

Exploring the pathway of academic entrepreneurs: The case of Stellenbosch University



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Background: Universities globally face challenges of becoming entrepreneurial, delivering third mission activities, including the support of academic entrepreneurship. Abundant research exists on academic entrepreneurs in the United States (USA) and Europe. Limited research exists on understanding pathways of academic entrepreneurship in South African Universities.

Aim: The aim was to critically review the pathway of research commercialisation of academics at a research-intensive university.

Setting: This single case study focuses on one research-intensive university; a pioneer in the field of academic entrepreneurship in South Africa.

Methods: A qualitative research approach following a single-case study design was selected to investigate a phenomenon within its natural setting, using purposeful sampling and semi-structured interviews. The data were thematically analysed.

Results: The nature of research outputs takes a hybrid form, the awareness of the commercialisation of research is ineffectively communicated, supporting mechanisms Technology Transfer Office (TTO) are in place, factors hampering research commercialisation include time constraints and academics' willingness to partner with the university.

Conclusion: Context is bi-modal, meaning the institution is orientated towards basic research, Mode 1, while there is a transition of the research culture towards commercialisation of research, Mode 2, contributing to ineffective communication within the institution. Commercialisation extends the life cycle of research, and the recognition for publication in ranking metrics contributes to tension between commercialisation and publication of research.

Contribution: Theoretically, this baseline study provided insights into the pathway of Academic Entrepreneurship in the context of an intensive-research university. Managerially, this article reflects that ineffective communication of transition from Mode 1 to Mode 2 leads to internal tension.

Keywords: academic entrepreneur; academic entrepreneurship; commercialising research; entrepreneurial university; third mission; technology transfer office; triple helix.

Introduction

Background

Universities are key actors in regional entrepreneurship ecosystems as producers of knowledge and vehicles of knowledge transfer (Iwara & Kilonzo 2022; Lahikainen 2021). Commercializing university-generated knowledge has increased globally. Entrepreneurial universities synthesise overlapping concepts such as the universities' Third Mission, academic entrepreneurship, and the Triple Helix model. At the core of these concepts lies the conversion of university-generated knowledge to value. Technology transfer offices (TTOs) and incubators have been established to support the commercialisation of university-generated knowledge globally (Amry, Ahmad & Lu 2021; McAdam, Miller & McAdam 2017) and in South Africa (Alessandrini, Klose & Pepper 2013; Cullen, Calitz & Chetty 2020; Kruger, Steyn & Steyn 2020; Urban & Chantson 2019). The potential for research-based commercialisation has incited scholarly interest towards academic entrepreneurship for some time globally and more recently in South Africa (Perkmann et al. 2021; Urban & Chantson 2019).

Academic entrepreneurship is an innovative activity, by an academic staff member, that extends beyond traditional teaching and researching (Abreu & Grinevich 2013; Urban & Chantson 2019). Innovative activities refer to activities with the potential to deliver developmental outputs such as patents, licences and inventions (Miyata 2000) or business opportunities such as sensors for early

detection of diseases, inclusive of cancer, being commercialised by an academic entrepreneur at Stellenbosch University (SU). Academic entrepreneurship involves characteristics of both the individual and the institution (Urban & Chantson 2019). The new expanding role accommodating commercialisation and social impact of universities attracted attention of external stakeholders (Pinheiro, Langa & Pausits 2015; Wurth, Stam & Spiegel 2021) and as traditional societal frameworks are being re-engineered by globalisation, digitisation and turbulent environments universities are increasingly establishing their position in the commercial markets (Rothaermel, Agung & Jiang 2007). Universities have developed internal mechanisms to bridge activities to meet expectations of external stakeholders and actively contribute to socioeconomic development (Čábelková, Normann & Pinheiro 2017; Pinheiro et al. 2015) increasing the potential for societal impact. Active participation in commercialisation provides third stream income and consequently access to resources and capacity, thereby underpinning independence (Swartz et al. 2019).

South Africa represents an entrepreneurial environment where universities can play a role in managing the competitive and complex nature of modern society (Iwara & Kilonzo 2022). With 11 research intensive-universities South Africa exhibits advanced research milieus in many areas, such as medicine, life science and biotech (Alessandrini et al. 2013; Urban & Chantson 2019). However, Urban and Chantson (2019) found that South African universities are not efficient in commercialising research output. Institutions in emerging economies are found to impact entrepreneurial choice differently compared with developed countries (Pathak, Xavier-Oliveira & Laplume 2015). Of the 50 economies surveyed, South Africa scored insufficient on all 13 Economic Framework Conditions (EFCs) (Global Entrepreneurship Monitor 2019), which according to GEM are the key influencing factors of entrepreneurial activity on economic growth. Academics in emerging economies, such as South Africa, are discouraged by factors such as inadequate institutional support (Haeussler & Colyvas 2011). Nevertheless, South Africa attempts to strengthen its position globally, embracing the need to enhance the outputs of innovation to direct the country into a 'knowledge-economy', where economic growth is driven by innovation (Alessandrini et al. 2013). South Africa is leading among sub-Saharan countries, with strengths being the size of the economy, the accountability of private institutions, business sophistication, good-quality scientific research institutions, and a sound intellectual property (IP) regime (Alessandrini et al. 2013). But challenges remain regarding R&D and innovation capacity. To address this, South Africa is seeking strategies to support the entrepreneurial system, with universities playing an important role in skills development, research, intellectual property (IP), licencing and spin-offs (Alessandrini et al. 2013; Department of Science and Technology 2019; Kruger et al. 2020).

Contextual insights into institutional constraints and enabling factors are crucial for promoting academic entrepreneurship (Miller, McAdam & McAdam 2018; Snowball & Shackleton

2018). Despite growing interest in South African university entrepreneurship, research predominantly focuses on developed countries, with limited, in-depth exploration of the dynamics within individual prestigious institutions such as Stellenbosch University (Ismail 2021; Kruss & Visser 2017). This study, through a qualitative, case-study approach, fills this gap by investigating the unique interplay of factors influencing academic entrepreneurship from a process perspective in South Africa's emerging economy context. To address this void of research, the study attempts to identify facilitating and hindering factors in the pathway of research commercialisation. Pathway refers to the procedure(s) and challenges academics follow and deal with, respectively, to commercialise research output. To this end, the research question to guide the study is: *What is the nature of the pathway of academic entrepreneurship at Stellenbosch University?*

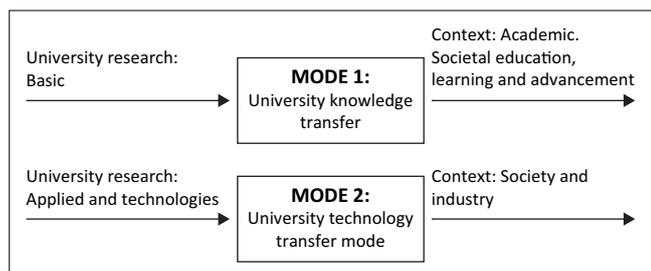
The rest of the article is structured as follows; Conceptual-model section, followed by research design and methods, findings, and a discussion of the findings. The article will end off with concluding remarks followed by the study's limitations, contributions and recommendations.

Conceptual framework

The entrepreneurial university

The entrepreneurial university concept emphasises the transformation of traditional universities into more proactive and innovative organisations that actively engage in entrepreneurial activities and commercialisation (Audretsch & Belitski 2021; Mascarenhas et al. 2017). This transformation is characterised by a shift in university missions, strategies and organisational culture, focusing on the creation, dissemination, and application of knowledge for socio-economic development (Audretsch 2017; Hayter et al. 2018). Entrepreneurial universities foster an environment that encourages and supports academic entrepreneurship through various initiatives, such as entrepreneurial education and learning, research commercialisation and community engagement (Audretsch & Belitski 2021; El-Sayed 2020; Rice, Fetters & Greene 2014).

Universities are experiencing a change in the institutional context of knowledge production and in the nature of the knowledge being produced (Limoges et al. 1994) and are encouraged if they are lagging (Dorji, Miller & Wu 2022). In Figure 1, the transition from Mode 1 to Mode 2 research demonstrates the shift from basic and traditional research, produced solely for an academic context, to applied research implemented in commercial and societal contexts. Mode 1 research is scientific-community-centric knowledge production, also referred to as basic research (Calvert 2006) not intended for extending to non-scientific application (Amara, Olmos-Peñuela & Fernández-de-Lucio 2019). Mode 2 research is problem-centric knowledge production (Frost & Osterloh 2003) extending basic research beyond scientific application (Amara et al. 2019). Mode 2 research is multidisciplinary (Callaghan 2019) characterised by inter-



Source: Adapted from Miller, K., McAdam, R. & McAdam, M., 2018, 'A systematic literature review of university technology transfer from a quadruple helix perspective: Toward a research agenda', *R&D Management* 48(1), 7–24. <https://doi.org/10.1111/radm.12228>

FIGURE 1: Knowledge production modes.

and trans-disciplinary collaboration promoting interaction between scientific and non-scientific actors (Alsaeed, Hadjri & Nawratek 2023). This leads to a network of diverse stakeholders and interface mechanisms, which collectively can be seen as an entrepreneurial university.

Triple Helix in the South African context

The entrepreneurial university is embedded in regional particularities, which makes it imperative to understand the regional context. The Triple Helix (TH) model of innovation presents a perspective to help understand the relationships and interactions between the government, industry and university (Etzkowitz & Leydesdorff 1995). The philosophy behind the model is that in today's knowledge-based society, the potential for economic development lies in effective government–industry–university interactions that facilitate the production, transfer and application of knowledge (Cai & Etzkowitz 2020).

Wanjiru (2020) found that the linkages between South Africa's triple helix actors are weak and fragmented, and attributed these weaknesses to the lack of trust, lack of strategic direction, lack of know-how and limited funding. Additionally, Patra and Muchie (2018) identify that the university–industry link, although one of the most vital, is weak in South Africa, and recommend that all TH linkages need to be strengthened. This poses major problems as it creates gaps between TH actors, which limits knowledge transference and mobility, and consequently limits the potential for innovation and business incubation (Kruss & Visser 2017; Paños-Castro et al. 2021). For example, financial institutes and venture capitalists are hesitant to partake in early-stage university–government–industry partnerships. Strong TH links and systematic collaboration with measurable outputs, is vital for regional entrepreneurial outcomes (Miller et al. 2018; Zhou 2008). Promoting university–industry interaction requires a strategic approach that persuades academics of the potential economic and social benefits of industry engagement, such as research funding and greater research impact (Fini et al. 2017; Kruss & Visser 2017). The transference of innovations between university and industry is a complex process; therefore, in adherence to the *Intellectual Property Rights Act 51* of 2008, South African universities are required to set up TTOs.

Technology transfer offices

Traditionally, universities have been responsible for the transference of knowledge through education, embodied in human capital, and the advancement of new knowledge through research (Alfalih & Rasmoun 2020). Universities are moving beyond these two mandated missions towards more actively addressing the needs of industry and society. The third mission refers to university activities conducted for the purpose of knowledge transference for socioeconomic development (Compagnucci & Spigarelli 2020). The TTO acts as an interface mechanism between the university and the market and manages the commercialisation processes. Their functions, according to *IPR Act 51:40* (1) are 'the identification, protection, management and commercialisation of intellectual property and in intellectual property transactions'. One major benefit of the TTO is that academics do not necessarily have to compromise on their teachings and research while choosing to engage with commercialisation. Engaging in commercialisation and entrepreneurial activities often requires resources such as funding, expert knowledge and an entrepreneurial culture, which is crucial not only for motivating entrepreneurial action internally but also as a way of attracting partnerships and funding. Entrepreneurial culture in this instance refers to the propensity of the individual to engage in leveraging opportunities towards entrepreneurial outcomes (Foreman-Peck & Zhou 2013).

Facilitating and inhibiting factors

Researchers have identified several factors that facilitate or hinder academic entrepreneurship (Hayter et al. 2018), which can be broadly categorised into individual, institutional and environmental factors (Guerrero & Urbano 2016). Alternatively, by taking a stage-based approach, the facilitating and inhibiting factors can be categorised into pre-commercialisation phase and commercialisation phase (Miller, McAdam & McAdam 2014; Wood 2011).

Prior to commercialisation, there are various conditions that affect the academic inclination for entrepreneurial engagement (Hayter et al. 2018; Perkmann et al. 2021). Individual factors include; the academics' awareness of the opportunities and availability of support for commercialisation, individual demographics and culture, which includes personal attitudes, values and beliefs towards commercialisation, the academics' perceived behavioural control to perform entrepreneurial activities, and the motivation for engaging in commercialisation such as financial rewards, research funding, and personal or professional recognition. Institutional factors such as university culture, resources, incentive structures and university policy may also impact academics' propensity to engage in entrepreneurial activity.

The commercialisation phase encompasses the actual process of transforming research output into marketable products and can be affected by various facilitating or inhibiting factors (Cullen et al. 2020; Hayter et al. 2018; Perkmann et al.

2021; Urban & Gamata 2020). Factors that may facilitate the commercialisation process include entrepreneurial training and courses, mentors and management support, university TTO, and university incubator. Factors that may hinder academic commercialisation are conflicts of interest, conflicting incentives, time constraints, risk aversion, insufficient funding and bureaucratic hurdles.

The pathway of commercialisation for academic entrepreneurs is heavily influenced by the interplay between individual and institutional factors, as well as the facilitating and inhibiting factors at various stages of the commercialisation process. Ultimately, the commercialisation pathway is a complex and dynamic process, requiring a supportive environment and strategic alignment of resources and initiatives to maximise the potential for successful outcomes.

Research design and methods

A qualitative research approach following a case study design was selected to allow investigation of a social phenomenon within its natural setting (Neergaard & Ulhøi 2007). A single case study was used to produce multi-levelled and in-depth insights into the context of academic entrepreneurship at Stellenbosch University (Crowe et al. 2011). As a result of the contextually embedded nature of academic entrepreneurship, an interpretive paradigm was adopted as it acknowledges that reality is socially constructed and contextually routed (Guba & Lincoln 1994; Hennink, Hutter & Bailey 2020). Alongside the interpretive approach, the study considered and incorporated details about the social, political, cultural and historical context of Stellenbosch University. These elements of contextualisation are crucial, especially for South Africa's unique operational landscape (Kruss & Visser 2017), for interpreting the data as it provides a better understanding of the relevant background from which data were collected (Collis & Hussey 2009). Given the emerging and early-stage development of research into academic entrepreneurship in South Africa, Yin (2009) argues that a singular case can be justified. Stellenbosch University was purposively selected as the ideal case for this study as it is an established research-intensive university and has equipped itself for entrepreneurial support and engagement. The university was also a pioneer in South Africa, having a TTO established already in 1999 together with The University of Cape Town (Alessandrini et al. 2013).

Stellenbosch University was founded in 1918 and is in the Western Cape province of South Africa. Historically, there is evidence of impactful entrepreneurial activity as seen with the collaboration of Stellenbosch University, industry, and government for the establishment of Technopark in the 1970s. INNOVUS (TTO) was created as a division of the university, and strives to:

[M]aximizes Stellenbosch University's impact on the South African society by using the output of the University's research to promote entrepreneurship, creating new jobs and new products and services that address the needs of all of South Africa's citizens. (INNOVUS 2022)

To assist identification, development and commercialisation of research output, INNOVUS established the LaunchLab, SU's wholly owned incubator, to provide further business support.

Data collection

Data were primarily collected through semi-structured interviews, which followed an interview guide, allowing flexibility for further probing and ensuring that important themes were covered. The interview guide is developed and anchored in research literatures, the TTO, academic entrepreneurship and entrepreneurial university literatures to reflect the latest research knowledge. We adapted questions depending on the type of respondent: TTO managers and executive academic entrepreneurs, faculty and management (see the interview guides in Appendix 1).

The research was conducted at an institutional level with Stellenbosch University being the unit of analysis. Non-probability techniques, namely purposive and snowball sampling, were used to identify the appropriate participants for this study (Suri 2011; Taherdoost 2016). Participants were selected based on their occupation and/or involvement with entrepreneurial activities at SU.

While selecting respondents, we aimed to capture diverse perspectives, to map the 'overall nature of the pathway of research commercialisation for academic entrepreneurs at SU'. Hence, within the category of academic entrepreneurs, we selected novices and serial entrepreneurs, diverse disciplines and professors, PhDs, Post-doctoral fellows and master students. We also included the TTO perspective, the management and faculty perspective. Interviews (in total 14) were mainly conducted face-to-face, and a few digitally, and lasted from 60 to 90 minutes. The interviews were audio recorded after the participants full informed consent were obtained and transcribed verbatim using Otter.ai. See an overview of informants in Table 1.

To ensure the quality of the data, the breadth and depth of the data set were considered in alignment with the topic area (Reay 2014). The reliability and validity are consistent with the quality criteria for qualitative research according to Lincoln (1995). Credibility was ensured by purposefully selecting respondents who were either academic entrepreneurs or integral to the research commercialisation process at the university. Transferability was ensured by providing contextual detail of the case for the application of findings to similar contexts. Dependability was ensured by documenting and describing the process in relative detail, and confirmability was ensured by sourcing data from multiple sources and verifying findings.

Data analysis

The transcriptions were processed according to thematic analysis, which followed three levels of coding using open, axial and selective coding (Williams & Moser 2019).

TABLE 1: Informant information.

Participants (Pseudonyms)	Type of informant	Faculty/Discipline	Nature of interview
Bravo	Faculty member (FM)	Chemical Engineering	Face-to-face
Delta	Academic Entrepreneur	Physiological Sciences	Face-to-face
Echo	Academic Entrepreneur (AE)	Biotechnology	Face-to-face
Foxtrot	Academic entrepreneur (AE)	Physiological Sciences	Face-to-face
Golf	Academic entrepreneur (AE)	Electrical Engineering	Face-to-face
Hotel	Academic Entrepreneur (AE)	Biochemistry/Biotech	Face-to-face
India	TTO	INNOVUS	Face-to-face
Juliet	TTO and Chief Director at SU	INNOVUS	Online (Microsoft Teams)
Kilo	Faculty and Vice Rector (FM)	Research, Innovation and Postgraduate studies.	Online (Microsoft Teams)
Lima	Faculty member (FM)	Economics and Management Sciences	Online (Microsoft Teams)
Mike	Incubator	LaunchLab	Online (Microsoft Teams)
November	Faculty member (FM)	Economics and Management Sciences	Online (Microsoft Teams)
Oscar	Lecturer and Custodian of entrepreneurship	Stellenbosch Business School	Online (Zoom)
Papa	Faculty member (FM)	Economics and Management Sciences	Online (Microsoft Teams)

SU, Stellenbosch University; TTO, technology transfer office.

Open coding was used to identify broad thematic codes, which were later condensed through axial coding by identifying and grouping relatable codes. Based on selective coding, the identified themes were plotted according to an *a priori* process perspective. The coding and theme development process is depicted in Appendix 2. This portrayed the relationships between themes, as well as helped to identify missing data from the value chain. Additionally, the data were interpreted considering the broader context, thereby not viewing entrepreneurial activities in isolation but as part of an interconnected system.

Findings

While universities are migrating from Mode 1 to Mode 2 (Gibbons 2013) in their quest to increase their entrepreneurial status, the notion of the academic entrepreneur is receiving increasing attention.

Five themes emerged from the thematic analysis of the data: the nature of research outputs, awareness of the commercialisation of research, supporting mechanisms, factors hampering research commercialisation and willingness to partner with the university. The themes are discussed from a process perspective (Fini, Rasmussen & Wiklund 2018).

Theme 1: The nature of research outputs

Research is an important aspect of an academic's traditional three-point agenda, which is to educate, produce research and enhance positive societal impact. The primary interest is the academic entrepreneur, therefore, the focus is limited to research output. Research output can primarily take two formats, publication or commercialisation, and while publication enjoys the merit as a metric by which academics are rated, there is a growing pressure for the commercialisation of research. Commercialisation should be conducted under the protection of intellectual property. For the commercialisation of research, two conditions must be met: firstly, the academic must have an appetite for it, and secondly, the viability of the opportunity. It is evident

that there is a desire to translate research into a more impactful form. Foxtrot (AE) states the following:

'I wanted my research to be more translating, it must make a difference in people's lives. We are doing basic research, and it always felt like when will it ever make a difference. But now it looks like we can make a difference.' (Foxtrot, AE, Face-to-face interview)

Market-pull forces and contact with the TTO and incubator have contributed to the choice to commercialise research output. It is unclear whether earlier exposure to the TTO would have made a difference, with Foxtrot (AE) stating 'I think no, I wonder if it would have made a difference. I think my mindset was maybe not in that direction yet'. However, Foxtrot (AE) does believe that learning about innovation and commercialisation earlier could have made a difference, adding 'I think that's what is making all of us reluctant, because it's certainly new to us'. Foxtrot (AE) continues by saying:

'I think also it will benefit researchers, because now they will think more laterally and maybe not so discipline specific. Also, think more about applications and social impact.' (Foxtrot, AE, Face-to-face interview)

Foxtrot acknowledges that earlier exposure to commercialisation and innovation could have shaped his or her mindset towards being more open to alternative outcomes of research output. Furthermore, such a mindset could change the nature of the research output – because now it is aligned with application and social impact, not discipline-specific.

In some cases, the researcher is aware of the alternative outcomes from the research output. According to Golf (AE):

'So that motivated me, just the influence that you can have with valid research. And I also want to have that type of impact. But I know that I can't do that just with my research, my research needs to translate into other spheres.' (Golf, AE, Face-to-face interview)

Exposure to other academic entrepreneurs and the impact they had through the commercialisation of their research output has created a sensitivity towards the potential value

of commercialising research. This impact-driven and market potential sensitivity, along with the experience of the professor who had successfully spun out a company, is what lead to engaging with the TTO for commercialisation. Golf (AE) recognises that research can have a greater impact when the research output is transferable, to the market or industry. Golf (AE) elaborates:

‘When you do research, but you don’t apply it in a sphere, or you apply it in a vacuum, then I think you lose something. You don’t get a feel for what your research could really change, you see some figures, but it doesn’t really mean anything ... and that really helped me a lot to realize that I’m actually adding value.’ (Golf, AE, Face-to-face interview)

Golf (AE) expresses that only once research output is of transferrable nature, its application will extend beyond purely academic uses, thereby increasing the value that it adds. This requires research to be angled towards a specific market or problem. Evaluation of the viability of commercialisation of research requires some form of business acumen, which is not expected to be part of an academic’s natural forte, in the words of Foxtrot (AE):

‘I think our academics or myself included, we don’t really have a business like brain ... we are academics and not always aware of how to proceed with these types of things.’ (Foxtrot, AE, Face-to-face interview)

Academics are generally not expected to be commercially or market-orientated, however, in other cases, the ability to identify commercial value from research output was attributed to the exposure to an entrepreneurial environment earlier in the researcher’s life. According to Bravo (FM):

‘My mom was an entrepreneur. We had many startup small companies, and both of my elder brothers started and run their own companies, I think I have an eye for thinking about that ... But I think I have a sort of an idea about value commercialization’ (Bravo, FM, Face-face interview)

Growing up in an entrepreneurial-oriented family has exposed Bravo (FM) to various entrepreneurial activities. This exposure has normalised entrepreneurship and given the researcher a sense of the value of the commercialisation process and how to identify commercial value in research output.

Identifying the commercial value of research raises concerns about the balance between publishing and patenting. Traditionally, academics pursue publication as an outcome of research output. According to Foxtrot (AE):

‘Maybe academics should get a little more training on this type of thing. Because this on the one side and publish or perish on the other side.’ (Foxtrot, AE, Face-to-face interview)

This is reflected strongly in the data as most academics mentioned the *publish or perish* challenge. Furthermore, what was interesting was the lack of awareness surrounding the commercialising of research.

Theme 2: Awareness of the commercialisation of research

Findings gathered from the voices of faculty and lecturers reveal that cultivating an entrepreneurial mindset within the university is essential in raising awareness and facilitating the successful commercialisation of research. Papa (FM) explains that their mandate is to enhance entrepreneurship through teaching and research, but extends by stating:

‘It’s also about being an entrepreneurial university, about promoting and enhancing the entrepreneurial mindset in your community.’ (Papa, FM, Online interview)

This sentiment underscores the need for the university to not only impart subject matter expertise but also foster a proactive and resourceful mentality among their constituents. By doing so, they can better prepare students and researchers to navigate the complex process of turning their research into marketable products or services.

Awareness of commercialisation refers to the awareness of the possibility to commercialise research output and the awareness of the potential benefits to be realised from commercialisation for all the possible stakeholders. From the analysis of the data, four modes of commercialisation awareness are identified: an organic mode, role models, prior exposure to entrepreneurship, and networking (with spillover effect).

Organic mode: The organic mode refers to direct exposure to the notion of commercialisation in the natural setting of the work environment, but in an informal way. This organic or informal mode of awareness of commercialisation is evident in the case based on the response of India (TTO):

‘We try to spend about roughly a third of our time interacting with researchers and students and spending time in departments, walking to the labs, building relationship ... people get to know you and one researcher will tell another one and maybe there might be commercial potential, why don’t you contact INNOVUS. We are busy with marketing material as well as just explaining to people what we do, why we do it, how we can assist them.’ (India, TTO, Face-to-face interview)

Role model: It was found that most academics were also made aware of the option for commercialisation through role models, where supervisors, mentors and colleagues were the main sources. For example, according to Golf (AE):

‘I got to work with one of the lecturers who is also an academic entrepreneur. And that stood out for me because with his research, he helped a lot of people. And it also gave them a platform to speak into the public ... And that whole thing is super attractive to me.’ (Golf, AE, Face-to-face interview)

Golf (AE) was inspired by his or her role model, a fellow professor and study leader, whose applied research created awareness of the opportunities for greater social impact through commercialisation. Through establishing a presence in the faculties through direct engagement with academics, the TTO raises awareness of research commercialisation possibilities and

becomes aware of research projects with the potential for commercialisation. This is corroborated by Delta (AE):

‘It started with the awareness of whether your research may have some kind of IP. And that awareness was created through our TTO. They came here for scouting, to get to know your research ideas and identifying if there could be some potential.’ (Delta, AE, Face-to-face interview)

Prior exposure to entrepreneurship activity is evident in the comment earlier by Bravo (AE) that an early exposure to entrepreneurship provides sensitivity to the realisation of the value of commercialisation.

Networking: In other cases, awareness of commercialisation opportunities was established earlier in the researcher’s career. According to Hotel (AE):

‘We had Western Cape Biotech, which was servicing the Western Cape area and used to bring entrepreneurs to the university startup ecosystem, and then those people would present to undergraduates and show them opportunities, what they went through, and that’s where it started. It is that initial interaction, then they planted the seed and then from there, obviously, I always dreamed of having my own company.’ (Hotel, AE, Face-to-face interview)

It was interesting to find that there is a lack of awareness of the institutional and regional benefits of engaging with commercialisation. At a micro level, the researcher benefits by access to funding for continued research, the use of university infrastructure and equipment, and access to an innovation pipeline. The regional benefits include job creation, increased competition, new innovations, increased investments and improved overall standard of living.

Following the vision of a knowledge region, India (TTO) explained the regional benefits of commercialisation:

‘A critical mass of spinout companies around the university that attracts more entrepreneurs to the region, that attracts funders to the region, that attracts multinationals to the region.’ (India, TTO, Face-to-face interview)

India (TTO) explains the spillover benefits that the university can gain from when academics engage with commercialisation. Even though this does not have a direct impact on the researcher, the institutional benefits enable the university to provide more support. These benefits include access to funding, networks and partnerships, and enhanced reputation.

Theme 3: Support mechanisms: The technology transfer office and incubator

In support of entrepreneurship and the commercialisation of research output, the university has a two-pronged approach. On the one hand, it instituted mechanisms to support commercialisation in the form of the TTO (Innovus), and an incubator (Launchlab), and on the other, it promotes an enabling environment for research and strives to attract innovative talent.

According to Juliet (TTO):

‘Because we saw that we were starting to spin out companies much faster than before. And I wanted to create a place where our companies can thrive. But we are still as close as possible to the university so that we keep them close to the place of birth.’ (Juliet, TTO, Online interview)

The LaunchLab (LL) was created in 2013 as an incubator to help the TTO spin out companies by providing business support. Referring to the business support provided by LL, Foxtrot (AE) states the following:

‘If it wasn’t for the LaunchLab, I wouldn’t have been able to do this, especially in the early phase, with the patenting and contracts and everything ... I don’t think it will be possible without [their help]. Definitely not. I think our academics, myself included, we don’t really have a business-like brain. When we went through this program, they actually made it clear to us that we might need to focus on something, because we were all over the place with different things.’ (Foxtrot, AE, Face-to-face interview)

It was found that the TTO specifically focuses on providing legal support. According to Golf (AE):

‘They helped us to start the company in the sense of legally starting the company. I don’t know how to do that; they registered the company. They put us in contact with tax practitioners, financial practitioners, and legal people to do that.’ (Golf, AE, Face-to-face interview)

The data reflect a strong presence of legal-oriented support. India (TTO) provides a potential explanation for this by stating:

‘INNOVUS is the first technology transfer office in South Africa to focus more on spinning you companies than licensing ... But we say if we just ship out our IP through licenses, it’s like taking our natural resources, sending it to another country for value to be added, and then buying it back.’ (India, TTO, Face-to-face interview)

The focus on legal support is underpinned by the need to protect IP not only because it is required by law but also to retain the value and potential outcomes within the institution and region. Even though support mechanisms are available, several factors were hampering the academics from taking advantage of commercialising research. These can be categorised into factors hampering research commercialisation and factors hampering partnering with the university for commercialisation.

Theme 4: Factors hampering research commercialisation

This category of factors is not influenced by which route the researcher chooses for commercialisation and reflects the general factors hampering willingness to engage. These factors are the lack of time and key performance indicators (KPIs).

The data show that academics perceive the lack of time as a major challenge for engagement. According to Foxtrot (AE):

'It is difficult, it feels like I'm totally overwhelmed and overworked at the moment ... it's a lot of work, because I have a lot of post graduate students to get through the system.' (Foxtrot, AE, Face-to-face interview)

There is a general understanding that academics can spend 20% of their time on alternative activities. This raises concerns about whether the amount of 'available time' is sufficient for commercial engagement. According to Bravo (FM):

'It's a lot of effort. It's a significant outlay of my own time, and my students time, it's not trivial. And I think that the benefit one would get back from it is very limited.' (Bravo, FM, Face-to-face interview)

Bravo (FM) admits that the benefits gained from commercialising research are not worth the time it requires. Furthermore, Delta acknowledges that academia is his or her expertise, not business, making the situation challenging. Delta continues by stating:

'But I just want to add to that scenario, it's even harder because for example, this year I couldn't publish as much as I would normally because of workload ... But for us, that is actually a big sacrifice.' (Delta, AE, Face-to-face interview)

In addition to publications being part of academics' KPIs, most academics enjoy their research role. Not being able to do so may impede the willingness to engage in commercialisation. India (TTO) explains the challenge that academics face:

'They need to be involved with innovation, but it is not part of the key performance indicators, they must publish, but they also need to protect [IPR] the invention ... So it's basically one of the things that limit academic careers. If you spend too much of your time working on the innovation and not publishing enough - so you can't progress. So the idea is that you can still become a professor, but your options are not necessarily research, it can be innovation.' (India, TTO, Face-to-face interview)

For academics, balancing research publication and research commercialisation is challenging, especially because only one of them is a KPI. The next category of factors is related to when the academic chooses to partner with the university for research commercialisation.

Theme 5: Willingness to engage in research commercialisation in partnership with SU

The factors that discourage this partnership are the university capital structure, IP ownership, and incentive and/or rewards. When research output is patented and licenced, the university gives a fair compensation portion of the amount to the researcher(s). According to Bravo (FM):

'I think it's too small. It could be restructured a little bit to be fairer to the generator of the knowledge. It feels a little odd to me that I as the creator of the idea, and the generator of this new thing that must be pushed forward, gets only a third of the value back. It means that for me to start a business, it has to be absolutely amazing, like definitely going to make lots of money. Otherwise, it's definitely not worth it. So I think the incentive is in the wrong way ...' (Bravo, FM, Face-to-face interview)

The capital structure was a major factor that negatively affected the academic's willingness to partner with the university. According to Echo (AE):

'Our equity stake that we give our universities is higher than in other countries. So, its exorbitantly high, and we get very little return for that. We have strained relationship. We enjoy the people that we work with thoroughly, but they [the TTO executives] are working with an ecosystem that they can't change themselves.' (Echo, AE, Face-to-face interview)

Researchers invest a lot of time and effort into their research and wish to have a larger share of ownership of their intellectual property. Yet, because of university policy, researchers are obliged to spin-out from the university. According to India (TTO):

'The IPR Act mandates universities to identify innovation, protect it if it's possible and to commercialize it. This Act leads to frictions internally. It's not ever the intention to do business with somebody else's [the inventor's] intellectual property. So that's one of the big communication struggles that we try to overcome - is just to communicate the value that we add.' (India, TTO, Face-to-face interview)

Evidently, a few respondents in our study (Echo, AE and Bravo, FM), reflected this internal friction, and found the TTO support and guidance to be poor compared with the university's large portion of their IP. According to Bravo (FM):

'So it's a mixed culture and a confusing incentive ... The government has stipulated that all technology that is developed in the university is owned by the university, which I think significantly disempowers the researcher.' (Bravo, FM, Face-to-face interview)

Our data revealed some degree of internal friction at SU with respect to rewards and incentives encouraging researchers to disclose ideas and to pursue the commercialisation route. Researchers who pursued academic entrepreneurship recognised the value of translation and social impact and had a drive to create new companies and knowledge-intensive workplaces. But the workload in addition to academic obligations were substantial, and for a few, sharing the IP ownership with the university, was not perceived as a fair share. Yet, many of the academic entrepreneurs acknowledged the TTO and Launch lab's contribution in the process of commercialisation, including patenting, legal work, funding and market orientation of the research technology. The TTO on the other side, acknowledged the friction and difficulties for researchers to pursue commercialisation, and they aimed to establish trusting relationships with researchers conveying their competence, support and added value. Yet, the TTO role is challenging and requires an intricate balancing between legal frameworks (*IPR Act 51*), researchers interests and market and industry requirements.

Conclusion, discussion and theoretical implications

The exploration into the nature of the pathway of academic entrepreneurship at Stellenbosch University has resulted in five key themes. The themes provide an integrative 'scaffold',

painting a nuanced picture of the nature of the academic entrepreneurship pathway at Stellenbosch University, which is embedded within a transitioning research culture and shaped by both internal and external constraints and enablers. These themes encompass the nature of research outputs that oscillate between academic publishing and commercialisation, the varying levels of awareness about research commercialisation among academics, the supportive mechanisms instituted by the university such as the TTO and LaunchLab, the identifying factors that hamper research commercialisation, including time constraints and limited incentives, and finally, the academics' willingness to partner with the university in commercialising their research.

The commercial opportunity of the sensor for early detection of diseases, referred to earlier as an example, is evident of the interplay between the integration of different mechanisms to realise academic entrepreneurship. The importance of the TTO for evaluating the commercial viability of the opportunity and providing support for networking and access to funding is evident. The value of the academia–industry linkage to realise social benefit is highlighted, and thus the notion of the entrepreneurial university as the institution for commercialisation of academic research becomes apparent.

Furthermore, the findings reveal that the university can benefit from third-stream revenue, an extended life cycle for research, entrepreneurship opportunities for academics, and positive social impact from the economic utility of spin-out companies, such as employment opportunities, as well as attractive economic hubs in the event of a critical mass of spin-out companies.

From the data, it is argued that academics desire their research to have a wider impact than the scientific community. However, the culture of research at Stellenbosch University is in a state of transition. Naturally, not all research is easily commercialised, and research from some disciplines and faculties is more easily translated into new technologies and products, such as life sciences, biotechnology, medical sciences and engineering (Alessandrini et al. 2013). It is also essential that faculty recognise and champion the entrepreneurial mindset through, for example, entrepreneurial learning (El-Sayed 2020). By embedding the entrepreneurial mindset, universities can raise awareness and create a supportive environment for the translation of research output across faculties.

The nature of research output is a hybrid of commercialisation and publication orientated, framed by the 'publish or perish' on the one side and extending the research life cycle by upselling the value of research beyond the scientific community on the other. The SU institutionalised a TTO and the LL and is technically in Mode 2. This finding corroborates with the assertion that research commercialisation should not be homogeneously applied across the institution (Burgelman 1983; Kruss & Visser 2017; Sanders & Miller 2010).

In addition, engaging with innovative ideas for commercialisation purposes demands resources, especially

time. Academics find themselves under pressure to deliver their mandate, and as the commercialisation of research is not a required metric for academic ranking, it does not enjoy priority attention. The lack of incentives has been identified as a barrier to commercialisation of research (Farrell et al. 2022; Lubango & Pouris 2009) and it has been shown that incentives promote participation (AR et al. 2021). Furthermore, the data suggest that the choice of academics to willingly partner with the university in commercialization is influenced by IP ownership and the degree of influence or stake in the spin-out ventures. Given the *IPR Act*, and that academics are employed by the university and hence can leverage the university's resources, it can be argued that academic entrepreneurs should have the prospect of reaching a negotiated settlement in terms of ownership when research commercialisation is protected by competitive advantage as opposed to patent. Krusser and Visser (2017) conclude that heterogenous incentives tend to facilitate the preparedness of academics to participate in commercialising activity.

While the context of academic entrepreneurs is found to be in transition, there are opportunities for enhancing the migration of the research culture from Mode 1 to Mode 2. With the support mechanisms for the commercialisation of research in place, it is evident that the notion of research commercialisation has not been communicated effectively throughout the university; hence, a lack of awareness is a hampering factor for research commercialisation. Various modes of awareness have been found and universities may benefit from communicating awareness via the different modes.

The TTO and university's ambition of the third mission, including licencing and establishing spin-offs contributing to regional growth and job creation may however be challenging or even conflicting with the actual practice of the *IPR Act*. The difficult and balancing role of TTOs is acknowledged globally (Taxt, Høvig & Pettersen 2022) but may appear differently in emerging economies, with different economic development trajectories and high degrees of social and income inequality (Kruss & Visser 2017). Hence, TTOs and universities may face the dual challenge of connecting to global science, and of addressing local economic and social problems, of a more contextualised and urgent nature. The balancing roles of universities in emerging countries may thus seem more complex compared with advanced economies. It is essential for these institutions to adapt and improve their technology transfer practices to effectively achieve third mission ambitions, contributing to regional growth and job creation (Compagnucci & Spigarelli 2020; Fini et al. 2018; Wanjiru 2020).

This study contributes a nuanced, process-oriented understanding of academic entrepreneurship through its pathway to research commercialisation, revealing key factors at various stages. It delivers a detailed roadmap of the academic entrepreneurship journey, enhancing the existing literature. Furthermore, it emphasises the crucial roles of the TTO and university incubators in fostering academic entrepreneurship, particularly in contexts with limited public support.

Limitations and future research

The study has inherent limitations as a single case study and adding new cases and other research-intensive universities could increase generalisability. Furthermore, the study could strengthen research validity by encompassing more respondents, obtaining a more comprehensive and richer view of the themes being studied, for example, by including a larger number of academic entrepreneurs from all disciplines and faculties, more professors and educators, and employing more people at the TTO and Launch lab.

Future research should envisage to conduct more studies, both qualitative and quantitative, to fully comprehend the 'entrepreneurial' state of South African universities, regarding incentives, cultures and barriers for academic entrepreneurship. More research in this area can provide useful knowledge of how South African universities should stimulate to enhanced research-based commercialisation, job creation and regional growth. More research on academic entrepreneurship in an emerging economy context, such as South Africa, will contribute to expand our research knowledge in this domain, to include more varied contexts, reflecting distinct historical, economic, social and institutional realities affecting the third mission of universities and technology transfer policies and practices (Kruss & Visser 2017).

Managerial implications

A variety of programmes, events and communications to promote awareness of research commercialisation are encouraged in aspiring entrepreneurial universities. This may be incorporated during research method programmes with presentations by TTOs and incubator managers in departments and post-graduate lectures. Research commercialisation programmes and strategies should also be extended to, for example, biokinetics, music, training programmes, and at a different level – for social impact. Early exposure to entrepreneurship in curriculum and extracurricular activities across study programmes is also assumed to incite students for an entrepreneurial career. The commercialisation of research should be introduced as a metric for ranking academics, as an incentive, to diminish the inherent conflict of traditional academic activities and innovation.

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Authors' contributions

L.-A.L., G.S., and I.B.P. contributed equally to the development of the study, drafting, editing and submission of the manuscript.

Ethical considerations

Ethical clearance to conduct this study was obtained from the Stellenbosch University, RED: Social, Behavioural and Education Research (RED: SBE). (No. 21997, REC: 2021/08/05).

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Data availability

The data that support the findings of this study are available from the corresponding author, G.S., upon reasonable request.

Disclaimer

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Appendix 1

Interview guide

Academic entrepreneurs and faculty

1. Introduction

- What is your scientific field?
- What is your prior research and work experience(s)?
- How long have you been working at this university?
- Do you have any previous industry and/or entrepreneurial experience with spin-offs?

2. Background: Idea/technology (academic spin-off)

- Describe the project/technology-from early idea to actual stage?
- Who is part of your research team? (PhD, Post-doctoral fellow)
- Main driver/motivation behind the idea to commercialise the technology?
- Ambition with the spin-off project? Do you plan on creating a company?
- The balance between the entrepreneurial role and researcher role?

3. Capabilities and network: Academic entrepreneur and the team

- Competences relevant for commercialisation in your team: knowledge of markets/industry
- Relevant networks to commercialise?
- Specific barriers related to a lack of competence and networks

4. University entrepreneurial culture/incentives

- University's contribution to the project?
- The entrepreneurial culture at the university?
 - Department/university support? Test-facilities, use of labs, human resources
- Main barriers for academics
- Change in entrepreneurial culture at the university?

TTO as a facilitator

- How has your TTO contributed to the project? Patenting, funding, networks?

- TTO involvement during the project period?
- Satisfaction with the TTO support?

Management at the university

Key topics in research interviews:

- Strategy and incentives stimulating the entrepreneurial university, entrepreneurial culture, spin-off establishment, management of funds, programmes
- Research/publishing versus commercialisation, tensions and dilemmas
- Relations to external stakeholders, industry, market and investors

TTO managers and executives

1. Introduction

- Background: Education, work experiences
 - Role as a TTO executive
 - Project portfolio?

2. TTO function

- TTO organisation, mandate and financing
- The academic spin-off process?
 - Selection criteria?
 - Most important milestones in the early development phases?
 - Different funding for projects?

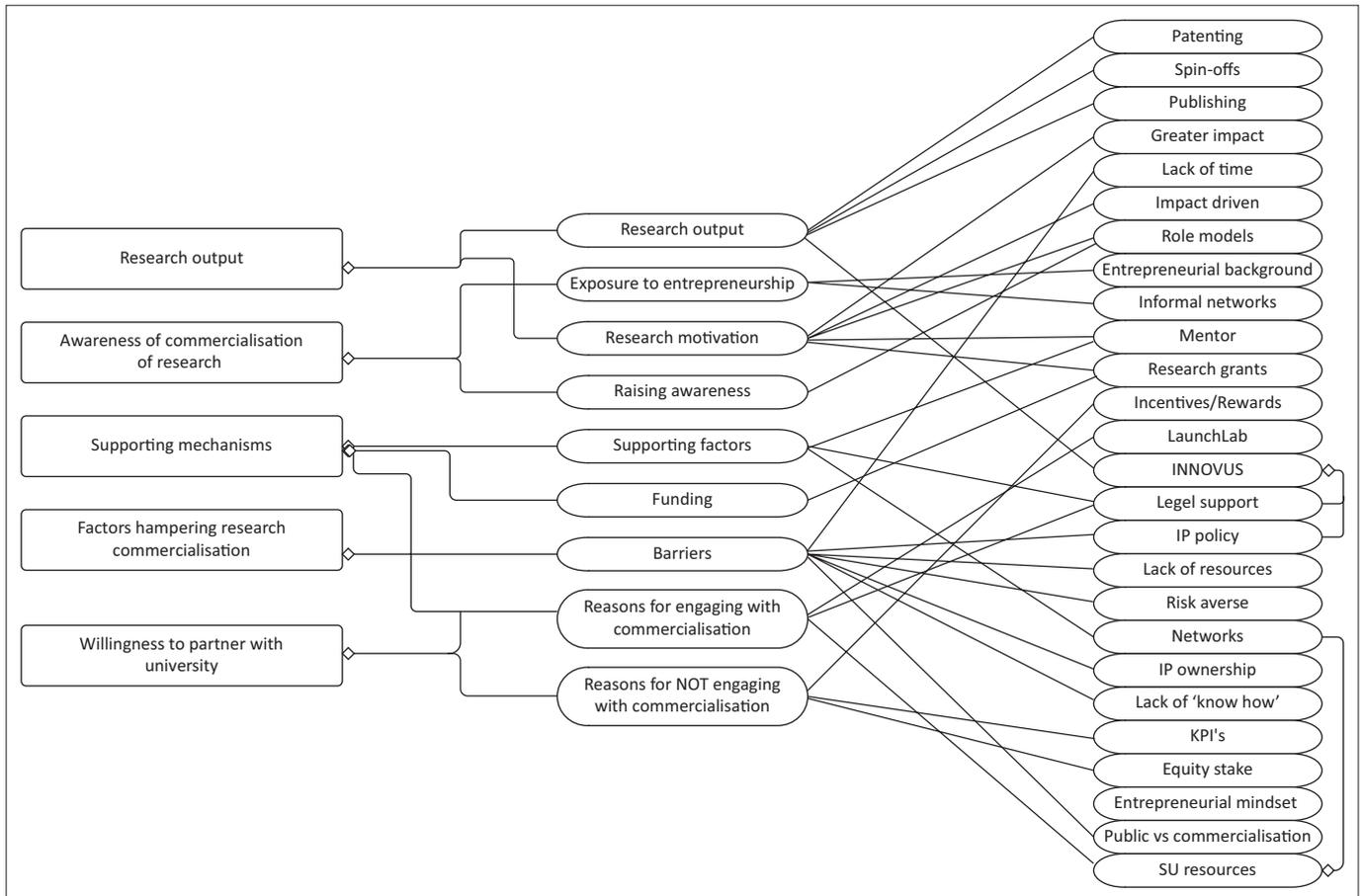
3. Academic entrepreneurs and capabilities

- Competencies researchers? (research/technology, prototyping/testing, commercial and market knowledge)
- Most important factors for successful development of spin-offs? Main barriers?
- TTO support? (commercialisation, market knowledge, patents)

4. Networks to industry partners and collaboration

- Contact with industry partners and networks?
 - Industry partner requirements? Main challenge regarding collaborations academia and industry? Research versus commercialisation?

Appendix 2



IP, Internet protocol; KPI, key performance indicators; SU, Stellenbosch University.

FIGURE 1-A2: Coding and theme development.