Mapping Academic to Entrepreneurial and Intrapreneurial Transition Pathways for Water Graduates to Support Water Sector Innovation in South Africa

Report to the
Water Research Commission

by

Amélie M.L. Guyot-Staal, Janavi Da Silva, Monika van der Merwe and Elize Hattingh

The Youth Bridge Trust

WRC Report No. 3037/1/22
ISBN 978-0-6392-0508-3

November 2022

Obtainable from
Water Research Commission
Private Bag X03
Gezina
PRETORIA, 0031

orders@wrc.org.za or download from www.wrc.org.za

This report relates to WRC project no. C2021/2022/001057.

EXECUTIVE SUMMARY

The research question focused on how to improve the academic to entrepreneurial transition of water sector graduates in South Africa. This was examined through four lenses: (1) Graduates' readiness; (2) Graduates' skills and capabilities; (3) Are there certain business models that are better for them to start-up with?, and (4) How does the ecosystem support them and how could this transition process be improved?

Due to the limited research timeframe and scope, the aim was providing an initial map of the developmental terrain conducive to nurture a path towards entrepreneurship. Recommendations were made to guide further research and discussions with key stakeholders to create more depth and build on the body of knowledge. The methodology utilised was a qualitative approach and involved desktop research and conducting fourteen interviews with three samples: (1) Organisations that incubate entrepreneurs in the water sector; (2) Water entrepreneurs; (3) Organisation that work with innovators or/and intrapreneurs.

Findings indicated that most graduates are not yet ready to start an enterprise, this is partly due to graduates needing further capabilities, and resources. The fact that most graduates are not yet ready to start an enterprise, does not mean that they never will. Graduates that develop entrepreneurship self-efficacy will be able to engage in entrepreneurship at different points in their life's journey, when an opportunity (or need) arises.

The research study investigated the potential business models available to water graduates to consider as viable market entries. Findings suggest that the proposed Independent Water Producers (IWP) policy, will open access to markets and business models which were previously mandated only for government entities, widening the range of viable business in the sector. Furthermore, (municipal) procurement guidelines need to be reviewed in order to be more inclusive of Small Medium Micro Enterprise (SMMEs) that offer sustainable and innovative water management service provisions. A value chain model is suggested as a strategic way to support specific water markets ecosystem development.

The research also explored the role universities could play as a pipeline for research, development and innovation, preparing entrepreneurs within specific clusters of specialisation, in line with the Water RDI Roadmap. By partnering with niche water/green economy incubators, centres of excellence could be created – offering the balance of technical and research expertise as well as market intelligence and networks. Such centres of excellence could attract further public-private collaboration as well as investment funding for commercialisation.

Findings emphasise the importance of innovators having the option of owning their IP and a possible way for this to happen. The role of brokers is also highlighted. These are brokers between the innovator and private sector investment in commercialising IP. There are also intrapreneur brokers within private or public sector organisations that could broker the relationship between a new technology and their organisation, facilitate the uptake and assimilation of innovations within their organisation.

Acknowledgements

The project team wishes to thank the following people for their contributions on the project:

Reference group	**Affiliation**
Dr Chantal Ramcharan-Kotze	Water Research Commission
Dr Valerie Naidoo	Water Research Commission
Prof Presha Ramsarup	Centre for Researching Education and Labour
Michelle Hiestermann	Water Research Commission
Verena Meyer	Department of Water and Sanitation
Henry Roman	Department of Science and Innovation
Duncan Hay	Green Matter
Other	
Ntsiki Gumbe	Youth Bridge Trust
Farhana Jacobs (graphic designer)	
Edith Katzenellenbogen (proof-reader)	
Dr Lee-Ann Sade Modley	University of Johannesburg
Akhiro Vermaak-Ndlovu	Research Assistant
Organisations	
Fetola	
Indalo Inclusive	
The Business Clinic	
Imvelisi Enviropreneurs	
Ocean Hub Africa	
BN-Aqua Solutions	
Maskam Water	
Indalo Water	
WADER / WRC	
GreenCape	
Isle Utilities	
Avocado Vision	

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACRONYMS

EDA	Enterprise Development Agency
ESE	Entrepreneurial Self Efficacy
FRAs	Research Focus Areas
HEI	Higher Education Institutions
IVC	Innovation Value Chain
IWP	Independent Water Producers
NASA	National Aeronautics and Space Administration
PPP	Public Private Partnerships
RDI	Research, Development and Innovation
SDG	Sustainable Development Goal
TRL	Technology Readiness Level
UNEP	United Nations Environmental Plan
WADER	Water Technology Demonstration Programme
WRC	Water Research Commission

This page was intentionally left blank

1 INTRODUCTION

This research explores ways to improve the academic approach to entrepreneurial transition of water sector graduates, with the aim to map entrepreneurship, innovation and intrapreneurship water sector pathways in South Africa. This inquiry and the mapping of the pathways are focused on four questions: (1) What is the readiness of water graduates in supporting innovation and entrepreneurial solutions in SA? (2) What skill sets and capabilities need to be strengthened to enable water graduates to transition into entrepreneurial and innovation pathways? (3) What are the potential entrepreneurial and innovation business models available to water graduates to consider? (4) What is the role of universities, development partners and water sector institutions in helping to support and encourage these capabilities and SMME pipelines for water security in SA?

There are a number of programmes and organisations that aim to support entrepreneurs and innovators, some of which are water-sector specific and/or focused on graduates. Currently, however, these efforts are fragmented. The Water Research, Development and Innovation (RDI) Roadmap provides a high-level planning and strategy guide for resource allocation in the water sector towards capacity building, but no guide exists on how to support entrepreneurship, innovation and intrapreneurship in the water sector.

No map exists, and the journey, to becoming an entrepreneur, innovator or intrapreneur in the water sector in South Africa, is challenging in many ways. Beyond acquiring specific skills and abilities, the entrepreneurs, innovators and intrapreneurs will face sector specific challenges. This research is an initial scoping and mapping exercise that aims to map the terrain to enable better understanding of where to focus further research and discussion. Recommendations are offered to this effect.

1.1 Research questions

The question to be scrutinised is how to improve the academic to entrepreneurial and intrapreneurial transition of water graduates in supporting water sector innovation in South Africa. The research sub-questions are as follows:

a. What is the readiness of water graduates in supporting innovation and entrepreneurial solutions in SA?

b. What skill sets and capabilities need to be strengthened to enable water graduates to transition into entrepreneurial and innovation pathways?

c. What are the potential entrepreneurial and innovation business models available to water graduates to consider?

d. What is the role of universities, development partners and water sector institutions in helping to support and encourage these capabilities and SMME pipelines for water security in SA?

1.2 Research objective

This research aims to provide an initial map of the developmental terrain conducive to nurturing a path towards entrepreneurship. It is an initial scoping exercise that aims to enable a better understanding of where to focus further research and discussion.

1.3 Research outcomes

Outcomes of this research study consist of:

- A mapping of the developmental terrain conducive to nurturing a path toward entrepreneurship;
- Recommendations are made for further discussion, research and consideration.

In terms of impact, this research is fundamentally an action research endeavour and is limited by programmatic timeframes. In such a short timeframe, with a small qualitative sample, findings can only be suggestive and important points will need to be followed up by further studies or key sector stakeholder discussions.

1.4 Research framework

This research is the tail end of an action research incubator pilot programme that started in January 2022, with 300 water graduates. This research takes this pilot further, closing the programme learning loop by following seven added processes: (1) refining the most relevant sector questions in partnership with the WRC (the current research questions), (2) revisiting and expanding the literature review based on these new questions (3) identify models and framework that can be used as a foundation in mapping sector pathways, (4) conducting a series of sector interviews, (5) consolidating findings and providing recommendations for sector review that will (6) inform new programmes and (7) contribute to the understanding of water sector pathways for entrepreneurs and intrapreneurs.

It should be noted that in this report, only sector recommendations will be discussed. Recommendation for the programme itself will be discussed and reported on separately.

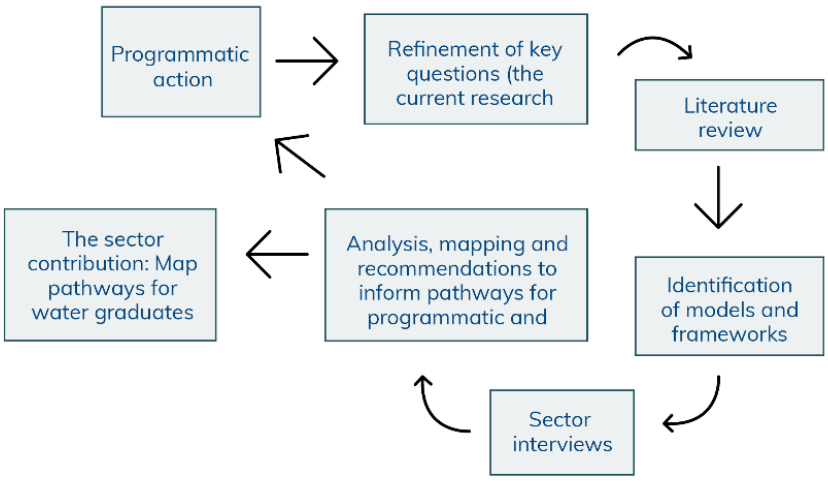


Figure 1: *Action Research and Learning Flow Diagram*

2 METHODOLOGY

This action research uses a qualitative approach. A desktop review, as well as 14 semi-structured interviews with key sector experts, businesses and organisations, were conducted from 20 June to 18 July 2022. Details are described below in terms of sampling, data collection and analysis. The interview schedules are attached (Appendix 2-5), as well as the interview guidelines (Appendix 1). Interviews were handled by the same researchers that were involved in the literature review, to ensure interview depth and the ability to pick up on emerging themes.

2.1 Sampling

Purposeful sampling was used to select key people to interview. The selection was made based on the relevance of the interviewee's experience or/and position in the selected organisations or businesses. Some suggestions on key informants were received from the WRC reference group. The three samples were: (1) Organisations that incubate entrepreneurs in the water sector; (2) Water entrepreneurs; (3) Organisations that work with innovators or/and intrapreneurs. The fourteen key informants are listed in Table 1.

Table 1: *List of interviewed participants*

Sample	Full Name	Name of Organisation
1	Janavi Da Silva	Imvelisi Enviropreneurs
1	Henry Sebata	Avocado Vision
1	Isabel du Toit	Fetola
1	Rest Kanju	Indalo Inclusive
1	Lucky Litelu	The Business Clinic
1	Dr Rethabile Melamu	n/a
1	Alexis Grosskopf	Ocean Hub Africa
2	Boitumulo Nkatlo	BN-Aqua Solutions
2	Gerhard Cronje	Maskam Water
2	Sivuyile Pezulu	Indalo Water
3	Doctor in Innovation and Policy (anonymous)	
3	Ashton Mpofu	GreenCape
3	Jo Burgess	Isle Utilities
3	Dr Manjusha Sunil	WADER / WRC

2.2 Data Collection

Audio and transcripts of 14 semi-structured interviews provided the data.

2.3 Data Analysis

This was a qualitative research procedure. All interviews were recorded and then transcribed using Trint transcription software, as well as being checked after that for errors. The interviews were coded using NVIVO (version 11.1.1) qualitative analysis software. Coding was done based on the research four sub-questions, and as well as emergent themes.

2.4 Ethics Management

Ethical consideration for research is informed by the Code of Ethics used by the South African Human Science Research Council (HSRC), as well as the POPI act of 2021.

Participants were given the choice to stay anonymous, or to be mentioned by name. If mentioned by name, they were given all quotes in which they were mentioned to review and were asked to give permission to use them.

3. READINESS OF WATER GRADUATES IN SUPPORTING INNOVATION AND ENTREPRENEURIAL SOLUTIONS IN SA

3.1 Literature Review

In terms of readiness, the different dimensions of entrepreneurial, and technical innovation readiness are unpacked in this section. But it would be good to introduce upfront the debate about when readiness should be introduced.

When one should infuse entrepreneurship into education is increasingly clear in theory, but in practice much remains to be done – starting at an early age. Lackéus (2015) argues that cultivating an entrepreneurial mindset, needs to be introduced at an early stage during childhood. In theory, entrepreneurial education should start at an early age with a wide definition of entrepreneurship embedded across the curriculum and relevant to all students, preferably in preschool and primary school. Lackéus (2015) recommends that later in the educational system, a parallel voluntary and more business-focused approach be introduced, applying a narrower definition of entrepreneurship. *"In practice however, explicit entrepreneurial activities on primary education levels are rare. And on secondary and tertiary levels most initiatives are business start-up focused, lacking embeddedness into other teaching subjects. In vocational education and training, entrepreneurial activities are frequent in terms of value creation for other people, but they are seldom connected to the entrepreneurship domain and its tools, methods and processes for creating value"* (Lackéus, 2015:7).

3.1.1 Entrepreneurship readiness

The concept of 'readiness' can be approached from different lenses. From the individual lens perspective, entrepreneurial readiness refers to the confluence of personality traits, skills and abilities that differentiate individuals who are ready, from those who are not. Entrepreneurial readiness includes the ability to observe and analyse one's environment (Coduras *et al*., 2016; Ruiz *et al*., 2016), as well as motivation, opportunity identification, resources, entrepreneurial ability and entrepreneurial training (Olugbola, 2017).

Schillo *et al*. (2016) suggests going beyond an individual lens and unpacks four dimensions of readiness, ranging from individual to country-level variables that affect entrepreneurial readiness and start-up intention. Their model includes four dimensions namely: the regulatory, the normative, the cognitive and the conducive dimensions.

- The *regulative dimension* refers to the effect of regulations or laws, in terms of either supporting or hindering entrepreneurial behaviour or businesses;

- The *normative dimension* refers to the social norms, values or beliefs that support or discourage entrepreneurial behaviour within a country or sub-grouping, such as a sector;
- The cognitive dimension refers to the skills and capabilities that facilitate or make more difficult entrepreneurial endeavours.
- The *conducive dimension* refers to the role of key institutions or organisations in being feeders such as in supporting the development of key skills or supporting key entrepreneurial stages or the development of critical technologies.

Training is part of the conducive dimension of entrepreneurship readiness and is an important factor that can influence the relationship between entrepreneurial ability, readiness, motivation and intent. Literature suggests that entrepreneurship education is positively correlated to entrepreneurial self-efficacy and intentions (Wilson *et al*., 2007; Sánchez, 2013; Bae *et al*., 2014; Maresch *et al*., 2015), as well as to entrepreneurship-related knowledge, skills and capabilities (Martin, 2013, Sánchez, 2013). Olugbola (2017) found that students who did not participate in entrepreneurship training had low levels of motivation. Incubators are organisations that support entrepreneurs to be ready, start and grow their businesses. Smilor (1987) classified the benefit of incubation into four dimensions: credibility development, the shortening of the learning curve, faster troubleshooting and access to a business network. Different incubators share common characteristics; however, no two incubators are the same. The differences are heavily dependent on the industry in which they operate, their stakeholders and the desired outcomes. Ross and Beckmann (2010) developed a biosciences incubator model that depicts the growth stages and funding requirements at each stage (Figure 2).

	Concept	Translational Research / Pre-commercialisation	Pre-Seed / Seed	Early-Stage	Growth
Activities	• Conduct R&D • Identify discoveries with possible commercial potential	• Assess potential of technology • Identify market • Develop prototype • Test and validate • Demonstrate proof-of-concept at lab scale • Protect IP • Optimise engineering • License or form business	• Establish business function • Secure initial financing	• Prepare business strategy • Put serial management team in place • Secure follow-on financing • Begin initial sales and marketing	• Begin full-scale production • Staff-up for sales and marketing
Financing sources	• Conventional peer-reviewed federal grant support	• Within university: Grants funded with university, state, or industry dollars • Non-university: Grants funded by public and philanthropic support • SBIR I	• Friends and family • Pre-seed/ seed funds • Angel investors • SBIR II	• Early seed-stage venture capital • Publicly-supported investment funds	• Venture funds • Equity • Commercial debt • Industry: strategic alliances, mergers and acquisitions
Investing	• Varies	• $50,000 - $500,000	• < $1 million	• $1-2 million	• $2 million

***Figure 2**: Bioscience Start-Up Company Growth Stages and Funding Requirements*

(Source: Ross & Beckmann, 2010)

3.1.2 Technical innovation readiness

In South Africa, there are over 300 active support organizations for entrepreneurs, including innovation hubs, innovation districts, accelerator programs, co-working spaces, event planners, and foundations, according to World Bank research published in 2018.

According to the Life Science Factory (2021) in Gottinger, Germany, the essential components of a technical innovation incubator include:

- Access to IP support;
- Support from professional mentors;
- Spaces where peers can share tales and data;
- Access to flexible infrastructure;
- Access to fully stocked labs for the creation of prototypes;
- Access to a network of specialists, including master classes and networking occasions;
- Access to more technical, water-specific, and business issues is provided to promote knowledge sharing;

- Access to funds support and fundraising techniques;
- Access to global hubs and networks of innovation and scientific research.

Innovation is used in layman's terms to define a new idea, method or product. When looking at innovation readiness, it is helpful to recognise that not all innovations are the same. Satell (2017) defines four types of innovation, namely basic research, breakthrough innovation, disruptive innovation and sustaining innovation, (see figure 3). Another more practical differentiation is between innovation available in the market and innovation that has to make it to the market. A technological innovation that has to make it to market should be dealt with separately, as it involves different technical readiness stages.

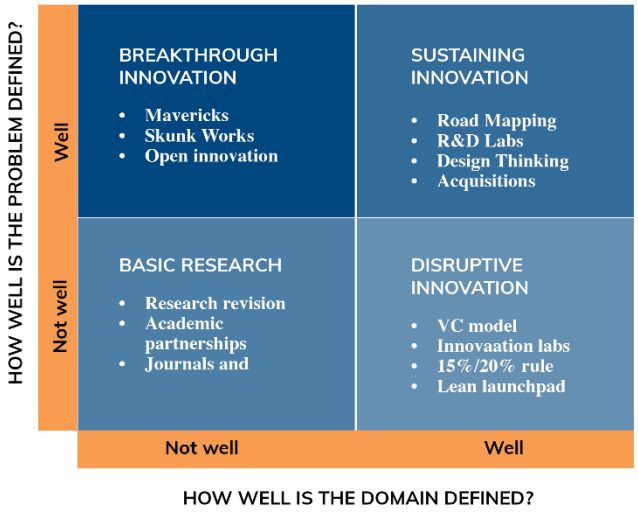


Figure 3: *Four Types of Innovation*

(Source: Satell, 2017)

Technology readiness levels (TRLs) are a framework developed by NASA, to judge the maturity of a technology. TRL level is usually assessed during a technology readiness assessment (TRA). TRLs depict nine levels of maturity.

TRL 9	*Actual system "flight proven" through successful mission operations
TRL 8	*Actual system completed and "flight qualified" through test and demonstration (ground or space)
TRL 7	*System prototype demonstration in a space environment
TRL 6	*System/subsystem model or prototype demonstration in a releveant environment (ground or space)
TRL 5	*Component and/or breadboard in relevant environment
TRL 4	*Component and/or breadboard validation in laboratory enviuronment
TRL 3	*Analytical and experimental critical function and/or characteristic proof-of-concept
TRL 2	*Technology concept and/or application formulated
TRL 1	*Basic principles observed and reported

Figure 4: *NASA's Technology Readiness Levels*

(Source: Tzinis, 2021)

Globally, many technical innovation programmes are associated with higher education institutions or research organisations. These types of technical incubators are usually specialised and fall under a certain university department, programme or research project. Such university incubator programmes often have their own entrepreneurship training programmes (Guerrero *et al*., 2011). Globally, some universities are moving beyond being centres for knowledge dissemination and are becoming places for university-industry collaboration, thus promoting student interaction and the incubation of their innovative ideas or postgraduate research topics (Bodolica & Spraggon, 2021).

South African universities have spearheaded water innovations with several centres of excellence and research chairs in various universities across the country. However, the linkages between universities and other spheres of the economy, which are key to the commercialisation of water innovations, are often not strong enough despite recently established technology transfer offices (WRC, 2018). An office set up at a university with an academic research programme or at a research centre to handle the intellectual property and license rights for faculty and student investors, is referred to as a technology transfer office.

In order to address these gaps, in terms of water sector innovation, WADER offers significant support for solutions that have undergone a reliable assessment procedure. WADER encourages the early adoption of promising technology and accelerates innovation in the water

industry. Innovative water and sanitation technologies will be found, assessed and presented to interested parties, including municipalities and industry, through a series of open requests for water innovations that are in the emerging, pre-commercial, or freshly commercialised phases of dissemination (WRC, 2018).

It was also found that, in terms of the National System of Innovation in South Africa, small firms and entrepreneurs in particular may be hampered by bureaucratic constraints (Bosma *et al.*, 2020).

3.1.3 Intrapreneurship

Intrapreneurship has been described as a type of entrepreneurship within organisations. The concept of intrapreneurship is more recent than its entrepreneurship counterpart and not as well known or developed. Broadly intrapreneurship is described as innovation emerging from employees within an organisation. The term has gained popularity as it promises financial returns and increased productivity and innovation, amongst many other benefits (Edu4Sure Team, 2019). Augusto Felicio *et al*. (2012) suggest that intrapreneurship has the potential to help businesses innovate, improve internal performance, respond to external changes, and re-energise their operations. In many ways, however, the term is often used as an umbrella term to describe innovation within organisations, which can lead to confusion.

The systematic literature review of Blanka (2019) helps unpack the term and differentiate it from other types of organisational innovation processes as follows:

- Corporate entrepreneurship;
- Corporate venturing;
- Employee innovation behaviour.

Amo (2010) differentiates intrapreneurship from corporate entrepreneurship to help differentiate the different types of innovations within organisations. One can also differentiate it from corporate venturing (Blanka, 2019). While corporate entrepreneurship is broadly a bottom-down approach to innovation in an organisation, intrapreneurship is described as a bottom-up approach – an innovation that is created by subordinates without being requested, expected, or perhaps even given permission to do so by higher management (Amo, 2010; Augusto Felicio *et al*., 2012).

3.2 Findings

3.2.1 Entrepreneurial readiness

Before being able to reply to the question, ***what is the readiness of water graduates in supporting innovation and entrepreneurial solutions in SA***, one needs to highlight that 'water graduates' and 'entrepreneurs' are not homogenous groups, and 'innovation' cannot be generalised.

> *"[Not all graduates are] uniform, but they come at different stages, [and from] different spaces. Some of them could actually tackle super high-tech solutions, and (...) do it pretty well. (...) One has to have a diversity of models, (...) [and support] the different levels. The lower level might be grassroots-based innovation, (...) [while others are] high-tech solutions. (...) [You can't] just putting everything in one basket."* (Lucky Litelu, Business, Clinic)

In terms of an individual lens (and cognitive dimension) of entrepreneurship readiness; the ability to observe and analyse one's environment, motivation, opportunity identification, resources, entrepreneurial ability and entrepreneurial training (Coduras *et al*., 2016; Ruiz *et al*., 2016; Olugbola, 2017), it can be assumed that university studies do provide some level of readiness. Readiness should, however, be seen as starting prior to university.

> *"We need to start in the high school space. (...) We did a study, in 2014, where we linked three continents. We had a school in Switzerland, a school in South Africa and a school in India working together on water and sanitation activities. (...) The Sustainable Sanitation Exchange Programme, [was about] getting [high school students] immersed within the water sanitation environment early enough. So they're in grade nine and we take them for a period of three years. They are working basically on projects, understanding basically the challenges within the sector, but also getting to visit (...) wastewater treatment plants, (....) participate in what we called 'technovation' – where [they] needed to come up with a technology based solution based on the issues that they're faced. They need to actually (...) create a social enterprise in the schools, around an issue that they have identified within the school. It was quite an interesting programme which allowed the kids (...) to exchange [through] Skype [across three continents]. (...) They needed to also create a start-up, (...) and be able to pitch their own solution in the respective schools. So these kinds of [programmes] are important because already when a child goes out of school, [the student] would have caught the entrepreneurial bug and developed an entrepreneurial spirit."* (Lucky Litelu, Business Clinic)

Regarding challenges graduates usually face, lack of capital was stated as the greatest obstacle to entrepreneurial intention in South Africa (Fatoki, 2010), as well as lack of work (and sector) experience, knowledge and skills, which this report unpacks further in sub-question 2 below.

In terms of the conducive dimension of readiness of Schillo *et al*. (2016), incubators play a crucial role in fast-tracking and building entrepreneurial readiness. There are many different incubators that have different focuses. For example, Fetola has an incubation programme focusing on the circular economy. The Ocean Hub focuses on businesses that are linked to the ocean. Avocado Vision focuses on building a value chain and small businesses around the clearing of invasive plants, which has a direct impact on water resources in South Africa. Focusing on specific areas or sectors, these incubators can facilitate the transfer of targeted knowledge and catalyse networks and funding opportunities. In the case of Avocado Vision, the aim of the incubator is to innovate on a whole value-chain and create their own ecosystem support for their entrepreneurs. This will be discussed later under sub-question 3.

This study has not explored the normative dimension of readiness; however, it does unpack challenges in terms of the regulative dimension, especially linked to the water sector entrepreneurs in sub-question 3.

3.2.2 Technical innovation readiness

In terms of technical innovation readiness more specifically, it was noted that the current entrepreneurial ecosystem only takes entrepreneurs to a certain point. A gap exists between prototype creation and taking that prototype to market. This readiness gap is partly regulative and partly due to the market not investing in bringing technology to market. (This will be explained further in sub-question 4.)

> *"We don't see any challenges in South Africa that are uniquely South African. We have this massive gap between R&D funding and then business development funding. And there's this chasm, [called] the valley of death in between. And it is all over the world. Nobody doesn't have this massive divide to try to leap between getting to the point where they've got a prototype and they think they're ready to go and actually being commercially viable. There are some countries which are slightly better at bridging that gap, but they're tiny little foot bridges and probably the US's is the best known and Germany, but they're not national programmes. It's not a systemic solution to the problem. It's just examples like the Massachusetts Institute of Technology in the US are very good at making their own funding programmes to get across this divide."* (Jo Burgess, Isle Utilities)

> *"WADER was brought in or launched as an intermediary that would address that gap – the Valley of Death. The gap between early-stage research or early-stage ideas and then getting them to market.*" (Dr Manjusha Sunil, WADER/WRC)

3.2.3 Intrapreneurial readiness

The concept of intrapreneurship, and intrapreneurship programmes are currently not common in the private or public sector in South Africa, based on the interviews. In some cases, the term

is also confused for what actually is corporate entrepreneurship or venturing. The only programme working with intrapreneurs that was uncovered in the interviews was *The Young Engineers Changemakers, WADER programme.*

> *"The Young Engineers Changemakers" programme targets specifically our municipal engineers. I'm sure you're aware of the challenges that we have in our municipalities and the current state of many of our municipalities, particularly when it comes to service delivery. So the whole idea of that programme was to bring in the young engineers that are based in municipalities across the country and introduce them to some of the innovative solutions that have been supported through WADER, but also through the other tech accelerator that we have in the organisation, which looks at sanitation specifically."* (Dr Manjusha Sunil, WADER/WRC)

It should be noted, however, that even if in terms of theory, it is good to differentiate the different paths of entrepreneurs, intrapreneurs and technical innovation because they have their own specific steps and challenges. In life, these paths might cross, and people change from one to another. Investing in early exposure to entrepreneurship and innovation thinking will indirectly also support the possibility and interest in intrapreneurship at an individual level.

4 SKILL SETS AND CAPABILITIES TO BE STRENGTHENED TO ENABLE WATER GRADUATES TO TRANSITION INTO ENTREPRENEURIAL AND INNOVATION PATHWAYS

4.1 Literature review

In this chapter, the skills and capabilities required for water sector entrepreneurs and intrapreneurs to increase their chances for entrepreneurial success along the business (or organisation's) growth journey will be addressed.

4.1.1 Entrepreneurship skills and capabilities

In layman's terms, 'skills' usually refer to specific tasks that can improve by being repeated over time (such as bookkeeping), while capabilities are a more deep-rooted ability that develops in a specific context through the doing of it. While one might need specific skills to develop technical innovation in a specific sector or run a business, entrepreneurship could be argued to be more of a capability that often involves developing added skills. Capabilities are harder than skills to assess. One can usually assess quite easily if a specific skill is acquired. Capabilities are more layered and difficult to decipher.

Within the broader context, it should be noted that in South Africa, recent statistics in 2019, showed that only 38.63% of entrepreneurs received education above the primary school level (Borgen Magazine, 2021). This study is focussed on graduates, a sample of a bigger pool of potential entrepreneurs. Skills and capabilities of university graduates will be different from someone that has only received primary school education and one could expect that more often than not, they result in very different type of business.

Capabilities emerge at the confluence of knowledge and experience, involving different life experiences that develop over a period of time and matures. As noted before, an early introduction to entrepreneurial and innovative thinking can support the development of the capability in the long term (see section: 3.1). The literature also emphasises that entrepreneurial learning should mostly be experiential in nature through practical teaching methods, action-based learning and real-world entrepreneurial experiences (Nabi *et al*., 2017, Guindalini *et al*., 2021). Developing some level of entrepreneurial capabilities is the core objective of the majority of entrepreneurship education. The capacity to do the entrepreneurial task of creating new value is influenced by one's knowledge, abilities and attitudes, which are referred to as entrepreneurial competencies (Lackéus, 2015).

Capabilities develop in a context. The study of self-efficacy in entrepreneurship can help unpack some of the building blocks of entrepreneurial capabilities. Self-efficacy is a person's perception of their capacity to mobilise the drive, mental tools and action plans required to exert control over events in their lives.

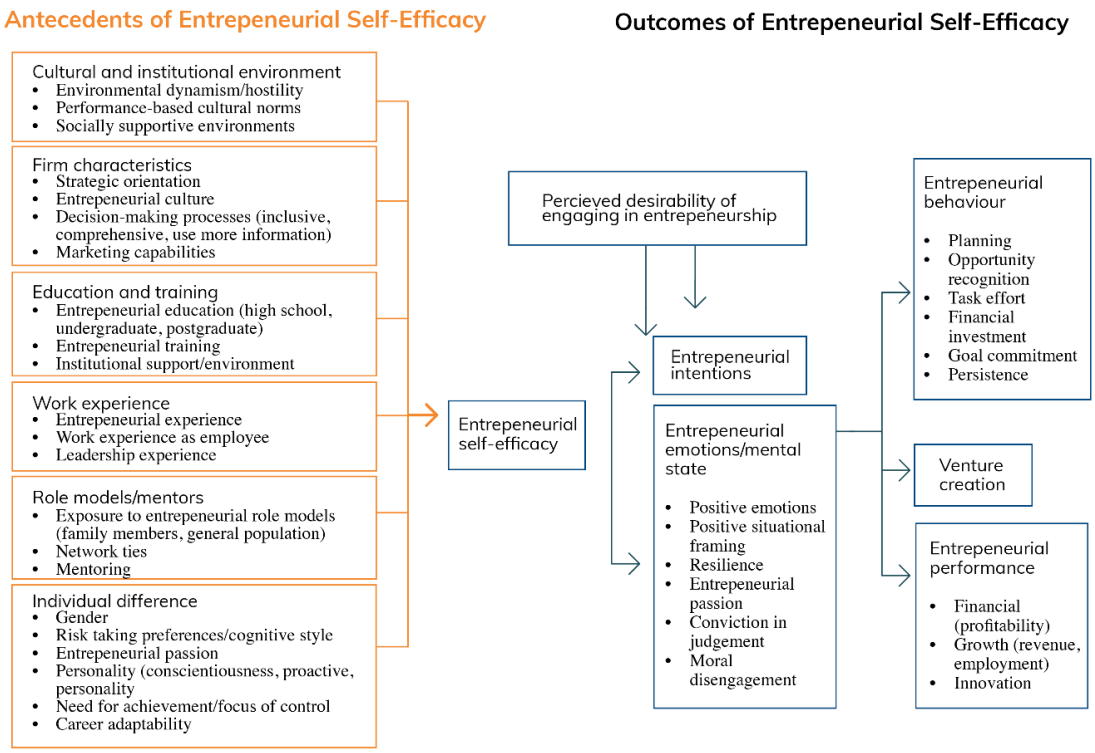


Figure 5: *Map focuses on Cognitive and Conductive Dimensions of Readiness*

(Source: Chen et al., 1998)

People frequently pick settings where they believe they will have a lot of personal control, while avoiding situations where they believe they will have little control. As a result, while deciding on a professional path, a person weighs their own qualifications against the demands of several professions. Therefore, based on their evaluation of their own talents, people direct themselves to prepare for and pursue careers in which they feel they will be effective and stay away from careers in which they feel they will be unqualified (Chen *et al*., 1998). The diagram (Figure 5) shows the precursors to Entrepreneurial Self Efficacy (ESE), leading to entrepreneurial readiness and intention.

There is growing consensus that specific entrepreneurial capabilities, such as creativity, increased risk-taking, learning agility, low fear of failure and problem-solving are teachable (Engel, 2016). Learning a competency involves a process of integration through experience and practice in a specific context, such as work experience. Ng (2022) built a model that maps the factors that influence the state of readiness for entrepreneurial opportunities. His model

includes psychological capital, human capital and social capital as conceptual building blocks to the capabilities entrepreneurs need in order to be ready to take on opportunities. He unpacks the dimension of human capital, which includes a wide array of skills and prior knowledge. This model also takes into account the dimension of social capital, which includes social and business networks (Figure 6).

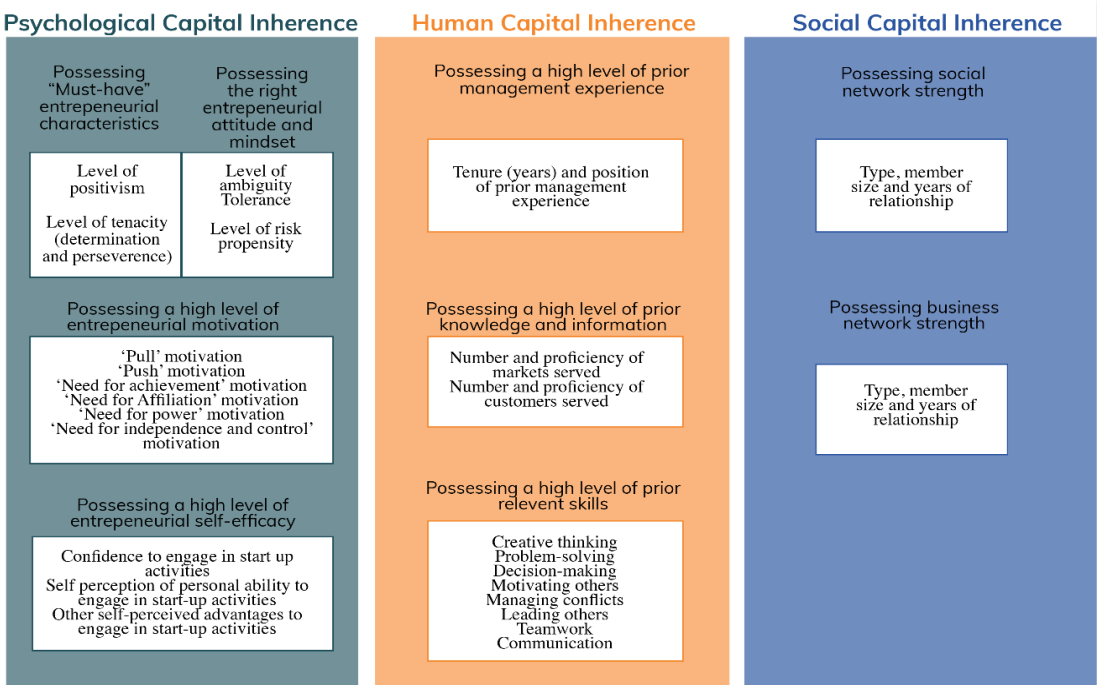


Figure 6: *Factors influencing State of Readiness for Entrepreneurial Opportunities (Source: NG, 2022)*

Another approach to mapping skills and capabilities has been to look at constraints and enablers. Rae and Woodier (2006) identify constraints and enablers of graduates prior or during the process of business start-up. These constraints and enablers are summarised in Table 2.

Table 2: *Constraints and Enablers to Graduate Entrepreneurship*

Constraints	Enablers
• Lack of finance • Initial lack of general business skills • Access to specialist advice and contacts • Confusing interactions with external • Support agencies • Experience of family entrepreneurship (Adapted from Rae & Woodier, 2006)	• Confidence and attitudes towards risk and control • Innovative and creative ideas • Business partner mentoring and support • Degree subject to enable vocational skills and development • Displacement of inertia • Potential for wealth creation • TV Programmes: Dragons Den • General support provided through an enterprise development agency • Timely and stage-appropriate interactions with external support agencies

4.1.2 Intrapreneurial skills and capabilities

The capabilities of entrepreneurs and intrapreneurs are in many ways similar, but what is totally different is their environment. While the entrepreneur sees an opportunity in the market and tries to enter it with a new offering, the intrapreneur sees an opportunity for change within an organisation (Maier, 2011). Intrapreneurship is a type of entrepreneurship which takes place within organisations and takes on a different form due to the employee framework where resources are available (Hecker, 2017). Based on Maier's (2011) comparison, the following main similarities and differences can be noted.

Similarities:

- They both have the capability to recognise opportunities;
- They both have a unique concept of the business (product, service or organisational process);
- They are usually people that can lead a team in bringing their idea about;
- They usually are people that can both do visioning and be practical (get things done);
- Both involve risks.

Differences:

- The entrepreneur carries most of the risk, while the organisation carries most of the risk in the case of the intrapreneurs;
- In a start-up the entrepreneurs own the intellectual property (IP) and an in an organisation the intrapreneur does not own the IP.

Hecker (2017) suggests to examine the intrapreneurship process flow within an organisation to have a better understanding of how organisational innovation happens since it will illustrate how the process develops from idea to end product. He identifies two main phases of intrapreneurship first innovation and exploration and secondly implementation and exploitation. These are unpacked further into 5 sub-phases as follows:

1. Opportunity recognition;
2. Idea development;
3. Acquisition of support and resources;
4. Application and propagation; and
5. Evaluation and refinement.

This process provides a framework for understanding how intrapreneurship unfolds and flows, giving shape and form to what is called organisational innovation.

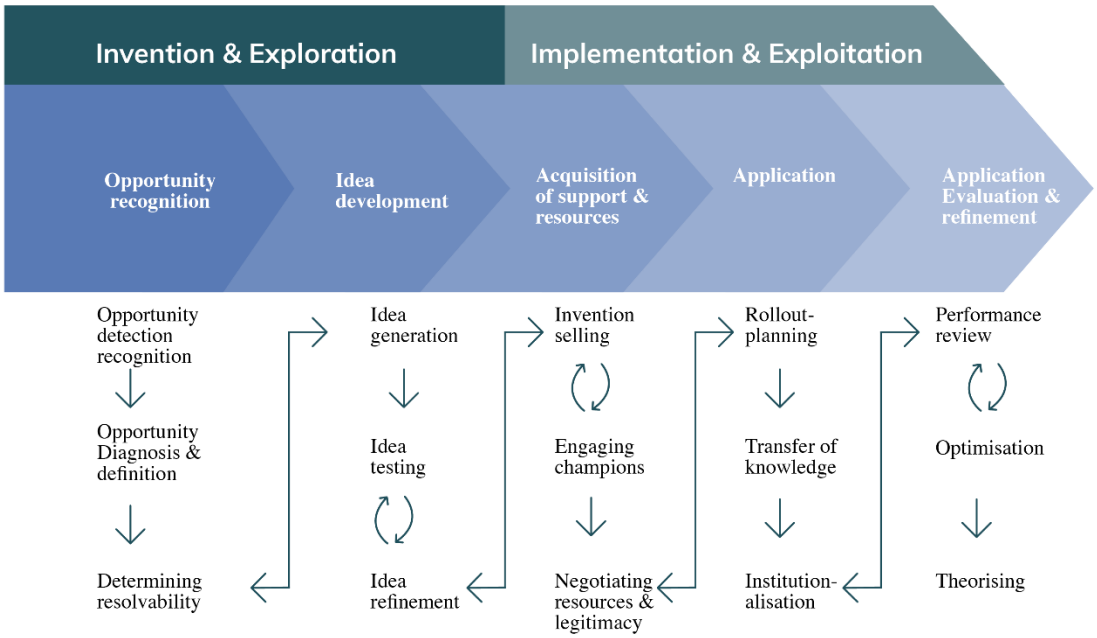


Figure 7: *A Process Model of Organisational Innovation*

(Source: Heckler, 2017)

Hecker (2017) explains each step as follows:

a) ***Opportunity detection*** occurs when intrapreneurs discover a potential new opportunity and begin to explore its potential and assess if it is a good opportunity or not;

b) ***Diagnosis and definition*** is when the intrapreneur begins the process of identifying the challenges around the opportunity and mapping out ways in which this can be mitigated;

c) ***Determining resolvability*** occurs when intrapreneurs determine the processes through which challenges can be resolved, and they use this process to weed out the good opportunities that are worth pursuing from the ones that are not worth time or investment;

d) ***Idea generation*** accounts for the way intrapreneurs generate and produce new ideas and communicate these ideas as potential solutions to solving challenges with key team members and leaders;

e) ***Idea testing*** is the experimental process which intrapreneurs put their ideas through to test the viability of their ideas to see if any of these ideas yield viable business models or not – this testing process saves time and resources;

f) ***Idea refinement*** is the process intrapreneurs take their ideas after they have been tested to refine them further to make sure that the idea is fully developed with a practical roadmap that ensures successful implementation;

g) ***Invention selling*** is the process intrapreneurs within an organisation go through, in showcasing and selling their innovative ideas and solutions to decision-makers, such as colleagues and managers who have the necessary resources to take the ideas further and turn them into products for the relevant market;

h) ***Engaging champions*** are those people within an organisation who see the value of one or more innovative ideas and who have the authority to promote the vision and garner support and buy-in from key people;

i) ***Negotiating resources and legitimacy*** is the process that intrapreneurs go through when they negotiate for resources needed with key decision makers and promote the legitimacy of their ideas and solutions so that they can be implemented in the organisation;

j) ***Rollout planning*** occurs after intrapreneurs have successfully negotiated and acquired the necessary resources and completed a pilot which informs how the product will then be strategically rolled out to the rest of the world;

k) ***Transfer of knowledge*** is the process in which intrapreneurs share their knowledge with one another and help one another to solve challenges;

l) ***Institutionalisation*** occurs when intrapreneurs establish a process that establishes regulations about how a new idea, discovery or solution can be regulated through frameworks to ensure consistency across the board;

m) ***Performance review*** is the process in which an organisation reviews their employees, including intrapreneurs, using a performance review metric. A similar process is applied to the process of intrapreneurship, assessing opportunities for organisational growth and improvement when it comes to innovation;

n) ***Optimisation*** is the process in which intrapreneurs make the best, most effective use of situations and resources to ensure the success of their innovation;

o) ***Theorising*** is the final step in this process model when the organisational innovation goes through various theories or social processes that test different hypotheses concerning the innovation to ensure the conditions in which it works make sense and are operationally sound before it goes to market.

4.2 Findings

4.2.1 Development of entrepreneurial capabilities and skills

Interviews with professionals in the entrepreneurship capacity-building sector mirror findings of the literature reviews, emphasising that capacities cannot only be taught theoretically but must develop in the doing. Those interviews with successful entrepreneurs revealed that often their entrepreneurship journey took a long time to mature and encompassed previous journeys into the workspace.

> *"One of the things that I've had to recognise when I went further to study business and worked with business schools, WITS, GIBS (...). As a sessional lecturer (...) one of the strangest recognitions is that you can't teach business. People have to do business and have to learn by doing. And so for me, one of the important things is that we've just got to be very careful. And as much as knowledge is useful and has an important role, we have to be very careful that we're not overly theoretical because that becomes exclusionary, you know, in our context in our country. So we have to be very practical in the methodologies that we choose to bring people into the business and help them to succeed."* (Henry Sebata, Avocado Vision)

The transition of graduates into entrepreneurship, innovation and intrapreneurship pathways needs to be seen as part of the overarching transition from study to work experience. More often than not, a graduate will first have to gain work experience before being able to set up a successful enterprise. Botham and Mason (2007) found that 14% of graduates become Entrepreneurs 11 years after graduation. They use their work experience in a complex professional arena to acquire capital, skills, contacts and market intelligence during that period. This helps them to resource their start-ups. However, graduates are increasingly starting their entrepreneurial ventures much closer to graduation from university. Al-Dajani *et al*. (2014) report that 4% of university graduates started their entrepreneurial ventures upon graduation.

Work experience is important, as the above literature points out in terms of human capital – the development of managerial experience and relevant skills (Ng, 2022).

> *"I would say you definitely should work, get some professional experience. (...) A company can afford to either send you places or equip you with all the tools of the trade that you will need to know and need to grow your skill. [It will also teach you with] those soft skills – like written communication (...) how do you respond to email? How do you pick up the phone? It adds to the tool kit, these skills that definitely will serve you when you start your own business one day."* (Sivuyile Pezulu, Indalo Water)

Work experience is also important in terms of sector knowledge (Ng, 2022).

> *"I was in the sector already. I studied chemical engineering. I worked from the beginning of my career at a water treatment company. (...)I've been doing this for so many years. (...) Being involved with young water professionals and (...) being involved in our water supply projects."* (Sivuyile Pezulu, Indalo Water)

Work experience is also important in terms of technical skills and social capital – professional networks (Ng, 2022).

> *'It's definitely [technical training] first that contributes to our success. The technical skill that you get through education and formal employment experience. That's number one. Number two, it's definitely network.'* (Sivuyile Pezulu, Indalo Water)

Graduates will acquire skills linked to their field of study, but usually do not have work experience. Because of this, they face many challenges, if they transition straight away into an entrepreneurial path.

> *"They struggle with a lot of things in my view, especially graduates who have not worked before, who just go straight from the universities into the innovation space. Most of them don't understand the space in which they operate. They don't understand the legislative framework. They don't fully understand who their competition is. They don't understand what share of the market they are going for or targeting. They generally haven't educated themselves enough about the trends, what's likely to happen, and who their not-so-obvious competition is (...) So that kind of intelligence is not always there (...) understanding what access to market business models, how the road to market, how that product or solution or business model will be sold, and how they will make money out of it. So both their business model and when they're at a point where they're selling their finance model or fundraising model, all those things are some of the things that those that are coming into this space very early on need support."* (Dr Rethabile Melamu, SAPVIA: Green Economy Sustainability)

4.2.2 Training entrepreneurial capabilities and skills

Incubators have a role to play in bridging capabilities and skills gaps. As seen above, capabilities take time to develop, and even if less common, an average of 4% of university graduates transition straight away from studying into entrepreneurship (Al-Dajani *et al*., 2014).

Incubators have a crucial role to play in creating programmes with strategic (sector) purposes, to be discussed further (section sub-section 3). Having defined their programme purpose, they go about recruiting people with the best capability fit and take them through a programme that supports them to overcome their potential gaps through teaching skills (such as bookkeeping) and support them to develop new capabilities from doing. Doing the latter is something that takes time.

> *"Incubation programmes are needed but in my experience, some of these enterprise development programmes tend to be for a very short period of time. There are lots of these overnight two-week, three-week, six-month interventions, which only play a very limited role in the development of these innovations and innovators themselves. So I think that's why programmes (...) which can last as long as four years, are crucial because there's a lot of hand-holding of entrepreneurs or innovators required. There are institutions that help in the ideation stage, but probably not enough because the point at which the university ends is still way too early for what the incubation programmes require."* (Dr Rethabile Melamu)

5 POTENTIAL ENTREPRENEURIAL AND INNOVATION BUSINESS MODELS

5.1 Literature Review

According to the Quarterly Labour Force Survey (QLFS) held in the 1st quarter of 2021, young people are still struggling in the South African labour market. The official unemployment rate was 32,6%. This rate was 46,3% among young people aged 15-34 years, implying that almost one in every two young people in the labour force did not have a job in the first quarter of 2021. In terms of entrepreneurship South Africa is ranked low on the Ease of Doing Business Index. South Africa is ranked 84th in the ease of doing business and 139th in ease of starting a business, out of 190 countries (Doing Business 2020). Against this backdrop, this section will explore the challenges and opportunities in terms of creating businesses in the water sector, and look at graduates specifically. Ideally, graduates entering the sector should be equipped both to pursue a meaningful career and/or business opportunities, by having a better understanding of the water sector as well as increased self-awareness to navigate opportunities in this complex and dynamic space. They should also have been able to develop feasible business ideas that would help them to earn a sustainable income and ultimately benefit the water sector, by providing a model to enhance job creation through business incubation (Allie-Edries & Mupela, 2019).

5.1.1 Defining business models

Business models can be described as stories that explain how organisations work, including how they make money and how they deliver value to customers at an appropriate cost. They are “a set of key decisions that collectively determine how a business earns its revenue, incurs its costs and manages its risks” (Magretta, 2002). Osterwald and Pigneur (2010) describe a business model as “the rationale of how an organisation creates, delivers, and captures value” and according to them, this can be described in terms of nine basic building blocks that show how a company intends to generate income. The nine blocks are: (1) customer segments, (2) costumer relationships, (3) channels, (4) revenue streams, (5) key activities, (6) key resources, (7) key partners, (8) cost structure, and (9) value proposition (Strategyzer, 2020). These nine blocks cover the four main areas of a business namely: customers, the offer, infrastructure, and financial viability.

There are different business models, such as Manufacturer, Distributor, Franchise or Subscription business model, and others (Table 3).

Table 3: Business Models and Examples

Business Model (Pahwa, 2022)	Description (Pahwa, 2022)	Water Business Examples	Water Research Focus Area
Manufacturer	Manufacturing from raw products and selling to end users or as input into other products.	***Atlas SSI*** an end-to-end manufacturer and service provider of water intake systems, featuring fish handling screens.	Sustainable resource management.
Distributor	Buy products from manufacturers and sells them to customers.	***Seal Water Tech, Puritech***: distributors of water filters and other technologies. ***Indalo Water***, sole distributors of Danish WWTW technology in South Africa.	Water quality, water use, sustainable resource management.
Franchise	Franchisee uses the parent business' model to generate value for the customer.	***Sanergy*** (Also social enterprise) franchising sanitation units to create a network across Nairobi's urban slums with an affordable and effective alternative to sewers.	Water Quality Cluster 3; Cluster 4.
Freemium	It offers a basic service for free and then makes customers pay for extras (premiums).	***Organica Water***, a cloud based platform for data analysis for WWTW engineers, offering a free version and a premium version.	Water quantity, sustainable resource use Cluster 3; Cluster 4; Cluster 5; Cluster 7.
Subscription	A long-term customer relationship with repeat revenue.	***Oasis Water***, a water dispenser monthly subscription.	Water quality Cluster 6.
Aggregator	A company has various service providers under a niche that sells their services under the company brand.	***The Hippo Roller***, may innovate to provide service providers to deliver water to residents.	Water use Cluster 1.
Data licensing/selling	Licensing or selling data of users to a third party.	***SME Monitoring***, remote water monitoring and data management.	Water use, water quality, sustainable resource management Cluster 2; Cluster 3; Cluster 6; Cluster 7
Blockchain	An immutable decentralised digital ledger, working on peer to peer records.	***Genesis Water*** Technologies, using block-chain to reduce mistrust and track water purity data.	Water use, sustainable resource management Clusters 1 to 7.
SAAS (Software as a Service), IAAS	Offering a software, platform or	***Aquatic Informatics*** is a water data management	Water use, water quality, sustainable

Business Model (Pahwa, 2022)	Description (Pahwa, 2022)	Water Business Examples	Water Research Focus Area
(Infrastructure as a Service), PAAS (Platform as a Service)	infrastructure as a service. The customer pays for the usage depending on the features.	company helping to protect water quality, infrastructure and communities. ***Leguaan SAAS***, water monitoring and data management software.	resource use Clusters 1 to 7.
High Touch/Consulting	High interaction between customer and business, for example: Consulting.	***Re-solve Water***, services such as water supply management, project planning contract administration and engineering. ***Volta Irrigation***, provides accessible, affordable, efficient, eco-friendly and reliable irrigation system to smallholder farmers.	Sustainable resource use, organisation management, industry management Clusters 1 to 7.
On-Demand	The customers' needs for goods and services are met on demand.	***Desalytics*** provides water quality, water disinfection, water treatment consumables, equipment, and associated services.	Water use, Water quality Clusters 5 & 6.
Razor and Blade	Selling a product with a use dependent on other products that are continually purchased.	***Blue Spot Water***, selling water purifiers and replacement cartridges.	Water use, water quality Cluster 1.
Pay per Use	Instead of directly purchasing a product or service the customer pays based on how much access they have to use it.	***Swiss Fresh Water*** installing water treatment systems with remote monitoring in isolated communities, charging a small upfront installation and fixed fee per consumption.	Water use, water quality Cluster 2; Cluster 3; Cluster 5; Cluster 6; Cluster 7.

Business models should take into account factors such as the size of a market and more generally try and understand their specific market in the bigger pool, which is a process in itself. The business model should also be responding to a specific customer need, or "pain point", which will influence demand. It should be noted also that business models are also on a spectrum in terms of how easy or complicated they are to run, how innovative they are, in terms of new approaches to old problems.

5.1.2 Water sector in terms of sustainability

Based on GreenCape (2021) the drivers of growth and long-term investment in the water sector in South Africa include the following: increasing resilience to recurrent droughts in South

Africa; attaining water security for sustainable economic growth; and ensuring universal access to water and sanitation. South Africa is ranked the 30th driest country in the world (GreenCape, 2022). It is predicted that South Africa will approach physical water scarcity by 2025, where we are expected to experience a water deficit of 17% by 2030, and climate change will worsen the situation (DBSA, 2022). The need for better management, change and innovation, should be driven more broadly by the Sustainable Development Goal (SDG) 6 on clean water and sanitation (Table 4).

Table 4: *Sustainable Development Goal 6: Clean Water and Sanitation*

Ensure availability and sustainable management of water and sanitation for all
• By 2030, achieve universal and equitable access to safe and affordable drinking water for all. • By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations. • By 2030, improve water quality by reducing pollution, eliminating dumping and minimising release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally. • By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity. • By 2030, implement integrated water resources management at all levels, including through transboundary cooperation as appropriate. • By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes. • By 2030, expand international cooperation and capacity-building support to developing countries in water- and sanitation-related activities and programmes, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies. Support and strengthen the participation of local communities in improving water and sanitation management.

Source: *Sustainable Development Goals,* UNEP 2022.

5.1.3 Doing business in the water sector

The need for water, better use, management, disposal and conservation of water is evident for economic, environmental and social reasons. Having free access to 600 litres per day of clean and safe drinking water is a human right, according to the 1996 South African Constitution. Many water sector entrepreneurs start by recognising a water-related need and potential solutions. South Africa faces major challenges, such as water scarcity in many regions, many

households still do not have access to safe drinking water, poor waste management threatens water sources, and aging infrastructure is the cause of massive water losses (SEED, 2020).

Considering the great challenges faced, there are many opportunities for entrepreneurial solutions in the water sector, such as: providing water to areas with limited access, improving water storage capacities and improving means of sustainable usage (Gupta *et al*., 2020; SEED, 2020). Understanding the need for solutions in the water sector is, however, the first step to a complex journey for entrepreneurs that decide to take this path. In this section, we will look at different business models and consider the factors graduates should take into account in trying to gain market access in the water sector.

Water is highly regulated:

Water is highly regulated and regulation changes based on context and use, sometimes water as a common good, sometimes as a commodity, sometimes as a private good and sometimes as a public good or an open access resource (Distaso & Ciervo, 2011). South Africa's water resources are protected, exploited, developed, preserved, managed, and controlled in a sustainable and equitable manner for the benefit of all people, according to the National Water Act of 1998. There are two references to national criteria for drinking water quality. The first is the Water Services Act (Act 108 of 1997), which refers to a mandatory national norm in accordance with section 9(1)(b) of the Water Services Act. The second is the Strategic Framework for Water Services, which mentions drinking-water quality (WSA 108 of 1997).

In terms of municipalities, all residents living inside a municipality's boundaries must have access to clean water and sanitary facilities. The Constitution establishes this obligation and gives local governments ‘executive power’ to carry it out. Bylaws are used by local authorities to implement details in compliance with provincial and national laws, which they are unable to override (Ryan, 2021). Many regulations, up to now have been based on a public sector-led centralised system and prescribe who is responsible for delivering certain services such as drinking water and sanitation.

An organization that owns and manages facilities to produce water for sale to consumers but is not a publicly owned water utility is referred to as an Independent Water Producer. Utilities, government, municipalities, and end users like business or farmers are examples of customers (Foster, 2022). Many of the business models proposed in this document could fit the definition of an Independent Water Producer (IWP).

The Municipal Finance Management (Act No. 56 of 2003) outlines regulations around independent water producers (IWPs). Issues linked to IWPs currently include the current procurement process in which criteria for services are set, based on what the municipality

understands to be availed. Entrepreneurs under the Municipal Finance Management (Act No. 56 of 2003) can only submit unsolicited proposals.

Policy amendments in terms of IWP are currently underway. The proposed changed will address some of the issues linked to the centralized role of government in the provision of water services and allow for more decentralized solutions and private involvement, opening a new market to upcoming enterprises.

Water is a limited commodity: Water management involves taking into account the paradoxical relationship between the revenue stability of an entity using water as a commodity and water conservation promotion (Hughes *et al*., 2014). Water is a limited resource, and the cost of water generally increases the harder water is to get.

Water business legal entity types: There are a number of legal entity types that can be considered viable in the water sector, such as social enterprises and public-private partnerships which are described below. These are in addition to the private company legal entity employed by many water businesses, such as Pty (Ltd), Sole Proprietorship and Trusts.

Social Enterprises**:** A social enterprise is an organisational model that attempts to generate multiple types of profit namely, financial profit and social or/and environmental gain (Dahan *et al*., 2010; Yunus *et al*., 2010; Jablonski & Jablonski, 2020). In South Africa, there is still considerable disparity regarding how the term 'social enterprise', is used and understood (Meldrum & Guyot-Staal, 2014). This is probably because social enterprises take on different forms as different legal entities, and exist in a wide spectrum of organisational types from highly skilled technological ventures to grass-roots community projects (Figures 8, 9, 10, 11, 12). Meldrum & Guyot-Staal (2014), research led to the mapping of five clusters of social enterprise: (1) Co-operatives that are social enterprises; (2) Registered non-profits that are social enterprises; (3) Registered for-profits that are social enterprises; (4) Hybrid social enterprises 5. Non-registered entities that are social enterprises.

In terms of plotting business models useful for graduates, we are referring to clusters 3 and 4 enterprises that are for-profit companies with a hybrid business model, or possibly 2 legal entities arms, which aim to maximise improvements in financial, social or/and environmental well-being. Social entrepreneurship in the water sector deals with household consumption, industry and agriculture as well as water for animals and species within ecosystems that support all of life as well as water use for drinking and sanitation. In Appendix 6, a wide range of case studies on different innovative water models, including social enterprises, are provided.

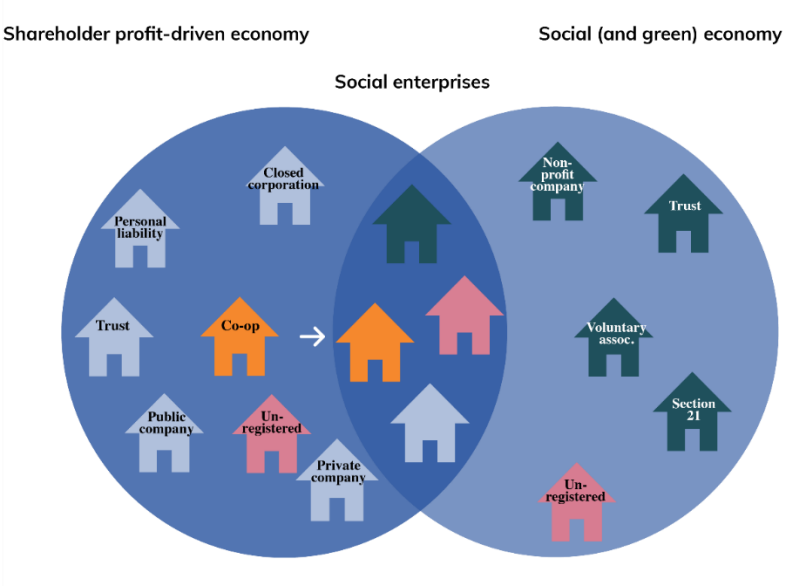


Figure 8: *Cluster 1 – Co-Operatives that are social enterprises*

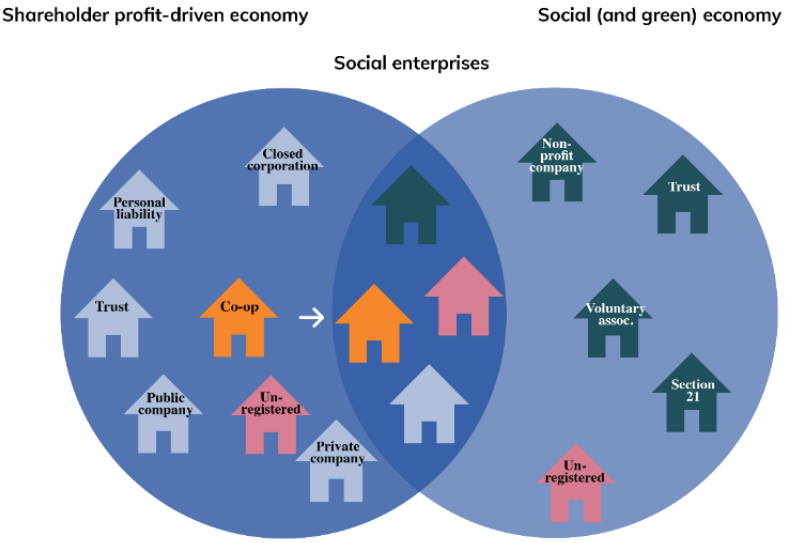


Figure 9: *Cluster 2 – Registered Non-Profits as Social Enterprises*

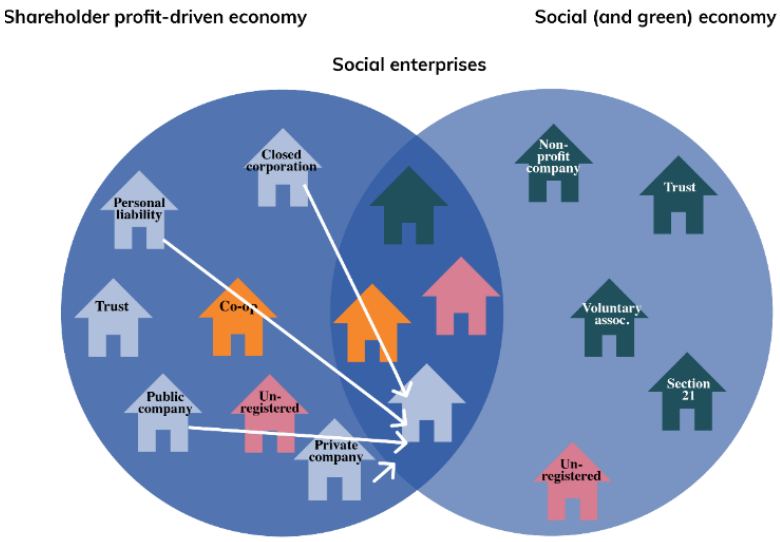


Figure 10: *Cluster 3 – Registered for Profits as Social Enterprises (Source: Meldrum et al., 2014)*

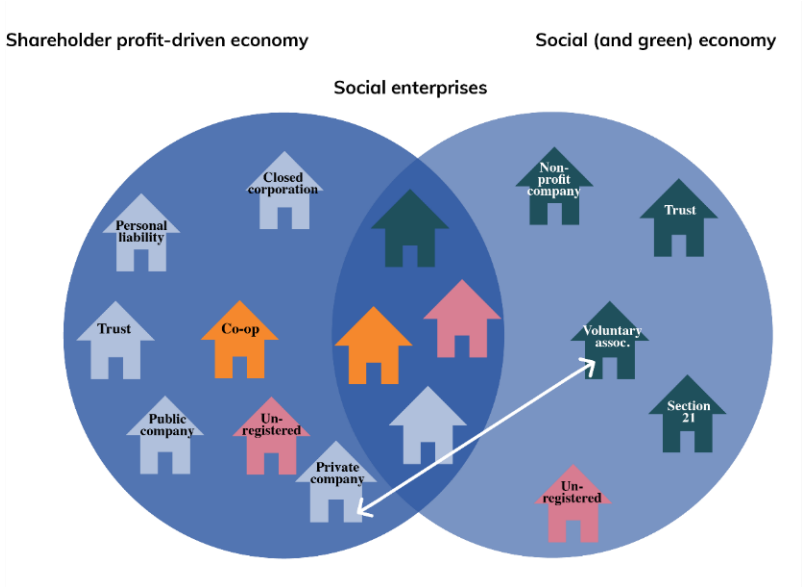


Figure 11: *Cluster 4 – Hybrids as social enterprises for Profit as Social Enterprises (Source : Meldrum et al., 2014)*

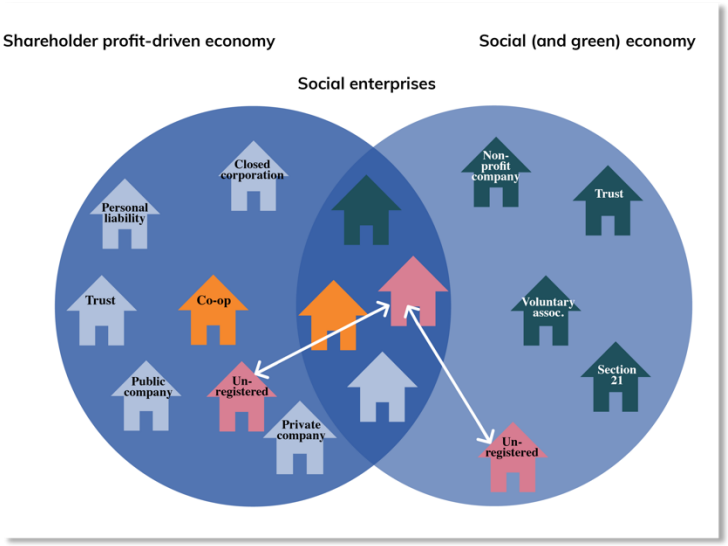


Figure 12: *Cluster 5 – Non-registered companies that are social enterprises*

***Public Private Partnerships (PPP)*:** A PPP focuses on building a partnership that includes a layer of public sector financing on top of private sector skills and expertise. This is known to improve the sustainability of systems, strengthen financial viability, and boost the quality of service. The main advantage of PPP is that the risk of operations, revenue, and the collection is done by a private company, while keeping the costs of service affordable (World Bank Group, 2014). Governments need to secure reliable water infrastructure but often lack the internal capacity to achieve this goal, increasing the attractiveness of PPP arrangements in the water sector (Lima *et al*., 2021). This sector's demands also require intensive, up-front and sunk investments and inefficiency levels are often significant, making PPP projects a viable, fitting option (Berg & Marques, 2011). Regulation 16 of the Public Finance Management Act, 1999 (PFMA) is the regulation governing PPPs in South Africa and offers important guidance with regard to the requirements of PPPs.

5.1.3 Dimensions for water business innovation and sustainability

Talonen and Hakkarainen (2014) argues that many organisations tend to go from crisis to crisis and innovate only when critical or imperative. They suggest that innovation can take three essential forms: (1) A revolution, in which an unconventional strategy enables a business to produce an unconventional financial revenue; (2) A renewal, which involves reinventing their ways of doing business (business model, rules…); (3) Resilience refers to the continuous process of responding to the market, re-questioning and applying changes when needed (Talonen & Hakkarainen, 2014).

5.1.4 Innovation value chain

Innovation literature indicates that the definition of innovation and how to measure it is constantly changing as knowledge is not static, but continuously being expanded and added to as researchers, scientists and other key role players discover new knowledge over time. The Innovation Value Chain (IVC) is a concept introduced by Hage and Hollingsworth (2000) that helps researchers to integrate their concept with practice. According to Sinyolo *et al*. (2020), innovation is sector and context-specific as an organisation's internal and external environments influence the IVC and the process and instruments organisations use to transform their knowledge and ideas into new products.

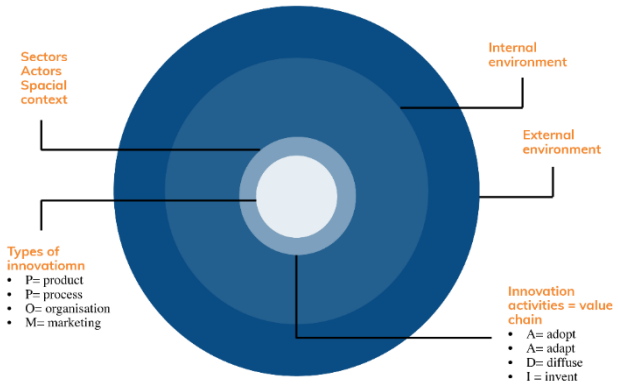


Figure 13: *Innovation Value Chain Framework*

(Source: Hage & Hollingsworth. 2000)

5.2 Findings

As seen above, entrepreneurs usually start with an idea, based on a certain need or problem and unpack possible solutions for it to explore different business models. There is no better or worse model as such, all models are context-specific and should respond to specific market demand (or should create it). In developing their business ideas, entrepreneurs should be aware of the water sector's sustainability goals (see section 5.1.2) and its drivers.

> *"The public water sector in South Africa has two main drivers for innovation. They either need to achieve the same results at a lower cost or they need to get better results without spending more."* (Jo Burgess, Isle Utilities)

5.2.1 Innovation and efficiency upgrades

In terms of business innovation, findings are that the term 'innovations' is used in layman's terms, to actually describe two different things. Many use the term innovation to describe the integration of existing and available (green) technology (or more efficient systems) into a new context. This should actually be a reference to the integration of more useful or sustainable

technology, or as an effectiveness update but is not in actual fact an innovation. Technical innovation should actually only refer to new technology that is completely new, not yet applied or available elsewhere. This is not to say that the integration of more sustainable technologies (or processes) is not of value, it is crucial, but it highlights two completely different gaps. First, there is a gap in the technological innovation development process, as already discussed (see section 3.1.2). Secondly, a gap in sector management and regulative framework that does not encourage the integration of the useful technological upgrade or other upgrades in efficiency, that fall outside the status quo.

"There is a huge need for problems to be solved [in the water sector] and 90% of them could be solved by better [asset management]. We don't need innovation to get the blue drop and green job status up of all the systems in the country. If they had conventional technology and ran it properly, they could all achieve drop status. They could do it more efficiently and more cheaply by innovating." (Jo Burgess, Isle Utilities)

From all the interviews conducted, the point most emphasised was that of the challenges in accessing the market in the water sector, especially the public water sector market. For those that currently have market access, this is a time of market opening and possibilities; for those that are struggling to gain market access the road seems endless.

> *"I think if you want to start in the water sector in the next five years, it is a good time to do that. (...) If we look at the history of water, it's been centralised for about 100 years now. Where there are central dams and central pumping systems, piped water to your house. Wastewater is parked away; you don't have to care about it. Before that period, it was decentralised; they had to harvest their own water and you had to get rid of human waste. We are going back to that time of harvesting and getting rid of your waste because the municipal systems cannot cope. So when we started out in this business in 2010 [in the private sector], we were going against the stream because the stream was the central water supply, central wastewater systems. And we were against the streams, we were pretty much ahead of our time. And we said guys this is not sustainable. There will be a change and that change is happening. Now. We are sitting with cities that cannot handle their wastewater. (...) But there is a huge water crisis there and businesses in certain parts of the city don't have continuous water flow anymore. So decentralised water options are the future and it is busy happening now, so even graduates want to get into the water industry. As an entrepreneur, now is the best time to do that. It's much better than five years to go, and I think it's much better now than it will be in five years' time, because in five years' time there will be established businesses that have a certain market share that you then need to penetrate. But I think the next five years is going to be very interesting in building market share and for people to start their own business.* (Gerhard Cronje, Maskam Water)

5.2.2 Regulatory dimension

Accessing the market was described as challenging due to the regulative framework around water. The regulative dimension of water, which as seen in section (3.1.1) above is one of the dimensions of entrepreneurship readiness. There are many challenges in terms of this in the water sector as in many instances the market is said to be driven by legislation.

"There are instances where some markets are driven by legislation. Our progressive nature of enacting new regulations to foster compliance supports market pull innovations [necessity is the mother of inventions]. There are however instances where legislation becomes a hindrance to technology adoption and investment. At the moment most municipalities do not have clear policies and regulations on the installation of non-sewered sanitation systems, next generation sanitation and/or packaged plants. Although, decentralised wastewater treatment is attractive for obvious reasons, particularly to afford universal sanitation while promoting circularity, the adoption of these technologies is still a challenge in the urban context. There are grey areas in legislation that still need to be addressed. Additionally, public procurement mainly allows for three year contracts and this does not have a good business case for some technologies (projects) that have longer pay back periods." (Ashton Mpofu, GreenCape)

The municipal procurement process was also described as a stumbling block for entrepreneurs.

> *Accessing markets is challenging for new innovators because most of the market in this water and sanitation space is established and they are looking for proven technologies that has been tried and tested. Trying to sell a new innovation in that rigid environment can be tricky. For instance, if an innovator would like to sell a product or solution to a municipality. First, the procurement process makes it seriously prohibitive for them because that technology needs to have a track record but how does a new technology have a track record? If it's a small player, they need to have many, many years, the requirements are also very demanding on the number of years, you've been in this sector or have practised as an innovator. Most of them would have been in the sector for 2 to 3 years. And unless they tender with the big guys it's difficult for them to break into that market. For those solutions that are suitable for the public sector, the procurement processes are seriously prohibitive. I suppose that's the reason that can be given for why some of these technologies, even the ones that are at a stage where they're ready to be deployed at a sizeable scale, still do not make it. It is because nobody is willing to take a risk and procure these services. So access to a market is a lot more challenging than access to funding.* (Dr Rethabile Melamu, SAPVIA: Green Economy Sustainability)

5.2.3 Challenges in bringing innovations to market in public sector

In terms of technological innovation, specifically on the issues in the water sector, the public sector dominates the water sector, but does not have the resources it takes to bring new technologies to market.

"We have a mismatch between the push for innovations to reach implementation in the market and the pull. There's very little market pull because there's very little spending capacity in the public sector. And until we can increase that pull for innovations, then it's always going to be an uphill battle to shove the boulder up to the top of the mountain. To get something onto the market, you have to find somebody that wants it and will pay for it." (Jo Burgess, Isle Utilities)

Furthermore, in terms of bringing innovations to market or just upgrading technology and processes to more efficient ones, a block is the lack of skills at the municipal level. [1]

> "*Sometimes a lack of technical skills hinders technology adoption and its success particularly in municipalities where personnel in treatment works cannot operate or conduct maintenance on these technologies. The sector still lacks skilled personnel to support the adoption of new technologies. We must embark on a skills development program for the whole municipal sector before we think about bringing new innovation because it's pointless to try and foster the adoption of new technologies while we are still struggling to operate and maintain simple and basic technologies, it's pointless. We have an opportunity to equip our young water professionals with technical skills so that they can promote technology adoption." (Ashton Mpofu, GreenCape)*

5.2.4 Value chain development for ecosystem support

Finally, it is worth noting the model of Avocado Vision, which has opted to build its own eco-system support and value chain for the alien and invasive species clearing entrepreneurs they work with. In their case, they are not innovating in terms of a technology or a business idea or model, but rather in terms of a sub-sector focus. Their approach is interesting on many levels and could be applied to other sub-sectors in order to assess potential leverage points for employment creation and build a wider client base and resilience.

> *We've supported the strengthening of the business acumen of people that were already in the Department of Fisheries, Forestry and Environment. In that value*

[1] A major challenge involves the severe shortage of skills and capacity, which leads to a lack of or hampered implementation efforts (Stuart-Hill, 2015). A skills gap analysis was conducted by WIN-SA (2015) providing an understanding of the competencies necessary to fulfil a scientific or technical role within a Water Sector Institution. While Siebrits *et al*. (2014) state that skills development is likely to be a long-term issue that requires careful monitoring, evaluation and interventions that are informed by long-term research, the following illustrates a list of potential skills required to operate successfully in the water sector. In terms of the DNA Economics (2020) list of skills shortages in South Africa, the academic research or lecturer skills that are in short supply are as follows: Groundwater hydrology; hydrogeology; surface and soil water hydrology; bio and water engineering; water resource engineering; geo hydrologists and water resource scientist; water engineering.

chain contracting to clear [alien and invasive species]. But we [realised it's] actually very unsustainable as businesses so we've then supported building those businesses to be strong and secondly, for them to be aware of opportunities that lie beyond the department and contracting with the department for clearing. And I mean, the first and the simplest of that is really recognising that the very service that they were (…) services that other people would be willing to purchase and actually do purchase. So it was getting them to recognise that the department can be an anchor client, but they needed to broaden beyond the department and reduce and eliminate their overreliance on the department. And then beyond that it was then introducing people to other value chains that [they would do something with] the biomass that they were clearing because the general practice was just you clear and you leave. And if people were doing something, they would sell wood. And what we're currently doing is working with similar entrepreneurs and refining the charcoal value chain for charcoal that is for export because it is FSC certified. (...). We introduce people to other value chains (...) certified charcoal, the wood, the furniture, etc." (Henry Sebata, Avocado Vision)

6 ROLE OF UNIVERSITIES, DEVELOPMENT PARTNERS AND WATER SECTOR INSTITUTIONS IN HELPING SUPPORT AND ENCOURAGE CAPABILITIES AND SMME PIPELINES FOR WATER SECURITY IN SA

6.1 Literature review

6.1.1 Defining an entrepreneurship ecosystem

Like biological ecosystems, an entrepreneurship ecosystem consists of different elements, which can be individuals, groups, organisations and institutions. These form a community by interacting with one another. Environmental determinants also have an influence on how these work and interconnect; in entrepreneurial ecosystems, these can be via laws and policies or cultural norms (GIZ, 2018).

An entrepreneurship ecosystem is: “a set of interconnected entrepreneurial actors (both potential and existing), entrepreneurial organisations (e.g. firms, venture capitalists, business angels, banks), institutions (universities, public sector agencies, financial bodies) and entrepreneurial processes (e.g. the business birth rate, numbers of high growth firms, levels of ‘blockbuster entrepreneurship’, number of serial entrepreneurs, degree of sell out mentality within firms and levels of entrepreneurial ambition) which formally and informally coalesce to connect, mediate and govern the performance within the local entrepreneurial environment” (Mason & Brown, 2014:5). These have a significant impact on the development of ideas, innovation and start-ups emanating from university environments.

6.1.2 Entrepreneurship ecosystem framework and dimension

An entrepreneurship ecosystem is defined with regard to three elements: (1) Surrounding environment, more precisely the business environment and investment climate; (2) Interacting actors; (3) Evolving culture and attitudes (GIZ, 2018). Isenberg (2010) list elements serving as major dimensions of an entrepreneurial ecosystem. These are leadership, government, financial capital, societal norms, non-government institutions, infrastructure, labour, networks and early customers (see Figure 14 for more details). In considering, what an entrepreneurship ecosystem looks like, Isenberg (2010:5) suggest the following questions:

a. Do public leaders, act as strong public advocates of entrepreneurs and entrepreneurship? Do they open doors for entrepreneurs and those promoting entrepreneurship?
b. Do governments: Create effective institutions directly associated with entrepreneurship (research institutes, overseas liaisons, forums for public private

dialogue)? Remove structural barriers to entrepreneurship, such as onerous bankruptcy legislation and poor contract enforcement?

c. Does the culture at large: Tolerate honest mistakes, honourable failure, risk taking, and contrarian thinking? Respect entrepreneurship as a worthy occupation? Are there visible success stories that: Inspire youth and would-be entrepreneurs? Show ordinary people that they too can become entrepreneurs?

d. Are there enough knowledgeable people who: Have experience in creating organisations, hiring, and building structures, systems and controls? Have experience as professional board members and advisers?

e. Are there capital sources that: Provide equity capital for companies at a pre-sales stage? Add non-monetary value, such as mentorship and contacts?

f. Are there non-profits and industry associations that: Help investors and entrepreneurs network and learn from one another? Promote and ally themselves with entrepreneurship (such as software and biotechnology associations)?

g. Are there educational institutions that: Teach financial literacy and entrepreneurship to high school and college students? Allow faculty to take sabbaticals to join start-ups? Does the public infrastructure provide sufficient transportation (roads, airports, railways, container shipping)? Communication (digital, broadband, mobile)?

h. Are there geographic locations that have: Concentrations of high-potential and high-growth ventures? Proximity to universities, standards agencies, think tanks, vocational training, suppliers, consulting firms and professional associations?

i. Are there formal or informal groups that link: Entrepreneurs in the country or region and diaspora networks – in particular, high-achieving expatriates? New ventures and local offices of multinationals?

j. Are there venture-oriented professionals, such as: Lawyers, accountants, and market and technical consultants who will work on a contingency basis, or for stock?

k. Are there local potential customers who are: Willing to give advice, particularly on new products or services? Willing to be flexible with payment terms to accommodate the cash flow needs of young, rapidly growing suppliers*?"*

In the mapping, the focus will be on questions g, b and f. The role of universities will specifically be looked at, in terms of creating a pipeline for entrepreneurship and the role of government institutions and industry in helping bridge the 'valley of death' phase of innovation. A full map of the ecosystem is outside the scope of this study.

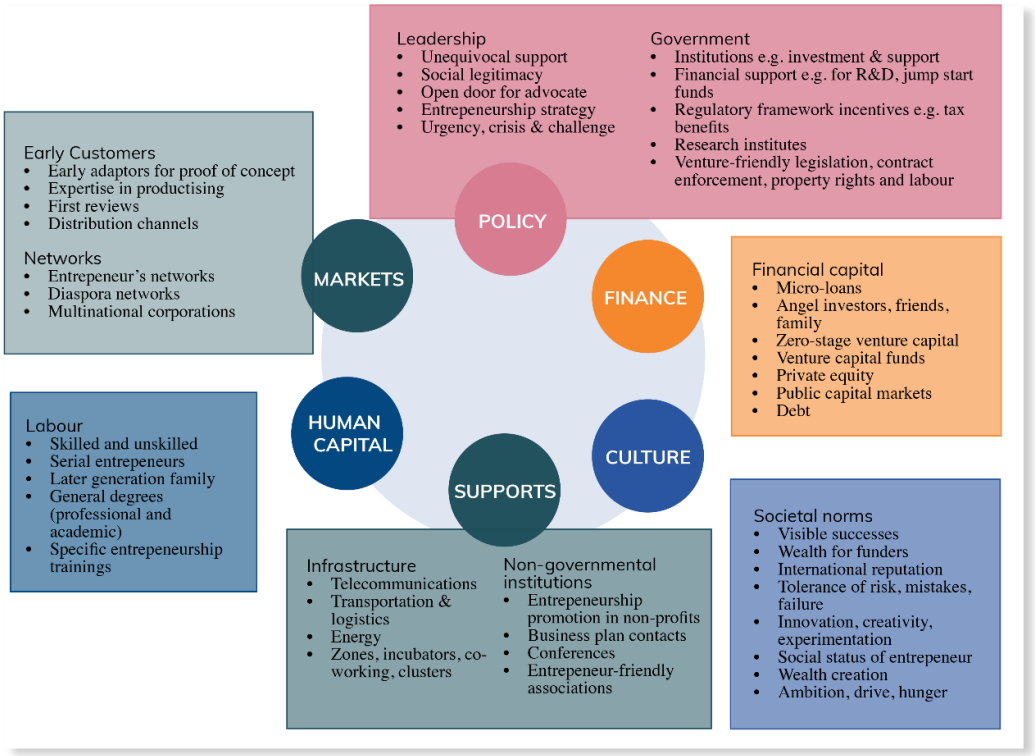


Figure 14: *Isenberg's Ecosystem Domains, Scale-Up Ecosystems for Growth*

(Source: Isenberg, 2010)

6.1.3 University, industry, and government collaboration

Effective articulation between a variety of stakeholders, including research organisations, industry and the public sector is essential to the development of a healthy entrepreneurship ecosystem (Isenberg, 2010). The Triple Helix Model describes the most conducive model of government, university and industry collaboration (Figure 15). It can be differentiated from a state-driven model, in which government dictates research and industry, or a laissez-faire model where collaboration is left to the market, with no formal collaboration between sectors (Gatune *et al*., 2018). In the Triple Helix model, each sector has autonomy but also has a structure to ensure collaboration.

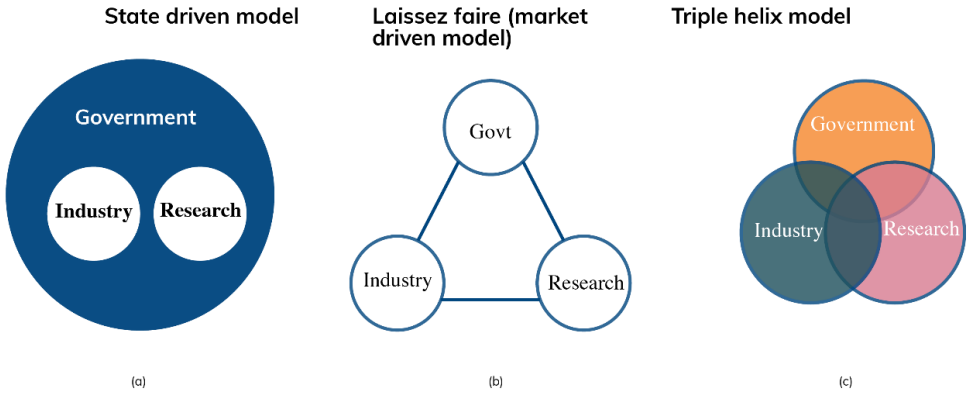


Figure 15: *Configurations of university-Industry-Government Collaboration (source: Gatune* et al*., 2018)*

6.1.4 Entrepreneurial universities as a potential pathway for graduates

In this literature review, the focus is on exploring a model that places universities as key pipelines for entrepreneurship. Key to this is the idea of having entrepreneurial universities.

***Entrepreneurial universities*:** There are factors that influence the development of entrepreneurial universities. These are generally factors such as entrepreneurial organisation; flexible support and governance structure, links with industry, entrepreneurship education and support programmes for academics and students (Guerrero & Urbano, 2012). In addition, there are intangible factors, such as attitudes towards entrepreneurship and a supportive culture, the kinds of teaching methods and pedagogy and, importantly, role models who have achieved success in their own related business (Kirby *et al*., 2011; Guerrero & Urbano, 2012).

The National Intellectual Property Management Office (NIPMO) performed a local survey, which revealed that 60% of South African institutions lacked the resources necessary to commercialise their intellectual property spinoffs, start-ups, or incubators. However, 92% of South African universities have Technology Transfer Offices (“TTOs”) that specifically deal with IP and technology transfer to assist with commercialisation of IP.

The IPR-PFRD Act of 2008 is applicable and offers three options:

1. The university is the owner of the intellectual property created by its researchers.

2. Through partnerships between the institution and the private sector, there is co-ownership.

3. The full cost alternative: Universities occasionally conduct contract research for product development. The IP Act does not apply if funding covers both the direct and indirect costs (Makoko & Maharaj, 2022).

According to Kirby *et al*. (2011), universities who are considering becoming more entrepreneurial should ensure that the administrators, faculty, government and industry stakeholders involved need to be clear on the meaning of being entrepreneurial. They state that there are a wide range of possibilities and roles for various stakeholders (students, faculty, and outside business professionals). Some universities may, however, not elect to emphasise entrepreneurship and understanding the agreement between the relevant stakeholders regarding the ultimate goals is difficult and complex and multiple resources must be acquired to support those aims. Figure 16 shows a proposed framework to assist in setting up entrepreneurship in universities.

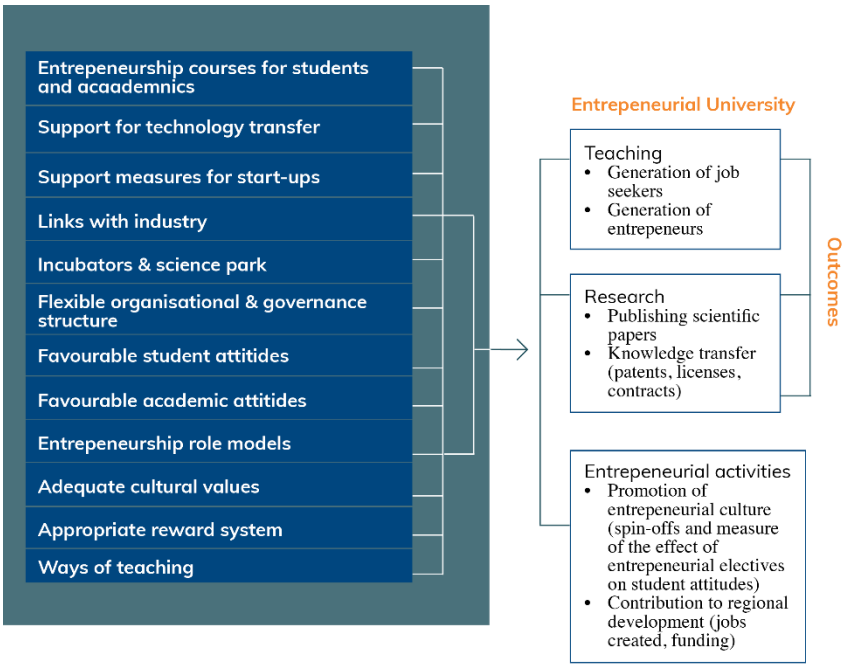


Figure 16: *Framework for making Universities More Entrepreneurial (source: Kirby et al., 2011)*

Role of government in this model: Etzkowitz (2003) suggests that for an entrepreneurial university model to work, the government should not only perform its traditional regulatory role, but also to act as a dynamic public entrepreneur and venture capitalist, supporting the development of an enabling environment for both innovation and entrepreneurship. The latter should involve a structured approach aimed at stimulating both the entrepreneurship ecosystem and clusters within the ecosystem (Etzkowitz, 2003).

***Wider eco-system nexus*:** In the model where universities take a leading role as a pipeline for entrepreneurship, a nexus linking universities to other key eco-system support infrastructures, such as liaison and technology transfer offices, incubators, accelerators and science parks that maintain proximity with research centres, help start-ups to overcome some of the constraints faced in the early stages of a start-up's development (Mason & Brown, 2014).

6.1.5 Higher education capabilities mapping in South African water sector

The Water Research, Development and Innovation (RDI) Roadmap provides information on the research focus areas (RFAs) of universities and various other research institutions and organisations. The purpose of this is to provide insight into research strengths so as to better guide and foster RDI in the sector. Entrepreneurs can use the information in the capability maps to inform opportunities and thinking relating to knowledge generation (Carstens *et al*., 2020), as well as ideas to generate water start-ups.

***Water research focus areas*:** According to Kurland and Zell (2010) one of the facets of the water taxonomy system are the Research Focus Areas (RFAs); which can be summarised into the following categories:

a. *Water quality*, the physical, chemical, thermal, and/or biological properties of water is often defined in terms of human usage for consumption, recreation, and aesthetics. Water quality affects all components of the aquatic ecosystem (Ritchie & Schiebe, 2000);
b. *Water quantity*, is the total yield in terms of time of water from a watershed and is measured by total yield and peak flow over a specified time-period (Zamora & Blinn, 2019);
c. *Water use*, consumptive use and at times to withdrawals of water is a facet (Gleick, 2003);
d. *Sustainable resource management* relates to the management of existing livelihood assets. It is aimed at repairing ecological infrastructure especially regarding improving the delivery of ecosystem services, particularly water, agricultural production, etc. through improved governance, awareness, motivation and capacity (Fabricius *et al*., 2007);

e. *Company management* includes the pursuit of organisational goals by integrating the work of people through planning, organising, leading, and controlling the organisation's resources (Kaehler & Grundei, 2019);

f. *Industry management* entails an awareness that water management is a network problem that one single organisation cannot tackle alone (Kurland & Zell, 2010).

***Water RDI research clusters*:** In addition to the RFAs outlined in the Water (RDI) Roadmap, seen above, the *Water RDI roadmap Skills mapping Study,* provides research taxonomy clusters, a high-level view of key disciplines and expertise and research specialisations of higher education institutions (HEIs). These clusters are (Carstens *et al*., 2020):

- *Cluster 1*: Increase ability to make use of more sources of water where the objective of this cluster is to increase the ability to use more water sources, especially alternative water sources. This can deal with technology development to use diverse water sources at catchment level;
- *Cluster 2*: Governance, planning and management of supply and demand where the objective of this cluster is to improve supply and demand in terms of governance, planning and management. Thus, this implies improving governance, planning and management of supply and delivery;
- *Cluster 3*: Supply infrastructure and operational performance adequacy (built infrastructure) where the objective of this cluster is the improvement of built infrastructure. This can also include increased volume and storage capacity for raw water and treated effluent;
- *Cluster 4*: Supply infrastructure and operational performance adequacy (ecological infrastructure/ecosystems) has as objective of this cluster to improve the performance of ecological infrastructure;
- *Cluster 5*: Running water as a smart business is the objective of this cluster to improve the management of demand and use in terms of governance and implementation and securing the financial sustainability of the water services system;
- *Cluster 6*: Efficient use of water in industry, agriculture and household consumers where the objective of this cluster is to increase efficiency of productive use and reduce losses;
- *Cluster 7*: Monitoring and metering as the objective of this cluster is to improve pricing, monitoring and collection.

6.2 Findings

6.2.1 Developing water sector entrepreneurship eco-system

The entrepreneurship eco-system has been described by the people interviewed as fragmented and initiatives happening in silos.

> *"The biggest challenge is fragmentation of the ecosystem. So there are a lot of people doing pockets of things there and there. (...) I'm part of what we call the Swiss Water Partnership, which is a Swiss broad based platform for all the water sector actors and stakeholders within Switzerland. And we've got a forum there where we used to actually meet and connect and understand who plays where, who does what to actually avoid duplication. (...) There is a lot we will actually be duplicating [otherwise]. (...) We can actually capacitate specific stakeholders to actually do specific things within the broader value chain."* (Lucky Litelu, Business Clinic)

There have been efforts to map the different stakeholders in terms of the Water RDI roadmap discussed (section 6.1.5). Ashton Mpofu from GreenCape, sees the need for the creation of a further map or directory of all entrepreneurship stakeholders in the water sector.

> *"[We need] that linkage. I mean, this is one of GreenCape's core competences, to bridge that gap and to bring all stakeholders together, but we can't do it alone. We have created an open source digital Green Business Support Services Directory that provides information on services and programmes that support enviropreneurs. There is a need to go an extra mile to map all stakeholders (TRL 1 to 9) in the innovation space and ensure that all stakeholders work in unison and complement each other. A clear pipeline of freely available and easily accessible services must exist to support young entrepreneurs including intellectual property protection services"* (Ashton Mpofu GreenCape)

For technical innovations in particular, hackathons were also recommended as a way of promoting technological innovation and for entrepreneurs to get recognised by investors.

> *"We've seen that through the hackathons that we hosted and we've been hosting over the last couple of years. (....) We've had a number of start-ups coming out of that space, and some of them actually have really received serious investment. Some of them even got (...) investments of investors from the US and other parts of the world investing in the start-ups purely because they've got this [hackathon] platform. I think in a year probably there's about 20 or 30 of them or even more than that. Look, hackathons are taking place on specific issues. So those as tech entrepreneurs, they then get to participate in those kinds of activities that help them to hone their muscles. (…)If you have participated in 20 hackathons in a year, working incrementally on the solutions, by the end of the year they will actually have figured out a better ways of doing it, and that's a great way of training."* (Lucky Litelu, Business Clinic)

6.2.2 Universities as pipelines and cluster hub

As outlined in the literature review, section 6.1.5, universities are strategically placed to be entrepreneurship pipelines for the water sector. And the Water RDI Roadmap and further Water RDI Capacity map already provides a framework for research, development and innovation focus in the sector.

This can benefit the water entrepreneurs by providing supportive hubs hosted by universities and other sectoral role players that work in Research Focus Areas and research clusters to support these kinds of technologies, innovations and business ideas emanating out of these hubs through graduates or faculty members and or other private institutions. These would be best supported through (Guindalini *et al*., 2021):

- An enabling institutional environment;
- Engagement of key stakeholders within and outside the institution;
- Development of entrepreneurial practices through the implementation of pedagogic approaches in teaching, learning and support.

Opportunities for projects in certain clusters can be determined by this list of clusters and to determine the funding needs in the RDI ecosystem.

These clusters are linked to clusters of RFAs, throughout South Africa. Therefore, researchers and potential entrepreneurs looking to collaborate on specific RFAs in the capability map can identify the location of water experts at HEIs for specific RFAs. This can also indicate if there is an oversupply of research in certain areas or if there is a need for more research in a specific area (Carstens *et al*., 2020). This, when tied to the various business model opportunities and the skills required to make the first steps into entrepreneurship can potentially set the stage for a supportive system for water sector graduates.

A recommendation for future research should address the linkages of the various business models that can create a pipeline of graduates and research or innovation that could be developed into feasible businesses with the proper support starting during attending the university. This should further be developed in terms of a review of university-based IP management, that allows for a potential exit strategy or diminishment of ownership of the university in the IP at a certain agreed upon phase of the business growth cycle. This may encourage the uptake of business training and the development of viable technologies that can lead to feasible businesses emanating from these clusters, based at strategically placed universities, and leveraging their networks to bring these technologies or products or services to market.

In term of this model mentioned in the literature review section 6.1.4, it is important that universities are in collaboration with industry and government, as the Triple Helix Model suggests. It is important that they are also in close relationship with incubators that can fill their capacity gaps, as well as play the relay role down the entrepreneurial pipeline into further start-up and growth phases. They do not necessarily attempt to become entrepreneurial incubators themselves, and rather work with organisations that specialise in enterprise development and incubation. Further 'entrepreneurial immersion exercises could also be used to further graduates' experience.

> *"[There is] new concept called the entrepreneurial universities, which is a new phenomenon that they're driving. However, universities are typically not entrepreneurial. In most cases. So, I feel that it is a space for incubators where universities can still play a role. Of course, they may have their own incubators within the universities, which actually I think (...) it can work well. But I find that, you know, there is an opportunity to ensure that the private sector still plays a role because we don't want this entrepreneurial engagement to be totally an academic exercise because we are going to theorise more than we actually make it practical. (...) young people in universities need to embark on programmes (...). [In these programmes graduates are asked to] help (...) come up with solutions (...). It serves basically as a Start-Up in the formalised environment, because we need to do those block types of activities where they're working in groups to come up with solutions (...) so that they can actually develop the appetite and understand of how it works (...). (...). Already from the first year [they have to] engage in these kinds of activities as an integral part of what they do to move forward.*" (Lucky Litelu, Business Clinic)

***IP model of Universities*:** One of the challenges mentioned with university technical incubators, has been reported to be their IP model. The IPR-PFRD Act of 2008 and its Regulations of 2009 seek to promote the protection and commercialisation of intellectual property (IP) generated through South African public funding, such as through universities (Ncube & Abrahams, 2014). This Act applies to IP emanating from publicly financed research and development (R&D), defined as "research and development undertaken using any funds allocated by a funding agency but excludes funds allocated for scholarships and bursaries" (IPR-PFRD Act of 2008:4). In particular, it applies to South Africa's higher education institutions. The critique of these principles have been as follows:

- It may be counter-productive towards promoting commercialisation;
- It has a conceptualisation of commercialisation that is excessively wide, i.e. includes knowledge that should be shared rather than commercialised;
- It takes IP protection in ways that might pose possible barriers to academic publication and may be counterproductive to fostering commercialisation;

- It features clauses that might be overly burdensome for academic institutions and universities.

> *"Most graduates actually the final papers for the degrees in most cases are not the best concept because of the IP situation. They will put their second idea or third idea, because they don't mind a bit and then only put their best idea forward to pursue because they don't actually want to share equity with the university. So I think the universities also have to look into the policy around IP and commercialisation units at the universities and so forth. I think UJ and others are starting to realise that we're in there to give to entrepreneurs because if you are developing a solution, they'll give you 80% and the university will take 20% of the equity. And this is unheard of and it's quite revolutionary, you know, because as a start-up then you can work on your best idea knowing that you can actually leverage the support that an academic institution such as a university often has become just, you know, giving them as a reference, you know, because they've also seen that they're not getting the best ideas and you're not commercialising the great ideas because of how the current arrangement is set, you know, labs and so, so there's a, there's a need to look into contracts and benefits."* (Lucky Litelu, Business Clinic).

6.2.3 Need for intrapreneur brokers

One theme that emerged was that intrapreneurs do not have to be innovators themselves but could play a role in bringing new technology and innovations into their organisation.

"Intrapreneurs make absolutely amazing innovation champions within their businesses, so if they have worked their way up through the business in the technical performance side of things or in central or field operations, if you bring them into the innovation or the R&D department specifically to have that entrepreneurial spirit, they make absolutely amazing innovation champions in their companies. They don't need to necessarily be the person that invents everything. They can have design sprints or hackathons, or they can put out calls for innovations. They can do all sorts of things to gather the best ideas from outside their organization. (....) They're really good at being the bridge between the users of the technology or users of the know how – whatever the innovation is – within the business and the people bringing it in. They're great at that." (Jo Burgess, Isle Utilities)

Innovation brokers create bridges, they analyse issues and identify various people and organizations as "enablers" by linking them. They are individuals or groups that, acting as a relatively unbiased third party, intentionally catalyse innovation by bringing actors together and encouraging their interaction. In the case of an example like agricultural extension, innovation is expanded through innovation brokering from that of a one-to-one mediator between research and farmers to that of an intermediary who forges and supports many-to-many connections. Innovation brokering is different from traditional R&D as an organisation and function because

it institutionalises the facilitation role from a broad systemic, multi-actor, innovation systems perspective (Klerkx & Gildermacher, 2014).

Furthermore, this type of intrapreneur broker could be encouraged at different levels in organisations, encouraging the push for new approaches to also be bottom up.

> *"Through my engagement with the municipal engineers (The Young Engineers Changemakers, WADER programme – with intrapreneurs in municipalities] I've come across so many of them who, after just two years or three years in an organisation in their municipality, have identified what some of the key issues are in their municipalities and what some of the approaches and solutions should be. So I think it's something that should be encouraged from a base level. As soon as people are employed in an organisation and it doesn't have to be something that should only be encouraged once you hit a certain level of experience or exposure in an organisation. So I think it really needs to start at the bottom."* (Dr Manjusha Sunil, WADER/WRC)

7 CONCLUSION AND RECOMMENDATIONS

This study has explored how to improve water graduates' academic to entrepreneurship and intrapreneurship transition by unpacking four research sub-questions. By doing so, we have explored the concept of entrepreneurship readiness and its cognitive, regulative and conducive dimensions. In the cognitive dimension, we have looked at skills and capabilities and seen that entrepreneurship and intrapreneurship are capabilities that take years to develop. Early introduction in high school to entrepreneurship programmes can support these capabilities developing at a younger age. Only a small number of graduates will transition directly from studies into building and enterprise. Many other factors such as work experience, developing professional networks and securing self-capital result in many graduates deciding to first seek employment prior to starting a business. However, in the longer term, a more significant percentage will return to entrepreneurship. The development of entrepreneurship self-efficacy will enable a person to return to entrepreneurship at different points in their life journey when an opportunity (or need) arises.

In the conducive dimension, we unpacked the incubator training process, outlining the different stages of enterprise growth. In terms of graduates transition from academia to entrepreneurship, readiness could be accelerated by funnelling graduates to choosing their university based on the (RDI) Roadmap's research focus areas (RFAs) and cluster of interest. This will enable the streamlining of research, innovation and expertise for each RFA and cluster. Added to this, universities would need to partner with niche water/green economy incubators to assist with building and commercialising the IP of new water technology. The role of the universities will be to bring research and technology expertise. The role of the incubators will be to develop entrepreneurial skills and capabilities. This model could enable the alignment of sector expertise, market intelligence and technological expertise into the development of 'centres of excellence'.

We explored what potential business models are available to water graduates to consider. The proposed Independent Water Producer policy will open new markets to independent water producers and social enterprises. Public water sector procurement guidelines need to be reviewed and be aligned with the policy. It was also noted that innovative business models are not necessarily needed, a lot of the needs of the water sector can be addressed with existing business models and currently accessible technologies. The challenges might not be in the lack of creative solutions but in the public sector's lack of ability to integrate them currently. This is partly due to the frameworks and rules that govern municipalities' ability to respond and partly due to a skills deficit and lack of capacity in the public sector, it has been suggested. One of the innovative responses to the latter is the WADER Young Engineer Changemakers

programme that works with intrapreneurs engineers at the municipal level. This initiative should be used as a case study to develop other such initiatives.

The concept of intrapreneurs is currently underdeveloped in the public and private sector in South Africa. The intrapreneurship role could be developed in terms of water innovation extension officers. These extension officers (intrapreneurs) could potentially broker the relationship between a new technology and their organisations. In this way they will be facilitating the uptake and assimilation of innovations within their organisations.

Finally, in terms of creating an SMME pipeline, universities have a core role to play in developing potential pipelines of research, development and innovation for the sector's SMMEs. However, for them to succeed a Triple Helix model of collaboration between the government, universities and the private sector needs to be present, to ensure that their endeavours go beyond merely a theoretical exercise. The IPR-PFRD Act of 2008, also poses certain challenges it was found within the university context. In order for the IP creator (water innovator) to own their IP, a new approach is suggested, in terms of the full cost alternative under the IPR Act. In this configuration innovation brokerage can act as an intermediary between the "centres of excellence" and potential investors. In this configuration, innovators are better incentivised to develop their best IP. Universities are compensated for their work, and the private sector benefits from new innovation.

Existing Technology Transfer Offices ("TTOs") could be leveraged to facilitate the full cost alternative, in terms of the IPR Act, in partnership with the centres of excellence and innovation broker, described above, bringing more water innovation to the market.

A public-private partnership could also be developed around strategic water sector value chains identified to support the development of SMMEs. From a water sector ecosystem's perspective, a lot can be done to support SMMEs in the sector. A forum including the following key stakeholder: HEIs, TTOs, water innovation brokers, entrepreneurs, and public and private sector organisations could provide a space for knowledge sharing and networking. This would lead to catalysing current market intelligence, linked to the specific Research Focus Areas, and feeding it back to HEI research clusters.

Based on the findings of this research a range of recommendations, in the form of possible further studies, programmes, events, or policy recommendations.

In terms of ***fostering entrepreneurship and intrapreneurship readiness***, the following are recommended:

- *Creation (or upscaling) of high school programmes* aimed at planting and growing the seed of entrepreneurship and innovation in learners at a young age;
- *Developing a case study* that would document the successes of *The Young Engineers Changemakers WADER programme, and use this case study to introduce the concept of intrapreneurship more widely to the (public) water sector.*
- *There should be early investment and exposure to entrepreneurship and innovation to enable support for the development of skills and mindset leading to entrepreneurial self-efficacy for graduates.*

In terms of ***fostering entrepreneurship and intrapreneurship skills and capabilities:***

- *Further research* is needed in terms of identifying how the concept of intrapreneurship is emerging in South Africa in the public and private sector.
- *Develop set of criteria* that would qualify each entrepreneur and innovation idea for incubation and support by TTOs for commercialization or start-up. In addition, incorporate into a funding system for qualifying graduates post-research to follow through with incubation – based on stringent incubation-worthy selection criteria.
- *Develop skilled "water innovation extension officers"* (intrapreneurs) to both enhance the technical skills to take up new technologies or innovations and to manage the process of these being assimilated into relevant public and private sector organisations.

In terms of ***business model recommendations***, the following are recommended:

- *Further study* on enterprises' going concern, although going concern success rates were addressed in the interviews. It is not possible to compare them and provide a sector average, because the tracer studies of different programmes are not comparable. A study that first set out criteria to measure 'going concerns' across the sector, is needed to be able to compare;
- *Conduct a review of procurement processes* in terms of different water sector markets (such as: Alien invasive Biomass Removal, Water Harvesting, Advanced Water Treatment, Water Use Efficiency, Water Sensitive Design, Primary Agriculture) so as to ascertain possible blocks to emerging enterprises, ideas or technologies, and how to resolve them, within each specific context.

- *Leverage the possibility of the Independent Water Producers* proposed policy so that SMMEs and social enterprises entering the market, can fit into water sector value chains.

In terms of ***ecosystem recommendations***, the following are recommended:

- *Further research***,** in order to create a map or directory of all entrepreneurship stakeholders in the water sector. The purpose of mapping the entrepreneurial ecosystem is defined with regard to three elements: 1. the surrounding environment, more precisely the business environment and investment climate, 2. its interacting actors, and 3. the evolving culture and attitudes (GIZ, 2018). This should be unpacked in a more detailed study on the formation of an enabling entrepreneurial ecosystem for the water sector in South Africa. This could be executed in the form of workshops, world cafes or different forms or round table events, in a more detailed or larger scale study;
- *Strategy focus* of the WRC could identify specific value chains (discussed in section 5.2.4) within the water sector that could be developed to provide further eco-system support for entrepreneurs (within those value chains). These value chains can be chosen strategically, based on key priorities identified, for example, job creation within the sector; and water sector market areas, (such as: Alien invasive Biomass Removal, Water Harvesting, Advanced Water Treatment, Water Use Efficiency, Water Sensitive Design, Primary Agriculture)
- *Investment in knowledge systems* where Government investment in R&D can be a very strategic intervention in alignment with the National System of Innovation;
- *Further study:* The South African water sector context should be further unpacked in a detailed study to illustrate an overview of the role players required to bring about an enabling environment for water entrepreneurship;
- *A* review of the IPR-PFRD Act of 2008 in terms of university IP ownership of technologies, innovation and IP from creators, based on international best-practice to encourage technological innovation in universities and business start-ups emanating from these ideas.
- *Insights from the Water GEP II Reference Group include:*
    - There is potential for an entrepreneur to raise funds or to negotiate through the TTO office if they are driven and tenacious enough to see it through in terms of securing improved ownership of their IP.

- There is also potential to incorporate a national “Water TTO” that can bridge the funding gap and bring together stakeholders as partners for innovation brokerage. This could act as a stop-gap to support innovation to market. It can also lend itself to a match-making activity between the right partners.
- These overarching recommendations have the potential to become embedded into the National System of Innovation.

In terms of **a potential pathway to accelerate the transition from graduate to entrepreneur in the water sector, as well as bring about innovation in the water sector,** the following are recommended:

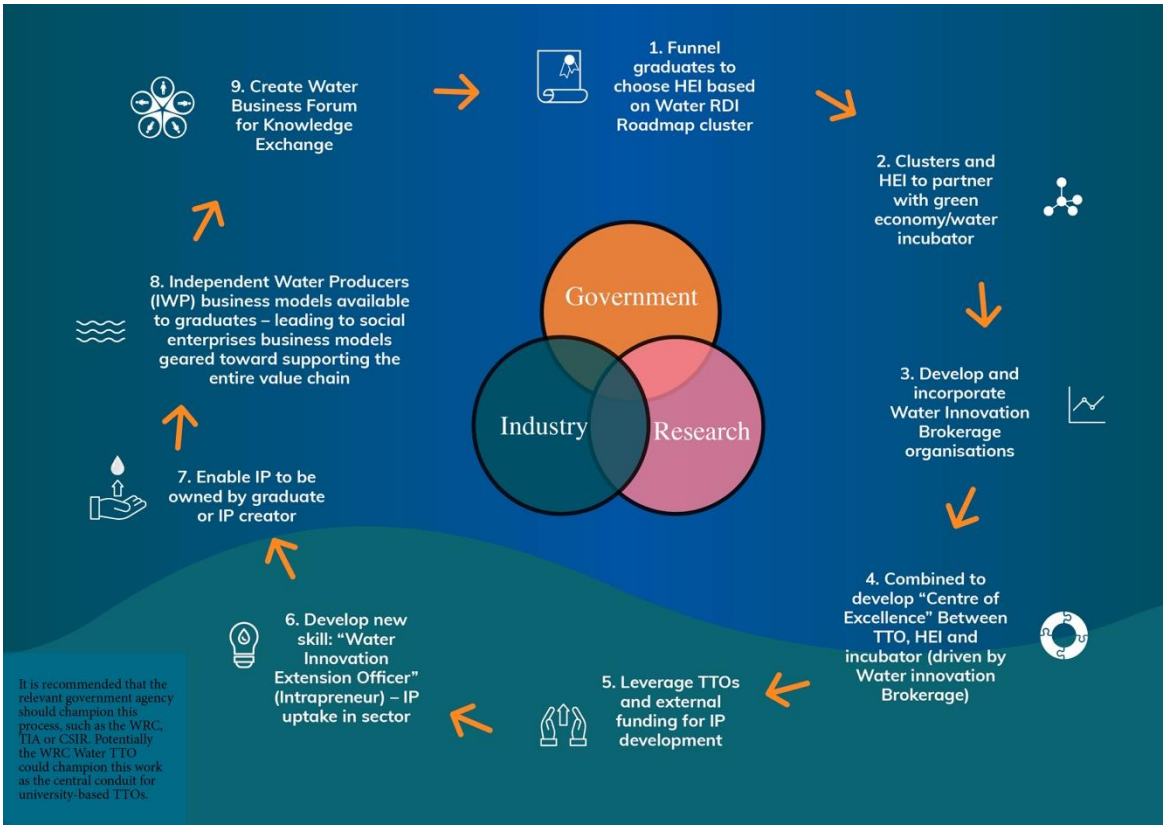
- Funnel graduates to choose their university based on the water (RDI) Roadmap’s research focus areas (RFAs) and cluster of interest. Outcome: To enable the streamlining of research, innovation and expertise for each RFA and cluster.
  - Outcome: to enable the streamlining of research, innovation and expertise for each RFA and cluster;
- Universities to partner with niche water/green economy incubators to assist with building and commercialising the IP of new water technology. The role of the universities will be to ensure research expertise, and the role of the incubators will be to develop entrepreneurial skills and capabilities.
  - Outcome: to align sector expertise, market intelligence and technological expertise, to identify new technology with high potential IP and ensure they reach the market;
- A water innovation brokerage to act as a stop-gap to support bringing innovation to market. This can also lend itself to a match-making activity between the right partners, for example WRC Water TTO.
- The above partnership could lead to the development of a ‘centres of excellence’ model that combines academic and incubation expertise, in terms of the relevant RFA and clusters. The centres of excellence become a space for public and private collaboration.
  - Outcome: this allows for targeted funding, knowledge sharing and networking in these clusters to facilitate commercialisation;
- Leverage existing TTOs to facilitate the full cost alternative, in terms of the IPR Act, in partnership with the centres of excellence and innovation broker, described above.
  - Outcome: bringing more water innovation to the market;
- Develop a new role of a water innovation extension officer – an intrapreneur, within private or public sector organisations. These extension officers (intrapreneurs) would broker the relationship between a new technology and their organisations.

- Outcome: the intrapreneurs facilitate the uptake and assimilation of innovations within their organisations;

- Enable innovators to own their IP. In order for the IP creator (water innovator) to own their IP, a new approach is suggested, in terms of the full cost alternative under the IPR Act. In this configuration innovation brokerage can act as an intermediary between the “centres of excellence” and potential investors.
  - Outcome: innovators/IP creators/water entrepreneurs are better incentivised to develop their best IP. Universities are compensated for their work, and the private sector benefits from new innovation;
- In terms of the proposed Independent Water Producers policy, in the future, water entrepreneurs will have access to markets and business models which were previously mandated only for government entities. Diverse business models, such as social enterprises, are available to incumbents, enabling SMMEs to enter the value chain.
  - Outcome: independent water producers and social enterprises will be able to create and operate sustainable businesses, resulting in increased opportunities within the value chain;
- Create a forum including the following key stakeholder: HEIs, TTOs, water innovation brokers, entrepreneurs, and public and private sector organisations. This forum will provide a space for knowledge sharing and networking. Example: WRC Water TTO.

  Outcome: current market intelligence is linked to the specific Research Focus Areas and will be fed back to HEI research clusters. National System of Innovation leveraged via a central coordinating body.

It is recommended that a relevant government agency champions this process. This could be WRC, TIA or CSIR. Potentially the WRC Water TTO could champion this work as the central conduit for university-based TTOs. (See the below illustration of the above process)



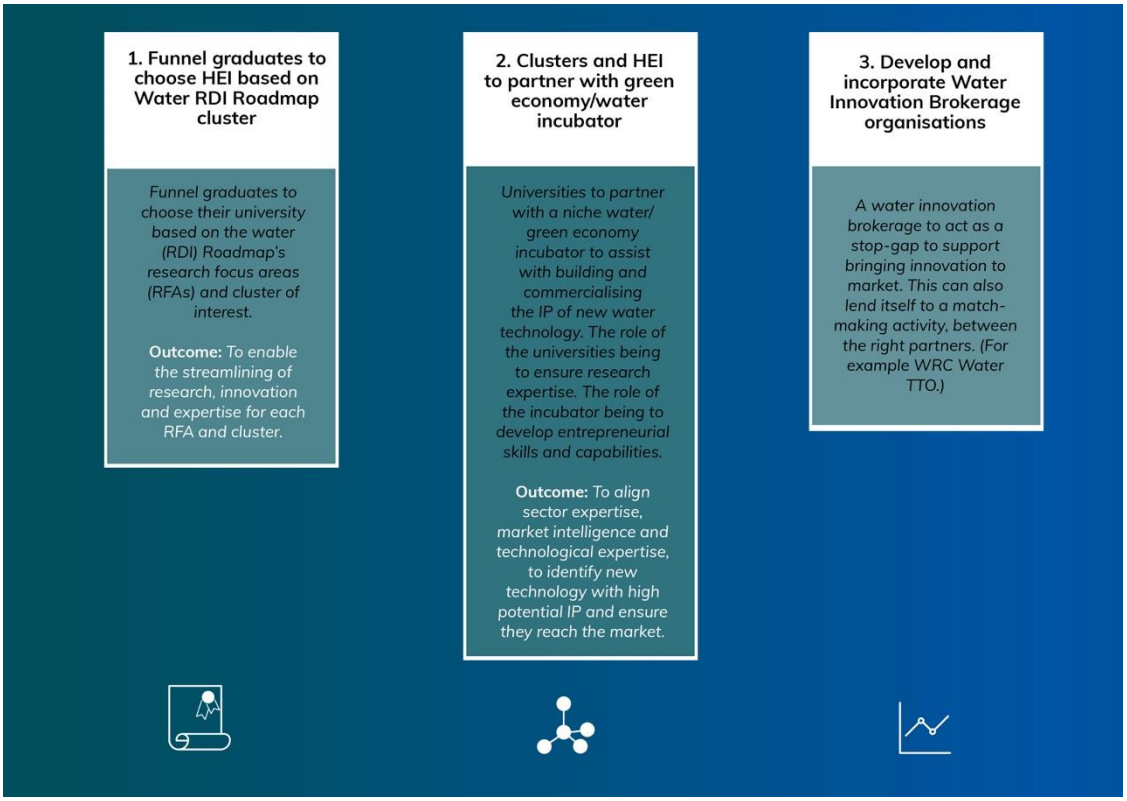


Figure 17: *Core recommendation framework summary*

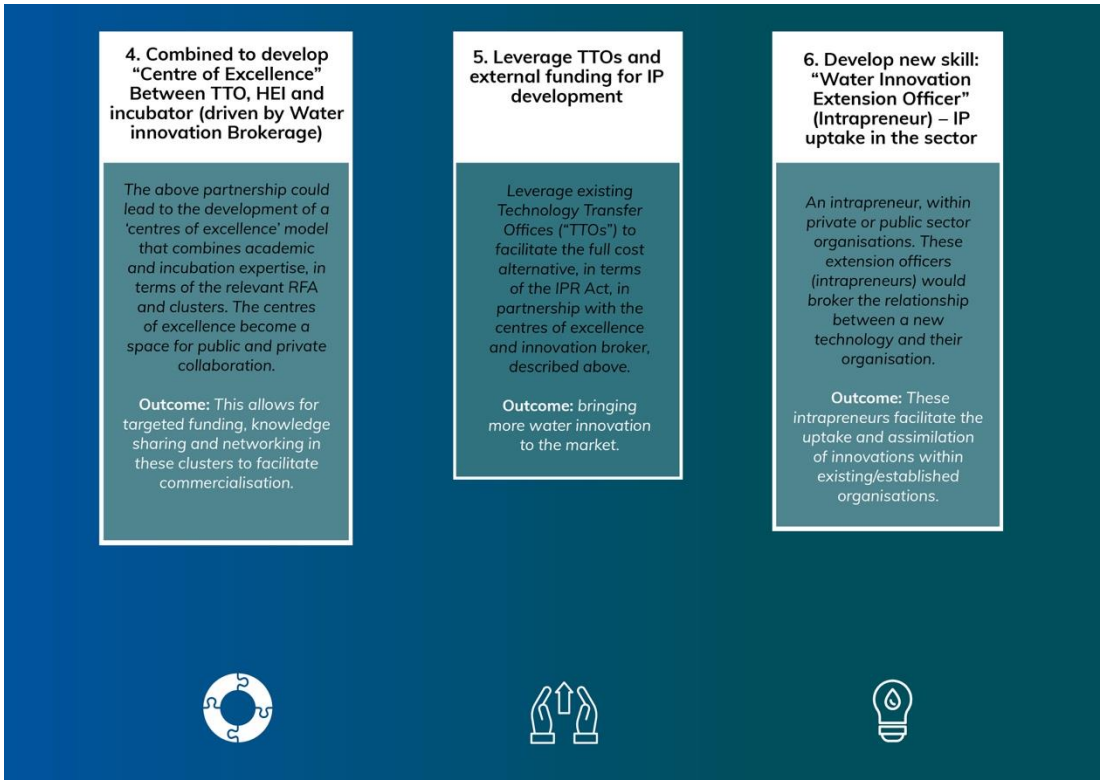


Figure 17: *Core recommendation framework summary (continues)*

REFERENCES

Al-Dajani, H., Dedoussis, E., Watson, E. & Tzokas, N. (2014). Graduate entrepreneurship incubation environments: A framework of key success factors. *Industry and Higher Education*, 28(3), 201-213.

Amo, B.W. (2010). Corporate entrepreneurship and intrapreneurship related to innovation behaviour among employees. *International Journal of Entrepreneurial Venturing*, 2(2), 144-158.

Augusto Felicio, J., Rodrigues, R. & Caldeirinha, V.R. (2012). The effect of intrapreneurship on corporate performance. *Management Decision*, 50(1), 1717-1738.

Bae, T.J.; Qian, S.; Miao, C. & Fiet, J.O. (2014). The relationship between entrepreneurship education and entrepreneurial intentions: A meta-analytic review. *Entrepreneurship Theory and Practice*, 38(2), 217-254.

Berg, S. & Marques, R. (2011). Quantitative studies of water and sanitation utilities: A benchmarking literature survey. *Water Policy*, 13(5), 591-606.

Blanka, C. (2019). An individual-level perspective on intrapreneurship: A review and ways forward. *Review of Managerial Science*, 13(5), 919-961.

Bodolica, V. & Spraggon, M. (2021). Incubating innovation in university settings: Building entrepreneurial mindsets in the future generation of innovative emerging market leaders. *Education and Training*, 63(4), 613-631.

Borgen Magazine. (2021). Article accessed on 8 August 2022: https://www.borgenmagazine.com/entrepreneurship-in-south-africa/#:~:text=In%202017%2C%2095.7%25%20of%20early,this%20figure%20dropped%20to%2038.63%25.

Bosma, N., Hill, S., Ionescu-Somers, A., Kelley, D., Levie, J. & Tarnawa, A. (2020). Global entrepreneurship monitor: 2019/2020 global report. London, UK: Global Entrepreneurship Research Association.

Botham, R. & Mason, C. (2007). Good practice in enterprise development in UK higher education. National Council for Graduate Entrepreneurship (NCGE) Research Report 004/2007. http:// www.ngce.com

Carstens, M., Swartz, C., Reyneke, B., Waso, M., Bester, E. & Jackson, M. (2020). Water Research Development and Innovation (RDI) roadmap skills mapping study Volume IV: Water sector skills demand. Report to the Water Research Commission, No. TT 865/4/21. Stellenbosch: Stellenbosch University.

Coduras, A., Saiz-Alvarez, J.M. & Ruiz, J. (2016). Measuring readiness for entrepreneurship: An information tool proposal. *Journal of Innovation & Knowledge*, 1(2), 99-108.

Dahan, N.M., Doh, J.P., Oetzel, J. & Yaziji, M. (2010). Corporate-NGO collaboration: Co-creating new business models for developing markets. *Long Range Planning*, 43(2-3), 326-342.

DBSA (Development Bank of Southern Africa). (2022). How can South Africa overcome its water challenges and avoid the African water crisis. Online: Retrieved from dbsa.org.

Distaso, A. & Ciervo, M. (2011). Water and common goods: Community management as a possible alternative to the public private model. *Rivista Internationale di Scienze Sociali*, 119(2), 143-166.

DNA Economics (2020). A Technical Report for the 2020 Critical Skills List. Produced for the Department of Higher Education and Training (DHET) as part of the Labour Market Intelligence (LMI) research programme.

Edu4Sure Team (2019). 5 Reasons why is intrapreneurship essential in companies (July 7). Available from: https://edu4sure.com/: https://edu4sure.com/intrapreneurship#:~:text=It%20leads%20to%20not%20only, their%20personal%20growth%20as%20well

Etzkowitz, H. (2003). Innovation in innovation: The Triple Helix of university-industry-government relations. *Social Science Information*, 42(3). 293-337.

Fabricius, C., Folke, C., Cundill, G. & Schultz, L. (2007). Powerless spectators, coping actors, and adaptive co-managers: A synthesis of the role of communities in ecosystem management. *Ecology and Society* 12(1), 29 (online).

Gatune, J., Deboer, D. & Mudde, H. (2018). The Triple Helix as a model for economic development: A background paper (31pp.). Kuwait City, Kuwait: Maastricht School of Management.

Gleick, P. (2003). Water use. *Annual Review of Environment and Resources*, 28(November), 275-314.

GreenCape (2021). Water Market Intelligence Report. Cape Town, South Africa: GreenCape.

Guindalini, C., Verreynne, M-L. & Kastelle, T. (2021). Taking scientific inventions to market: Mapping the academic entrepreneurship ecosystem. *Technological Forecasting and Social Change*, 173(December), No. 121144.

Gupta, A.D., Pandey, P., Feijóo, A., Yaseen, Z.M. & Bokde, N.D. (2020). Smart water technology for efficient water resource management: A review. *Energies*, 13*(*23), No. 6268.

Hage, J. & Hollingsworth, J.R. (2000). A strategy for the analysis of idea innovation networks and institutions. *Organization Studies*, 21(5), 971-1004.

Hecker, A. (2017). The intrapreneurial nature of organizational innovation: Toward a new process model. *International Journal of Innovation*, 5(3), 375-398 [online]. Available from: Mendeley Reference Manager (Accessed 5 June 2022).

Hughes, J., Tiger, M, Eskaf, S., Berahzer, S., Royster, S., Boyle, C. & Batten, D. (2014). *Defining a Resilient Business Model for Water Utilities.* Chapel Hill, NC: Environmental Finance Center, University of North Carolina.

Isenberg, D. (2010). How to start an entrepreneurial revolution. *Harvard Business Review*, 6 July 2010.

Jablonski, A. & Jablonski, M. (2020). Business models in water supply companies: Key implications of trust. *International Journal of Environmental Research and Public Health*, 17(8), No. 2770.

Kaehler, B. & Grundei. J. (2019). The concept of management: In search of a new definition. In *HR Governance* (pp. 3-26). Project: HR Governance and Management/Leadership Systems, Merseburg and Berlin. New York, NY: Springer Publishing.

Kirby, D.A., Guerrero, M. & Urbano, D. (2011). Making universities more entrepreneurial: Development of a model. *Canadian Journal of Administrative Sciences/Revue Canadienne des Sciences de l'Administration*, 28(3), 302-316.

Kurland, N.B. & Zell, D. (2010). Water and business: Taxonomy and review of the research. *Organisation and Environment*, 23(3), 316-353.

Lackéus, M. (2015). Entrepreneurship Education: When, what, when, how. Entrepreneurship 360 Background Paper. OECD LEED Programme. The Hague, Netherlands: the Dutch Ministry of Economic Affairs.

Lima, S., Brochado, A. & Marques, R.C. (2021). Public-private partnerships in the water sector: A review. *Utilities Policy*, 69(C). doi: 10.1016/j.jup.2021.101182.

Magretta, J. (2002). Why business models matter. *Harvard Business Review*, 80(5), 86-92, 133, June.

Maresch, D., Harms, R., Kailer, N. & Wimmer-Wurm, B. (2015). The impact of entrepreneurship education on the entrepreneurial intention of students in science and engineering versus business studies university programs. *Technological Forecasting and Social Change,* 104(December), 172-179.

Maier, V. (2011). Entrepreneurship versus Intrapreneurship. *Review of International Comparative Management*, 12(5), 971-976.

Martin, A. (2013). Adaptability: How students' responses to uncertainty and novelty predict their academic and non-academic outcomes, *Journal of Educational Psychology*, 105(3), 728.

Mason, C. & Brown, R. (2014). Entrepreneurial ecosystems and growth-oriented entrepreneurship. OECD LEED Programme. The Hague, Netherlands: the Dutch Ministry of Economic Affairs.

Meldrum, B. & Guyot-Staal, A. (2014). Financial Training for Social Enterprises Report. Geneva, Switzerland: International Labour Organisation.

Nabi, G., Linan, F., Alain, F. & Walmsley, A. (2017). The impact of entrepreneurship education in higher education: A systematic review and research agenda. *Academy of Management Learning Education,* 16(2), 277-299.

Ncube, C. & Abrahams, L. (2014). Effects of the South African IP regime on generating value from publicly funded research: An exploratory study of two universities. In J. de Beer, C. Armstrong, C. Oguamanam, T. Schonwetter (Eds.), *Innovation and Intellectual Property: Collaborative Dynamics in Africa* (pp. 281-315). Cape Town: UCT Press.

Ng, K.C. (2022). The factors that influence the state of readiness for entrepreneurial opportunities: A case study of late-career professionals, managers, executives and technicians (PMETs) in Singapore. Unpublished doctoral thesis. London, UK: University of Wales Trinity Saint David.

Fatoki, O.O. (2010). Graduate entrepreneurial intention in South Africa: Motivations and obstacles. *International Journal of Business and Management*, 5(9), 87-98.

Olugbola, S.A. (2017). Exploring entrepreneurial readiness of youth and start-up success components: Entrepreneurship training as a moderator. *Journal of Innovation and Knowledge*, 2(3), 155-171.

Rae, D. & Woodier N. (2006). Graduate Career Choices and Entrepreneurship. National Council for Graduate Entrepreneurship Research Report 007 / 2006.

Ritchie, J.C. & Schiebe, F.R. (2000). Water quality. In G.A. Schultz and E.T. Engman (Eds.), *Remote Sensing in Hydrology and Water Management*, (pp. 287-303). Berlin/Heidelberg, Germany: Springer. Available from: https://doi.org/10.1007/978-3-642-59583-7_13

Ross, C.R. & Beckmann, M.P. (2010). Planning a bioscience incubator program: Entrepreneurship and economic initiatives from invention to venture. Available from: Kaufman Fellows website: https://www.kauffmanfellows.org/journal_posts/planning-a-bioscience-incubator-program-entre preneurship-and-economic-initiatives-from-invention-to-venture

Ruiz, J., Soriano, D.R. & Coduras, A. (2016). Challenges in measuring readiness for entrepreneurship. *Management Decision*, 54(5): 1022-1046. Sanchez

Sánchez, J.C. (2013). The impact of an entrepreneurship education program on entrepreneurial competencies and intention. *Journal of Small Business Management*, 51(3), 447-465.

Satell, G. (2017). *Mapping Innovation: A Playbook for Navigating a Disruptive Age*. New York, NY: McGraw Hill.

Schillo, R.S., Persaud, A. & Jin, M. (2016). Entrepreneurial readiness in the context of national systems of entrepreneurship. *Small Business Economics*, 46(4), 619-637.

SEED (2020). Health and Hygiene: Improving access to climate-smart WASH Products: Replicator Workbook. Available from: https://www.seed.uno/articles/workbooks/health-and-hygiene-improving-access-to-climate-smart-wash-products-replicator-workbook (Accessed 26 July 2022).

Siebrits, R.M., Winter, K., Barnes, J., Dent, M.C., Ekama, G., Ginster, M., Harrison, J., Jackson, B., Jacobs, I., Jordaan, Am., Kasan, H.C., Kloppers, W., Le Roux, R., Maree, J., Momba, M.N.B., Munnik, A.V., O'Keeffe, J., Schulze, R., Silberbauer, M., Still, D. & Van Zyl, J.E. (2014). Priority water research questions for South Africa developed through participatory processes. *Water SA*, 40(2), Online ISSN 1816-7950.

Sinyolo, S., Mokhele, T., Mpyana, M., Nyezi, K., Bolosha, A., Dyantyi, P., Booys, M., Dlamini, S., Ramigo, P. and Maila, M. (2020). Mapping the innovation landscape of the Karoo region with the local innovation advancement tools consolidated final report. Pretoria: South African Department of Science and Innovation.

Smilor, R. (1987). Managing the incubator system: Critical success. *IEEE Transactions on Engineering Management*, 34(3), 146-155.

Statistical Release P0211 (2021). Available from: www.statssa.gov.za,info@statssa.gov.za.

Stuart-Hill, S.I. (2015). Mainstreaming adaptation to climate change into decision making in the water sector: Concepts and case studies from South Africa. Durban: University of KwaZulu-Natal, South Africa.

Talonen, T. & Hakkarainen, K. (2014). Elements of sustainable business models. *International Journal of Innovation Science*, 6(1), 43-54.

Tzinis, I. (2021). Technology Readiness Level. National Aeronautics and Space Administration (NASA) Available from: https://www.nasa.gov/directorates/heo/scan/engineering/technology/technology_readiness level – Last Updated: April 1, 2021.

Wilson, F., Kickul, J. & Marlino, D. (2007). Gender, entrepreneurial self-efficacy, and entrepreneurial career intentions: Implications for entrepreneurship education. *Entrepreneurship Theory and Practice*, 31(May), 387-406.

WIN-SA (Water Information South Africa) (2015). Water Sector Skills Gap Analysis: A skills intervention map for South Africa, Lesson Series June 2015, 20 pp. Gezina, South Africa: Water Research Commission.

World Bank. (2018). South Africa digital economy assessment. Background paper series: Digital entrepreneurship pillar. Washington, DC: World Bank.

World Bank Group (2014). Water PPPs in Africa (July 2014). Washington DC: World Bank Group, Public-Private Partnership Legal Resource Center.

WRC (Water Research Commission) (2018). *The South African Water Innovation Story,* Gezina, South Africa: Water Research Commission.

Yunus, M., Moingeon, B. & Lehmann-Ortega, L. (2010). Building social business models: Lessons from the Grameen experience. *Long Range Planning*, 43(2-3), 308-325.

Zamora, D. & Blinn, C. (2019). Water Quality and Quantity – Wood Energy. [Online] Wood-energy.extension.org. Available from: https://wood-energy.extension.org/water-quality-and-quantity/ (Accessed 17 June 2022).

Additional Sources

Allen, D.N. & McCluskey, R. (1990). Structure, policy, services, and performance in the business incubator industry. *Entrepreneurship Theory & Practice,* 15(2), 61-77.

Allie-Edries, N. & Mupela, E. (2019). Business Incubation as a job creation model: A comparative study of business incubators supported by the South African Jobs Fund. *Africa Journal of Public Sector Development and Governance,* 2(2), 72-95.

Antoncic, B. & Hisrich, R.D. (2001). Intrapreneurship: construct refinement and cross cultural validation. *Journal of Business Venturing*, 16(5), 495-527.

Chaminade, C., Lundvall, B., Vang, J. & Joseph, K.J. (2009). Designing innovation policies for development: Towards a systemic experimentation-based approach. In L. Bengt-Åke, J. Joseph, C. Chaminade & J. Vang (Eds.), *Handbook of Innovation Systems and Developing Countries*, chapter 13, pp. 360-379. Cheltenham and Camberley, UK: Edward Elgar Publishing.

Cheah, J., Amran, A. & Yahya, S. (2019). External oriented resources and social enterprises' performance: The dominant mediating role of formal business planning. *Journal of Cleaner Production*, 236(November), No. 117693.

Diyamett, B.D. (2012). Building systems of innovation in an African setting: The cluster initiative development approach. *African Journal of Science, Technology, Innovation and Development*, 3(3), 300-303.

DWAF (Department of Water Affairs) (2000). *Governing Board Induction Manual 4*, Chapter 1: Overview of the South African water sector. Pretoria: Department of Water Affairs.

Engel, J.S. (2015). Global clusters of innovation: Lessons from Silicon Valley. *California Management Review*, 57(2), 36-65.

Foster, K, R. Paladh, A. Knox & J. Bhagwan. (2022). Working Paper: Position paper: The opportunity of independent water producers in South Africa. Water Research Commission, Pretoria, South Africa.

Gerba, D. (2012). Impact of entrepreneurship education on entrepreneurial intentions of business and engineering students in Ethiopia. *African Journal of Economic and Management Studies*, 3(2), 258-277.

Guerrero, M., Urbano, D. & Gajon, E. (2020). Entrepreneurial university ecosystems and graduates' career patterns: Do entrepreneurship education programmes and university business incubators matter? *Journal of Management Development*, 39(5), 753-775.

Hansen, T. & Birkinshaw, J. (2007). The innovation value chain. *Harvard Business Review*, June 2007. Available from: https://hbr.org/2007/06/the-innovation-value-chain#:~:text=Hansen%20and%20Birkinshaw%20recommend%20viewing,and%20spread%20of%20developed%20ideas (Accessed 13 June 2022).

Hardy, E. (2019). How to grow an ecosystem for water entrepreneurs. Available from: Water Centre website, http://www.watercentre.org/blog/how-to-grow-an-ecosystem-for-water-entrepreneurs/ (Accessed 13 June 2022).

Hooley, A., Hutchinsen, J. & Neary, S. (2012). *Supporting STEM students into STEM careers: A practical introduction for academics*. Derby, UK: International Centre for Guidance Studies. Available from: http://hdl.handle.net/10545/23161

Isenberg, D. (2011). The entrepreneurship ecosystem strategy as a new paradigm for economic policy: Principles for cultivating entrepreneurship. The Babson ecosystem project. Institute of International and European Affairs, Babson Global, Ireland.

Klaasa, P. & Thawesaengskulthai. N. (2018). Incubation framework for a new start-up: A case study in Thailand. International Conference on Industrial Engineering and Operations Management Bandung, Indonesia, March 6-8, 2018.

Klerkx, L. & P. Gildemacher. (2014). The role of innovation brokers in agriculture innovation systems. Agricultural Innovation Systems: An investment sourcebook.

Lee, S. & Doherty, I. (2010). Rapid instructional design: Increasing educator capacity for developing E-learning solutions. Available from: https://www.researchgate.net/publication/229021299

Lundvall, B-A., Vang, J., Joseph, K.J. & Chaminade, C. (2009). Innovation system research and developing countries. In B-Å. Lundvall, K.J. Joseph, C. Chaminade, J. Vang (Eds.), *Handbook of Innovation Systems and Developing Countries*, pp. 1-32. Cheltenham, UK: Edward Elgar Publishing.

Mhlongo, S D. & Mzyece, M. (2022). The business of business incubation: How stakeholders measure value and investment returns in South African fintech incubators. *African Journal of Science, Technology, Innovation and Development*, Online 2 June, 1-14. doi: 10.1080/20421338. 2022.2069215.

Moyo, L. & Wehn, U. (2017). Interaction dynamics: The case of the water sector skills plan in South Africa. *Evaluation and Program Planning*, 60(C), 91-99.

Osterwalder, A. & Pigneur, Y. (2010). *Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers*. Hoboken, NJ: John Wiley.

Pahwa, A. (2022). What is a business model? The 30 types explained. Available from: https://www.feedough.com/what-is-a-business-model/ (Accessed 6 June 2022).

Robichaud, Y., McGraw, E. & Roger, A. (2001). Toward the development of a measuring instrument for entrepreneurial motivation. *Journal of Developmental Entrepreneurship*, 6(2): 189-201.

Rose, J. & Winter, K. (2015). A gap analysis of the South African innovation system for water. *Water SA*. 41(3): 13.

Rose, K. (2012). Enhancing innovation in developing country systems: A synthesis of case studies and lessons from Uganda. In M. Muchie and A. Basakarn, (Eds.), *Creating Systems of Innovation in Africa: Country Case Studies* (1st edition), (pp. 78-96). Pretoria: Africa Institute of South Africa / Institute for Economic Research on Innovation.

Sanergy (2018). Impact. Available from: https://www.sanergy.com/impact/ (Accessed 20 June 2022).

Scott, G., Leritz, L.E. & Mumford, M. D. (2004). The effectiveness of creativity training: A quantitative review. *Creativity Research Journal*, 16(4): 361-388.

Shahab, Y. (2019). CEO attributes, sustainable performance, environmental performance, and environmental reporting: New insights from upper echelons perspective. *SSRN Electronic Journal*, 29(1), 1-16.

SSWM (Sustainable Sanitation Water Management). (2020). Sanitation Water Management Toolbox. Available from: https://sswm.info/perspective/innovating-business-models (Accessed on 25 July 2022).

Statistical Release P0211 (2021). Available from: www.statssa.gov.za,info@statssa.gov.za.

United Nations in South Africa (2022). Sustainable Development Goal 6: Clean water and sanitation. Available from: https://southafrica.un.org/en/sdgs/6 (Accessed 30 July 2022).

Wasdani, K.P., Vijaygopal, A. & Manimala, M.J. (2022). Business Incubators: A need-heed gap analysis of technology-based enterprises. *Global Business Review*, 23(1), Online February 2022. doi: 10.1177/09721509221074099

Ziegler, R. (2009). *An Introduction to Social Entrepreneurship: Voices, Preconditions, Contexts*. Cheltenham and Camberley, UK: Edward Elgar Publishing.

Zvimba, J. (2015). FETWater: Building the bridge between capacity building and sector sustainability. *Water Wheel*, 14(4), 38-39.

APPENDIX 1: INTERVIEW GUIDELINES

Recording the interview

Please note all interviews should be done on Zoom, and recorded. It is important to ask permission from the interviewee for the recording. Please ask them casually, then put the recorder on – then repeat for the recording "you agree to this interview being recorded for the purpose of research". It is important they agree on the recording, like this we don't need to add signed consent forms. (Please note, if for some reason this does not happen we need email consent.)

Introduction

The interviewer should give a short introduction just to put the interviewee at ease. You can use the introduction letter you sent them in terms of info to cover.

- the purpose of the research
- main questions and sub-questions

Conducting a semi-structure interview

Please note, in conducting a semi-structure interview it is important you cover all questions in this schedule. It is possible however, that a topic of interest emerges during the interview and you are welcome to ask added questions if this is the case. As an interviewer you were chosen for your knowledge of the topic at hand, it is therefore for you to judge what a relevant emerging new thread is. The interview schedule is there to bring you back to focus, and to ensure all is covered. Please agree with interviewee at the beginning of the interview how much time you will have, and keep track of time to avoid rushing through questions at the end.

Preparation before the interview

It is recommended that you print and tweak the interview questions prior each interview. By tweaking it is meant customising them to make the questions flow better, but do not change to question's meaning. (For example, instead of saying can you tell me about your organisation you can name the organisation) You also welcome to change the order of questions if you believe another flow is better. In reviewing the questions for a specific person you might find that a certain question is not relevant, and this can be discussed with your research team.

Downloading and naming the recording

Remember to download the recording from zoom and save it. Recording should be named with the surname & name of the person interviewed as well as the date of the interview.

APPENDIX 2: INTERVIEW SCHEDULE SAMPLE 1

Background questions:

- Can you tell me briefly about your current role and work?
- What capacity building and/or educational programme does your organisation offer water-related entrepreneurs?
- How is your organisation linked to the water sector?

Readiness of water graduates in supporting entrepreneurial solutions questions:

- **Does your organisation run a programme that aims to improve the transition of graduates into water sector entrepreneurship?**
- **Can you tell me about your entrepreneurship programme(s) broadly?**
  - *Briefly, what does it aim to do?*
  - *Briefly, what transition does it aim to achieve? (It aims to take participants on a journey from point A to Z – please describe what the 'A' and the 'Z' are in your programme)*
  - *Briefly, can you tell me a bit more about your programme as a journey, what are they key steps in it?*
  - *What is your programme idea of entrepreneurial readiness? (What is the end-point it leads to or does it wants to achieve?)*
  - *In what way does your programme integrate water-sector specific readiness elements? (What is specific to being ready in the water sector?)*
  - *What are the main challenges you have identified in supporting entrepreneurism in the water sector?*
  - *What are the greatest gaps in understanding of water entrepreneurs coming through your programmes?*

Skill sets and capabilities questions:

- **How do you recruit graduates with the best potential, for your programme?**
  - *What is your selection criteria for water entrepreneurs?*
  - *What is your selection strategy?*
    - *Are you looking for innate attributes? Motivation? How far on the ideation journey are they already when they enter the programme?*
- **Do you service ideation or start-up water entrepreneurs? Or both?**
  - *In your experience how long does it take to develop ideation stage skills?*
  - *In your experience how long does it take to develop start-up stage skills?*

- **In your experience, in terms of skills sets what are the skills graduates are missing in terms of being able to transition into entrepreneurial pathways?**
- **What percentage of your entrepreneurs are running going concerns 3 to 5 years after incubation?**
    - *What type of tracer studies have you conducted on this?*

<u>Potential business models available to water graduates to consider:</u>

- **Starting a business in the water sector comes with its own challenges, in your experience, what are those challenges?**
- **Do certain business models make more sense in terms of entrepreneurship in the water sector?**
    - *What type of business model are entrepreneurs in the water sector trying out?*
    - *What type of business model are entrepreneurs in the water sector NOT trying out?*
    - *In your experience are PPP and Social Enterprise models young entrepreneurs can take on (why yes or no)?*

<u>Role eco-system</u>

- **In terms of new technology and intellectual property are you able to support new enterprises or are you in partnership with a university in this regard?**
- **Do you offer post-incubation support and what do it entail?**
    - *What post-incubation support do water sector ideation stage enterprises require? Who should be supporting them with this?*
    - *What post-incubation support do water sector start-up stage enterprises require? Who should be supporting them with this?*
- **To what extent would you say the enabling environment and support from other sector stakeholders play a role in entrepreneur's success?**
- **What is post-incubation success attributed to in your opinion?**
- **How much does the regulative dimension of the water sector, support or hinder entrepreneurial endeavours?**

APPENDIX 3: INTERVIEW SCHEDULE SAMPLE 2

BACKGROUND

- **Can you tell me about your business and what your role is in it?**
  - *How long have you been in operation?*
  - *How would you describe your business model?*
  - *What factors caused your intention to start a business?*
    - *In a nutshell the story of success and the main challenges on the way*
    - *Lessons learnt*
- **To what do you attribute your success as an entrepreneur?**
  - *Skills?*
  - *Training?*
  - *Mindset?*
  - *Other?*

READINESS OF WATER GRADUATES TO CONTRIBUTE TO WATER SECTOR ENTREPRENEURSHIP

- **Based on your experience how easy or hard would it be for graduates to start businesses in the water sector?**
  - Based on what you know is there enough support for them – in terms of incubator programmes or the like?
  - What support did you get when you were ideating and starting up?
    - Would you have like to have more support and what type of support would have been useful?
    - What are the main barriers and challenges start-up face in the water sector?

SKILL SETS AND CAPABILITIES

- **In your experience, in terms of skills sets what are the skills graduates are missing in terms of being able to transition into entrepreneurship in the water sector?**

POTENTIAL BUSINESS MODELS AVAILABLE TO WATER GRADUATES TO CONSIDER

- **Starting a business in the water sector comes with its own challenges, in your experience, what are those challenges?**

- **In terms of business models are there business models, which might be easier for graduates to look into (and business models that are just too complex in terms of the water sector regulations and laws)?**

THE ROLE OF THE ECO-SYSTEM

- **What support can graduate entrepreneur in the water sector get, in your experience?**
- **Would you say the eco-system of support is developed in South Africa?**
    - What is developed and what is missing, in your experience

APPENDIX 4: INTERVIEW SCHEDULE SAMPLE 3

BACKGROUND:

- **Can you tell me briefly about your current role and work?**
- **In what way does your organisation support innovation in the water sector?**
- **(If relevant) How is your organisation linked to the water sector?**

READINESS OF WATER GRADUATES IN SUPPORTING INNOVATION SOLUTIONS IN SA:

- **Does your organisation run a programme that aims to improve innovation in the water sector?**
    - Does your programme support intrapreneurial pathways of innovation in the water sector?
- **What are the key 'water innovation pain points' that you think could be helped through innovation through intrapreneurship?**
- **What key content topics would you suggest intrapreneurs must be educated on in the water industry?**

Can you tell me about this programme(s) broadly?

- *Who is it aimed at? (intrapreneurs, businesses, etc.?)*
- *Briefly, what does it aim to do (in terms of innovation in the water sector)?*
- *Briefly, what transition does it aim to achieve? (It aims to take participants on a journey from point A to Z – please describe what the A and the Z are in your programme)*
- *Briefly, can you tell me a bit more about your programme as a journey, what are they key steps in it?*
- *What is your programme idea of innovation readiness? (What is the end-point it leads to or does it wants to achieve?)*
- *In what way does your programme integrate water-sector specific innovation readiness elements? (What is specific to being innovation ready in the water sector?)*
- *What are the main challenges you have identified in supporting innovation in the water sector?*

SKILL SETS AND CAPABILITIES

- **How do you recruit for your programme?**
    - *What criteria, attributes do you look for?*

- **In your experience, in terms of skills sets what are the skills graduates are missing in terms of being able to transition and contribute to innovation in the water sector?**
    - *How is innovation in the water sector in South Africa emerging?*
    - *Based on your experience, how is intrapreneurship understood and supported in the water sector?*
    - *Although intrapreneurship might require higher levels of work experience, as an approach to thinking and seeing work how important is it for graduates in the water sector to think that way?*
    - *Have you conducted tracer studies to see the effect of your programmes over longer periods*
    - *What are the opportunities within your company or if not any others that you are aware of that offers water industry intra and entrepreneur skills training?*

ROLE OF THE ECO-SYSTEM

- **In terms of new technology and intellectual property are their clear pathways of support for innovation in the water sector? (Is so what are they? If not who's role should it be to create this level of support in the sector)**
- **Are their clear pathways in terms of what type of innovation should be supported in-house and what type of innovation should be supported by an eco-system?**
- **How much does the regulative dimension of the water sector support or hinder innovation in the water sector?**
- **Is there a level of risk aversion, in terms of companies tackling innovation in the SA water sector?**
- **At what level should intervention happen to ensure the next generation of graduates embraces innovation related risks and challenges?**

APPENDIX 5: INTERVIEW SCHEDULE FOR SAMPLE 3 (B)*

*This interview schedule was only used in the interview with Jo Burgess, Isle Utilities. The reason it was changed (from the one on Appendix 4) is that it was our last interview. We were more advanced in the research process and found these questions would be more useful.

BACKGROUND:

- **Can you tell me briefly about your current role and work?**
- **Do you have any experience in the water sector?**

INNOVATION IN SA

- **Innovation is a huge field and the term innovation means many different things depending on the context. Is it possible for you to tell give us a brief overview of the field of innovation in South Africa, highlighting what is different in South Africa from the rest of the world?**

INTRAPRENEURSHIP IN SA

- **The term 'intrapreneurship' is a more recent offshoot of the study of entrepreneurship, which is different from 'corporate entrepreneurship' or 'cooperative venturing', how well understood is this term in South Africa?**
- **Is intrapreneurship a concept that is understood to your knowledge in the private and/or public sectors in South Africa (if yes by who, how is it practised, encouraged)?**
- **In terms of innovation developing through means of intrapreneurship, is there a reason why this strategy will be easier or harder in South Africa?**
- **Are there any key stakeholders developing the concept of intrapreneurship in South Africa?**

ECO-SYSTEM APPROACH TO INNOVATION

- **Are systems (complex-systems or ecosystem) approaches to innovation being applied by the private/or public sector in South Africa? (If yes, in what way? If no, why not?)**

APPENDIX 6: DETAILED CASE STUDIES

Komodo Water

"Komodo Water is a social enterprise providing universal access to decent water and sustainable water management solutions for small islands and coastal communities. Komodo Water produces and sells water and ice flakes to fishermen, fish sellers, and tourist boats which diminishes the use of plastic packs for ice. They use efficient reverse osmosis machines and icemakers powered by solar technology. The company purifies brackish water of TDS 9000 ppm into water of drinking quality of TDS 11-13 ppm certified by the National Health Department in Indonesia.

Value Proposition: Komodo Water solutions seek to answer the problem of scarce fresh water supply in small island communities and high numbers of rotten fish due to a shortage of ice supplies for fishermen. Komodo Water targets the water and ice flakes supply for fishermen, fish sellers, and tourist boats. Drinking water is distributed in 20 litres jerry-cans or gallons, and the ice in the form of ice flakes. The production facility is located on Papagarang Island, where most customers reside. Komodo Water's location outperforms its competitors who mostly reside in the main town, requiring a 2-hours boat ride from Papagarang Island" (SEED, 2020).

Detailed Case Studies: Tusafishe

"Tusafishe produces, advertises, sells, and installs automated low-cost filters that eliminate the use of solid fuels to provide safe drinking water for large communities. Together with Finance Trust Bank, customers such as schools have access to flexible loans to acquire the filters. Tusafishe also supplies water filters to non-profit organisations involved in WASH activities, providing installation services and training for the beneficiaries.

Value Proposition: Tusafishe is an eco-inclusive enterprise that builds water filters using locally available materials. These filters are easy to maintain which makes them cheap and affordable for the Ugandan population. The filters have been proven over the years as a method of water purification. Tusafishe installs these filters for institutions and communities where they take time to train the women and the youth on the operations of the system. The filters provide "in the glass" ready to drink water which reduces the risk of contamination" (SEED, 2018).

According to the SSWM website (2020), these are some innovative business model examples that water entrepreneurs can consider, as a market follower strategy:

Eco Soap Bank

"Eco Soap Bank was launched in 2014 and is a humanitarian and environmental non-profit organisation saving, sanitising and supplying recycled hotel soap for the developing world. With the clever idea of adding value to a wasted resource, the organisation generates social, ecological and economic impact at a very low cost. Since 2014, Eco Soap Bank has provided more than 1.2 million people with soap and hygiene education.

The business model combines three objectives;

1) Provide a highly cost-effective hygiene product,

2) Contribute to reducing waste in the hotel industry,

3) Provide livelihoods and free education to disadvantaged women.

Eco Soap Bank partners with hotels and guesthouses providing gently used soap bars and thus being the main 'input providers'. These partners can promote their collaboration as CSR activity. For the distribution, Eco Soap Bank pays special attention to strong partnerships with NGOs to donate the soaps to hospitals, clinics, schools and village communities.
The organisation currently employs 147 women from disadvantaged backgrounds. They serve as hygiene ambassadors, selling recycled soap in their communities. In this way, Eco Soap Bank combines their social and environmental impact with an economic impact."

DipBag

"DiPure invented the DipBag as an affordable and eco-friendly solution to purify water. The DipBag is an easily adaptable method for filtration and disinfection of water; it prevents waterborne diseases and is a highly efficient alternative to chlorination which has detrimental side effects on people's health.

The compact and lightweight DipBags are the size of a teabag and contain moringa oleifera seeds that can remove pathogenic bacteria in water in less than 10 minutes. The purifier is also highly nutritious as the edible seeds can be used as food.

The DipBag is a good example for the strategy of using abundantly available inputs, because the main input of this product is the Moringa seed, which is at home in India. The seeds are obtained from the Moringa plant or tree, native to Northern India.

The seeds are available locally and do not require complicated processing, so the overall production and logistical costs are kept very low which is also reflected in the very low price. DiPure combines a clever and cost-effective technology with a clear dedication to creating an environmental and social impact. The portable herbal water purifier tackles the problem of

unsafe drinking water because it is affordable for underprivileged people, and is also completely sustainable."

Spouts of Water

"Spouts of Water is a social business that provides affordable ceramic water filters in Uganda. It manufactures the pots in Uganda from locally sourced clay and rice husks and sells the "Purifaaya" filters for around $20-25 each. Spouts of Water has been growing its reach to various regions within Uganda but also to neighbouring countries like South Sudan. To date, over 32'000 filters have been distributed, impacting over 125'000 people.

One of the success factors of Spouts of Water can be seen in its elaborate distribution system aimed at reaching as many customers as possible regardless of economic status or location. On the one hand, Spouts of Water sells its filters to high-income families via a broad network of local retailers like pharmacies, supermarkets and grocery stores, etc. From this – mostly urban – customer segment, Spouts of Water sells the filters at a profit. For middle and low-income customers, Spouts of Water is working out financing plans in cooperation with micro-finance institutions (Finca) as well as local savings and credit cooperatives (SACCOs). By facilitating access to funding for rural communities like subsistence farmers, less affluent customers are able to buy "Purifaaya". Without this service, these customers would otherwise struggle to afford water filters.

The last customer segment are individuals at the very bottom of the pyramid that simply cannot afford to purchase a water filter. In such cases, Spouts of Water partners with local aid organisations that serve such communities. Spouts of Water offers the filters at a reduced price to the aid partners, who then install them for free while also educating the poor communities on water safety. The costs for servicing the customers in immediate need are cross subsidised by the revenues from the other more profitable customer segments.

Besides building a broad distribution network, Spouts of Water further leveraged different communication channels in order to reach its various customer segments. It was able to gain the trust of its customers through local product certification processes, word of mouth, brand ambassadors, and experiential promotions."

GARV

GARV Toilets is an initiative in India that works with governments, NGOs and private actors in providing smart solutions to public sanitation challenges in the country – challenges which reverberate across the world, particularly in low-income communities. These include poorly

maintained facilities, vandalism, lack of service upkeep, etc. GARV Toilets sought to address some of these challenges by anticipating them and factoring them into the design of their business model. The public toilets they offer are claimed to be 'indestructible' since they are made from resistant materials such as steel, therefore reducing the risk of vandalism and subsequently reducing the costs of maintenance. The toilets are also integrated with smart tech features which allow the implementing company to get real-time updates of service usage and functionality, which in turn minimises the resources spent on O&M activities.

Pump for Life

"In 2009 about 50% of Tanzanian water pumps were broken and abandoned. Pump for Life (MSABI) provides maintenance services for water points in rural areas of Tanzania to increase coverage and sustainability of water infrastructure in the region.

For their water point maintenance services MSABI promotes a fee per service and a subscription-based maintenance model. The novel subscription-based model consists of free maintenance and repair in exchange for a monthly premium.

The premium can be paid through mobile phones, making the system accessible to people in remote areas with no access to conventional banking systems. The service includes proactive and reactive maintenance visits by decentralised mechanics. Location and number of mechanics have been calculated based on the spatial distribution of water points. Their strategic position allows them to cost-efficiently serve the water points."

Innovating Green Technology

"Innovating Green Technology (IGT) is a young Lebanon-based company developing a broad variety of tailor-made solar-based approaches to water, sanitation and energy-related challenges.

As part of their portfolio, IGT has launched a solution called PRO-Shield, an innovative solution for the overheating problem faced by solar water heaters, especially in regions with extensive sunshine such as the Middle East. Overheating of solar water heaters can cause up to 30% losses of water, reduces the life span of the heater by half, and decreases the solar water heater efficiency by 30-40%.

In order to reach customers, IGT partners with providers of solar water heaters that distribute the PRO-Shield mechanism as an add-on. IGT thus cuts down on marketing costs (e.g. reaching out to customers interested in purchasing or already owning a solar water heater) as well as the transportation and distribution of the PRO-Shield itself."

Drinkwell

“The social enterprise Drinkwell aims to provide access to safe and affordable water for customers in underserved urban areas. Up until now (April 2020), it employs around 50 people and is based in the US while operating in Bangladesh and India.

Drinkwell’s model combines a patented purification technology, filtration and an ATM water dispensing system. With a simple turnkey solution, customers can easily purchase clean water via prepaid cards at water ATM booths. Drinkwell is operating and maintaining these systems in cooperation with small NGOs or public utilities that provide water at a local level.

To cover capital investments and operation costs, Drinkwell closely collaborates with the utilities to co-finance the efficient and sustainable provision of local water supply through their system. Drinkwell provides the filtration technology and water ATM booths for the utilities at no cost. With the help of a micro-franchise model, Drinkwell employs local entrepreneurs to operate and maintain the water filtering system as a service. The franchisee sells the clean water directly to the whole village, thereby extending water provision to the most underserved areas.”

Uduma

“Uduma is a private company that builds private-public partnerships with government entities or other public bodies to provide smart water pump services for un- or under-served rural communities at an affordable price. Through a context-specific and well-designed O&M strategy they manage to provide a reliable, sustainable and affordable drinking water service. They install water pumps that have a breakdown alert mechanism in place, allowing users to easily notify the maintenance team when there is an issue. This allows the maintenance team to seamlessly locate the pump and address the problem in a far more efficient way – resulting in shorter pump down-time and as a result higher customer satisfaction. Regular maintenance check-ups including water quality controls contribute to pump breakdown prevention as well as water-borne disease prevention. The company also has a smart payment system in which users use pre-paid electronic cards to pay for their water – allowing water consumption to be tracked and monitored in a cost-efficient way without users needing a bank card or mobile phone. Uduma is a good example of The Couch Potato strategy as it has recognised the importance of optimising O&M activities and use resources in a smarter way in order to reduce overall company costs, while at the same time providing a sustainable, reliable and affordable service.”