

# Commercialisation dynamics system principles and support units of entrepreneurial universities



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**Background:** The Fourth Industrial Revolution has given rise to the demand for universities to produce knowledge and innovation. Universities play a significant role in equipping students with skills and knowledge conducive for commercialisation of innovation (CoI). This investigation addressed the commercialisation dynamics research gap of entrepreneurial universities.

**Objectives:** To investigate commercialisation dynamics of a strategic information management (SIM) system to facilitate the CoI process of an entrepreneurial university.

**Method:** This paper presents the qualitative component of a larger mixed method complex action research strategy. Data were collected through an in-depth face-to-face interview and analysed through descriptive content analysis.

**Results:** The results highlight successful CoI practices fulfilled through the signification framework for the SIM system for commercialisation dynamics of entrepreneurial universities. The system is based on various components deemed suitable for commercialisation.

**Conclusion:** This study has the potential to guide the University of Johannesburg (UJ), as well as other higher education institutions (HEIs) and institutions involved in entrepreneurship, innovation, and commercialisation, in creating an entrepreneurial environment for their innovators. Furthermore, this study can guide students, entrepreneurs, inventors, and innovators in terms of the process to follow to commercialise their business ideas, inventions, and innovation.

**Contribution:** The SIM system incorporates dynamic system principles with intervention benchmarks and has intervention keys that will provide innovators with the safety net that will assist them in converting their ideas into commercialised products and services.

**Keywords:** strategic information management; innovation and commercialisation; systems theory; higher education institutions; entrepreneurial universities; signification framework; intervention keys.

## Introduction

Although existing strategic information management (SIM) frameworks and systems exist as described by Galliers (1985), Myburgh (2002), and Galliers, Leidner and Simeonova (2020), the commercialisation dynamics system principles of SIM in the context of an entrepreneurial university presented a research gap. An investigation of the commercialisation dynamics was required in order to develop a SIM system to facilitate the commercialisation process. Universities play an important role in equipping students with skills and knowledge conducive for commercialisation of innovation (CoI). Commercialisation of innovation is part of an overarching research agenda in the information age (Datta, Reed & Jessup 2013).

The information age has given value to higher education institutions (HEIs) as the core source of knowledge and innovation development (Overton-de Klerk 2016). The information age introduced the Fourth Industrial Revolution (4IR), which has given rise to the demand for HEIs to produce new knowledge and innovation such as cloud systems, additive manufacturing, machine learning, and artificial intelligence for 'smart ecosystems' and 'smart innovation' (Kruger & Steyn 2020; Mhlanga 2021). Universities, be it private, public, entrepreneurial, comprehensive, technology or other focused universities, are regarded as HEIs that play a significant role within societies by teaching and educating a variety of students, generating new knowledge, and sharing knowledge (Eletter, Refae & Kaba 2020; Matli & Ngoepe 2021; Perkmann et al. 2013).

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Universities are generally viewed as one of the pillars for generating new knowledge, producing skilled personnel and citizenry, and stimulating innovation. Bansi (2016), and Overton-de Klerk (2016) identified innovation as one of the desired outcomes of government funding and businesses' investment for higher education, specifically on research and development (R&D). Research and development, innovation, commercialisation and entrepreneurship serve as proxy for a country's economic growth (Mhlanga 2021; Shane 2012; Sibanda 2008). The role universities play in developing and nurturing students' entrepreneurial skills varies. Some universities have knowledge management project offices, commercialisation units and strategic information management systems, while others do not intend on commercialising innovations, transferring technology, and managing information of strategic importance for commercialisation of innovation (Ismail, Majid & Omar 2011; Mabunda & Du Plessis 2022; Morland, Scott & Thomspson 2021).

The identified gap presented a research opportunity focused on commercialisation dynamics as the unit of analysis. To fill the gap, it was necessary to develop a SIM system to guide innovators through the complexities of commercialisation dynamics. This paper is focused on addressing the research question: 'What are the commercialisation dynamics system principles and support units of entrepreneurial universities?' The paper begins with literature review on universities creating an entrepreneurial environment, and the commercialisation stages and steps in entrepreneurial activities, followed by the research methodology, findings, analysis, discussion, conclusion and recommendation.

### Universities creating an entrepreneurial environment

Universities have the potential to contribute to the economy by creating an entrepreneurial environment (Kruger & Steyn 2020). The internationalisation and globalisation processes of universities have been issues for the past 10 years (De Wit & Deca 2020). Along with the issues of internationalisation and globalisation is the rising number of youth unemployment on the one hand (Matli & Ngoepe 2021), and on the other hand, the increasing student population especially in the South African context. These issues add financial burden and deepen South Africa's economic crisis. To combat the economic crisis, universities must develop an entrepreneurial organisational culture.

The organisational culture of a university builds on principles of trust, integrity, teaching and learning excellence, academic research ethics, information and knowledge sharing, knowledge creation, knowledge networks, management information, funding, transparency, good governance, resolution, proof of principle, innovation, commercialisation, and commercialisation of innovation (Arnaut 2019; Datta et al. 2013; Rooke 2017). Some universities have studied their principles relating to information and knowledge management (IKM), such as knowledge sharing, knowledge mentoring, information security, information technology factors, knowledge incentives, innovation, research

data management and other IKM principles (Akosile & Olatokun 2020; Anduvare & Mutula 2019; Musembe & Mutula 2019). Other universities have studied the rise in entrepreneurial activities at universities which are practised in the form of licencing, research joint ventures with private businesses, patenting, and the creation of spin-off companies (Lui 2012:91). With the development of university-based intellectual property (IP), CoI and spin-off business, the phenomena of entrepreneurial universities are not strange (Lui 2012).

Entrepreneurship education is not merely teaching an individual to run a business; it is about teaching students on how to develop businesses and sustain them (Rooke 2017). This includes teaching students how to identify and pursue opportunities through generating new innovations and ideas and locate the necessary resources, the ability to manage and operate a new business, and how to think creatively (Hassan, Khan & Nabi 2017). Organisational culture and principles are important for determining whether innovators are encouraged to maximise the opportunity to commercialise their commercialisable ideas and entrepreneurial activities (Datta et al. 2013).

### Commercialisation stages and steps in entrepreneurial activities

There are various stages involved in the development and commercialisation of products and services and the following can be considered as a standard step-by-step process or stage-gate system to product development and commercialisation. The gates were identified by Rajkovic, Arh and Vaupot (2011). In stage 1, gate 1, the idea is properly assessed as part of the initial screening; this involves assessing different alternatives and making the decision whether to go through with the business idea or project. Stage 1 consists of preliminary assessment on the market and assessment of the technical aspect of the idea. This stage involves the assessment of the market to determine the market availability, market acceptance and competition in the market environment (Rajkovic et al. 2011). In this stage, pre-disclosure, invention disclosure and idea protection are assessed and practised (Rajkovic et al. 2011).

In stage 2, gate 2, the focus is on screening the above-mentioned assessment; this means a detailed business investigation or research is conducted on the market (Rajkovic et al. 2011). Gate 2 requires studies on the feasibility and viability of the business idea; the focus is on users' needs and wants, testing the concept and conducting a proper market analysis. Business analysis and financial projections and indication are practised. In stage 3, gate 3, a decision must be made on the business plan, and this is normally done before moving to the development stage. Gate 3 requires a decision on whether to form a start-up or partner with an existing business and licencing agreements are signed (Rajkovic et al. 2011).

Stage 4, gate 4, is based on the development, prototyping and review of the product (Rajkovic et al. 2011), and in this stage,

various tests are conducted, especially the validation of the innovation is conducted. Tests include in-house tests, demo tests and field tests with the customers. Gate 4 requires efficient testing of innovation viability in the market. Lastly, stage 5, gate 5, is based on a pre-commercialisation analysis of the business and financial analysis. Gate 5 requires a full production when the marketing launch is implemented through a proper market plan (Rajkovic et al. 2011). The process of commercialising innovation is complex and implies commercialisation dynamics system principles. A university's organisational culture and principles either create an entrepreneurial environment or restrain entrepreneurial activities. The next section describes the research design and methods for investigating the commercialisation dynamics system and support units of entrepreneurial universities.

## Research methods and design

This section describes the qualitative research component of a larger mixed method complex action research (AR) strategy. The larger study consisted of quantitative research and qualitative research, and the qualitative research (Khumalo & Du Plessis 2023), had two components, namely business case study (BCS) content analysis and an in-depth face-to-face interview. This paper presents the interview component of the AR strategy, illustrated in Figure 1, cycle 1.

Figure 1 illustrates this study's AR strategy consisting of three cycles of diagnosing, planning action, taking action and evaluating action which ultimately produced a SIM system for commercialisation dynamics of entrepreneurial universities (Khumalo 2022). This paper relays findings from AR cycle 1 of data collected and analysed through descriptive content analysis for sensemaking as described by Saunders et al. (2016). According to Saunders et al. (2016:186–187), AR is research with purpose, process, participation, knowledge and implications. The researcher's interpretation was that an AR strategy referred to the involvement of practitioners in research and a collaborative equal partnership between various research participants, whether they were internal or external participants. In this study, the researcher was part of the organisation within which the research and change were taking place. The AR purpose was to develop a SIM system that would act as a safety net to safeguard innovators while they were walking on the tightrope of CoI complexity. The AR unit of analysis was commercialisation dynamics which included relevant principles, stages, synergies, capabilities, competencies, skills, pitfalls, benefits, best practices, processes and activities for commercialisation of business ideas and innovations. By analysing commercialisation dynamics, the researcher would then be able to develop a SIM system.

The AR strategy was best suited for this research taking into consideration the practical application of a signification framework's intervention keys. A retroductive approach was chosen for this study because it combined well with an AR

strategy of which the findings had to be generalisable to support innovators across all departments of an entrepreneurial university. This paper presents the qualitative research carried out through an in-depth interview which was conducted with UJ entrepreneurship and commercialisation units. These were UJ Project Management Office, UJ Commercialisation & Technology Transfer Office, UJ Centre for Entrepreneurship, UJ Izindaba Zokudla, UJ Process, Energy & Environment Technology Station (UJ-PEETS), and UJ Technopreneurship Centre.

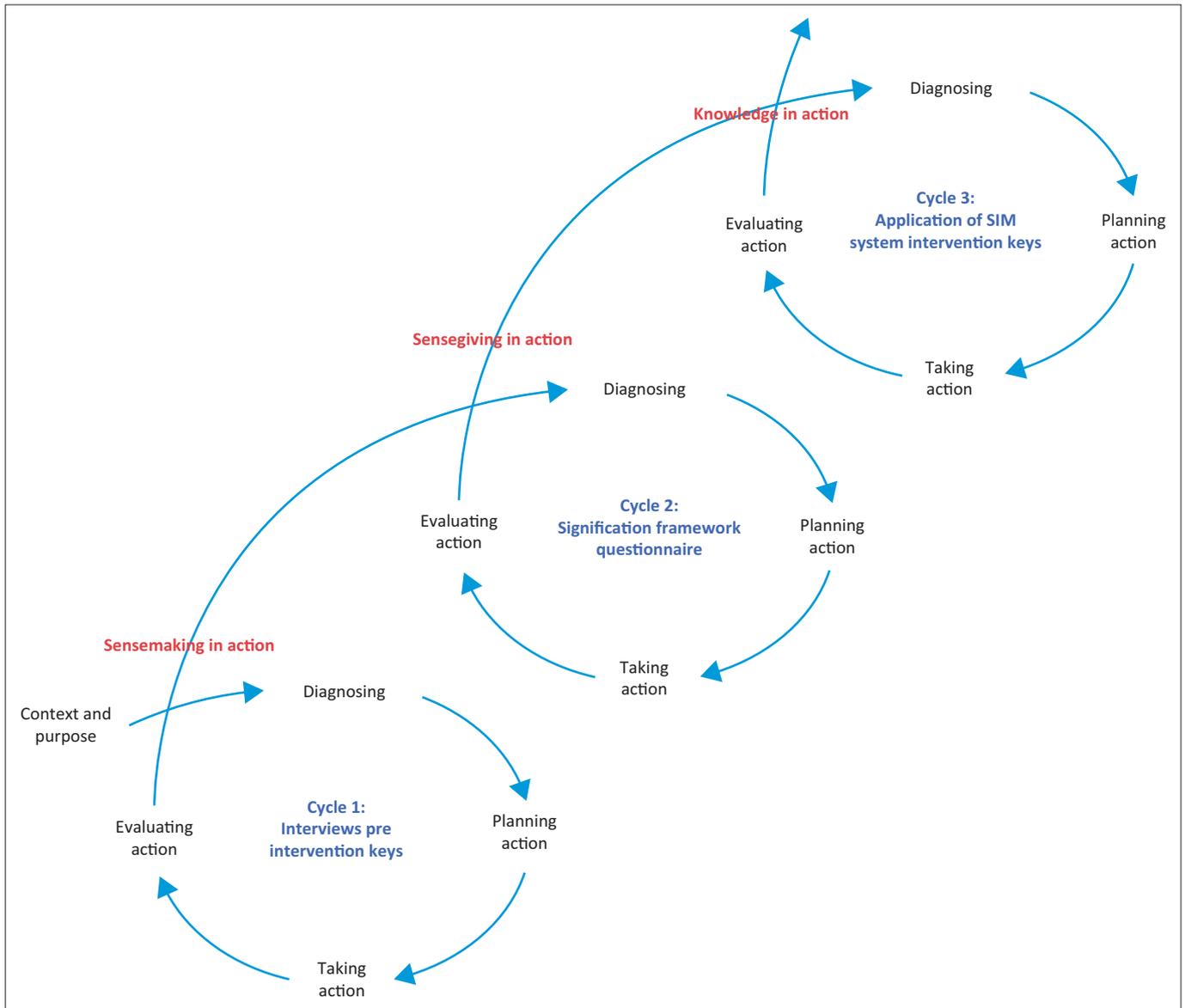
The sampling method for this study was non-probability sampling, that is, purposive. Purposive sampling is the deliberate and thoughtful selection of the right participants for the research project (Saunders, Lewis & Thornhill 2009). The data from the in-depth interview were analysed using the qualitative descriptive content analysis method to obtain a rich understanding from interpreting data using thematic coding techniques. The tools and features of ATLAS.ti qualitative data analysis software facilitated the process of thematic analysis with the commercialisation units. Data analysis was guided by the ATLAS.ti filter 'commercialisation of innovation'. What this means is the words 'commercialisation' and 'innovation' had to be in proximity of four words of each other in any order and allowing truncation. The study utilised a signification framework to make sense of the data collected, as illustrated in Figure 2 and Figure 3.

Figure 2 illustrates the first step in the signification framework method of reducing the original transcripts from the verbatim interview transcripts to produce the combined coded transcripts per colour coded analytical category, that is, what is an entrepreneur (yellow), key success factors of entrepreneurship (green), entrepreneurship benefits and/or advantages and challenges and/or pitfalls (teal), core skills and competencies required of an entrepreneur (blue), institution equipped student with skills (grey), entrepreneurial skills (pink), innovator character traits (red) and best practices (jade and olive green). The identification of principles of commercialisation dynamics was linked to each of the coloured themes; for example, best practice for commercialising a business idea is linked to the theme of entrepreneurship benefits and/or advantages and challenges and/or pitfalls, as evidenced by the large teal component in Figure 3 and principles listed in Table 1 in the findings section. This process allowed for triangulation of data by comparing findings from interviews with entrepreneurs and support units in the second step of the signification framework illustrated in Figure 3.

Figure 2 and Figure 3 illustrate the steps in the signification framework method of relevance to this paper, whereas Khumalo (2022) describes three complete AR cycles, further demonstrating proof of concept, implementation and value.

## Ethical considerations

The researcher adhered to the University of Johannesburg code of academic and research ethics (University of



Source: Adopted from Saunders, M., Lewis, P. & Thornhill, A., 2016, *Research methods for business students*, 7th edn., Pearson Education, Harlow SIM, strategic information management.

**FIGURE 1:** Action research spiral.

Johannesburg 2007). The researcher's highest priorities were research ethics and good conduct. The first step was to apply for research ethics approval and clearance from the UJ College of Business and Economics Research Ethics Committee (CBEREC). The research project obtained CBEREC clearance (Code 01), which meant that the rating of the most recent application was approved in October 2018, and was assigned the clearance number IKM2018\_023.

## Research findings and discussion

This section presents the findings from the data collected through face-to-face interviews with 11 entrepreneurs and staff from UJ commercialisation units. This section begins with presenting the findings to these interview questions: What is a successful business idea? What are the best practices for commercialising a business idea or innovation? What are the key business principles to apply in testing the

viability of an innovation, idea, or product? The findings are summarised in Table 1, followed by an outline of commercialisation dynamics associated with competencies, skills and knowledge required within institutions to produce capable innovators, entrepreneurs, and business experts.

Table 1 presents the research findings regarding CoI dynamics. A successful business idea must add value to the customer and the society and gain profit. Conducting proper feasibility and viability studies for a business idea, acquiring funding and protecting the IP are the best practices for commercialising a business idea. Applying design thinking, conducting viability and feasibility studies, market field test, and pilot or demo tests are key in testing the viability of a business idea. The dynamic system principles of CoI were derived by grouping the findings in Table 1, comparing findings with literature review



Yellow = what is an entrepreneur; Green = key success factors of entrepreneurship; Teal = entrepreneurship benefits and/or advantages and challenges and/or pitfalls; Blue = core skills and competencies required of an entrepreneur; Grey = institution equipped student with skills; Pink = entrepreneurial skills; Red = innovator character traits; Jade & olive green = best practices.

**FIGURE 2:** Interview transcripts combined colour coded analytical categories.



**FIGURE 3:** Interview transcripts reduced to themes.

findings, and comparing findings in thematic analysis, AR cycle 2.

The study identified dynamic system principles in seven categories:

- information management and innovation commercialisation dynamics
- ideation
- innovation
- design thinking
- intellectual property protection
- strategic information management
- project management.

The dynamic system principles form an integral part of the signification framework for the SIM system for commercialisation dynamics of entrepreneurial universities illustrated in Figure 4.

The findings presented from the qualitative component of the mixed method complex AR cycle 1 were added to the qualitative and quantitative findings in AR cycle 2 and AR cycle 3, which has led to the development of a SIM system, illustrated in Figure 4 (Khumalo 2022). The system will only be of value if certain signification framework elements are identified according to their significance to be able to develop an effective safe guiding intervention. The nexus of dynamic system

principles and intervention benchmarks is described by Khumalo (2022). The signification framework elements are the different agents that form the system, and these agents possess the embedded knowledge, insight, experience, skills, processes, architecting infrastructure, and methodologies to aid student innovators to effectively have their ideas commercialised. In turn, the agents will assist in the process of ensuring that student innovators develop into well-established entrepreneurs who own their businesses and contribute to the wealth creation. The findings presented in this paper contributed to developing the signification framework which demonstrates the value of SIM summarised in the next section.

### Contribution of study

The signification framework proposes the agents that would be essential for the development of a SIM system with intervention benchmarks that acts as a safety net and guides student innovators from innovation ideation to commercialisation of products or innovative ideas or services. The system is governed by dynamic system principles. This paper presents seven categories of dynamic system principles, namely information management innovation and commercialisation dynamics, ideation, innovation, design thinking, IP protection, SIM principles and project management. The contribution of this study is the SIM system for commercialisation dynamics of an entrepreneurial university, which includes the entrepreneurial university support units.

**TABLE 1:** Dynamics of commercialisation of innovation research findings.

Features of successful business idea	Best practices for commercialising a business idea	Key business principles for testing viability of idea
<ul style="list-style-type: none"> <li>• Add customer value</li> <li>• Add value to the business</li> <li>• Address social challenges</li> <li>• Clearly identified market need</li> <li>• Commercialisable product</li> <li>• Create an impact on society</li> <li>• Create financial benefit</li> <li>• Drive profit</li> <li>• Driven by somebody keen on getting it to market</li> <li>• Facilitate production</li> <li>• Focus on customer-centric service or product</li> <li>• Implement idea in reality</li> <li>• Market segment needs product or service</li> <li>• Provide solutions</li> <li>• Resolve technical problems</li> <li>• Sweet spot product market fit</li> <li>• Understand market dynamics</li> <li>• Understand stakeholder criteria, for instance, the Technology Innovation Agency (TIA), Department of Science and Innovation (DSI), and Technology Station Program (TSP) requirements</li> </ul>	<ul style="list-style-type: none"> <li>• Accurate understanding of actual landscape precedes commercialisation</li> <li>• Buy-in from all stakeholders</li> <li>• Buy-in from different departments</li> <li>• Competitive intelligence</li> <li>• Competitor analysis</li> <li>• Design thinking</li> <li>• Develop solutions based on current market research</li> <li>• Embed social relations</li> <li>• Establish funding criteria</li> <li>• Imperative finance and procurement buy-in</li> <li>• Industry analysis</li> <li>• Intellectual Property (IP) protection</li> <li>• Investor potential</li> <li>• Licence to companies that are already existing</li> <li>• Meet minimum market need</li> <li>• Mentorship and guidance</li> <li>• Platform to test idea</li> <li>• Product viability</li> <li>• Proper feasibility study of start up</li> <li>• Pushing dream to actual target market</li> <li>• Research imperative</li> <li>• Right people understand right market</li> <li>• Royalties</li> <li>• Sign an arm's length agreement</li> <li>• Solving the right problem</li> <li>• Specific product or service</li> <li>• Spend time understanding customer pain points</li> <li>• Stakeholder engagement</li> <li>• Start up with money benefits</li> <li>• Start up without money challenges</li> <li>• Sustainability of resources</li> <li>• Technology Transfer Office (TTO)</li> <li>• Understand commercialisation criteria</li> <li>• Value chain analysis</li> <li>• Viability testing</li> </ul>	<ul style="list-style-type: none"> <li>• Accurate identification and interpretation of a need</li> <li>• Business idea testing</li> <li>• Feasibility and viability testing</li> <li>• Competitive intelligence</li> <li>• Competitor analysis</li> <li>• Demonstrate practical application</li> <li>• Design thinking</li> <li>• Establish market</li> <li>• Fund raising</li> <li>• Identify market need change</li> <li>• Intact management team</li> <li>• Market testing</li> <li>• Marketing budget</li> <li>• Minimum Viable Product (MVP)</li> <li>• Pilot demo</li> <li>• Pricing methodology</li> <li>• Proof of concept review</li> <li>• R&amp;D due diligence</li> <li>• R&amp;D finance</li> <li>• R&amp;D service continuity</li> <li>• Regression testing of software</li> <li>• Research path to market</li> <li>• Secure coding of application</li> <li>• Sequence of prototypes</li> <li>• Sustainable resources, funds, people support</li> <li>• Test market over time</li> <li>• Trust, trust, trust</li> </ul>

R&D, research and development.

## Strategic information management system for commercialisation dynamics of an entrepreneurial university

The signification framework illustrates the SIM system agents that are vital for the application of innovation and commercialisation of student innovators' innovative ideas. In the SIM system, the person is seen as important in the establishment, performance, implementation, execution and improvement of their innovativeness, driven by effective and efficient commercialisation of ideas. The person can come up with a unique idea that has the potential to be commercialised. To assist the person with the idea, certain facets can be adopted to improve their innovation and commercialisation process. The person must grasp the principles of commercialisation dynamics found in seven categories namely, information management innovation and commercialisation dynamics, ideation, innovation, design thinking, IP protection, SIM and project management principles. For example, SIM principles can be adopted to enable the person to identify vital information and knowledge systems and processes to ensure the effective deployment of ideas and these principles are also significant for the sustainability of a business.

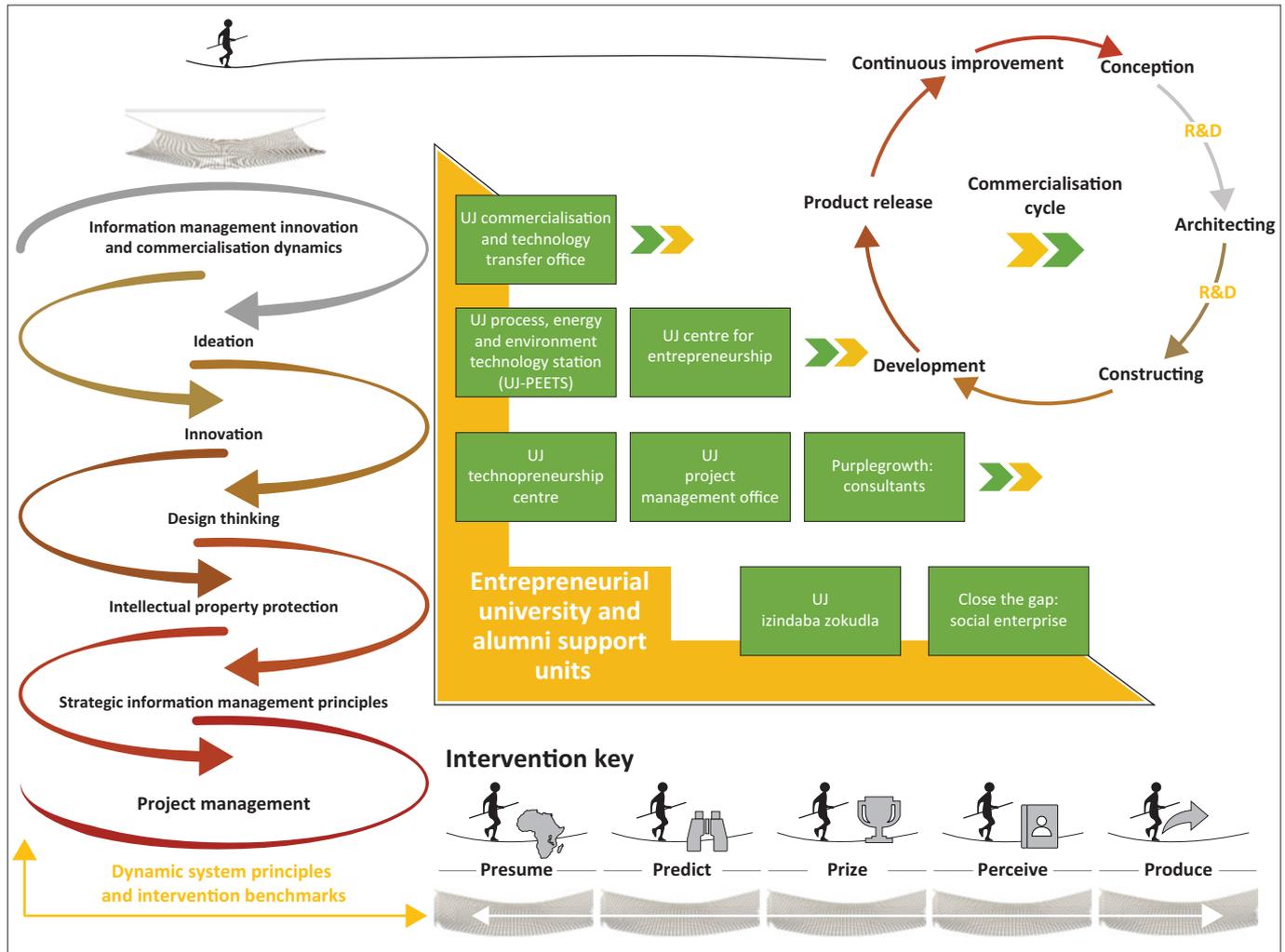
The dynamic system principles are all linked to the commercialisation cycle which is significant for ensuring the commercialisation of innovators' ideas. The commercialisation cycle will assist students in the process of introducing their products into the market. The signification framework outlines a system that can be formulated and designed as safety net to guide students from innovation to commercialisation of their ideas. The signification framework recognises the complexities of CoI and suggests dynamic

system principles and intervention benchmarks as the cornerstone of the SIM system. The main SIM system agent is the innovator's grasp of information management innovation and commercialisation dynamics. Equally important are the three other SIM system agents: entrepreneurial support units, commercialisation cycle, and intervention. The interaction of these four agents of the SIM system will not only ensure the commercialisation of innovation ideas but also help in mastering the creation and providing a product that adds value to customers.

## Entrepreneurial university support units

The literature review contribution of the study highlights entrepreneurial universities' focus on transforming their business approach to an entrepreneurial modus operandi (Farsi et al. 2012:194; Davey, Hannon & Penaluna 2016:172). An entrepreneurial focus enables the creation of innovative ideas that have the capability to be impactful and commercialised. In the context of this study, the supporting units relevant for the commercialisation of innovation include the UJ Izindaba Zokudla, UJ Technopreneurship centre, UJ-PEETS, UJ Commercialisation & Technology Transfer Office, UJ Project Management Office and UJ Centre for Entrepreneurship. These units can support the commercialisation of innovation within the UJ, and this can be done through different initiatives mandated by each of the units.

Entrepreneurial university support units through the commercialisation cycle must refine student innovators' characteristics of entrepreneurship and drive to ensure they become successful entrepreneurs. In general, support units such as TTOs and project management offices guide



R&D, research and development; UJ, University of Johannesburg.

**FIGURE 4:** Signification framework for the strategic information management system for commercialisation dynamics of entrepreneurial universities.

students in developing their products. However, entrepreneurial universities must also establish unique units that enable student innovators to be guided throughout their innovation until the commercialisation of their ideas; for example, the UJ Izindaba Zokudla specialises in urban agriculture innovation. Specialised support units have unique policy documents that stress the drive of entrepreneurship. They are linked to the project management offices which ensure the development and commercialisation of innovative ideas and more likely to identify intervention. The functioning of specialised support units and intervention keys rely on the effective implementation of commercialisation dynamics system principles (Khumalo 2022).

## Conclusion and recommendation

This study developed a SIM system through literature review and action research aimed at identifying commercialisation dynamics system principles to ensure the commercialisation of ideas, innovative products, and services. Universities must create an environment conducive for entrepreneurship to thrive if they wish to contribute to the economy through converting students' inventive ideas into commercial

products and services. This paper identified principles of relevance to the commercialisation of innovation through qualitative interviews conducted with an entrepreneurial university's commercialisation units and entrepreneurs. The development of the SIM system was based on the insights collected from entrepreneurs' business case studies, commercialisation units, and innovation experts. The SIM system incorporates dynamic system principles with intervention benchmarks and has intervention keys that will provide innovators with the safety net that will assist them in converting their ideas into commercialised products and services.

The study recommends commercialisation dynamics system principles that are fundamental to CoI; for instance, if funding is the major challenge most innovators come across, an intervention is required which means that entrepreneurial universities must create funding opportunities and models directly for viable and feasible innovations and ideas. The signification framework suggests how this can be achieved through continuous engagement with stakeholders who can provide funding and getting buy-in from them. Stakeholders mentioned by this study's interview participants were the Technology Innovation Agency, Department of Science

and Innovation, and the Technology Station Programme (cf. Table 1).

In conclusion, this study has the potential to guide HEIs and other institutions involved in entrepreneurship, innovation and commercialisation, in creating an entrepreneurial environment for their innovators. This study can guide students, entrepreneurs, inventors and innovators in terms of the process to follow to commercialise their business ideas, inventions and innovation.

### Limitation of study

The limitation of the study was its focus on one South African HEI. The recommendation of the study is therefore proposed for the consideration of the UJ, based on the observation by the researcher (Khumalo 2022).

### Future research

Future research should be conducted using staff members from commercialisation units within different South African universities, academic staff of universities responsible for teaching, as well as support staff of universities.

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### Competing interests

The authors declare that they have no financial or personal relationship(s) that may have inappropriately influenced them in writing this article.

### Authors' contributions

S.K. and T.d.P. contributed equally to this article. S.K. was a PhD student, supervised by T.d.P.

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### Data availability

Data is available from author S. Khumalo as part of the signification framework methodology in line with UJ ethics clearance code: IKM2018\_023.

### Disclaimer

The views and opinions expressed in this article are those of the authors and are the product of professional research. It does not necessarily reflect the official policy or position of any affiliated institution, funder, agency, or that of the publisher. The authors are responsible for this article's results, findings, and content.

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