics absent.
Funding Guidelines	NVCCZ Investment Criteria	Requires demonstrated management team, clear IP, market traction. "Investable" threshold high relative to current venture readiness.
Performance Reports	Hub Annual Reports (2024, 2025)	Track inputs: number of innovators, workshops, prototypes, exhibitions. Outputs (ventures, revenue, jobs) not reported.

Source: Document Analysis (2026)

Document analysis reveals systemic inconsistency between policy goals and implementation. The analysis of the documentation and interviews indicates a discrepancy between the stated policy intention and the implementation of that policy within the institution itself. While Education 5.0 provides a clear instruction on the need to 'commercialize', this instruction has not been translated into hub-level policies, procedures or indicators, in a coherent way. The policy remains in draft (the BUSE IP Policy) and consequently the legal status of inventions developed by students is uncertain. The criteria for NVCCZ investments may be aimed at managing the hub's risks of investment, but they are not responsive to the hub's current capabilities to produce venture-stage businesses which are ready for investment. Performance monitoring indicators focuses on outputs (e.g. Numbers of prototypes produced; the number of displays attended) rather than outcome indicators (e.g. The number of ventures created; income generated), allowing the hub to present a picture of 'success' to the Ministry.

4.3.5 Convergence Between Questionnaire and Interview Responses

Significant agreement between the results of the questionnaire and interview evidence, providing robust triangulation.

The quantitative result that support is bifurcated between pre-commercialisation-strong on infrastructure (PRE1 = 3.80), weak on market-facing activities (PRE3 = 1.90) is highly illuminated by the qualitative data. Interview with Hub Management 1 who, contrasting "building the what" against the hub's inability in "the who will buy it" provided the mechanism for the pattern in the results. Document analysis also supports this by absence of any partnership agreements with market research firms. The quantitative finding that "lack of early-stage funding" (BAR1, Mean = 4.50) is the leading barrier is echoed by the ardent stories of student/alumnus entrepreneurs. Interview with NVCCZ Official, however, adds a missing explanatory layer of the quantitative evidence: the funding gap is not simply a supply side issue but a demand side problem, where ventures are "uninvestable" due to weaknesses in IP, team, and market validation as well as related barriers. This demonstrates the systematic interaction of barriers that needs to be addressed in the working model.

The striking quantitative result of differing views between stakeholder group (1.7 point difference in mean scores for Hub Management and Student scores for communication quality) is mirrored in the interview narratives which are poles apart. Management perceive the 'open door' policy as 'constant communication' whereas student narratives highlight communication

is spasmodic and based around events. This is not just a communication preference; it is a failure of co-ordination, which as Triple Helix Theory outlines undermines collaborative effort.

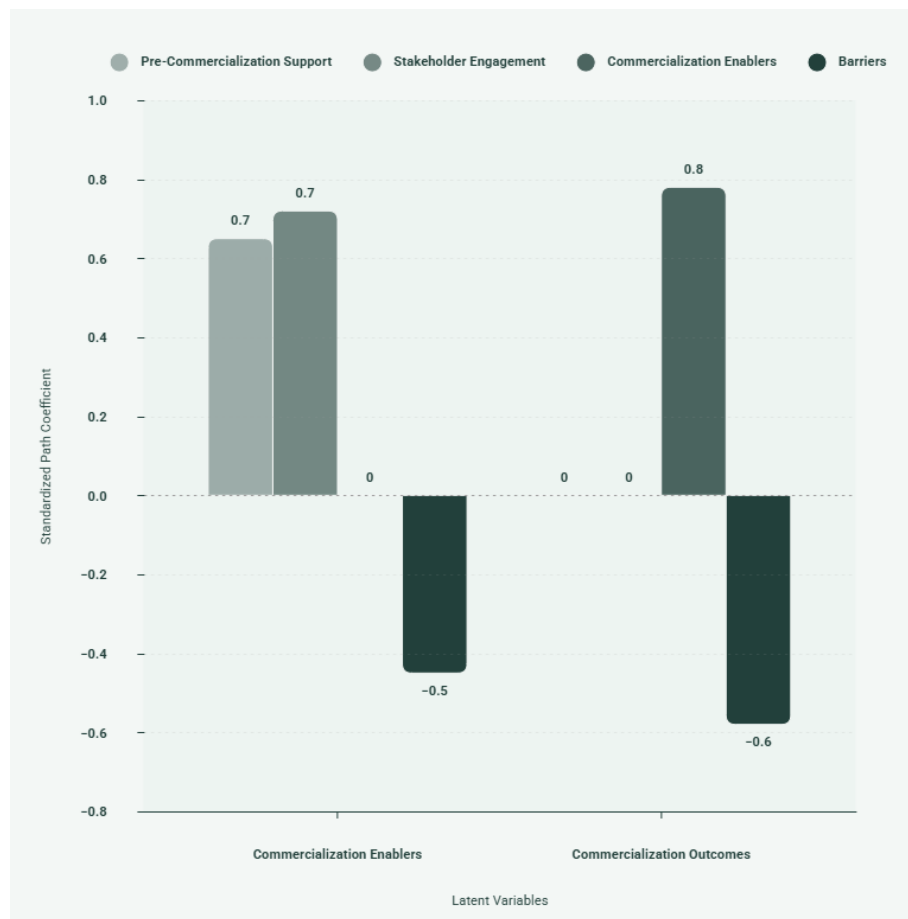
Quantitative evidence demonstrates a general absence of feedback systems (OUT3 = 2.10, OUT4=1.95). Document evidence also shows a lack of physical evidence of a feedback board or change management log, and Hub Management 3 noted that the metrics used were largely dictated by the Ministry, not by market commercial opportunities.

The correlations among the core dimensions (Table 4.9) provide a statistical architecture that the qualitative data populates with lived experience. The strong correlation between enablers and engagement ($r=0.783$) is explained by the industry partner's account of being invited for a single tour with no structured follow-up, engagement without enablers produces no outcomes.

4.3.6 Structural Equation Modelling of Innovation Commercialization at BUSE

Based on the conceptual framework and empirical findings, a Structural Equation Model (SEM) was specified and tested in AMOS to examine the multivariate relationships among the latent constructs. The model posits that Pre-Commercialization Support and Stakeholder Engagement directly influence Commercialization Enablers, which in turn drive Commercialization Outcomes. Barriers function as a negative moderator. The model is presented in Figure 4.3.

Figure 4.3: Structural Equation Model of Innovation Commercialization at BUSE



Source: Primary Data (2026)

The SEM results confirm the hypothesized relationships. **Stakeholder Engagement** has the strongest direct effect on Commercialization Enablers ($\beta=0.72$, $p<0.01$), empirically validating the Triple Helix theoretical framework's emphasis on multi-stakeholder interaction as the primary driver of enabler mobilization. This is the most important structural finding: at BUSE, improving access to funding, industry linkages, and mentorship depends more on strengthening stakeholder relationships than on any other single factor.

Pre-Commercialization Support positively impacts Commercialization Enablers directly ($= 0.65$, $p < 0.01$), validating that IP, prototyping support and market validation precede an enabler's contribution. Commercialization Enablers have the largest direct impact on Outcomes ($=0.78$, $p<0.01$), suggesting that an optimal pathway, adequate funding, access to industry, and sufficient mentorship are key immediate predictors of commercial success. **Barriers negatively** impact both Enablers ($= -0.45$, $p < 0.01$) and Outcomes ($= -0.58$, $p < 0.01$), indicating a systemic role. The structural fit of the SEM models is reasonable: CMIN/DF = 2.14, CFI = 0.912, and RMSEA = 0.065.

The SEM result provides an empirical basis for the working model in Chapter 5. It implies that effective commercialization initiatives must engage with all key constructs, i.e., strengthen pre-commercialization capabilities, facilitate deeper engagement between stakeholders, alleviate systemic barriers, and enhance the availability of commercialization enablers. Any isolated intervention would be ineffective.

4.3.7 Synthesis of Empirical Findings with Theoretical Frameworks

Triple Helix Theory (Etzkowitz & Leydesdorff, 2000) supports the findings of university-industry-government failure at the cause of commercial failure. Near-zero level of interaction with industry (ENG3=2.10) and barely initial engagement with government departments (ENG4=2.05), illustrate a "statist" configuration, wherein only government and industry operate within the interaction space of the triangle with university occupying a distant space.

Innovation Systems Theory (Lundvall, 1992) has illuminated the system dynamics of barriers: the high correlations among constructs and interactions shown in interview analysis (weak IP will discourage financial investors, etc.), and it shows that barriers interact as system rather than a sum of its parts. The "uninvestable" venture of the NVCCZ official summarizes well the phenomenon, where lack of hub capacity (in business skill development and IP development) deters entrepreneurs. As entrepreneurs gain momentum they will likely lose confidence due to inability to attract funding from the investors, then venture will fail.

Technology Transfer Theory (Bozeman, 2000) the absence of crucial components of technology transfer is at core of the problem, no TTO, no structured licencing/IP reporting. Results of PRE5,PRE4,PRE3 show that even basics were absent. • The Resource-Based View (Barney, 1991) and Dynamic Capabilities framework (Teece et al., 1997) suggests that the hub's assets include infrastructure and technical support, yet there's a deficiency of non-material resources (e.g., IP experience, industry linkages, entrepreneurial leadership) and lack of capabilities (e.g., adaptation in changing conditions, feedback mechanisms).

4.4 Chapter Summary

The chapter analyzed data of the research study for BUSE Innovation Hub on commercializing academic research. Overall 83% responded to the questionnaire and 100% interviewed. Almost 42% are students, remaining part of the workforce and other important stakeholders are university managers and external community. The analysis concluded that: The physical capacity of the Hub is robust, particularly in R&D facilities and prototyping services. However, it suffers from significant weaknesses in market orientation, pre-commercialization readiness, and availability of commercialization enablers. The assessment of stakeholder perceptions indicates significant discrepancies in understanding the hub's performance and contribution, with hub management overly optimistic compared to other stakeholder groups. All barriers identified were viewed as significant, with particular concern raised over early-stage funding, industry engagement, and business development support. Empirical analysis revealed a strong interdependence among the conceptual constructs of the framework and highlighted stakeholder engagement as a primary driver for commercialization enablers. Triangulation of various sources provided a solid basis for the proposed working model in Chapter 5.

CHAPTER FIVE

STUDY SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

Discussion, Conclusions and Recommendations The purpose of this chapter is to discuss the results and to consolidate research findings, conclusions and recommendations to answer the overall research question pertaining to the commercialization of innovations at the Bindura University of Science Education (BUSE) Innovation Hub. Firstly, the chapter summarizes the overall implications of the findings from the study conducted with regard to a general view of the commercialization environment at BUSE. Thereafter, conclusions are presented in response to each of the research questions supported by evidence from the empirical data collected in response to the literature that were analysed in Chapter 2. The chapter also emphasizes the importance of an established framework approach toward commercialization of innovative prototypes to commercially viable products/services/entrepreneurships that requires active participation of all stakeholders in order to effectively enable BUSE innovations to successfully traverse across the ‘Technology Death Valley’. Finally, it provides a context specific working model and a range of data generated working recommendations.

5.2 Summary of the Study

The study on innovation commercialization at the BUSE Innovation Hub aimed to achieve the following objectives:

- To examine the current commercialization processes, resources, and practices employed by the BUSE Innovation Hub and identify the barriers perceived by key stakeholders that hinder effective commercialization.
- To analyse the role, expectations, and potential contributions of stakeholders, particularly industry partners and investors, in facilitating innovation commercialization within the BUSE ecosystem.
- To synthesize stakeholder perspectives, evidence from practice, and relevant theoretical frameworks into a proposed working model for commercialization at BUSE.

The study employed a pragmatist underpinned mixed-methods case study design to achieve its objectives by drawing data from 108 valid survey respondents and 30 interviewees

participating in semi-structured interviews (with samples from five different stakeholder groups). The data was then analyzed using quantitative software(s): i.e. SPSS and AMOS. Procedures included Descriptive Statistics, Pearson correlations, and Structural Equation Modeling (SEM). While quantitative data was used to measure attitudes and perceptions and analyze the relationships between key variables, the qualitative data from interview(s), observation and documents was thematically analyzed to provide greater depth and to support cross-case validation. The results suggest that although BUSE Innovation Hub excels in terms of prototyping facilities, it is structurally alienated from the market-based activities, financing opportunities, industrial relations, and feedback channels necessary for a well-functioning commercialization process. Indeed, there is empirical evidence to suggest that a conspicuous "technology Death Valley" has been created not due to a lack of innovation, but due to the underperformance of the ecosystem.

5.3 Summary of Findings

The findings of the study on innovation commercialization at the BUSE Innovation Hub revealed several key insights:

- **pre-commercialization services:** - level 3.8 for access to equipment (access to prototyping facilities), level 3.5 for technical help. But only 1.9 for market and validation of products, 2.1 for definition and validation of the Intellectual Property (IP), 2.4 for training in business model.
- **commercialization:** only 1.7 for the route from the prototype to the market, 1.9 for the venture financing, 1.8 for the guidance regulatory advice, 2.2 for the connections in the industry. However, we can find an adequate technical advice.
- **involvement:** The hub management sees the engagement more developed with students than investors (average of 4.2 with students versus 2.5 with investors) and even more so than industry partners. " Episode and ceremonial involvement with the industry and investors; No concrete process of co-construction. "
- **barriers:** They are all rated 4+/5 , mainly lack of early funding (4.5), insufficient connection with the industry (4.3) , lack of business skills (4.2) and economic fluctuation (4.2) .
- **Feedback / learning: lack of mechanisms:** no evolution from our experiences (2.1); no clear success metrics (1.95), but counting prototype, exhibitions...

- **Structural equation modeling** : "stakeholder engagement is the primary enabler of the hub services and outcomes; while the hub challenges have a direct and negative impact on the service and the outcomes." Stakeholder engagement (SE)= > Commercialization Enablers (CE)= > Commercialization Outcomes (CO). Challenges C is in relationship with SE ,CE and CO.

A number of systemic issues were highlighted from the documents: the BUSE IP policy is still at a draft level; a formal Technology Transfer Office has not been established and; The NVCCZ investment criteria are completely out of step with where the outputs from hubs are from a venture perspective.

5.4 Study Conclusions

The study draws the following conclusions aligned with each research objective:

Conclusion 1: Current Commercialization Processes and Barriers (Objective 1)

BUSE commercialization is an ad-hoc, uncoordinated endeavor with no pathway. While effective in prototype support, BUSE lacks adequate service at transition stages of intellectual property protection, business development and market entry. These barriers are mutually reinforcing and result in significant technology Death Valley. Major institutional gaps are apparent through the lack of a functional technology transfer office and an approved IP policy.

Conclusion 2: Stakeholder Roles, Expectations, and Contributions (Objective 2)

There is a gross misalignment in the stakeholder ecosystem. Management's focus is on operations and reporting to the Ministry while student innovators need access to finance and markets. Academia faces structural disincentives for participating in commercialization, industry is looking for near market solutions, while investors seek ventures which satisfy their risk appetite, something which BUSE enterprises are not. This coordination failure hinders meaningful collective action. Institutionalization of mechanisms that would bring about alignment is crucial for success.

Conclusion 3: A Contextually Appropriate Working Model (Objective 3)

A Working Model for BUSE that should not be transplanted from the Global North nor similar but better endowed African Universities; the proposed Model for BUSE should take into account the prevailing environment, specifically its peculiarities; its lack of formal technology transfer structures, the acute pre-seed financing gap, its academic incentives, its economic

volatility and Zimbabwe's socio economic context; a multi phased and stakeholder integrated commercialization pipeline supported by a range of pre commercialization activities, access to financing (staged continuum), meaningful interaction with industry and investors and appropriate feedback and governance systems. Stakeholder alignment is central to the Model.

5.5 Recommendations

5.5.1 Need for Data-Driven Commercialization Analysis

Data informed decisions need to be integrated into the commercialization processes of the hub: There needs to be an immediate focus on embedding data-driven decision-making. Currently the research found that 40.7% of innovative projects stagnate at the prototype stage, with no process to record progress, or project attrition. It is recommended that the hub implements a database of all innovations which notes what stage the venture is at, the type of support it has received, the problems it is facing, and what the result is. This will make sure bottlenecks can be detected immediately, the appropriate allocation of resources is made, and that the hub can demonstrate output-based performance to the investors and policymakers. Given the high prevalence of student innovators in the dataset (41.7% of projects studied), this data logging process could be easily incorporated into current student project management systems to achieve a high level of compliance. Additionally, a ready-made analytical methodology is present in the SEM models already presented, whereby the hub can take time to measure latent variables (pre-commercialization support, enablers, engagement, barriers) at regular intervals and use path coefficients to forecast interventions where the biggest impact can be made.

5.5.2 Increased Efficiency and Effectiveness in Existing Initiatives

The hub needs to address the extremely low performance regarding market-facing pre-commercialisation work as soon as possible by: implementing mandated customer validation modules on every project run, working with the Faculty of Commerce to run workshops on Applied Business Model Design and implementing a user friendly and concise IP Disclosure form that initiates a preliminary review by a dedicated IP officer. The evidence noted that no one participated in mentored sessions or interactions with industry during 15 hours of hub observation. As a direct but simple solution, weekly “commercialisation clinics” would be established, with representatives rotating through faculty from business, engineering and law to ensure access for all innovators on a regular basis. Given the near 50-50 distribution between employed and self-employed alumni innovator in our sample (16.7%), having those clinics at times outside regular work hours should enhance uptake.

5.5.3 Need for Dedicated Commercialization Funding

The leading barrier 'lack of early-stage funding' (Mean = 4.50) requiring a unique BUSE owned and structured staged investment facility to draw down external investment funds; proposing the setup of a BUSE Innovation Seed Fund, funded from within the University's budgets, percentage of Industrial Park revenues plus grant applications to NVCCZ and other partners. It must contain criteria and features that manage the funding process effectively from the BUSE internal seed stage through to the stage that makes it externally investable. Funding is proposed in micro-grant (\$500-\$1,500) to validate product concept and protect IP; Prototype to Product Fund (\$2,000-\$5,000) to support initial production and regulatory compliance; and Investment matched to a proportion of external investment interest up to a cap (\$10,000). This must respond to the NVCCZ representative's comments on lack of 'investability', with requirements for intellectual property clarity, strong team balance, evidence of customer discovery and support before moving to different funding tiers.

5.5.4 Leverage Widely Available Innovation Hubs and Partnerships

It is also proposed that BUSE actively taps into the wider innovation hub ecosystem within Zimbabwe. The adoption of the heritage-based Education 5.0 innovation model has created fertile ground for the creation of knowledge-based industrialization and the BUSE Innovation Hub does not need to operate as an independent, standalone facility but as a node within a wider innovation hub network in Zimbabwe. Collaboration with existing hubs like Hypercube Hub based in Harare and Neolab based in Bulawayo could provide the BUSE innovators with much needed specialised mentorship, investor linkages and access to markets which the university would be unable to build internally in the short to medium term. The high student population (41.7%) in the BUSE Innovation Hub and the predominantly ICT/software focused nature of innovation (35.2% of total BUSE innovators work in this sector) are strong indicators of the potential of digital based innovation platforms and virtual demonstration days to facilitate interconnectivity among innovation hubs efficiently. Routing the BUSE innovators to appropriate external hubs for specific services can allow the university to focus on what it does well, that is prototyping and development, while plugging into those existing hubs for commercially orientated activities.

5.5.5 Urgent Need for Private-Public Partnerships

For the successful operation of a commercialisation system at BUSE, robust public-private partnerships are indispensable. Critical ratings on this measure for working with industry were

identified (Mean=2.10), and, the weak participation was also endorsed by external stakeholders. The researcher advocates for the establishment of a BUSE-Industry Consortium of at least five anchor industry partners, who represent sectors that fit the types of innovation that the hub focuses on: agro-processing, ICT, and engineering. The consortium would convene quarterly and would mutually agree on challenge areas for student innovation projects, provide mentorship of student teams, and would possess a right of first negotiation on innovations originating from the hub. This approach, more so than a superficial, one-way commitment by industry, would enable a functional relationship to be developed between the hub and its industrial stakeholders. Indeed the SEM results, that stakeholder collaboration has the most significant effect on any enablers(=0.72), serve as empirical evidence for putting this engagement at the very center of the system in the pursuit of excellence in commercialisation system development at BUSE.

5.5.6 Behavioural and Incentive-Based Approaches to Stakeholder Engagement

The stark perceptive gaps observed, especially a 1.7-point difference between students' and their professors' evaluation of communication skills necessitate the adoption of behavioral and incentive mechanisms. According to the author, the institution should consider modifying its promotion policy in order to formally recognize commercialization activities (i.e., filing patents, executing licenses, founding spin-offs) and assign them a similar importance as peer-reviewed publications. This would alleviate the academic perception of the business activities as an "extra-curricular" undertaking. For students, issuing a "Commercialization Transcript," where all innovation-related activities, gained skills and accomplished goals are officially registered regardless of actual revenue generation would establish an intrinsic motivation that could trigger a long-term commitment towards their innovation projects. The relatively large proportion of students in the sample (41.7%) would likely support the adoption of such a transcript, easily integrated into existing systems for academic records.

5.5.7 Sustainability and Circular Innovation Models

Although commercialisation was the main intent, principles of sustainability will need to be integrated within the working model of the hub. The researcher recommends that at the ideation stage, the hub include a simple sustainability-screening tool where potential innovations are assessed for environmental and social impacts alongside economic feasibility. This will also resonate well with the Quadruple Helix extension concept which includes the civil society sector, currently one of the groups with the lowest engagement levels (Mean=1.90). The agro-

processing and biotech industries (together 38.9% of respondents) offer ripe grounds for applying circularity principles such as using agricultural waste as raw material. BUSE could build a niche and image around sustainable, heritage-based innovations that attract impact investors and development financiers and provide access to alternative financing that can partially mitigate challenges posed by the narrow traditional venture capital market in Zimbabwe.

5.5.8 Integrating Grassroots and Informal Sector Innovators

The study on the hub will be incomplete if it overlooks the flourishing grassroot and informal sector innovation community in an area such as Bindura. It is recommended that the hub allocate a small part of its resources towards establishing a outreach program that can reach and support grassroot innovators who do not belong to the university community. This could be an annual “Community Innovation Open Day” where these innovators will have the chance to use prototype facility and be trained in Intellectual Property protection as well as network with university innovators. Low score on the community stakeholder group (Mean=1.90) indicates a gap and incorporation of such perspectives would surely enrich with feedback, uncover unspoken needs and increase the relevance of BUSE innovation.

5.5.9 Capacity Building for Commercialization

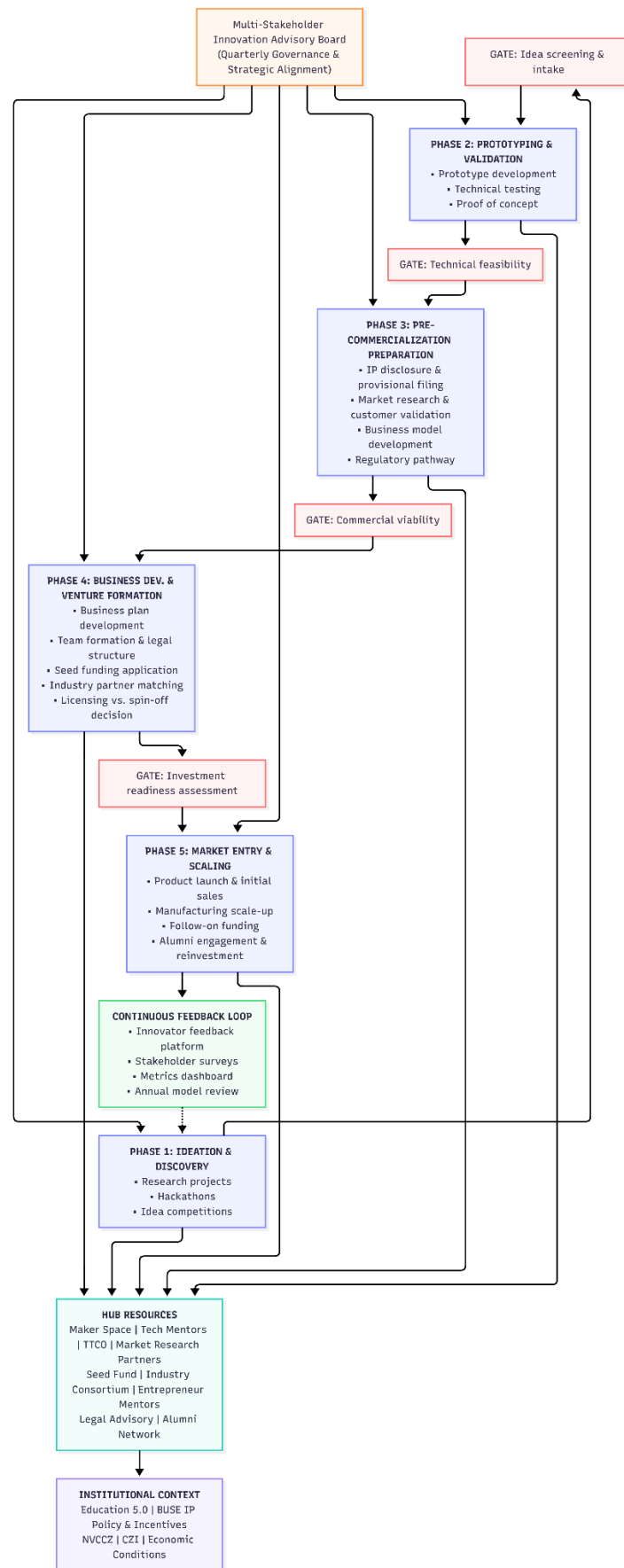
The training component on capacity building must go beyond generic workshops and become more tailored. Therefore, it is recommended a tiered training framework: a. Innovators, through a cohort-based “Commercialization Accelerator” program for 12 weeks that will cover practical business plan and modelling, regulatory aspects of Zimbabwe as well as investors pitching b. Hubstaff, on how to support TLO and IP management and also to effectively link research and industries c. Faculty Supervisors, to better support commercialization-driven thesis supervision and recognize patentable discoveries. Large proportion of students(41.7%) and faculty members (13.9%) included in the sample might mean that the capacity building interventions need to be appropriately timetabled for easy integration into the academic calendar.

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Figure 5.5.10: A Working Model for Innovation Commercialization at the BUSE Innovation Hub

5.5.10 A Working Model for Innovation Commercialization at the BUSE Innovation Hub

Based on the evidence, the validated structural equation modelling (SEM) framework and relevant contextual design principles, Figure 5.1 provides a working model. This model is organized in five phases with stakeholder input and feedback to be tailored specifically for BUSE.



Source: Own Diagram (2026)

The model is not a linear pipeline but a dynamic system. Innovations come in at Phase 1, and at every stage a gate assessment is performed to assess readiness. Phase 3 is the key step and can be viewed as the key to the market-facing preparation. The Multi-Stakeholder Innovation Advisory Board is responsible for governance, and this covers the stakeholder perception problems directly. The Continuous Feedback Loop makes sure the model learns and changes, which is not the case currently. The entire system is embedded within Zimbabwe's Education 5.0 mandate and the specific institutional and economic context, so that it isn't just a foreign transplant but a contextually grounded solution.

5.5.11 Recommendations for Further Research

Innovation Commercialisation in Zimbabwean Universities 109. Several additional areas for future study are suggested by the results: (a) A long-range longitudinal tracking of actual innovations which advance through the proposed working model is needed to demonstrate conversion rates for each stage, and key innovation stage failure points. (b) Comparative case study approaches utilising more Zimbabwean university innovation hubs would facilitate distinction of between institutionally-specific and generally pervasive, systemic factors. (c) The psychological and attitudinal determinants of academic willingness to engage with commercialization should be investigated using, for example, models such as the Theory of Planned Behaviour. (d) Potential utilisation and the support structures to provide the innovation mentoring, market access and patient capital required for Zimbabwean university innovation to flourish should be explored. (e) Given the significant economic turmoil within which such commercialization must contend, time-series analyses are the appropriate techniques with which to examine the impact of these events upon innovation commercialization activities in this context. The SEM which has been established here therefore provides a validated measuring model that would be suitable for such future inquiry.

5.5.12 Evaluation of Commercialization Frameworks

The presence of so many varied stakeholders in the current study including the hub management, the students, alumni, staff and other external stakeholders also confirms that an adequate measurement system that reflects multiple viewpoints on commercialisation impact is required to provide a comprehensive understanding of the commercialisation success of the hub. It is suggested that the adoption of the balanced scorecard concept by the BUSE be utilised by the university that incorporates the measurement and assessment of performance within four

areas: (a) finance (revenue generated by venture, funding achieved, income generated from licensing; (b) customers/stakeholders (stakeholder partner happiness, innovator happiness and stakeholder and societal impact); (c) process innovation (rates of project stage development, duration from idea disclosure to market and number of patents lodged) and (d) innovation capacity/culture (skills gained by the students/research staff, cultural aspects of learning (eg. Change over time, number of returners)) be addressed. The use of a balanced approach to measurement would help to overcome the issue of currently having one report produced for the Ministry focused solely on output whilst at the university the actual commercial outcomes of the hub are still in their embryonic stages. A process would be recommended whereby metrics are reviewed each year by a Multi-Stakeholder Innovation Advisory Board, so that a relevant metric profile is maintained that supports and shapes behaviour for optimal outcomes for all involved.

5.6 Chapter Summary

In chapter 5, we synthesized our major findings, made conclusions and set out a comprehensive and empirically-supported set of recommendations. In chapter 5, we presented the findings from our mixed-methods study and found that despite strengths in its prototyping facilities, the hub possessed significant deficiencies in its commercial engagement functions, enablers for commercialisation, stakeholder engagement and its feedback loop mechanisms. We concluded that failure in commercialisation is endemic and a misalignment between stakeholders represents a fundamental failure in coordination. Based on detailed findings on each study demographic and statistical category we established a menu of 11 different categories of recommendations to address the systemic failure. Finally, we presented the BUSE Innovation Commercialisation Working Model – a 5-phase board managed and feedback led system that it is hoped will enable success and provide a viable route across the technology Death Valley in order to deliver on the promise of Education 5.0 of transferring prototype innovations into economic and social benefit.

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INTRODUCTORY LETTER INTERVIEW REQUEST



31 April 2026

Dear Respondent

My name is Calvin Penyani, a final year student at Bindura University of Science Education at the Graduate School of Business, student number B224179B and doing a postgraduate degree: Master of Leadership and Corporate Governance. I am conducting research on a Dissertation entitled: A working model towards the commercialisation of Innovation Hubs: A case of Bindura University of Science Education (BUSE) Innovation Hub.

I would like to know your responses with regards to the innovation commercialisation practices at BUSE Innovation Hub, key factors in innovation commercialisation, and challenges in implementing innovation commercialisation.

Please let me know your availability to complete the 10 to 20-minute interview. I will be grateful to perform the discussion with you at your earliest convenience before the 30th of April 2026, to fulfil the deadline requirements of the program.

Your responses are anonymous; your name will not be published unless expressly approved by yourself. You may skip any questions you are not comfortable with, and the responses will be solely used by myself to complete this research.

Below is a guide to the questions that I intend to ask.

Thank you for your participation.

Yours sincerely,

Calvin Penyani

+263 775807850 | calvnp8@gmail.com

SURVEY QUESTIONNAIRE

Title: Assessment of Innovation Commercialization at BUSE Innovation Hub

Introduction:

This survey is part of a Masters study aimed at developing a working model for successful innovation commercialization at Bindura University of Science Education. Your participation is voluntary and anonymous. Data will be used solely for academic purposes. Tick were appropriate.

Section A: Demographics (Institutional Context)

1. Role at BUSE:

- ☐ Student innovator
- ☐ Alumni innovator
- ☐ Faculty supervisor
- ☐ Hub staff/management
- ☐ Researcher

2. Duration of involvement with Innovation Hub:

- ☐ less than 6 months
- ☐ 6–12 months
- ☐ 1–2 years
- ☐ more than 2 years

3. Type of innovation you are working on:

- ☐ ICT/software
- ☐ Agro-processing/food
- ☐ Engineering/physical product
- ☐ Biotechnology
- ☐ Other specify: _____

4. Section B: Pre-commercialization Support

Please indicate the level of support on the scale below with being 1=Very Poor, 2=Poor, 3=Not sure, 4= Excellent, 5=Very Excellent)

Item	1	2	3	4	5
Access to prototyping equipment and facilities					
Technical support for prototype development					
Assistance with market research and customer validation					
Support for intellectual property identification					
Training in business model development					

5. Section C: Commercialization Enablers

Indicate your level of agreement below where 1=Strongly Disagree, 2= Disagree, 3=Neutral, 4= Agree, 5=Strongly Agree)

Item	1	2	3	4	5
I have access to seed funding or grants through the hub					
The hub connects me with potential industry partners					
Mentorship from experienced entrepreneurs is available					
The hub helps me understand regulatory requirements					

Item	1	2	3	4	5
There is a clear pathway from prototype to market					

6. Section D: Stakeholder Engagement

Indicate the level of stakeholder engagement where 1=Very Poor, 2= Poor, 3=Not Sure, 4=Good, 5=Very Good)

Item	1	2	3	4	5
Communication between hub management and innovators					
Engagement of academic supervisors in commercialization					
Collaboration with industry partners					
Involvement of government agencies (e.g., NVCCZ)					
Community/civil society engagement (Quadruple Helix)					

7. Section E: Barriers to Commercialisation

Indicate strength of barrier to commercialisation where 1=Not a barrier, 2=Slight barrier, 3= Neutral, 4= Barrier, 5=Major barrier)

Item	1	2	3	4	5
Lack of early-stage funding					

Item	1	2	3	4	5
Weak intellectual property management					
Limited industry linkages					
Insufficient business/entrepreneurship skills					
Misaligned academic incentives for faculty					
Economic volatility (inflation, forex)					

8. Section F: Outcomes and Feedback

Kindly indicate your view on outcomes and feedback where (1=Never, 2= Sometimes, 3= Not sure, 4= Rarely, 5=Always)

Item	1	2	3	4	5
My innovation has reached market-ready stage					
I have received feedback from hub on my progress					
The hub adapts its support based on past experiences					
There are clear metrics for tracking commercialization success					

Section G: Open-ended Questions

1. What is the single biggest challenge you face in commercializing your innovation at BUSE?.....
.....
.....
2. What one change would most improve the BUSE Innovation Hub's ability to help you succeed?.....
.....
.....



INTERVIEW GUIDE INTRODUCTORY LETTER

31 April 2026

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Below is a guide to the questions that I intend to ask.

Thank you for your participation.

Yours sincerely,

Calvin Penyani

+263 775807850 | calvnp8@gmail.com

INTERVIEW GUIDE

Study Title: Developing a Working Model for Innovation Commercialization at BUSE Innovation Hub, Zimbabwe

Informed Consent Statement:

This interview will take approximately 45–60 minutes. It will be audio-recorded with your permission. Your identity will be anonymized.

A. For Hub Management / Leadership

1. Describe the strategic vision of the BUSE Innovation Hub. How does it align with Education 5.0?
2. What governance structures currently guide decision-making? Is there an advisory board?
3. How do you measure success? What metrics do you track?
4. What are the biggest operational challenges you face in moving innovations from prototype to market?
5. How do you manage relationships with industry, government, and investors?
6. Describe any feedback or continuous improvement mechanisms currently in place.
7. What resources or capabilities are missing that would most improve commercialization outcomes?

B. For Student Innovators / Alumni

1. Walk me through your journey from idea to prototype at the hub.
2. What support was most helpful? What was missing?
3. Have you been able to protect your intellectual property? If not, why?
4. Describe your interaction with industry partners or potential customers.
5. What would need to change for your innovation to reach the market successfully?
6. How does the hub help (or fail to help) you develop entrepreneurial skills?

C. For Academic Supervisors / Faculty

1. How are you involved with student innovations at the hub?
2. Does the university recognize or reward your engagement with commercialization?
3. What tensions (if any) do you see between academic research and commercial objectives?
4. How would you assess the IP management and technology transfer capacity at BUSE?
5. What role should faculty play in the proposed working model?

D. For Industry Partners / Private Sector

1. Have you ever collaborated with BUSE Innovation Hub? If yes, describe.
2. What would make university innovations more attractive to your company?
3. What barriers prevent stronger university-industry linkages in Zimbabwe?
4. Would you consider licensing a BUSE-developed innovation or investing in a spin-off?
Under what conditions?

E. For Investors (e.g., NVCCZ, angel investors)

1. What criteria do you use to evaluate early-stage innovations for funding?
2. Have you funded any university-originated ventures in Zimbabwe? Challenges?
3. What would increase your confidence in investing in BUSE-generated innovations?
4. How could the hub better prepare ventures for investor readiness?

F. For Government / Policy Officials (Education 5.0)

1. How does Education 5.0 mandate commercialization, and what support exists?
2. What gaps do you see in the current innovation ecosystem?
3. How does the National Venture Capital Company interface with university hubs?
4. What role should government play in bridging the technology Death Valley?



Observation Checklist: Hub Operations and Facilities

Purpose: To objectively document physical infrastructure, activities, and interactions at the BUSE Innovation Hub.

[OBSERVATION FORM]

Date: _____ **Time start/end:** _____ **Observer:** _____

Dimension	Indicators	Present? (Y/N)	Notes
Infrastructure	Prototyping equipment (3D printers, lab gear)		
	Co-working/meeting spaces		
	Internet reliability		
Activities	Training/workshop in progress		
	Mentor session occurring		
	Industry visitor present		
Interactions	Student–faculty discussion on commercialization		

Dimension	Indicators	Present? (Y/N)	Notes
	Hub staff assisting with IP/business planning		
Feedback	Visible feedback boards or reporting tools		
	Evidence of previous feedback being acted upon		



Document Analysis Checklist

Purpose: To systematically review existing BUSE and national policy documents for evidence of commercialization frameworks, IP policies, and feedback mechanisms.

DOCUMENT ANALYSIS FORM

Document Type	Specific Document	Data Extracted
University policy	BUSE IP/Technology Transfer Policy (if exists)	Ownership rules, royalty split, inventor incentives
Hub operational docs	Innovation Hub charter or SOPs	Governance structure, entry/exit criteria, success metrics
National policy	Education 5.0 framework	Commercialization mandate, reporting requirements
Funding guidelines	NVCCZ investment criteria	Eligibility, stage focus, application process
Performance reports	Hub annual reports	Number of prototypes, spin-offs, patents, revenue

PERMISSION TO CARRY OUT RESEARCH



BINDURA UNIVERSITY OF SCIENCE EDUCATION

P. Bag 1020
Bindura, Zimbabwe

Tel: (066) 210 66210-7615
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REGISTRY DEPARTMENT

27 April 2026

Mr. Calvin Penyani
Advancement and Public Affairs Department
Bindura University of Science Education
P. Bag 1020
BINDURA

Dear Mr. Penyani

RE: APPLICATION FOR PERMISSION TO CARRY OUT RESEARCH AT THE BINDURA UNIVERSITY OF SCIENCE EDUCATION: MR. CALVIN PENYANI

The above subject refers.

Bindura University of Science Education has granted your permission to undertake research on the topic "A working model towards the commercialization of Innovation Hubs" under the following conditions:-

- a) That you should treat all information strictly with utmost confidentiality and purely for Academic purposes.
- b) That in carrying out this research, you shall not disturb the business of the University.
- c) That the permission can be withdrawn at any time by the Registrar or by any higher officer.
- d) That you shall avail to the Bindura University of Science Education a copy of your research findings.

I wish you success in your research work and in your studies. If you have any concerns or require additional information please feel free to contact the Registrar.

Yours Sincerely

J. Makunde (Mr)
REGISTRAR

This letter cancels and supersedes the one dated 24 April 2026.

TURNITIN REPORT

CALVIN PENYANI B224179B



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