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Role of technology incubators in the development of micro-, small and medium-sized enterprises in selected Southern African countries

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The study was presented and discussed at the subregional meeting on technology and innovation for micro-, small and medium-sized enterprises in Southern Africa, held in Cape Town, South Africa from 21 to 23 June 2023.

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Executive summary

Micro-, small and medium-sized enterprises are the backbone of economies, in particular in the developing world. They account for over 80 per cent of jobs in Africa, although most are predominantly micro, informal, low value added and needs-driven businesses. As such, they need to be supported in order to develop and be sustainable. Their growth and sustainability are essential for the economic development and growth of the continent's economies. If these enterprises were more opportunity driven, more innovation focused and higher growth, they would have a significant impact on and would contribute to economic development. Micro-, small and medium-sized enterprises face several challenges, including a shortage of business and technical skills, limited access to finance and technology, a lack of market knowledge and regulatory hurdles. Incubators are essential interventions to help such enterprises navigate through these challenges. Incubators take various forms and offer a variety of services, which include the provision of office or laboratory space or a mixture of dedicated services, such as: intellectual property advice; training on implementation modalities for innovative projects; business model concept testing and product insight testing; access to research and development through their proximity to universities and research institutions; prototyping and piloting facilities; access to financing and, in some cases, seed financing provided by the incubators themselves; mentorship and coaching; networking; and industry linkages. Technology incubators enable micro-, small and medium-sized enterprises to gain access to technology, appropriate equipment and prototyping and piloting facilities and to embrace innovation, enhancing their value addition, productivity and competitiveness. Given the catalytic role of technology in the blue, digital and green economies and the potential of micro-, small and medium-sized enterprises in these sectors, it is essential to encourage entrepreneurs in Africa to establish businesses that solve challenges and capitalize on the opportunities presented by these economies.

In the present report, the consultant details the outcome of a study that was undertaken on the role of technology incubators in the development of micro-, small and medium-sized enterprises in selected Southern African countries, namely, Angola, Botswana, Eswatini, Lesotho, Malawi, Mauritius, Mozambique, Namibia, South Africa, Zambia and Zimbabwe, with a view to ensuring holistic and comprehensive interventions to facilitate the growth and scaling of micro-, small and medium-sized enterprises through access to innovation and technology, and thus their contribution to the subregion's industrialization and economic development.

The study comprised desk research on incubators in general, the mapping of technology incubators in Southern Africa, interviews or surveys with over 35 incubators in the subregion and surveys with 32 micro-, small and medium-sized enterprises supported by participating incubators. The objective was to gain a better understanding of various incubation models, the types of support provided by the incubators, their sectoral specialization and coverage (with a particular emphasis on the green, blue and digital economies), their impact on supported micro-, small and medium-sized enterprises, their relationships with other stakeholders in their country's innovation system, and any differences across the countries in the subregion. The present report includes a comparison of experiences of technology incubators from other countries

in the global North and global South concerning different aspects of incubating micro-, small and medium-sized enterprises.

Most incubators in Southern Africa are established as non-profit organizations and sustained by funding from one or more sources, including the Government, donors, private organizations and individual sponsors. The next most common types are government-owned, for-profit and university-owned incubators, respectively. Governments remain a crucial financier of incubators, including those established as non-profit organizations. It was revealed through the study, however, that, despite significant efforts, Governments were constrained in providing adequate financial support to the incubators, as evidenced by the closure of several entrepreneurship initiatives aimed at supporting micro-, small and medium-sized enterprises, thus eroding the gains that have been achieved to date. Accordingly, incubators need to be integrated into economic development policies, national priorities and government budgets, given their role in supporting the establishment and growth of micro-, small and medium-sized enterprises. More specifically, Governments should increase their efforts to enable access to technology and innovation for micro- , small and medium-sized enterprises so that they can be more competitive.

It was revealed through the study that, whereas the entrepreneurial system in Southern Africa was in its developmental stages, there were disparities among the different countries regarding entrepreneurship and innovation support, with some countries having greater government support for incubators than others, and with pockets of excellence appearing in several countries and within the subregion. Some countries, such as South Africa, have well-developed, government-backed innovation and entrepreneurship systems, supported by strong tertiary educational and research institutions and significant research and development investment. As such, these countries have more incubators spread across multiple cities, unlike in other countries, where the incubators tend to be concentrated in just one or two cities. There has been increased entrepreneurship even in some countries with small markets, such as Botswana, Mauritius and Namibia, which have been characterized by increased start-up activities, primarily in digital innovation. The subregion has also benefited from such programmes as the Southern Africa Innovation Support Programme that have created some linkages among the incubators and other stakeholders in the subregion.

With a few exceptions, many of the incubators in the subregion are not adequately equipped to provide the required support to entrepreneurs and to micro-, small and medium-sized enterprises, in particular concerning access to technology, equipment, prototyping and manufacturing facilities, markets and finance. Some countries, such as Botswana, Eswatini, Namibia, South Africa, Zambia and Zimbabwe, have established specialized funds or interventions, including science and technology parks, to support the access of such enterprises to technology, equipment and facilities needed for their development. South Africa has benefited from its legislative requirement for large companies to be involved in enterprise and supplier development as part of societal redress to empower communities that were historically excluded from economic participation under the apartheid system. This has stimulated the entrepreneurship system, with a disproportionately larger amount of significant private funding in South Africa than in the rest of the subregion, enabling incubators to run programmes to develop suppliers for these large companies.

An insufficient capacity among science, technology and innovation personnel was revealed through the study. This consequently results in innovative and high-tech start-ups needing more research and development guidance and support for product development. This situation is not surprising, given the low levels of investment in research and development in the subregion and the performance of the countries in such indicators as the Global Innovation Index. Consequently, access to technology remains a challenge, as demonstrated by the low capacity of many of the incubators to provide technology support, the weak linkages between the incubators and universities and research institutions, the lack of funding for acquiring technology and equipment and the overly bureaucratic processes for gaining access to it, and the absence of capacity to operate the equipment or effectively embed the technology once it is received, as was highlighted by some of the incubators. There are examples of deliberate efforts to increase the focus on science, technology and innovation and access to technology by micro-, small and medium-sized enterprises in the subregion, one being the decision of the Government of Zimbabwe to embed innovation and technology hubs into the education system under the education 5.0 policy. This has the potential to ensure a value chain approach, nurturing and building an innovation system that is well-positioned to contribute to the modernization and industrialization of the economy. It was revealed through the study that micro-, small and medium-sized enterprises could benefit from greater collaboration and the sharing of resources and facilities by incubators, and the cases of the innovation hubs in Zimbabwe and the science and technology parks in several other countries in the subregion (Botswana, Eswatini and South Africa) are examples that show potential for enabling this.

Most incubators in Southern Africa do not have specific technology interventions to support technology development among micro-, small and medium-sized enterprises or their access to technology. Almost half of the incubators participating in the study support information and communications technology and digitally inclined micro-, small and medium-sized enterprises, 37.5 per cent support micro-, small and medium-sized enterprises in agriculture, 21.8 per cent support such enterprises in the green economy, and 6 per cent support those in biotechnology. A handful of incubators mapped in the present study had incubated micro-, small and medium-sized enterprises in the digital and green economies or had a specific specialization in those areas. For example, BongoHive, the Mobile Applications Laboratory (mLab), Tshimologong Digital Innovation Precinct and mHub, to name a few, were focused on the digital economy. Alternatively, such incubators as the Climate Innovation Centre South Africa, the Small Enterprise Development Agency Atlantis Renewable Energy Business Incubator, the Botswana Digital & Innovation Hub, Mzuzu E-Hub, TheNeoHub and the Impact Amplifier stated that they specialized in supporting entrepreneurs and micro-, small and medium-sized enterprises in the green economy. The Innovation Hub in South Africa and the Botswana Digital & Innovation Hub were the only technology hubs providing specialist incubation that incorporated information and communications technology or digital technology and at least one other sector, either the bioeconomy or the green economy. Only one incubator – OceanHub, in South Africa – was focused on the blue economy. This sector has great potential within the subregion, given the diversity of water and coastal resources and the potential for value addition. Other than the handful of university-based incubators that were mapped, most incubators had very weak linkages to universities, except those that were more focused on agriculture, which appeared to have closer ties with agriculture faculties or colleges. Technology incubators must work closely

with universities and other research institutions to increase access to technology for the enterprises they support. Young people have higher chances of success in digital technology and related sectors, owing to the ease with which they embrace and work with digital tools and technology. This has potential for driving the development of the fourth industrial revolution industries in the subregion.

Most of the incubators are located in urban areas, and mostly in large cities. Accordingly, there must be deliberate efforts to establish incubators in peri-urban, remote and rural areas, thereby mainstreaming access for micro-, small and medium-sized enterprises to office space or workspace, mentorship and coaching, industry experts and social support, in particular in township and rural economies. Within the context of "not leaving anyone behind", one of the recommendations emanating from the study is for incubators to ensure the diversification of the range of services and support offered to cater for different types of entrepreneurs and micro-, small and medium-sized enterprises. Increasing entrepreneurship awareness and education and having digital platforms where micro-, small and medium-sized enterprises can gain access to free tools and resources could enhance the productivity and competitiveness of such enterprises in the subregion. It is also important to design programmes that cater for enterprises at various stages of development, recognizing that some enterprises will come from a low technological and entrepreneurial base and that others will require more support.

A big challenge is the sustainability of technology incubators, given the need for more funding by some Governments. To address this challenge, some technology incubators resort to "following the money" and focusing on donor-funded and corporation-funded programmes. This could lead to misalignment between the funders of these programmes and the countries' development and industrialization priorities. In most cases, there is a more significant bias towards fulfilling donors' agendas than towards supporting the realization of priorities and goals in the national development plan or industrial policy or contributing to regional development goals. Accordingly, there is a need for technology incubators to be more focused, to be integrated into their country's national development plan, industrial policy and public budget, and to be anchored by an enabling intellectual property environment. The consultant also recommends that, instead of establishing new technology incubators on an ongoing basis, in some cases there is a need to consider expanding and strengthening the existing ones by increasing their financial capabilities for operational expenditure and the funding of projects, enabling their access to equipment, and increasing the availability of prototyping and manufacturing facilities. Carrying out this recommendation requires proper mapping of the technology incubators in each country, and the present study contributes to that endeavour. This should include mapping all infrastructure and facilities currently available to micro-, small and medium-sized enterprises. The incubators, together with policymakers, will also need to develop new business models to ensure consistent revenue and their own sustainability. One of the recommendations contained in the present study is to explore having shared or open access laboratory or technical facilities and equipment to which micro-, small and medium-sized enterprises supported by different incubators at a national or subregional level could gain access, given the prohibitive costs of some facilities in growth sectors, such as the green economy and biotechnology. The Southern Africa Network for Biosciences initiative was identified as one example of enabling such shared access, whereby the Council

for Scientific and Industrial Research in South Africa acted as an anchor, supporting researchers from institutions in other countries in the subregion.

There is a need for broad-based consensus on integrating technology incubators into economic and industrial policy, given the incubators' positioning regarding knowledge transfer networks, including technology transfer, which is critical for developing industries. In the light of the importance of technology transfer and new knowledge generation, more incubators must integrate intellectual property support into their offering of services to micro-, small and medium-sized enterprises. Some incubators in the subregion offer intellectual property support to such enterprises, either directly through in-house personnel, as is the case with the Innovation Hub in South Africa, or in collaboration with the national intellectual property office, as is the case with the incubators in Botswana, Namibia and Zambia.

Regarding the role of incubators in contributing to inclusivity and enabling greater access to opportunities for women and young people, it was revealed through the study that women entrepreneurs faced additional constraints relating to access to funding and complete access to incubator services. Many female founders experience unfair discrimination based on gender, sex, pregnancy status, marital status, family situation and age. Some discriminatory environments stem from social norms and ancient African moral laws. Having facilities in the incubators or close to the incubators that support women who have just given birth or who have young children was identified as one intervention that could contribute to increasing the participation of more women in entrepreneurship. It was highlighted through the study that, in general in the subregion, there was little consideration for those with disabilities or impairments in the design and programmatic interventions of the technology incubators. When ensuring inclusivity and that no one is left behind, there must be deliberate consideration for people living with disabilities, as much as for young people and women.

Regarding measures to assess the impact of an incubator, it was revealed through the study that there was a tendency, in particular in donor-supported incubators, to focus on the number of enterprises supported – or jobs created in the case of incubators established by the Government – as a performance indicator. The assessment of the performance of the incubators should go beyond quantity to focus on substance. The performance of an incubator should be assessed on the basis of the extent to which it enables the growth of the enterprises it supports – using multiple indicators that include jobs created or saved, research and development commercialization, exports generated, intellectual property developed or licensed, technology acquired, revenue, profitability and survival rate of the enterprises supported. This requires incubators to go beyond the usual business and mentorship support to enable access to technology, including enabling access to the critical technical equipment necessary to provide proof of concept, support manufacturing, improve productivity and allow enterprises to incorporate technology into their products, services and processes.

The present report is aimed at contributing to a better understanding of the technology incubator environment in Southern Africa, given the mapping of close to 100 incubators in the subregion and the survey and interviews conducted with 35 technology incubators in the subregion, as well as with micro-, small and medium-sized enterprises that these incubators have incubated.

Abbreviations and acronyms

COVID-19	coronavirus disease
ECA	Economic Commission for Africa
GDP	gross domestic product
ICT	information and communications technology
IFC	International Finance Corporation
OECD	Organisation for Economic Co-operation and Development
SADC	Southern African Development Community
UNCTAD	United Nations Conference on Trade and Development
UNDP	United Nations Development Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNIDO	United Nations Industrial Development Organization
WIPO	World Intellectual Property Organization

1: Background

Many African countries have low levels of industrialization (Naudé and Tregenna, 2023), which has resulted in a dearth of large businesses. According to Runde, Savoy and Staguhn (2021), micro-, small and medium-sized enterprises account for over 80 per cent of jobs on the continent, and the 44 million such enterprises in sub-Saharan Africa are essential for the subregion's economic development and growth. This is because micro-, small and medium-sized enterprises are the backbone of many African economies. This situation notwithstanding, most of these enterprises are predominantly micro, (Runde, Savoy and Staguhn, 2021), informal, low value added and needs-driven businesses (Molai, 2022). However, they contribute to improved livelihoods, given the extent of development of most African economies and the rising unemployment levels. If these micro-, small and medium-sized enterprises were to be more opportunity driven, more innovation focused and higher growth, they would have a significant impact on and would greatly contribute to the Southern African economies (Molai, 2022). Some of these could scale to become large growth businesses that contributed to the subregion's industrialization, taking advantage of opportunities presented by the establishment of the African Continental Free Trade Area. High-impact and opportunity-driven entrepreneurship can drive economic growth and structural transformation on the continent, in contrast to the "survival entrepreneurship" that currently characterizes most micro-, small and medium-sized enterprises (United Nations Conference on Trade and Development (UNCTAD), 2018).

There is an opportunity to nurture business ventures that exhibit stronger value addition and higher productivity through access to technology and innovation. For this to be sustainable, it is important to understand the context in which these enterprises operate and the kind of nurturing and support mechanisms that would be most effective. One of the critical support mechanisms for helping such enterprises to grow and scale is the incubation support provided by incubators. Depending on how they are structured, incubators could be critical enablers for supporting start-ups and entrepreneurs in gaining access to technology and innovation to achieve higher levels of innovativeness, productivity and competitiveness (Bramann, 2017). Chisha (2021) highlights that technology incubators can resolve many of the challenges that micro-, small and medium-sized enterprises in Southern Africa face, which range from a shortage of skills and limited access to finance and technology to a lack of market knowledge. Incubators take various forms and offer a variety of services, which include but are not limited to the provision of office or laboratory space and a variety of dedicated services, such as: intellectual property advice; training on implementation modalities for innovative projects; business model concept testing and product insight testing; access to research and development through their proximity to universities and research institutions; prototyping and piloting facilities; access to financing and, in some cases, seed financing provided by the incubators themselves; mentorship and coaching; networking; and industry linkages.

Given the critical role played by micro-, small and medium-sized enterprises in the development of the economies of many countries in Africa and the need to ensure that they receive appropriate support – and in particular access to technology and

innovation capabilities – in order for them to grow and scale, it is essential to gain a good understanding of the role of technology incubators, including in the context of the blue and green economies, in facilitating such access.

Through the present study, the consultant explored the role of technology incubators in the development of micro-, small and medium-sized enterprises in Southern Africa with a view to ensuring holistic and comprehensive interventions to facilitate the growth and scaling of such enterprises through access to innovation and technology, thus contributing to the subregion's industrialization. The study was part of a technical assistance project, entitled "Innovative approaches in entrepreneurship and private sector development to promote trade and inclusive industrialization in Southern Africa", initiated by the Economic Commission for Africa (ECA) Subregional Office for Southern Africa, with the following implementing partners: UNCTAD, the Department of Economic and Social Affairs, ECA, the Economic Commission for Europe, the Economic Commission for Latin America and the Caribbean, the Economic and Social Commission for Asia and the Pacific and the Economic and Social Commission for Western Asia, with funding provided by the United Nations Development Account. The overall objective of the project was to develop and implement capacity-building tools for Governments and micro-, small and medium-sized enterprises to facilitate resurgence and strengthen the resilience of such enterprises in developing countries and economies in transition, to mitigate the economic and social impact of the global COVID-19 crisis, and to facilitate the enterprises' contribution to the implementation of the Sustainable Development Goals. The present report is a contribution to that project, in which the consultant details the outcome of the study focused on the role of technology incubators in the development of micro-, small and medium-sized enterprises in the following selected Southern African countries: Angola, Botswana, Eswatini, Lesotho, Malawi, Mauritius, Mozambique, Namibia, South Africa, Zambia and Zimbabwe.

In the present report, the term "micro-, small and medium-sized enterprise" refers to a registered company with up to 100 employees but does not include farmers, self-employed people or the informal sector (i.e. unincorporated or unregistered businesses) (ECA, 2018a). Additionally, the term "start-up" refers to a company in its early stages of business that is focused on developing and testing a new business model that can disrupt or create markets (Sethi, 2023). Typically, start-ups employ less than 100 people. In the present report, the terms "micro-, small and medium-sized enterprises" and "start-up" are used interchangeably.

2: Objectives

The main objective of the study was to investigate the role of technology incubators in the development of micro-, small and medium-sized enterprises in the Southern Africa subregion. The focus was on incubators' current and potential role in nurturing the high-impact, innovative entrepreneurship needed to enhance economic transformation and inclusive industrialization through subregional trade. Of critical importance was understanding the different incubation models, the types of support provided by the incubators, their sectoral specialization and coverage (with a particular emphasis on the green, blue and digital economies), their impact on supported micro-, small and medium-sized enterprises, their relationships with other stakeholders in their country's innovation system, and any differences across the countries in the subregion. In the study, the consultant also compared the experiences of technology incubators in other countries from the global North and global South.

The study was aimed at addressing the following questions:

- How do technology incubators contribute to the development of micro-, small and medium-sized enterprises in general and in Southern Africa in particular?
- How can their impact on the development of micro-, small and medium-sized enterprises be assessed?
- What incubators are operational today in Southern Africa, where are they located, in which sectors, who are the target beneficiaries, what linkages exist, if any, with other support structures, and what types of support do they offer?
- What are the most critical aspects of the support they provide, and how effective has the support been so far?
- How can the effectiveness of technology incubators as a development tool be assessed? What indicators should be used?
- What are the important (additional) support measures that technology incubators should provide to achieve optimal impact for micro-, small and medium-sized enterprises in terms of competitiveness, profitability, survival and growth?
- What complementary measures must be in place for technology incubators to impactfully deliver support to start-ups and ensure their growth?
- How can technology incubators be embedded within national and subregional innovation systems that support the emergence of national and subregional business systems?
- How can the sustainability (including financial sustainability) of technology incubators in Southern Africa be ensured?

- How can linkages between the science, technology and innovation community – including incubators and micro-, small and medium-sized enterprises – and Governments be built and sustained, and how can it be ensured that science, technology and innovation is a critical lever for the competitiveness of micro-, small and medium-sized enterprises in Southern Africa?

- How can the need to build a critical mass in leading innovation hubs be reconciled with the ambition to "leave no one behind"?

- What are the particular constraints women and young people face in gaining access to technology incubator services?

- To what extent are technology incubators embedded in existing development policies (including policies on entrepreneurship, the development of micro-, small and medium-sized enterprises, investment, industry and trade), and what are the implications of any disconnect?

- How can technology incubators in Southern Africa contribute to building the green, blue and digital economies?

- What are the best practices and lessons learned from the global South regarding the use of technology incubators to drive entrepreneurship and industrial development?

3: Methodology and scope of the study

When conducting the study, the consultant used both primary and secondary data, carrying out a literature review on incubators and similar entrepreneurship support mechanisms (mostly referred to as "hubs", "innovation hubs" or "technology hubs" – terms which are used interchangeably, often to refer to incubators), desk research on technology incubators in Southern African countries, and interviews and surveys in the form of questionnaires. The surveys were used to draw out the perceptions and insights of the incubator managers and the supported micro- , small and medium-sized enterprises on the questions listed above that the study was aimed at addressing.

Primary data were derived mainly from two sources. The first source was the interviews conducted with representatives of technology incubators or their stakeholders, selected from those identified through the desk mapping of the incubators in Southern Africa. These interviews were conducted mainly with incubator representatives and stakeholders in Namibia and Zambia, specifically as part of missions associated with the study, and also in Botswana, Malawi, Mauritius, Mozambique, South Africa and Zimbabwe, utilizing the author's network, with some conducted as follow-ups to the survey. The second source was the responses to the surveys administered to the incubators that had been mapped as part of the desk research.

A further survey was administered to micro-, small and medium-sized enterprises that were either being supported or had been supported by the incubators, whose details were provided by the incubators that had responded to the incubator survey. The selection was random. The incubators were requested to provide contact details of a mix of at least five micro-, small and medium-sized enterprises that they either were incubating or had successfully incubated. There was no specification regarding the gender of the founders or the sectors from which the enterprises were to be drawn.

The secondary data used comprised a literature review of published articles, journal articles, reports, studies, policy documents and blogs. That review was important for better understanding the role of technology incubators in the life cycle of micro-, small and medium-sized enterprises and the challenges faced by supporting technology incubators and by such enterprises wishing to gain access to technology capabilities and tools. Sources that were relied on for the literature review and the desk research included academic and non-academic sources, published reports on incubators and several studies that had been undertaken on innovation enablers in Africa, including but not limited to those undertaken by AfriLabs, Briter Bridges, the Aspen Network of Development Entrepreneurs, the United Nations Development Programme (UNDP) and the Southern Africa Innovation Support Programme, country-specific reports on the entrepreneurship and innovation systems, and a review of the websites of incubators and other entrepreneurship support organizations.

The countries covered by the study are set out in table 1, in which the diversity of the subregion's economies according to the World Bank 2021 income classification is also indicated.

The technology incubators mapped during the present study is listed in annex A. Survey questionnaires were prepared for the technology incubators and for micro-,

Table 1: Income classification of Southern African countries covered by the present study

Low-income group	Lower-middle-income group	Upper-middle-income group
Malawi	Angola	Botswana
Mozambique	Eswatini	Mauritius
Zambia	Lesotho	Namibia
	Zimbabwe	South Africa

Source: Hamadeh N. and others (2022).

small and medium-sized enterprises supported by the incubators that responded to the survey for incubators.

The survey questions sent to the technology incubators and to the enterprises supported by the respondent incubators are contained in annexes B and C. In addition, two missions were undertaken to Namibia and Zambia, where meetings and interviews were held with various incubator managers and innovation system stakeholders to better understand the issues affecting technology incubators and micro-, small and medium-sized enterprises in the subregion.

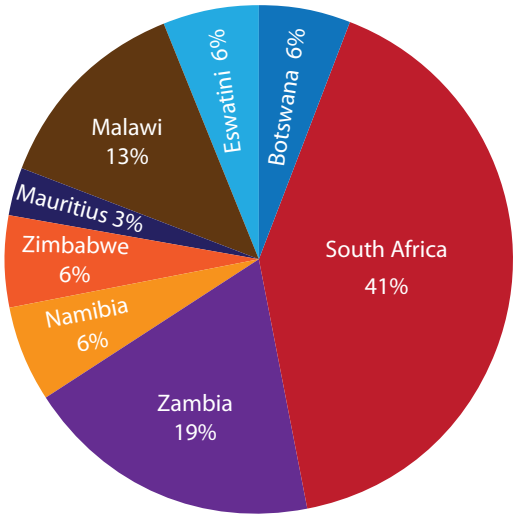
Of the incubators mentioned in annex A, the 36 listed below responded directly to the survey. An additional three did not respond to the survey but provided their input through interviews, at their request, one of which did so on an anonymous basis.

- Africa Beyond 4IR, South Africa
- Agribiz Hub, Zambia
- Agribusiness Incubation Trust Limited, Zambia
- AgriEn Network, Zambia
- AgriWorth Incubator Limited, Zambia
- BioPark@Gauteng – Innovation Hub, South Africa
- Bokamoso Entrepreneurial Centre, Namibia
- BongoHive, Zambia
- Botswana Digital & Innovation Hub
- Chinhoyi University Innovation Hub, Zimbabwe
- Climate Innovation Centre South Africa
- Dzuka Africa Organization, Malawi
- Elevate Trust Science and Technology Incubation Hub, Zimbabwe
- Great Zimbabwe University Innovation Hub

- Harare Institute of Technology Innovation Hub, Zimbabwe
- Impact Amplifier, South Africa
- Impact Hub Harare, Zimbabwe
- Jacaranda Hub, Zambia
- La Page Factory, Mauritius
- Maxum Business Incubators – Innovation Hub, South Africa
- mHub, Malawi
- Mobile Agricultural Skills Development and Training
- Mobile Applications Laboratory (mLab), South Africa
- Mzuzu E-Hub, Malawi
- National Technology Business Centre Incubation Programme, Zambia
- National University of Science and Technology Innovation Hub, Zimbabwe
- Royal Science and Technology Park Business Incubator, Eswatini
- Siyafunda Community Technology Centre, South Africa
- Small Enterprise Development Agency Atlantis Renewable Energy Business Incubator, South Africa
- Small Enterprises Development Company, Eswatini
- Startup Hatchery, South Africa
- Tembisa Incubation Hub, South Africa
- TheNeoHub Innovation Lab, Botswana
- Tshimologong Digital Innovation Precinct, South Africa
- Women's Entrepreneurship Access Center, Zambia
- Wot-if? Trust – Father Louis Blondel Centre, South Africa

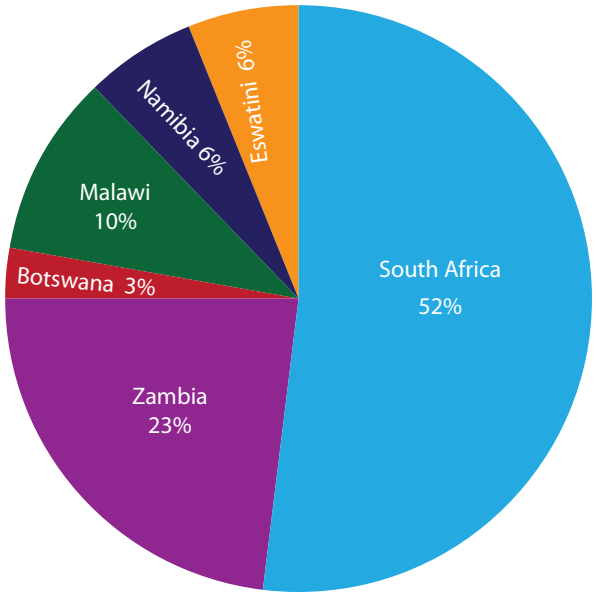
As indicated in figure I, the incubators that specifically responded to the survey were from eight different countries. One incubator in Mozambique opted to give an interview instead of responding to the survey. Since it was not possible to deal with all the questions in the survey during that interview, it has not been considered as part of the survey. No responses were received from any incubators from Angola or Lesotho.

Figure I: Countries where the respondent incubators are located *(Percentage)*



Source: Author-generated on the basis of responses to the incubator survey.

Figure II: Countries where the micro-, small and medium-sized enterprises nominated by respondent incubators that responded to the survey are located *(Percentage)*



Source: Author-generated on the basis of responses to the incubated micro-, small and medium sized enterprises survey.

Micro-, small and medium-sized enterprises from six of the eight countries whose incubators responded to the incubator survey responded to the survey for enterprises, as illustrated in figure II.

The survey of the incubators was aimed at gaining a better understanding of the different types of incubators and working modalities, the support mechanisms they provide, how they are funded, linkages to national and subregional innovation systems (with a particular emphasis on industries and universities), operations, resourcing,

sustainability, and the extent of specialization and contribution to the building of the green, blue and digital economies.

The survey of micro-, small and medium-sized enterprises supported by the incubators was aimed at understanding the enterprises' perceptions of the added value of incubators in the subregion, the types of services from which the enterprises benefited, the role of technology incubators in fostering the development and growth of such enterprises, gaps and areas for improvement, high-impact and opportunity-driven entrepreneurship, the contribution of incubators to the enabling of such enterprises to gain access to technology, funding and markets, and specific gaps with regard to the availability of and services offered by the technology incubators.

It was also deemed to be particularly important to identify case studies of successful incubator models through both the literature review and the surveys.

4: Literature review

4.1: Introduction

It is generally understood that micro-, small and medium-sized enterprises are among the strongest drivers of economic development, innovation and employment. According to the International Finance Corporation (IFC, 2021), such enterprises account for 90 per cent of businesses worldwide, more than 50 per cent of employment worldwide and up to 40 per cent of gross domestic product (GDP) in emerging economies. There is also empirical evidence from various studies suggesting that access to technology, and to digital technology in particular, enhances the efficiency of micro-, small and medium-sized enterprises and their ability to innovate, scale up and further contribute to economic development (Organisation for Economic Co-operation and Development (OECD), 2017). Consequently, in an environment with rising unemployment and low levels of development in many emerging economies, and in particular in several countries in the subregion, it is crucial to explore how micro-, small and medium-sized enterprises can be further supported so that they can play a more significant role in the economy. As such, the role that technology innovation and entrepreneurship systems can play in fostering the development and growth of micro-, small and medium-sized enterprises is essential. While access to finance is often seen as a critical barrier to growth for such enterprises, it is important to understand the financing that enables growth and the support mechanisms necessary for the development of such enterprises (IFC, 2021). Access to technology, which is one of the interventions that incubators may facilitate for micro-, small and medium-sized enterprises, may contribute to their development. In many countries with a low technological base, linkages with universities and research institutions are critical for incubators to facilitate such access. Could micro-, small and medium-sized enterprises thrive to the same extent in countries with low levels of industrialization as in industrialized countries? There are lessons to be learned from literature to answer this question and to enable a better appreciation of incubators' role in the development of micro-, small and medium-sized enterprises in sectors where technology matters.

Over the years, incubation has been seen as being important to the industrialization process and as a factor that accelerates that process by increasing the survival rate of supported companies (Ayatse, Kwahar and Iyortsuun, 2017). In most cases, micro-, small and medium-sized enterprises are started or run by individuals with limited business experience or networks necessary to gain access to funding, general business support and markets. Accordingly, Ayatse, Kwahar and Iyortsuun (2017) state that incubation is generally carried out by business incubators, which are major actors in the entrepreneurial system, by linking talent, technology, capital and know-how. As will be discussed in the present report, incubators are one of several actors that support micro- , small and medium-sized enterprises in their journey towards survival and sustainability.

In a 2017 report, the African Development Bank stated that, despite extremely high entrepreneurship rates in Africa (standing at 22 per cent of working-age Africans) compared with the rest of the world (18 per cent in Latin American countries and 13

per cent in Asia), only 20 per cent of African entrepreneurs introduced new products or services. Most of them resorted to entrepreneurship because of high levels of unemployment. It is stated in that report that, whereas 44 per cent of African entrepreneurs start new businesses to exploit opportunities in the market, 33 per cent do so because of their inability to find a job. The African Development Bank (2017) advocates entrepreneurship and industrialization as elements that are critical for African development and "a catalyst for job creation, higher productivity and innovation". It further underscores the role of entrepreneurs in bringing innovation to an economy through new technologies and production methods. The value of new technologies for firms is their ability to facilitate manufacturing and competitiveness through increased efficiency and to enable better use of environmental resources. They also increase the need to develop new skills.

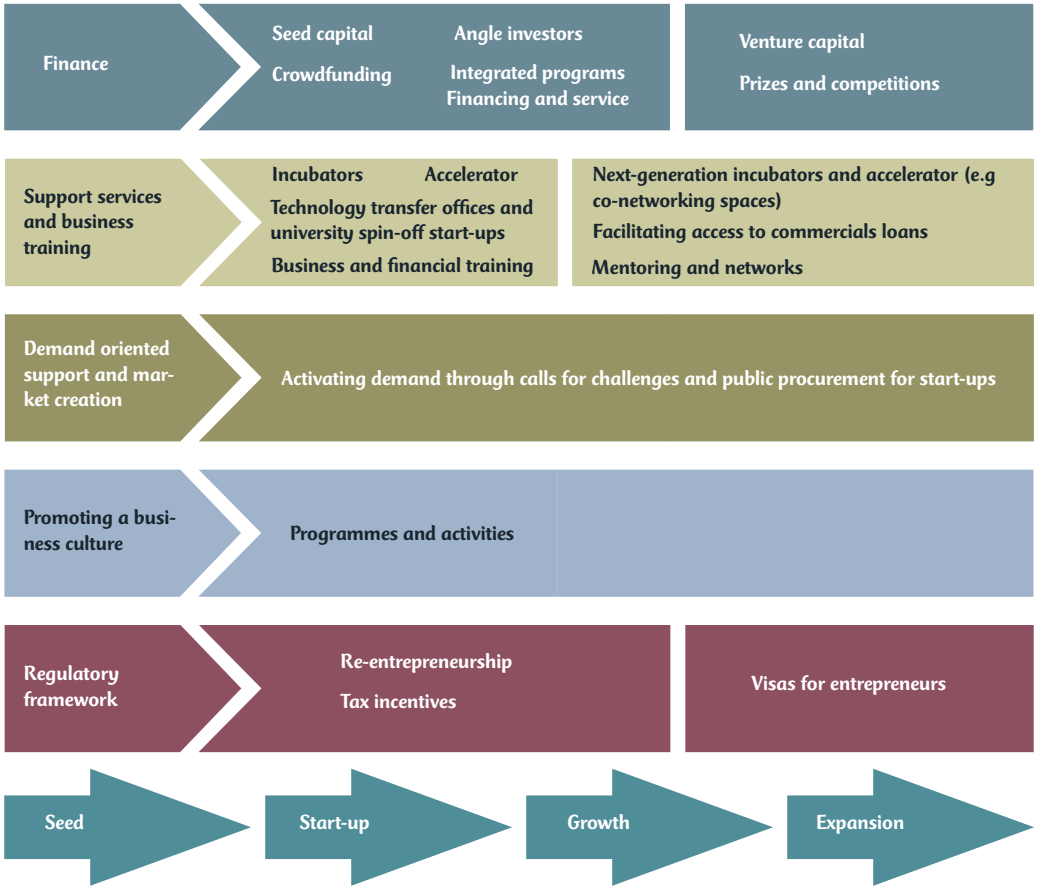
Regarding the industrialization imperative, entrepreneurship offers the greatest potential in Africa because of the sparse presence of large companies and the high levels of entrepreneurship. Accordingly, the focus should be on opportunity-driven entrepreneurs. Such entrepreneurs have a greater potential to achieve higher productivity, industrial upgrading and innovation, unlike survival entrepreneurs, who resort to entrepreneurship owing to a scarcity of employment or job opportunities. The African Development Bank (2017) sees business incubation, in addition to accelerators, as one of the essential support services, policy instruments and determinants of success in fostering entrepreneurship in Africa, as illustrated in figure III. Other determinants include appropriate financing mechanisms, an entrepreneurship culture, market access and an enabling regulatory framework.

The African population is growing faster than that of any other region globally, with Africa expected to contribute to half of the global population growth by 2050 (Kazeem, 2017). With half of the African population currently comprising persons 19 years old or younger, coupled with an average birth rate of 4.4 children per woman, the African population is projected to almost triple by 2100. The continent will have a greater workforce than many developed countries, where half the population is made up of people in their late forties or older (Grant, 2023).

Given that the growing, youthful population in Africa has demonstrated a high rate of entrepreneurship compared with the rest of the world, the continent is at the cusp of a promising future in which new, innovative micro-, small and medium-sized enterprises have the potential to create quality jobs for the many other young people who cannot find employment. In order for these enterprises to scale up and contribute to economic development, it is essential to ensure that adequate support mechanisms are in place.

Hubs, incubators and accelerators are typical support mechanisms for entrepreneurs and micro-, small and medium-sized enterprises (Shenoy, 2022). Often, these terms are used interchangeably, and there is a blurring of lines, with hubs often being called innovation hubs, science parks or technology hubs. In most cases, however, the term "hub" includes incubators. There are also different types of incubators. Some are focused purely on business support and are sometimes called "business incubators". By contrast, others are focused on providing access to technology or support specifically for technology-focused businesses and are thus referred to as "technology incubators". Accelerators are generally agnostic regarding the supported business type and are focused instead on revenue growth. It is evident from figure

Figure III: Policy mix to support entrepreneurship



III that incubators coexist with accelerators as part of the support structures for entrepreneurship, with the incubators being positioned in the seed and start-up phases, while the accelerators are positioned in the growth and expansion stages. With many African young people starting businesses, incubators are critical to the survival of micro-, small and medium-sized enterprises to ensure they reach the expansion phase.

Hubs are a growing phenomenon in Africa, including co-creation spaces, incubators and science and technology parks (Briter Bridges, 2021). Whereas incubators are traditionally associated with supporting new businesses, science and technology parks are a relatively new and increasingly growing phenomenon within Africa, as in most developing countries. According to Sibanda (2021), the main drive for establishing science and technology parks would appear to be the realization that many countries need to transition from resource-based economies to knowledge-based economies, with science and technology parks contributing to the competitiveness of the regions where they are located. This is owing to their role in commercializing research and development undertaken by higher education and research institutions and their positioning as intermediaries that are trusted by the various stakeholders. Accordingly, in catalysing innovation within the local economies in which the science and technology parks operate, each hub and incubator must adapt its programmes and operations to serve the needs of its local area for it to be relevant and effective.

There is often a blurred line regarding the use of terms relating to support mechanisms for micro-, small and medium-sized enterprises. In the present section, the author

deals with the terms “incubators”, “technology hubs”, “innovation hubs” and “science parks” and seeks to find an acceptable definition of “technology incubator” and what that encompasses. As will become evident, the definitions are not exhaustive.

It is worth further elaborating on the fact that some innovation hubs or science parks may also have or host incubators. Typical examples within the subregion are the Botswana Digital & Innovation Hub, the Innovation Hub in South Africa and the Royal Science and Technology Park, which have their own dedicated technology incubators, in addition to having other functions and offering services to both micro-, small and medium-sized enterprises and well-established businesses. Accordingly, it is important to briefly discuss each of these concepts below.

4.2: Definitions

4.2.1 Accelerators

Accelerators tend to focus on later stages of entrepreneurship or of a start-up, focusing on “product-market fit and a desire to scale” (Shenoy, 2022). The main feature of accelerators is access to the capital required to validate the product in the market or scale the business. Accelerator programmes tend to be of a far shorter duration than incubators, typically ranging from 3 months to 12 months. The intake into accelerator programmes tends to be in the form of a cohort that starts and ends the programme together, in order to ensure that there are opportunities for networking and sharing growth strategies and experiences among the cohort. The financial support provided by most accelerator programmes takes one of several forms, ranging from grant to equity, as further described in table 2.

Whereas most accelerators prefer to provide funding in the form of equity, debt is the rarest form of financing, mostly because of the stage of development of the start-ups and the uncertainty of repayments. Almost all start-ups supported by accelerators are either pre-revenue but have some validated business model with a minimum viable product or are at the early stages of revenue generation. Accordingly, it does not make sense to burden the start-up with debt funding when there is still a great degree of uncertainty about the amount of potential revenue and the venture’s sustainability. Some accelerators also offer a grant or royalty type of financing.

4.2.2 Hubs

Hubs tend to be spaces run by specialized organizations that provide a range of services and support for entrepreneurs within a particular city or area. Often referred to as “innovation hubs”, they serve “as a central landing zone, often a physical place, for the region where these startups, startup support programs, and investors can be based” (Shenoy, 2022).

Hubs generally run training and other seminars or workshops and often provide access to mentorship and coaching for start-ups, but generally they are known for offering a broad set of resources for entrepreneurs, including office or co-working spaces, community programming, social events, networking opportunities and access to technology development assistance. Unlike incubators and accelerators, most hubs do not have cohorts or a set curriculum for entrepreneurs. The major focus of hubs tends to be contributing to local economic development by providing infrastructure and support services to businesses. In recent years, most tend to have a technology

Table 2: Different accelerator "archetypes"

	The global networker	The smart capital investor	The co-founder	The system builder	The first impact
Theory of change or driving priority	Big global programmes whose primary added value is fundraising support, a "stamp of approval" for start-ups and links to corporations. They attempt to link the supply and demand sides of innovation to boost exits and are likely corporation-backed programmes.	They think of themselves as investors or funds but know that start-ups at the earliest stages need additional support to succeed. They use technical assistance to increase chances of success. They are likely to have a follow-on fund and be looking for exits.	They think of themselves as a co-founder, are likely to have a series of programmes (incubator followed by accelerator, and a follow-on fund) and take early stakes in the company since they are "building alongside the founders".	They are likely funded by Governments to create an innovation system and likely support the company at several growth stages, from idea through to scaling up.	They likely work with for-profit organizations, non-profit organizations and hybrids, focus on start-ups with a social mission and potential for scaled impact, and believe that patient capital is a better source of funding for impact start-ups than venture capital at the early stage.
Offer to start-ups			Equity Grant No capital		
Financial structure	Corporation-backed programmes, usually with an investment vehicle with limited partners	Investment vehicle with limited partners	Investment vehicle with limited partners	Investment vehicle with limited partners	Likely to be philanthropic or donor funded and likely to work with both for-profit and not-for-profit entities

Source: Anand and others (2021).

focus, typically digital, and hence they are often referred to as "technology hubs". This is the case with a special class of hubs called "science and technology parks", often referred to as "science parks" or "technology hubs", which the International Association of Science Parks and Areas of Innovation defines as "an organization managed by specialised professionals, whose main aim is to increase the wealth of its community by promoting the culture of innovation and the competitiveness of its associated businesses and knowledge-based institutions" (International Association of Science Parks and Areas of Innovation, n.d.). Whereas science and technology parks and technology hubs may appear similar, they are not always the same. Science and technology parks are of a much larger scale, typically incorporate one or more incubators and are designed to act as intermediaries to bring together various actors comprising, among others, Governments, industry, research institutions, communities, entrepreneurs, funders and venture capitalists. Hubs tend to be more focused and have far less real estate emphasis than most science and technology parks. Later in the present study, there is a discussion specifically about these entrepreneurial support structures in Africa and how they tend to differ within that context.

4.2.3 Incubators

The main characteristic of an incubator is that it often establishes business concepts and associated fledgling businesses in their journey to validate product-market fit.

Entrepreneur (n.d.) defines an incubator as "an organization designed to accelerate the growth and success of entrepreneurial companies through an array of business support resources and services that could include physical space, capital, coaching, common services, and networking connections". Incubators can be either generic or specialized. Technology incubators are an example of specialized incubators, which are focused on supporting start-ups in the technology sector – meaning that the start-ups are either developing new technologies or are enabled by technology.

Incubators offer various services and support mechanisms, ranging from providing access to offices and co-working spaces to connecting entrepreneurs "with subject matter experts, instructors, mentors, investors, and fellow founders" (Shenoy, 2022). Incubators tend to vary with respect to the specific services they provide. Table 3 contains a description of various services typically offered by an incubator. Not all incubators provide the specific services labelled in table 3 as "less popular services", as some of these require additional infrastructure and resources that add a layer of operational costs to the incubator, which it may not be able to recover from the start-ups it supports.

Table 3: Different types of business incubation services that incubators provide to entrepreneurs

Secretarial services	Infrastructure or facilities based services	Business services	Financing and access to financing	People connectivity and networking	Education and access to knowledge	Brand Building	Management of the programme
Secretary or assistant	Office space	Business idea or feasibility analysis	Accounting and financial management services	Mentoring and access to a network of mentors	Comprehensive business training programmes	Strict admission and exit rules	Conduct a feasibility study before starting the programme
Courier, mail or business address	Internet or a wide area network of alumni members	Business model, strategy or plan development assistance	Fundraising and access to venture investors or business angel investors	Coaching	e-learning	Attract and select new clients, members and enterprises	Develop a consensus-driven mission statement
Receptionist duties	Laboratory facilities and specialized equipment	Technology commercialization assistance	Seed investment capital	Linkages to strategic partners	Access to business school programmes in management and entrepreneurship	Build a reputation to generate eagerness to belong to the community and to recruit volunteers and sponsors	Establish client entry and exit criteria
Photocopying	Training or teleconference rooms	Marketing assistance	Access to non-commercial loans	Capital and financing network (business) angel investors and venture capital	Links to higher education and its resources	Influence the business environment	Take equity stakes in client firms
Clerical, filing or faxing	Conference or exhibition space	Pre-incubation services	Access to commercial loans	Network of external providers, intern networks and fellow entrepreneurs	Group training, workshops and business topic seminars	Market incubators beyond the entrepreneurial community (i.e. embed the programme into the fabric of the host community	Budgeting

Telephone answering	Kitchen or lounge	Intellectual property protection and licensing services	Access to grants	Management team identification and loaned executive	Presentations and regular matchmaking events		Collect outcome data
Word processing	Telephone	Customer relations	In-house venture funds	Advisory boards	Resource library, access to knowledge databases (e.g. Scopus)		Showcase clients
	Security	Regulatory compliance	Providing information on grant facilities, business plan competitions and sources for funding credits	Crowdsourcing	Business etiquette training		Establish effective tools to deliver support services
	Library	Human resources development	Pitching sessions	Virtual communities (experts, mentors, investors etc.)	Commercialization or licensing seminars		Build networks with area business service providers
	Computers	General legal assistance	Provision of a small salary	Organizing competitions	Hot topic seminars		Provide milestones and follow-up
	Electricity	Registration or formation of a legal entity	Crowdfunding services	Member or client selection			Write a marketing plan
		Logistics and procurement	Brokering financial services	Programme referral service			Offer pre-incubation and post-incubation services
		Prototyping and product design and development		Intern network and community			Provide networking opportunities among client firms
		Assistance with the development of business culture and etiquette		Facilitating exchange of knowledge and ideas			
		International sales, exports or partner search					

Source: Ryzhonkov (2013).

Note: Blue shading indicates more popular services. Yellow shading indicates less popular services.

Table 4: Comparison between an incubator and accelerator

Feature	Incubator	Accelerator
Entry requirements	Business idea or business plan	Established business model or minimum viable product
Application	Competitive, restricted on the basis of industry vertical or sector	Extremely competitive but open to all
Timeline	Flexible, typically one to three years	Rigorous, typically three to six months
Purpose	Building the foundation of a new start-up	Accelerating the growth of an established start-up
Support	Office space, administrative and legal assistance, business planning, product development and prototyping, networking and learning opportunities	Seed funding, networking and mentorship from industry experts
Financial obligation	Typically, monthly fees in exchange for physical space and access to programme offerings	Equity in exchange for seed funding or investment
Operational funding	Economic development organizations, non-profit organizations and educational institutions	Private funds

Source: Gibb (n.d.).

As can be seen from table 3, incubation support services range from typical office support and access to equipment and machinery offered by physical incubators to specialized services, such as intellectual property support, finance and marketing services and other management services that may be provided regardless of the incubator's business model.

The comparison set out in table 4 is a useful guide to the differences between an accelerator and an incubator. This notwithstanding, the definition by Briter Bridges (2021) of a technology hub encompasses an incubator, an accelerator and a science park or innovation hub.

Lastly, according to OECD (1997), a technology incubator is a specific type of business incubator "which provides tangible and intangible services to new technology-based firms, entrepreneurs, and spin-offs of universities and large firms, all with the aim of helping them increase their chances of survival and generate wealth and jobs and diffuse technology". The businesses incubated in a technology incubator need not necessarily be exclusively technology focused. They could include businesses that use any form of technology as the primary means of innovation to develop and grow the business and those whose business model is enabled by technology. Thus, an important part of a technology incubator is linking micro-, small and medium-sized enterprises to technology sources to help them become more innovative and enhance their competitiveness or help them to gain access to such technologies.

The incubation process can be carried out physically or virtually. In the latter case, the companies' support services are provided through Internet-based tools, such as Zoom, Microsoft Teams, Skype and webinars. Naturally, virtual incubation offers some advantages regarding costs to the incubator, as there are lower or, in some cases, no expenses incurred for physical infrastructure. The other benefit is that it is easy to gain access to the support services. It is also possible to tap into expertise

that may not be readily available in physical incubation, such as specialized mentors based in a different city or country than the incubator. The advantages of virtual incubation for the enterprises include reduced costs, as there is no need to travel to the incubator to receive incubation services, and the fact that mentorship sessions can be scheduled at times that are more convenient for both the enterprises and the mentors. Notwithstanding the cost benefits of virtual incubation, there could also be limitations, given that Internet connectivity may be poor or non-existent in some areas, or the incubated enterprise may not have appropriate devices to gain access to the services. Even so, in particular in the post-COVID-19-pandemic era, hybrid business models are becoming more common, offering the best of both physical and virtual incubation.

Technology brokerage is an essential part of a technology incubator. This type of business service requires specialized human resources, often with a science, engineering or technology education background or work experience, or who are competent in such issues as international intellectual property regimes, the negotiation and conclusion of licensing agreements, technology audits and due diligence investigations, and the ability to identify marketable technologies from local and foreign partners and, in essence, champion technology transfer to enhance the capability and competitiveness of the start-ups and enterprises.

Not all incubators contribute to technological development per se. Technology incubators distinguish themselves from all other incubators by, in addition to offering the support that incubators provide for the establishment of a viable and sustainable business, also:

a) Having technology specialists who support incubated companies;

b) Providing access to laboratories, experimental equipment, machinery and facilities;

c) Offering technological guidance by their staff or researchers at collaborating universities or research institutes;

d) Facilitating the exchange of technological information or technology transfer, including assistance with intellectual property issues;

e) Promoting or supporting the commercialization of technology innovation;

f) Supporting technology-intensive micro-, small and medium-sized enterprises;

g) Providing all other specialist services typically required for technological innovation, including access to funding and markets.

4.3: Incubation best practices in the global South and global North

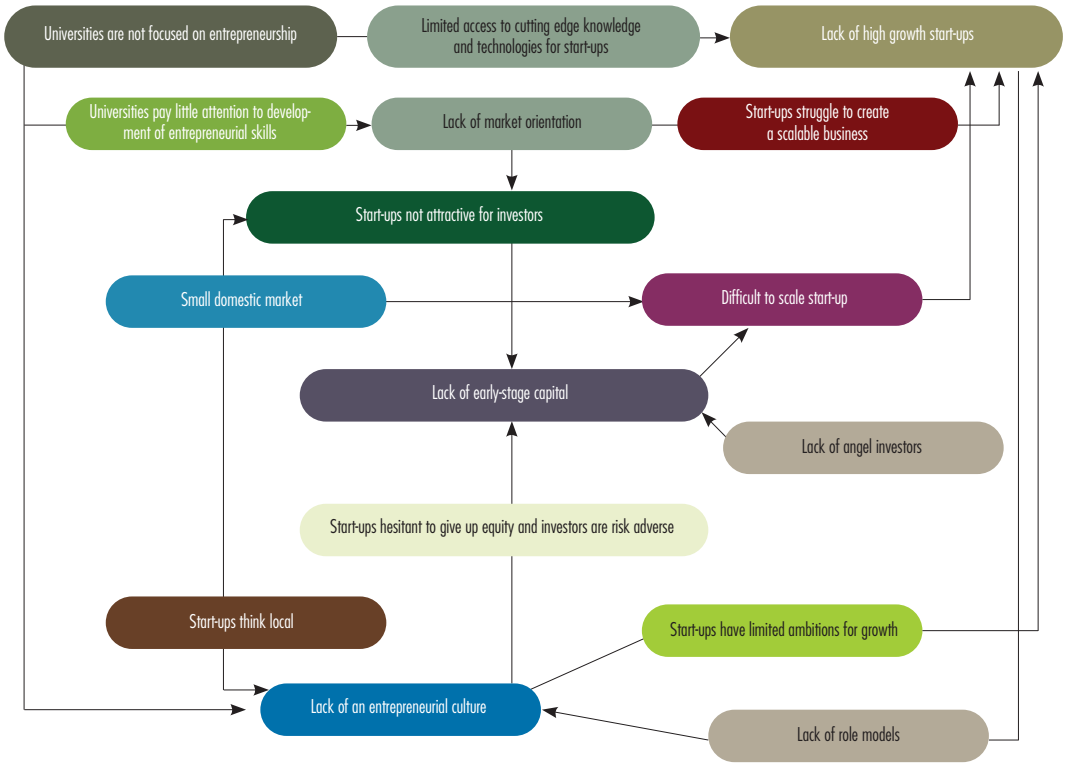
Van Weele and others (2016), in their study on the challenges faced by Western European start-ups and how incubators from several countries and areas – including the Silicon Valley in the United States of America, the greater Boston area also in

the United States, Israel and Australia – addressed those challenges provides some valuable findings and best practices that incubators in Southern Africa could emulate.

An important observation made by the authors of that study was that most of the challenges faced by incubators in Western Europe were caused by institutions in the entrepreneurial system, and that the incubators created an environment that protected micro-, small and medium-sized enterprises from unfavourable institutions. That study was focused on actors comprising (a) a talent pool of individuals with a high level of human capital, which included both technical and entrepreneurial skills, who were essentially start-up founders or employees; (b) customers, comprising domestic and foreign markets, sufficiently large and accessible to the start-ups; (c) both public and private parties who provided the financial capital necessary for the start-ups to fund their development and growth; (d) support services for specialized knowledge, such as mentors selected from experienced entrepreneurs who advised young founders, professional service providers (e.g. lawyers, accountants or consultants) and incubators; (e) universities and research institutions, which played a catalysing role by contributing to the system's human capital and also by offering technologies from research activities, thus strengthening the technological base on which the start-ups could build their products; and (f) actors who contributed to the system's physical infrastructure, which included office space, telecommunication facilities and transportation infrastructure.

Various challenges faced by Western European start-ups were revealed through the study, as illustrated in figure IV.

Figure IV: Challenges faced by Western European start-ups



Source: van Weele and others (2016).

It was further highlighted through the study that what was more important than the mere presence of the various actors for a thriving entrepreneurial system was how they were connected through multiple formal and informal networks, to "facilitate the flow of resources between them". Van Weele and others (2016) further emphasized the importance of a culture that encouraged "entrepreneurship as a career path" and regulation, with Governments being crucial in creating "optimal conditions for innovation and entrepreneurship to flourish, for example by ensuring low levels of corruption, a high quality educational system and adequate intellectual property protection" and in providing regulatory institutions that were specifically aimed at

Table 5: Some incubation best practices in selected countries and regions

Challenges and associated practices	Europe	Silicon Valley	Australia	Israel	Boston
Lack of market orientation					
• Push for interaction with customers	X	X	X	X	X
• Provide mentorship	X	X	X		X
• Provide small amounts of funding		X		X	
• Facilitate outsourcing			X		X
Lack of an entrepreneurial culture					
• Organize start-up tours			X	X	
• Create a supportive community	X	X	X	X	X
• Create healthy competition among start-ups		X	X	X	X
Small domestic market					
• Create an international community	X			X	
• Create international partnerships		X	X	X	X
• Enable a soft landing in foreign environments				X	
Lack of early-stage capital					
• Selectively connect start-ups to funding sources	X	X	X	X	X
• Enable start-ups to be capital efficient	X	X	X	X	X
• Create a separate joint fund		X			
Universities are not focused on entrepreneurship					
• Provide access to technical expertise and equipment	X				X
• Mediate in internships					X
• Complement university curriculum					X
• Create a student board		X			X

Source: van Weele and others (2018).

stimulating start-ups, including start-up subsidies or incentives to support research and development collaboration between start-ups and universities.

Some benefits that incubators afford start-ups, as articulated by van Weele and others (2016), include: (a) help coping with the institutions of the entrepreneurial system by acting as a "safe harbour" that protects start-ups from unfavourable institutions; and (b) added credibility, as acceptance into the incubator acts as a "stamp of approval" in the eyes of potential collaborators and funders, who may see start-ups in an incubator as part of a credible and validated pipeline. Of course, this benefit would hold only assuming that there were strict criteria to be met for admission into an incubator, coupled with the credibility of the incubator within the system.

Table 5 contains a summary of incubation best practices in various Western European countries, the Silicon Valley, Australia, Israel and the Boston area, identified in the aforementioned study, in response to the challenges identified by van Weele and others (2016).

Van Weele and others (2016) examined various countries and various cities in the United States to identify best practices to address the identified challenges. In particular, they examined Silicon Valley as one of the most developed entrepreneurial environments with the most mature and developed incubators in the world "to identify incubation practices through which incubators make start-ups more market oriented".

When examining the situation in Australia, the focus was on how to address the lack of an entrepreneurial culture. By contrast, when examining the situation in Israel the emphasis was on overcoming a small domestic market, given the small size of the domestic market in that country and its isolation from foreign markets. Lastly, the greater Boston area was particularly interesting, as it is home to many top-tier research institutes but also to many start-ups in a variety of industries, such as information technology, clean technology and the life sciences. Accordingly, Boston was well placed for identifying incubation practices that facilitated the relationship between start-ups and universities.

With regard to incubators in Africa, where incubation is generally still at a nascent stage, van Weele and others (2016) suggest that transforming institutions to strengthen entrepreneurial environments is a process that takes several years**.** As such, it is essential for incubator managers and policymakers to use the incubation practices set out in table 6 to address the various challenges faced by micro-, small and medium-sized enterprises instead of hoping that the institutions will be mature enough to deal with them.

Alinsunod and others (2019), in their study of incubators in the Philippines, position technology business incubators as one of the driving factors behind the economic status of a country and the "variant of more traditional business incubation schemes", which "assist technology-oriented entrepreneurs in the start-up and early development stage of their firms by providing workspace (on preferential and flexible terms), shared facilities, and a range of business support services". Some of the incubation best practices followed by incubators from the Philippines – one of the countries of the global South that formed part of the present study – are listed in table 6.

Table 6: Incubation best practices from selected technology business incubators in the Philippines

Incubator	Best practices
Incubator	• Has strong partnerships and linkages with various funding government agencies, non-governmental organizations (NGOs) and other local and international funding institutions • Has a conducive environment with state-of-the-art facilities for incubated enterprises • Trainers are well trained in their respective fields of specialization • Has its own framework for promoting its services • Programmes and activities of the centre are aligned with the vision, mission and goals of the university • Other students, alumni and community members are allowed to utilize the facilities of the centre • Provides start-ups with financial resources and continuous coaching and mentoring • Rigorously implements intellectual property rights
Incubator	• Strong support for the incubator from both the university management and the rank-and-file faculty and staff • Available funding from various government agencies, local government and local industry • Presence of a technology business incubator centre for marketing goods, products and services • Available working, training and warehouse facilities • Know-how in the coaching and mentoring of incubated enterprises to ensure their survival • Provisions to fulfil administrative and statutory requirements • Sufficient physical sites for technology business incubator product processing and manufacturing • Existence of a technology business incubator building and various research centres in the university
Incubator	• Strong network linkages and partnerships with various funding agencies, NGOs and local and international incubation centres • Continuous benchmarking for best practices • Involvement of the management in the activities of the centre • Alignment of programmes and activities of the centre with its goals, vision and missions • Continuous conduct of mentoring and coaching among start-ups • Continuous conduct of training seminars and other relevant classes for the community • Permission granted to the community to utilize facilities and equipment as part of an income-generating mechanism
Incubator	• Ensuring the support of the university in terms of providing space and facilities, and for the activities of the centre • Mentoring students to use their research as start-ups • Well-defined vision, mission, strategies, objectives and goal • Access to technology for the production and processing of enterprises' products or services • Access to specialized equipment, laboratories and research facilities • Help with building relationships with higher education institutions and facilitation of the use of institutions' facilities, equipment and laboratories • Support regarding intellectual property registration

Incubator	Best practices
Incubator	Well-defined vision, mission, strategies, objectives and goal Precise criteria for the selection of incubated enterprises before commencing each incubation project Technology business incubator supporting services offered before and after incubation, along with various training sessions, coaching or mentoring for start-up support and promotion for enterprises from both the public and private sectors Creation of a networking environment for incubated enterprises with other entrepreneurs and businesses within and outside the business community
Incubator	Well-defined vision, mission, strategies, objectives and goal Complete food laboratory, facilities and equipment from processing to packaging Funded by the local department of science and technology Support from the administrator and the department of science and technology
Incubator	Well-defined vision, mission, strategies, objectives and goal Facilities, equipment and building supported by the school administrator and the department of science and technology Funded by the local department of science and technology Support from the administrator and the department of science and technology

Source: Alinsunod and others (2019).

Within the context of technology incubators, one of the critical elements is the ability of the incubator to support technology development by micro-, small and medium-sized enterprises. In this regard, technology transfer becomes essential. This is included under "technology commercialization assistance" in table 3 as part of the business incubation services offered.

Table 7: Critical technology transfer elements for technology incubation

Stage	Description	Further information
Awareness	Improving understanding of the importance of science and new technology for firms' competitiveness through various means, including training, seminars, workshops, printed material and the sharing of best practices or case studies.	Provides a technology transfer manual that explains the main elements
Auditing	Identification of technology capabilities and needs of the recipient company in respect of its product and service offerings	Requires that the recipient company have some innovative ideas or at least potential products or services that could be enhanced by technology
Search	Identification of owners of technology solutions that match the recipient company's needs – often through a review of databases, search of patent literature, attendance at brokerage events or exhibitions, or visits to other technology incubators or technology parks in foreign countries	Depending on the sectoral focus of the incubator, it could develop a database of technology offerings or be plugged into the system technology databases offered by the government departments responsible for science and innovation or trade and industry Promotes cooperation among companies in the incubator and other firms (local and international) Conducts company visits to gather technology data and analyse needs

Stage	Description	Further information
Negotiation	The focus is on mutually beneficial licence and technology transfer agreements between technology owners and recipient companies. May include understanding of intellectual property issues	Advises on various aspects Provides information and project management services
Implementation	Includes the actual technology transfer or diffusion of identified technologies to the recipient company, and thus the embedding of them to improve the level of innovation, produce new or improved products or services and increase the level of competitiveness of the company	Supports incubated companies with the implementation of technology solutions that have been brokered Re-engages with technology solutions providers for know-how transfer Conducts monitoring and evaluation

Source: United Nations Industrial Development Organization (UNIDO) (2003).

The United Nations Industrial Development Organization (UNIDO) (2003) shed further light on high-tech incubation systems in several European transition countries, with a particular emphasis on the elements of technology transfer with which an incubator should be well equipped. These elements are summarized in table 7. In that study, UNIDO specifically dealt with stages one to four as described in table 7, while stage five is assumed to be part of the technology transfer process. Technology transfer is a critical element that requires the incubator to be competent in assisting the incubated enterprises and monitoring results to ensure that the identified technology needs are indeed met. It is hoped that the recipient enterprises of the technology solutions will become more competitive thanks to the technology transfer process.

Several challenges typically hinder the effectiveness of technology business incubators. These include a lack of funding, a prolonged procurement process, limited capacity and capability of staff involved in incubation and the absence of a clear intellectual property policy (UNIDO, 2003).

The Republic of Korea runs a successful technology incubator programme, known as the Tech Incubator Program for Startup (TIPS), that is designed to identify and nurture the most promising start-ups with innovative ideas and ground-breaking technologies. The Program is based on the availability of highly qualified human capital as founders of micro-, small and medium-sized enterprises and also as mentors, and a robust private sector willing to play the role of incubating start-ups. The Program forms start-up teams using private resources, such as successful entrepreneurs and venture capitalists, and links them with private investment funds and governmental research and development (Han, 2019). The success of this programme hinges on a solid technology-focused private sector that is also involved in the selection and formation of the start-up teams, financial support from the Government in respect of the research and development sector, matching funding from industry, and close government monitoring. In practice, the Tech Incubator Program for Startup is based on four steps: (1) the selection of incubator operating companies; (2) the selection of start-up teams; (3) education and mentoring; and (4) graduation and follow-up support. The incubator operating companies include angel investment companies founded by entrepreneurs with a successful track record, venture capitalists specialized

in early-stage funding, a consortium of research universities, a technology holding company, and domestic and overseas accelerators. According to Han (2019), as of 2019, the Government of the Republic of Korea had provided funding for research and development ($500,000), commercialization ($100,000) and global marketing ($100,000). The Program also requires matching funding from the private sector. The strong mentoring from investors enables the start-up teams to obtain practical knowledge and increases their prospects of success. Even though many countries in the subregion do not have many strong private sector companies that would enable them to emulate the Tech Incubator Program for Startup successfully, there is an opportunity to develop similar technology incubation programmes with the few private sector companies in the subregion, which could perhaps be more focused on enterprise supplier development along industry value chains.

Incubators have evolved over the years. While earlier incubators offered office accommodation, telephone and Internet connection to business advice, including legal services, incubators today offer much more, including access to technology, testing and prototyping facilities, access to finance and, in some cases, stronger linkages to industries and universities. Technology incubators may also establish their accelerator programme, offering some seed capital or associate with an established accelerator, to support high-growth micro-, small and medium-sized enterprises in validating their business models and play a more significant role in unlocking market access.

4.4: Performance and impact of incubators

In their study of firm performance, Ayatse, Kwahar and Iyortsuun (2017) reviewed business incubation literature and concluded that performance measures were multidimensional. Some of the performance indicators for incubators identified through their research include revenue, finance, venture capital funds, graduation from the incubation programme, firm survival, networking activities, the number of innovative firms, organizational or firm growth, job creation and employment growth, sales growth, profitability, the number and type of intellectual property rights (in the form of applications for patents, trademarks or registered designs, or successfully registered patents, trademarks or designs), alliances with industry or other companies in the value chain, technology transfer, technology development or innovation, research and development productivity, and the number of high-technology jobs created or enabled by the innovation.

Other significant factors for the successful operation of technology incubators include:

- Financial support from the Government or NGOs
- Close relationship with pre-eminent universities
- Access to technology talent and, in particular, technology venture founders
- Remarkable incubator managers who understand the incubation process and have been founders, have been part of a start-up or are generally entrepreneurial

- Access to finance for the incubated start-ups or enterprises
- Strong selection criteria and assessment based on the business opportunity, technology and personal characteristics of the enterprise founders
- Linkages to industry and international networks to facilitate market access
- Ability to attract sponsors, raise funds and mobilize resources for the incubator (Sibanda, 2021)

5: Science, technology and innovation, industrialization and linkages

5.1: Science, technology and innovation linkages

Context is very important when developing solutions for entrepreneurship and for innovation in general. Whereas the present study is focused on technology incubators and their role in the development of micro-, small and medium-sized enterprises in Southern Africa, it would not be complete without some reflection on the national and subregional innovation systems in which these incubators and enterprises operate. Accordingly, the present section is focused specifically on the science, innovation and technology environment in Southern Africa, with an appreciation of the principles of variable geometry, given the different levels of development of the countries in the subregion. To that end, the focus is on institutions, innovation input and output, markets, and types and levels of funding available for the development of micro-, small and medium-sized enterprises.

Whereas the role of technology incubators in economies in developed countries is well established, there is a need for a greater appreciation of contextual differences that contrast with the situation in developing countries, mainly in Africa and, in this case, in Southern Africa. The technology incubators in developed countries operate within a context of greater resources, robust innovation systems and strong institutions. That is not the case in most developing countries, and the countries of Southern Africa are no exception.

According to Surana, Singh and Sagar (2020), the following three areas are emphasized in science, technology and innovation policy, regardless of a country's level of development:

a) Strengthening the "supply-side" for science, technology and innovation by, for example, promoting science and technology-based education, setting up research and development laboratories, funding research and development in universities, creating science and technology-based large public enterprises and improving the protection of intellectual property rights;

b) Supporting entrepreneurship at large by, for example, implementing policies and programmes that finance small and medium-sized businesses or start-ups and easing regulatory barriers to starting or ending a business;

c) Strengthening the links among science, technology and innovation, entrepreneurs, start-ups and markets by, for example, setting up incubators (and other intermediaries, such as science parks and technology transfer centres) that support technology transfer, especially for technologies related to societal goods that would be unable to advance to market in the absence of different types of public support.

In this context, it is evident that technology incubators are a critical component of science, technology and innovation policy but cannot exist in isolation from the other two areas, which are very much dependent on the level of development of a country or region. In most developing countries, the supply side is weak, as evidenced by low publication rates and patent output. This can be attributed mainly to underinvestment in human capacity-building related to undertaking research and in research and development itself, and the availability of critical research and other supportive infrastructure. Notwithstanding weaknesses on the supply side of science, technology and innovation policy and the innovation systems, many developing countries find themselves increasingly emphasizing the second and third areas highlighted above, primarily driven by the need to provide work opportunities for a growing youth population and the quest to increase the level of development of their economies.

Much of this effort will likely be stifled by the underinvestment in human capacity, research and development and critical infrastructure. While countries can establish incubators or aspire to greater levels of entrepreneurship, much of that entrepreneurship will remain at a small scale or will be necessity driven rather than opportunity driven. Consequently, the incubators will likely have a greater pipeline of start-ups with weak science, technology and innovation linkages.

An important takeaway from Surana, Singh and Sagar (2020) is the role that incubators can play in enabling science, technology and innovation-based entrepreneurship and implementing the Sustainable Development Goals. In this regard, a technology incubator framework for supporting the development of micro-, small and medium-sized enterprises in Southern Africa should be anchored on science, technology and innovation fundamentals for each Goal. In this way, the emphasis should not necessarily be on technology-sector-driven incubators but rather on Goal-focused incubators grounded in solid science, technology and innovation fundamentals, such as good investment in research and development, human capacity-building, the availability of critical technical or scientific infrastructure and equipment, intellectual property protection and utilization, and technology transfer.

5.2: Investment in research and development

In general, in only a handful of countries worldwide are significant investments in research and development made by the business sector, and these tend to be primarily middle-income or high-income countries. A few countries also have substantial funding from private non-profit organizations or donor organizations. These tend to be low-income countries.

Studies suggest a direct correlation between government spending on research and development and research output, which could explain the paltry 0.2 per cent global share of Patent Cooperation Treaty applications from Africa, given that only 1 per cent of the global research and development budget is spent in Africa. This contrasts with the United States, which in 2016 accounted for 26.4 per cent of global research spending (Bediako, 2020). Consequently, the higher education sector and publicly financed research institutions must contribute to the productive activities of the economies of developing countries, including those in Africa. One way to do that is by focusing on research and development that is strategic to the development needs

of these countries and on translating the results of this research and development into societal benefit. This makes a case for technology transfer and the establishment of relevant commercialization and technology transfer units. However, Surana, Singh and Sagar (2020) elaborated on an underlying assumption that there will be some minimum investment on the supply side of the science, technology and innovation value chain to ensure that there is enough output to serve as the basis for commercialization and incubation.

In table 8 is shown the gross expenditure on research and development as a percentage of the GDP of selected Southern African countries (on the basis of the available data) relative to other countries in Africa, along with a comparison between sub-Saharan Africa and the world. In general, as seen in table 8, the gross expenditure on research and development in sub-Saharan African countries varies, is significantly low compared with that of well-developed economies, and falls short of the African Union aspiration of 1 per cent of GDP being invested in research and development (ECA, 2018b).

Table 8: Gross expenditure on research and development of selected sub-Saharan African countries

Country or subregion	Expenditure as a percentage of GDP (most recent year available)
Botswanaa	0.54 (2013)
Côte d'Ivoire	0.10 (2016)
Ghana	0.45 (2017)
Kenya	0.79 (2010)
Mauritiusa	0.35 (2018)
Namibiaa	0.34 (2014)
Rwanda	0.65 (2016)
Senegal	0.58 (2015)
South Africaa	0.83 (2017)
Togo	0.27 (2014)
United Republic of Tanzania	0.51 (2013)
Sub-Saharan Africa	0.37 (2018)
World	1.73 (2018)

Source: United Nations Educational, Scientific and Cultural Organization (UNESCO) (2021) (regional chapters) and UNESCO statistics.

a A Southern African country.

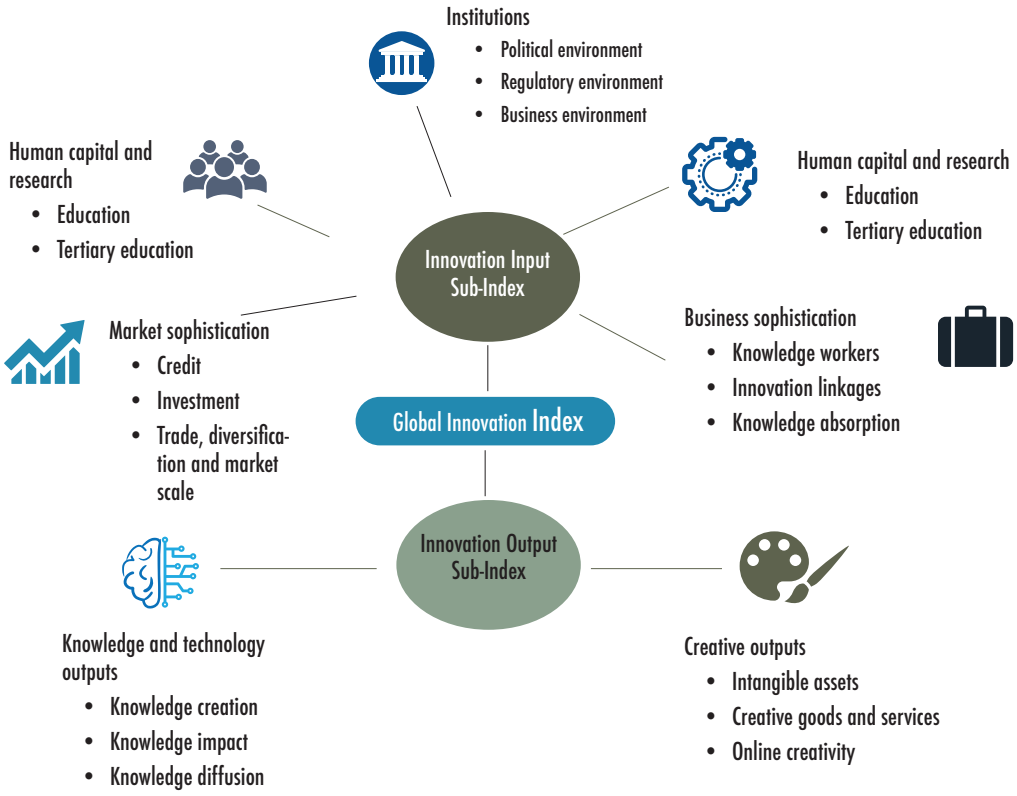
Coupled with the lack of domestic research and development funding, there is a great deal of dependence on foreign sources for the majority of countries in Africa. Examples include Uganda, Kenya, the United Republic of Tanzania and Burundi, where 73 per cent, 60 per cent, 50 per cent and 50 per cent, respectively, of their gross expenditure on research and development is financed by external sources (United Nations Educational, Scientific and Cultural Organization (UNESCO), 2021).

5.3: Global Innovation Index

In the present section, the author explores the innovation performance of the countries in Southern Africa in terms of the Global Innovation Index, released annually by the World Intellectual Property Organization (WIPO) – a United Nations specialized agency – together with Cornell University and the Institut européen d'administration des affaires.

The Global Innovation Index is a ranking of countries in terms of their success and capacity for innovation, and in 2021 it was based on 81 indicators compiled under seven pillars in two subindices – the Innovation Input Sub-Index and the Innovation Output Sub-Index – as shown in figure V (WIPO, 2022). The Input Sub-Index comprises five pillars, which capture elements of the national economy that enable innovative activities. By contrast, there are two pillars in the Output Sub-Index, representing the result of innovative activities within the economy. The Global Innovation Index highlights innovation strengths and weaknesses within national innovation systems, in particular gaps in innovation metrics represented by the 81 indicators.

Figure V: Components of the Global Innovation Index



Source: WIPO (2022).

From the rankings of countries in terms of the Global Innovation Index, a correlation can be observed between the level of development of a country and its innovation performance. This is no different in the case of African countries, as seen in table 9. More particularly, all of the Southern African countries ranked in the top 100 – Mauritius, South Africa, Botswana and Namibia – are classified as upper-middle-income countries, as shown in table 1.

Table 9: Global Innovation Index 2022 rankings in sub-Saharan Africa

Top 80	Top 100			Top 110		Top 120		Other rank	
45	Mauritius	86	Botswana	103	United Republic of Tanzania	114	Nigeria	121	Cameroon
61	South Africa	88	Kenya	105	Rwanda	117	Ethiopia	122	Togo
		95	Ghana	106	Madagascar	118	Zambia	123	Mozam-bique
		96	Namibia	107	Zimbabwe	119	Uganda	124	Benin
		99	Senegal	109	Côte d'Ivoire	120	Burkina Faso	125	Niger
								126	Mali
								127	Angola
								129	Mauritania
								130	Burundi
								132	Guinea

Source: WIPO (2022).

Table 10: Global Innovation Index 2022 rankings in sub-Saharan Africa

Performance level	Low-income group	Lower-middle-income group	Upper-middle-income group
Above expectations for level of development	Mozambique	Zimbabwe	South Africa
In line with level of development			Mauritius
All other countries		Zambia	Botswana
		Angola	Namibia

Source: WIPO (2022).

Zimbabwe, a lower-middle-income country, was ranked in the top 110. Despite its lower-middle-income status, Angola was ranked lower than the low-income Southern African countries of Zambia1 and Mozambique. Eswatini, Lesotho and Malawi were not ranked, as there were no reliable data for those countries.

It is evident from table 10 that four countries in Southern Africa performed above expectations given their level of development. Perhaps what is important with respect to the Global Innovation Index rankings is to determine whether any of the countries, particularly those in Africa and Southern Africa, have been able to take advantage of the crisis presented by the COVID-19 pandemic to focus on innovation. Thanks to the pandemic, awareness increased in the subregion of the dangers of concentrating manufacturing and supply value chains in particular regions, highlighting the need for more distributed manufacturing and supply value chains. This does present opportunities for technology entrepreneurship and the development of micro-, small and medium-sized enterprises. Accordingly, with the lifting of pandemic restrictions,

1 Zambia was treated as a lower-middle-income status country in terms of the Global Innovation Index in 2022, despite its classification as a low-income country by the World Bank (Akiwumi, 2022).

innovation becomes critical for countries as they move from containment caused by lockdowns to economic recovery and growth – and the establishment of local manufacturing and regional supply value chains.

As will become apparent later in the present report, there are indications that, despite increased interest in the development of micro-, small and medium-sized enterprises in the subregion, efforts to support technology entrepreneurship are being hampered by financial constraints. Thus, in such countries as Namibia there has been reduced investment in technology incubation and innovation, as evidenced by the closure of such initiatives as StartUp Namibia and the reduced scope of the FABLab and the incubators at some of the universities, which have elected to focus purely on supporting students and faculty and not the broader micro-, small and medium-sized enterprises sector.

5.4: Linkages to industries and markets

Industry linkages are critical for the commercialization of applied research conducted by universities. Within the context of the present study, such linkages include those with micro-, small and medium-sized enterprises and technology hubs. The industry linkages vary across different countries in Africa. In their study of university-industry linkages, Outamha and Belhcen (2020) identified examples of research collaboration through eight years of Global Innovation Index reports (from 2011 to 2018), providing some useful insights (see table 11).

On the basis of the most recent collaboration scores, assigned in 2018, the Southern African countries that form part of the present study are ranked as follows in order of decreasing levels of collaboration:

Table 11: University-industry research collaboration scores in Southern Africa *(0–100)*

Country	2011	2012	2013	2014	2015	2016	2017	2018
Botswana	41.4	43.2	44.6	37.2	35.7	35.7	40.2	38.0
Lesotho	..	30.0	25.7	28.7	36.7	..	..	..
Malawi	39.9	43.9	41.6	35.0	30.7	30.7	28.5	28.4
Mauritius	36.5	36.8	38.3	38.0	36.5	36.5	36.5	36.6
Mozambique	..	46.5	41.3	37.8	38.0	38.0	37.8	37.2
Namibia	39.8	41.4	41.7	42.0	41.0	41.0	37.7	38.0
South Africa	60.1	60.3	58.5	59.0	58.1	58.1	57.4	56.3
Zambia	42.5	45.8	46.3	42.5	41.4	41.4	41.4	37.8
Zimbabwe	34.9	36.6	35.0	34.7	30.4	..	25.0	25.6

Source: Outamha and Belhcen (2020).

1. Botswana (38.0)
2. Malawi (28.4)
3. Mauritius (36.6)
4. Mozambique (37.2)

5. Namibia (38.0)
6. South Africa (56.3)
7. Zambia (37.8)
8. Zimbabwe (25.6).

Angola, Eswatini and Lesotho were not scored, given that no data had been provided for the Global Innovation Index ranking. On the basis of the above data, it can be concluded that there is a poor relationship between universities and firms in most of the countries in the subregion. Strengthening this relationship is critical for innovation and the provision of support to micro-, small and medium-sized enterprises and the effectiveness of technology hubs on the continent. Notwithstanding the poor scores of the countries in the Southern Africa subregion that received scores, all scored higher than the mean score (25.37) of the 31 African countries that received scores, thus suggesting that the industry-university linkages are stronger in Southern Africa than in other African countries.

5.5: Subregional linkages among incubators

A review of programmes establishing subregional linkages among incubators in Southern Africa revealed three initiatives – the Aspen Network of Development Entrepreneurs, the Southern Africa Innovation Support Programme and the International Association of Science Parks.

The Aspen Network of Development Entrepreneurs is a global network of organizations that propel entrepreneurship in emerging markets. Some of these organizations are incubators and participate both formally as members and on an informal basis by attending events organized by the Network.

The Southern Africa Innovation Support Programme was initially funded by the Government of Finland and later with some co-funding from the Government of South Africa in 2017. The focus of the initiative was on enhancing subregional cooperation and helping national innovation systems to contribute to inclusive businesses and development. Both phases of the Programme were hosted by the National Commission for Research, Science and Technology of Namibia and operated in several Southern African countries. Five countries – Botswana, Namibia, South Africa, the United Republic of Tanzania and Zambia – were part of the Programme, the second and final phase of which ended in 2021. According to its website, the objective of the Programme was to strengthen innovation systems and to promote cross-border collaboration between innovation role-players in Southern Africa. It was focused on strengthening early-stage enterprises and young entrepreneurs, connecting innovation systems and promoting innovations that served socially or economically disadvantaged populations.

The three focus areas of the Southern Africa Innovation Support Programme were:

- Institutional capacity for subregional cooperation. Improved capacity of institutions and innovation support organizations in expertise and delivery to support private sector innovation and enterprise development.

- Innovation in enterprises. Improved capacity of early-stage enterprises and start-ups to enter new markets with new or improved products, processes and services.

- Inclusive innovation. Improved capacity of innovation support organizations and entrepreneurs to develop new or improved products, processes and services with and for socially and economically excluded communities.

In addition to developing a training curriculum for innovation-supporting organizations, the Southern Africa Innovation Support Programme was also focused on mentoring innovation accelerators and holding hackathons and start-up weekends in the five countries mentioned above.

5.6: Lessons learned from other countries and regions

In their research, Yuan and others (2022) explore the factors that affect the performance of technology business incubators in China. The authors propose an entrepreneurial system framework that comprises four essential pillars, namely, people, capital, technology and infrastructure. The technology pillar is described as being requisite to the development and establishment of technology start-ups and a predominant indicator of the innovation landscape of a technology incubator. This suggests a relationship between investment in research and development and innovation supported by an incubator. There is sufficient evidence that the level of research and development investment in a country has a direct and positive impact on the performance of technology incubators (Yuan and others, 2022). As such, technology and innovation are essential elements in the entrepreneurial system of incubators. The number of patent applications filed and patents granted to micro-, small and medium-sized enterprises in a technology incubator may also be an indication of the extent to which such enterprises in a technology incubator harness research and development investment by gaining access to technology.

An investigation into the impact of science, technology and innovation-based incubators on the implementation of objectives related to the Sustainable Development Goals in developing countries, including India, and the relationship with policy drivers for science, technology and innovation-based entrepreneurship, reveals the need for Governments in developing countries to support science, technology and innovation activities through specific policies (Surana, Singh and Sagar, 2020). There is a positive impact when such policies are focused on promoting science and technology-based education, providing requisite facilities at academic and research institutions and strengthening the link between science, technology and innovation, start-ups and the market. More particularly, more significant impact is achieved by setting up incubators to facilitate technology transfer and supporting them in that endeavour. Essentially, technology incubators should support technology transfer and help to promote science, technology and innovation-based entrepreneurship. Surana, Singh and Sagar (2020) suggest that public policy on supporting science, technology and innovation-based entrepreneurship to achieve the Sustainable Development Goals should be focused on strengthening incubators and the overall incubator system by implementing training and support programmes and incorporating the Sustainable Development Goals into incubator goals.

Some examples of successful technology incubators from the global South are provided below:

Example of a global South incubator in the green economy: Clean Energy International Incubation Centre (India)

The Clean Energy International Incubation Centre is a joint initiative of Tata Trusts and the Government of India, supported by the Department of Biotechnology, the Biotechnology Industry Research Assistance Council, Tata Power and Tata Power Delhi Distribution Limited. Established in 2018, it is an incubator that promotes innovation in the energy sector. It offers complete "laboratory to market" incubation support to clean energy enterprises, both Indian and international. The focus is on micro-, small and medium-sized enterprises that can bring about a profound and irreversible social and environmental impact. It provides last-mile connectivity and end-use deployment of successful research output. The Clean Energy International Incubation Centre offerings include access to funding, access to markets, assistance with designing and rapid prototyping, manufacturing assistance, mentorship, partnerships, and research and development support (including access to the world-class infrastructure of advanced laboratories, equipment, maker spaces and test beds for pilot and field testing). It is an example of a successful private-public partnership aimed at tackling global challenges through innovation.

Example of a global South incubator in the digital economy: Malaysian Technology Development Corporation

An example of a technology incubator in the global South is the Malaysian Technology Development Corporation, which has been supporting the vision of the Government of Malaysia of growing the information and communications technology (ICT) sector – one of the Government's top priorities (Khalid and others, 2017). Micro-, small and medium-sized enterprises account for 99 per cent of total business establishments in Malaysia, most of which are in the services sector.

Established in 1992 as an agency under the Ministry of Science, Technology and Innovation, the Malaysian Technology Development Corporation encourages micro-, small and medium-sized enterprises to implement technology, in particular technology related to the fourth industrial revolution, in their businesses. The Corporation is located near important universities, thus enabling access to collaborative linkages and student training programmes for the entrepreneurs it supports.

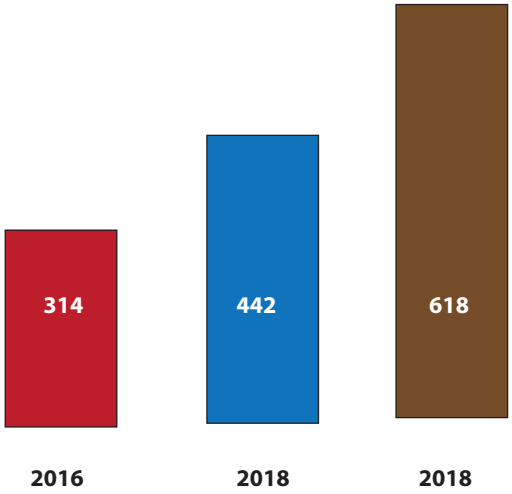
It is focused on specialized technology transfer and commercialization, thus offering technology and business advisory services to technology-focused micro-, small and medium-sized enterprises. Its technology advisory services are focused on helping such enterprises to increase their competitiveness through the acquisition or upgrading of technology. It works collaboratively with the enterprises to assess their technological needs and connect them to relevant providers. Its business advisory services include linkages and connections to local and international organizations, review and assessment of business strategies and models, and access to finance and markets. The Corporation also provides training in technical and social competencies and business-related capacity-building. Furthermore, it invests in micro-, small and medium-sized enterprises and facilitates their access to finance through peer-to-peer lending, equity crowdfunding and access to various funds. It is wholly owned by the sovereign wealth fund of Malaysia and is run by a board of directors.

6: Incubators in Southern Africa and some case studies

6.1 : Introduction

In its mapping of technology hubs in Africa (see figure VI), Briter Bridges (2019) uses the Global System for Mobile Communications Association 2016–2018 definition of an active technology hub, which is defined as an organization that is currently active with a physical local address, offering facilities and support for technology and digital entrepreneurs.

Figure VI: Mapping of technology hubs in Africa by Briter Bridges



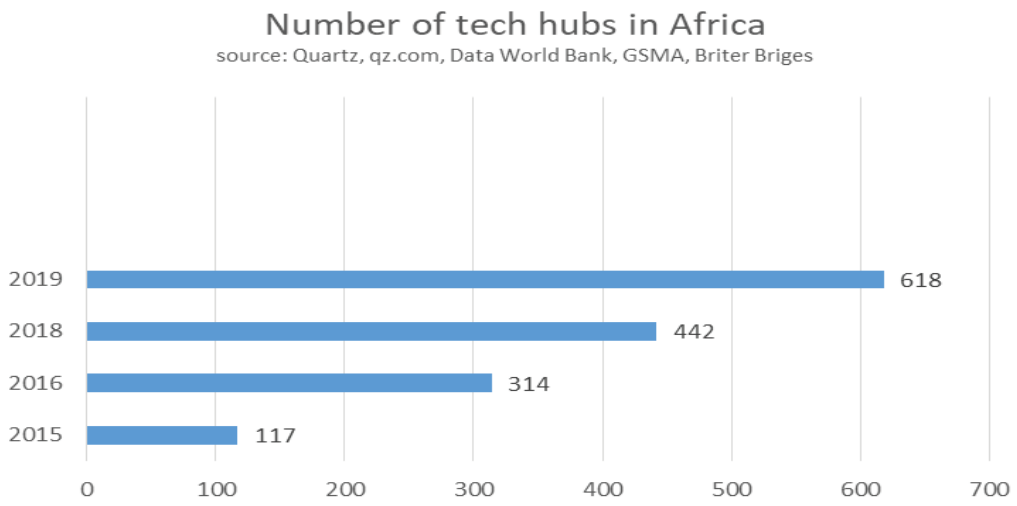
Number of hubs Countries	
1 en 4	Eswatini, Lesotho, Namibia
5 en 9	Malawi, Zambia
10 en 19	Senegal (15), United Republic of Tanzania (17), Uganda (10), Zimbabwe (12)
20 en 49	Côte d'Ivoire (22), Ghana (25), Kenya (48), Morocco (31), Tunisia (29)
50+	Egypt (56), Nigeria (85), South Africa (80)

Source: Adapted by the author from Briter Bridges (2021).

Technology hubs are categorized on the basis of the type of support or facility offered to entrepreneurs and include incubators, accelerators, university-based innovation hubs, maker spaces, technology parks and co-working spaces. This definition is aligned with best practices followed in both the global North and global South, as detailed in the previous section.

According to Briter Bridges (2021) (see figure VI), as of 2019 there were 618 technology hubs in Africa, ranging from accelerators and incubators to co-working sites (Norbrook and others, 2020). A total of 160 of these hubs were located within the Southern African Development Community (SADC).

Figure VII: Number of technology hubs in Africa in the period 2015–2019



Source: Onokwue (2021).

The number of technology hubs in Africa has increased over the past few years, as illustrated in figure VII (Onokwue, 2021).

In an earlier report, David-West and others (2018) stated that technology incubators constituted around 20 per cent of innovation support entities in sub-Saharan Africa, sharing the landscape with technology hubs (41.3 per cent), technology laboratories (17.3 per cent) and accelerators (9.2 per cent). In SADC, most technology incubators and innovation hubs are concentrated in South Africa. This is not surprising, given that country's stature as a middle-income country and as the most industrialized economy in the subregion. In addition, South Africa has a well-developed research and innovation system, as evidenced by the high levels of investment in research and development and various government funding mechanisms for micro- , small and medium-sized enterprises and for innovation in general. While the earlier versions of technology hubs, such as iHub in Kenya and Co-Creation Hub in Nigeria, were aimed at providing spaces for developers and hacker communities and were thus essentially co-working spaces, this model has evolved. The focus is now on scaling up and ensuring impact by providing a range of business advisory services and access to investors.

6.2 : Angola

The entrepreneurship system in Angola is still in its infancy. There is a partnership between the Government of Angola and UNCTAD to deliver the Entrepreneurship Development Programme in the country. This flagship UNCTAD capacity-building programme is aimed at promoting entrepreneurship and micro-, small and medium-sized enterprises to facilitate sustainable development and inclusive growth. IFC has partnered with Acelera Angola – an Angolan incubator and accelerator – to help expand and support innovative technology start-ups.

Acelera Angola

Acelera Angola is an incubator based in Luanda. It supports start-ups through mentorship with partners, networking and the training of micro-, small and medium-

sized enterprises. Founded in 2017, it is strongly focused on digital literacy, and it hosts several digital platforms to support entrepreneurs.

6.3 : Botswana

Botswana has a handful of technology hubs, the biggest and probably most notable being the government-led Botswana Digital & Innovation Hub – a science and technology park located in a special economic zone in the capital, Gaborone. The Local Enterprise Authority, an enterprise development agency in Botswana, has several satellite incubators and enterprise support facilities around the country.

Several private technology incubators have been established in the past five years. The most notable ones are TheNeoHub and Market Players, which are covered in the present study. Both of these private sector technology incubators were established within the past three years by female founders who believe that Botswana needs more interventions to support technology entrepreneurs in the country.

None of the country's universities operate their own dedicated technology incubators. The Botswana International University of Science and Technology has a strong focus on research and development commercialization and innovation through its technology transfer office, with a stated mandate to support and contribute to the realization of national economic and social development by making products and services to address societal problems.

Market Players has now established its incubation programme at the University of Botswana, which would greatly benefit the students and staff of the University. Below is an overview of selected incubators in Botswana.

Case study: Botswana Digital & Innovation Hub

The Botswana Digital & Innovation Hub is a State-owned entity with a board appointed by the Government through the relevant Cabinet minister. One of the stated objectives of the Hub is that it supports start-ups and existing local companies and attracts international companies and institutions to develop and grow competitive, technology-driven and knowledge-based businesses.

According to its website, its incubator, First Steps Venture Centre, is a technology entrepreneurship development and innovation commercialization programme within the Hub. The Centre was established to support entrepreneurship and innovation through technology transfer. It identifies, develops and nurtures viable technology-oriented start-up businesses with the potential to grow locally and into international markets.

The services provided by the First Steps Venture Centre include hot-desking, business advisory services, brand activation and publicity, fully furnished offices at affordable rates, technology entrepreneurship coaching and mentoring, and matchmaking, whereby it connects start-ups with the right partners.

The coaching and mentorship are outsourced, owing to the constraints resulting from the incubator having only three staff members – a programme manager and two entrepreneurship development advisors.

Other services include the following: meeting rooms, coffee and canteen services, ICT and Internet connectivity, intellectual property protection and commercialization services (i.e. assistance with the registration and commercialization of intellectual property), accounting and bookkeeping services, access to finance (i.e. strong partnerships and linkages with various sources of funding from government funding agencies, NGOs and other local and international funding institutions), the facilitation of partnerships, business training services, workshops, events and other networking services.

Access to finance is also achieved through a competitive process run by the Hub's innovation fund, which it manages.

Incubation with the Botswana Digital & Innovation Hub is focused on acceleration and commercialization, with the support taking the form of both business and technical interventions.

The Hub runs pitching workshops and assists with pitching. It holds a quarterly innovation competition among incubated companies, with a cash prize of up to $10,000, which it encourages its start-ups to use for business-related expenses. There are no formal processes in place to enforce this, however.

The Hub's incubation programme runs for 18 months, at the end of which the incubated companies are expected to graduate, presumably by becoming profitable, as it appears that there are no clear entry or exit criteria. This expectation notwithstanding, some companies have been in incubation for a much more extended period. The Botswana Digital & Innovation Hub is considering revamping its incubator to make it a commercialization centre with cohort-based intakes of one year each. Whereas in the past it used to run a pre-incubation programme, it no longer does so but instead refers entrepreneurs who are at an early stage (pre-start-ups) to developmental organizations in Botswana, such as the Local Enterprise Authority, which also runs an incubation programme and has shown interest in expanding into technology incubation.

The Botswana Digital & Innovation Hub reaches out to partners to create markets for its companies. It has no formal linkages to universities or research institutions through which the incubated companies could gain access to technology or technological support. Incubated companies are encouraged to collaborate among themselves. To that end, the Hub provides networking events and supports its companies that are interested in obtaining market access in other countries through networks.

According to the Hub, it plays an essential role as an aggregator, bringing all players together, as is to be expected given its focus as a science park.

Local Enterprise Authority

The Local Enterprise Authority was established through an act of Parliament with a mandate to promote entrepreneurship and to develop small, medium and micro-sized enterprises. At the time of the present study, it operated five incubators that provided business support to such enterprises through shared facilities, subsidized operational space, business and technical skills acquisition, and technology support to accelerate the growth of the incubated enterprises.

The five incubators are the Francistown Business Incubator, the Gaborone Leather Industries Incubator, the Glen Valley Horticulture Incubator (Gaborone), the Pilane Multi-Purpose Incubator and the Kutla Incubation Center (Gaborone).

The Local Enterprise Authority is focused on agriculture, service industries, tourism, technology, innovation and manufacturing. According to its website, small, medium and micro-sized enterprises comprise 14.3 per cent of the GDP of Botswana and account for over 300,000 formal and informal jobs in the country. Given its relationship with the Botswana Digital & Innovation Hub, the Authority is strengthening its capacity to support technology-focused micro- , small and medium-sized enterprises in the digital and biotechnology sectors.

TheNeoHub

TheNeoHub was founded in 2020 with a focus on agriculture, education, ICT and the green economy. It is aimed at start-ups that are intentional about using technology to optimize processes and disrupt industries. TheNeoHub appears to have positioned itself as an alternative to the Botswana Digital & Innovation Hub, as it not only offers incubation but also provides open innovation and programmes for university students and young people. It provides all the support needed to incubate a business and acts as a one-stop shop (providing, for example, business development, legal services, administrative services, strategy and marketing). As a private incubator, it has a hybrid funding model whereby it provides certain services for free and others for a fee.

TheNeoHub runs a pre-incubation programme, and the duration of its incubation programmes typically ranges from 6 to 24 months and varies on the basis of a needs assessment and the stage of development of the micro-, small and medium-sized enterprises, as they can start as early as the idea level.

Other services provided include the following: ICT and Internet connectivity; intellectual property protection and commercialization services (i.e. assistance with the registration and commercialization of intellectual property); legal services, including the drafting and review of contracts; accounting and bookkeeping services; access to finance (i.e. strong partnerships and linkages with various government funding agencies, NGOs and other local and international funding institutions); the facilitation of partnerships; business training services; workshops; laboratory and prototyping services; events and other networking services; linkages to researchers at universities and research institutions; pitching workshops and assistance with pitching; virtual incubation services and innovation competitions.

Market Players

Established in 2020, Market Players is a non-profit company with an advisory board. It provides market access, access to funding opportunities training and mentorship to enable entrepreneurs to develop viable and sustainable business models, and it hosts various networking events.

According to its website and an interview with the founder, almost 80 per cent of its beneficiaries have been young people and women.

While Market Players has associated itself with the University of Botswana, where it has a physical space and offers support to university students, staff and entrepreneurs outside the university, it operates as an independent incubator. Market Player's

activities are still at an early stage, with much of its focus being on business training and mentorship, without much engagement regarding access to technology for micro-, small and medium-sized enterprises or support specifically for technology-focused micro-, small and medium-sized enterprises.

Other system considerations

The number of technology incubators in Botswana would appear to match the size of the population (approximately 2 million) and the small number of higher education institutions, the most prominent of which are the two public universities – the Botswana International University of Science and Technology and the University of Botswana. In general, the entrepreneurial and technology innovation system in Botswana is still in its infancy, given that the Government decided not so long ago to transition the country's economy to a knowledge-based economy, as evidenced by the decision to establish the Botswana Digital & Innovation Hub. This situation notwithstanding, the country holds a great deal of potential, with its proximity to South Africa offering some advantages (such as the ability to gain access to capital and other complementary technology development capabilities) and possibly better access to the market for its technology entrepreneurs, given the small size of the Botswana market.

At the time of writing of the present report, the Botswana Digital & Innovation Hub was in the process of merging with the Botswana Institute for Technology Research and Innovation. It is currently unclear how micro-, small and medium-sized enterprises would benefit from this merger. However, the Botswana Institute for Technology Research and Innovation, as the premier research institute in Botswana, has equipment and facilities that could help such enterprises to develop technological products. With a mandate to identify, develop or adapt appropriate technology solutions that are sustainable and innovative through co-creation and collaboration, in line with the national priorities and needs of Botswana, the Institute appears to be the right partner for micro- , small and medium-sized enterprises in the natural resources and materials, energy, ICT and electronics and communications sectors.

Suggestions were made in responses to the survey and in some interviews about what could be done to enhance the entrepreneurial system in Botswana. Given the market's small size, it would be beneficial for government procurement regulations to be amended in order to ensure support from the Government in the form of procuring services and products developed by the micro-, small and medium-sized enterprises supported by the incubators.

Access to funding appears to be a challenge and is regarded as being inadequate, notwithstanding the various funding instruments, such as the innovation fund run by the Botswana Digital & Innovation Hub. As such, the Government may need to work with the private sector to broaden the available funding. There is also a realization that government-backed incubators could benefit from having an implementing partner that could provide additional skills and a successful track record. In this regard, broader public and private sector cooperation is critical for supporting the development of micro-, small and medium-sized enterprises.

The linkages between universities and research institutions could be improved to enhance access to technology for micro-, small and medium-sized enterprises

supported by incubators. As one incubator pointed out, such linkages could address the need for more specialized laboratories.

6.4 : Eswatini

Eswatini has two organizations that support micro-, small and medium-sized enterprises through the incubators they run – the Royal Science and Technology Park and the Small Enterprises Development Company. No private incubators were identified in the country through the present study.

Royal Science and Technology Park

The Royal Science and Technology Park is at the forefront of incubation in Eswatini. It is a science and technology park comprising two separate sites covering 317.17 hectares of land – the Nokwane site and the Phocweni site. The two sites include land zones for industrial development, research laboratories, administration centres and residential buildings. Established by an act of Parliament as a public entity, the Park has a board appointed by the King of Eswatini. It reports to the Minister responsible for ICT and science.

The Royal Science and Technology Park operates the first non-academic technology business incubator in Eswatini, which supports innovative start-ups so that they may survive and grow through the complex and vulnerable early stages of development and become profitable projects.

According to its website, the incubator provides "research facilitation, co-working space and amenities, business facilitation, intellectual property protection and commercialization, legal services and fundraising support". Although much of the incubator's focus has predominantly been on ICT-based businesses, responses to the survey suggest that it is also focused on biotechnology, agriculture and food, climate adaptation and the environment (green solutions), Indigenous knowledge systems and other sectors of innovation.

Small Enterprises Development Company

The Small Enterprises Development Company was established in 1970 as a public enterprise under the Ministry of Commerce, Industry and Trade to support micro-, small and medium-sized enterprises in Eswatini. It provides various services for such enterprises, including capacity development, sector support, business advice, legal consultations, business incubation, business and market linkages, access to finance and training.

Similarly, to the Royal Science and Technology Park, the Small Enterprises Development Company is a public enterprise that is wholly owned by the Government of Eswatini, with the mandate to create, develop and promote micro-, small and medium-sized enterprises in Eswatini and stimulate homegrown entrepreneurship with sustainable economic growth.

Some micro-, small and medium-sized enterprises are incubated by the Royal Science and Technology Park and then supported by the Small Enterprises Development Company, even though the latter is not a technology incubator. The Company's incubation programme comprises pre-incubation (targeted at entrepreneurs who have

not yet established a business), incubation (once a company has been established) and post-incubation (after successful incubation or revenue generation). The Company also provides virtual incubation.

Its interventions are aimed at micro-, small and medium-sized enterprises in all sectors, including but not limited to, light manufacturing, textile, retail, services and construction. The incubation process lasts for three years. Some businesses remain in the programme for longer, however, because the Small Enterprises Development Company has vacant units that it rents out to these companies, as it must run the incubator on a sustainable basis using the rental income. Each business is supported with mentorship and coaching. Regarding access to the market, the Company shares market research findings and opportunities available and tries to match the opportunities to the requirements of the enterprises. The Company provides typical incubator services, which include: legal services, including contract drafting and review; accounting and bookkeeping services; access to financing (i.e. solid partnerships and linkages with various government funding agencies, NGOs and other local and international funding institutions); the facilitation of partnerships; business training services; workshops and virtual incubation services.

Other system considerations

The entrepreneurial system in Eswatini is in its nascent stages, with the national system of innovation having underdeveloped linkages and information, knowledge and resource flows. Investment in research and development is low, at 0.26 per cent of GDP (Hlophe and Dlamini, 2018), while mechanisms for knowledge flow between universities and industries are weak. The capacity of science, technology and innovation personnel is weak. Respondents to the survey indicated a need to develop a national science, technology and innovation strategy and to establish appropriate institutions and innovation funding mechanisms for technological innovation to empower micro-, small and medium-sized enterprises in their business endeavours.

The need for flexible financing, or financing suited to the life cycles typical of micro-, small and medium-sized enterprises, was highlighted as being critical. The nature of innovative enterprises of that size follows a growth and development path that is not typical or conventional and, therefore, cannot be adequately financed using traditional business credit or financing models.

Incubators need to increase awareness among micro-, small and medium-sized enterprises in Eswatini of what it means to be “innovative” and “technology-enabled”. Financial products are not accessible to such enterprises, owing to high risk, a lack of collateral and the wrong mindset. People start businesses owing to social pressures and lack the tenacity needed to grow their business, so most businesses are necessity-driven rather than opportunity-driven.

There is a need to create stronger linkages between academic and research institutions and industries to facilitate the smooth transfer of technology. The incubator should establish information networks crucial to the business world, including networks related to accounting, management, technology, marketing (domestic and international) and fundraising, through the incubator’s affiliation with government and private institutions or agencies. The users should not bear the burden of obtaining the funds required for business incubators to operate their programmes effectively.

With regard to strengthening the national system of innovation, recommendations from respondents to the survey conducted as part of the present study included creating a school curriculum that gave some degree of attention to teaching students to be entrepreneurial, fuelled start-up systems and created a mutually reinforcing relationship between the two. One respondent to the survey recommended that business education should begin at the grass-roots level, namely in primary schools, that students should be taught business thinking from a young age and that such thinking should be considered a critical life skill. The respondent argued that the same was true for technology, because currently business was not considered to be a viable career path from an early age in Eswatini, though such institutions as Junior Achievement Eswatini sought to address that situation. Strengthening the national system of innovation was fundamental to creating an enabling environment that would naturally then necessitate the establishment of technology incubators. An important observation from one of the respondents to the survey was that, in the absence of a functional, effective, efficient and performing national system of innovation, technology incubators were a long shot.

In Eswatini, one of the respondents highlighted a lack of appropriate financial and business development services for women, which impeded the productivity of the entrepreneurial investments that Eswatini was making and tended to widen the gender gap.

Technology incubators have the potential to provide a mechanism through which businesses can be nurtured and scaled so that they can contribute meaningfully to sustainable green, blue and digital economies.

Some stakeholders in Eswatini proposed the following interventions to enhance the support of technology-oriented micro-, small and medium-sized enterprises: (a) creating a network system between academic and research institutions and industries to facilitate the smooth transfer of innovation; (b) strengthening women's voices in business associations, ensuring effective and balanced gender representation from the bottom to the top of the organizations; and (c) systematically tackling the credit constraints that impeded start-ups and the growing of a business by combining loans and grants with other services, such as skills training or financial literacy training and business advisory services.

6.5 : Lesotho

The entrepreneurship system in Lesotho is still young and is characterized by a handful of incubators, the most notable one being the University of Lesotho Innovation Hub. The Hub is aimed at the commercialization of research-based and laboratory-tested ideas. It operates as a department within the university, with a focus on businesses initiated by students. It acts as an interface between academia and industries.

The Hub assists businesses in testing and strengthening the quality of products through market and production processes to improve speed and reliability for mass production and raw material supply to ensure sustainability. Its interventions in the small-scale manufacturing of products emanating from the laboratory facilitate market access by testing market acceptance and gathering feedback on the prototypes.

The incubation period is a maximum of three years, during which the business has access to typical incubation facilities, in particular, free space, electricity, water, Internet and other amenities.

6.6 : Malawi

There are a few incubators operating in Malawi, the most prominent ones being mHub, Mzuzu E-Hub and Agribiz Hub.

mHub

mHub is a non-profit incubator founded by a woman in 2014. It is hailed as the first technology and innovation hub in Malawi. Based in Lilongwe, it has satellite sites in Blantyre, Malawi and in Lusaka. It is focused on ICT innovation at different stages of value chains, from the ideation to the post-revenue and acceleration stages.

mHub offers co-working spaces equipped with high-speed Internet connectivity, an uninterrupted power supply and on-demand technical support. According to its website, it has facilitated over 950 jobs, had an impact on more than 5,000 people and trained over 40,000 young people in business and technology skills.

It offers a one-year incubation programme, and its mentorship is primarily focused on technical assistance.

Access to finance is one of its offerings, having raised over $1 million in financing for entrepreneurs. Its focus appears to be mainly on digital technologies. mHub provides a complete service by combining training with co-financing and mentorship.

Mzuzu E-Hub

Mzuzu E-Hub provides co-working space, business incubation and technical assistance to start-up and emerging enterprises by linking them to a network of services for growth and success.

According to its website, as of mid-2021 it had supported over 67 entrepreneurs, created 145 jobs, trained 112 young people and mentored 12,000 students.

The E-Hub's incubation support covers diverse sectors, including agricultural production, agricultural processing, supply chain management, media and ICT, fashion and designing, construction, water and sanitation and renewable energy.

The E-Hub also offered seed financing of $5,000 to 10 investment-ready enterprises.

Its programme is pitched as a six-month intervention, which appears to be more of an accelerator than an incubator.

Dzuka Africa Organization

The Dzuka Africa Organization was founded in 2015 by a woman as a non-profit organization with a focus on supporting micro-, small and medium-sized enterprises in agriculture, furniture manufacturing and ICT and has operations in Blantyre, Thyolo, Balaka and Mangochi.

Its interventions include incubation (providing co-working spaces and access to working equipment), training (in digital skills for business management, entrepreneurship and

product development) and market access (setting up platforms to facilitate customer identification and customer service).

Target beneficiaries of its programmes are young people with formal or informal vocational technical skills who have attained a degree or diploma.

The incubation process comprises a residency of a maximum of 24 months with online business support, including 1 month of digital training, 1 month of entrepreneurship training, 1 month of product development and quality assurance, 1 month of product development market readiness, and 3 to 6 months of post-programme support and membership, after which the enterprise exits the programme.

The Organization runs a pre-incubation programme called InvestInMe for young mothers and older women, through which it trains them to produce non-food items so that they can generate income within their communities, and a programme called Me2iCount for young adults, through which it provides them with primary certification and teaches them social entrepreneurship and productive skills so that they can produce products for daily use in the villages.

Mentorship is geared towards product development. Accordingly, the Organization has set up 6to6 (a physical shop) for selling the products of the incubated businesses.

Other system considerations

Regarding the state of the system in Malawi, the respondents to the survey were of the view that the following were specific gaps in the support provided to micro-, small and medium-sized enterprises:

a) Lack of connectivity, which limited access to technology and other tools required by micro-, small and medium-sized enterprises;

b) Policy inefficiencies, including regulation policy that did not support entrepreneurship;

c) Availability of capital;

d) Limitations in private sector and public sector buying;

e) Lack of effective collaboration among enterprise support organizations;

f) Weak structures to protect entrepreneurs;

g) Less involvement of women entrepreneurs;

h) Lack of funding capital.

One of the recommendations contained in the survey responses was to change the regulation policy so as to strengthen the entrepreneurship system. Other recommendations included creating deliberate policies and an enabling environment for women entrepreneurs to start businesses and thrive. Some recommendations concerning the lack of funding capital included having enough seed capital funding to create and sustain businesses and easing taxation on emerging enterprises.

On the matter of the sustainability of incubators, the stakeholders were of the view that incubation had to be funded by the Government and, as such, should be made a government priority. One of the stakeholders emphasized that, while there was an increased focus on access to or the incorporation of technology by micro-, small and medium-sized enterprises, there needed to be a similar focus on character-building training rather than just technical training for such enterprises, as some failed despite having access to technology, owing to character flaws.

The following were identified as constraints faced by women-led micro-, small and medium-sized enterprises: illiteracy, a need for mindset change, the unavailability of technological gadgets, the cost of data bundles and uninterested individuals or groups.

6.7 : Mauritius

The Government of Mauritius, through the Mauritius Research and Innovation Council, has established the National Small and Medium-Sized Enterprise Incubator Scheme to promote the establishment and development of innovative start-ups facilitated by a network of private-sector-led accredited business incubators.

The incubators accredited under the scheme provide incubation in three phases: pre-incubation, focused on the ideation stage to the prototype stage; incubation, with the outcome being the establishment of a start-up; and acceleration, which is focused on the growth of the start-up. According to the Mauritius Research and Innovation Council website, the scheme, which was launched in December 2017, had enrolled seven accredited incubators and graduated 22 start-ups as of March 2023.

The accredited incubators are the Mauritius Africa Fintech Hub, Verde Ventures Limited, Trampoline, Future Females Foundation, LinearArc Solutions, La Plage Factory and Turbine Incubator. Some of these, such as Verde Ventures and Mauritius Africa Fintech Hub, are very focused on financial services, given the country's positioning as a location for offshore investment and the headquarters of many financial institutions and investment companies.

LinearArc
LinearArc offers three programmes – pre-incubation (6 months), which is focused on building a minimum viable product, incubation (18 months) and acceleration (6 months).

Through its incubation programme, it provides access to co-working space, formal training sessions, administrative support, assistance in pitching to potential investors, mentorship and networking events.

La Plage Factory
La Plage Factory provides start-ups with access to co-working space, mentorship, business development support and access to funding. It appears to be sector-agnostic. Its incubation programme is focused on developing a minimum viable product through mentorship, access to government support schemes or grants and the development of a business plan. It also offers acceleration, with a focus on minimum viable traction, investor-readiness and growth. According to its website,

La Plage Factory has successfully incubated 17 start-ups and accelerated 7 and has created jobs through its successfully incubated companies.

Turbine Incubator
The Turbine Incubator runs several programmes, including business idea competitions targeting pre-start-up and start-up business ventures. The competitions are used for pipeline development for its Inspire programme, focusing on start-up development and growth. In return for the support it offers, Turbine takes up equity in the start-ups it supports over the course of two years (Jackson, 2016).

Mauritius Start-up Incubator
The Mauritius Start-up Incubator is focused on creating innovative companies linked with new technologies. With a focus on smart cities, call centres and information technology, tourism, real estate and finance, the incubator offers incubation support, office and co-working premises, company formation and accounting, and assistance with the recruitment of talent.

Other system considerations
The Mauritius entrepreneurial system appears to be nascent, in particular regarding technology incubators and their role in the development of micro-, small and medium-sized enterprises. Despite the performance of Mauritius in the Global Innovation Index, its innovation system is still very small, as is the number of academic and research institutions and the number of incubators in the country, along with low levels of investment in research and development. The positioning of Mauritius as a location for global businesses may also contribute to what may be an artificial strength in innovation, as some of the companies registered in Mauritius do not undertake any research or development in the country yet choose to register their intellectual property under their Mauritius global subsidiaries or companies, for one or more of a variety of reasons, including access to funding for further development and tax benefits.

6.8 : Mozambique

Some organizations in Mozambique support innovation but do not act as incubators. One such organization is MozDevz, which operates more as a community for ICT students and enthusiasts and acts as a capacity-building and solutions-seeking platform to address local problems but is not actively following up on start-up creation or development. It partners with ideiaLab, which has more specialized incubation and acceleration programmes.

ideiaLab
ideiaLab is a for-profit organization that offers paid entrepreneurship and innovation programmes funded by or on behalf of various partners. It is the implementer of the incubation programme for Orange Corners – an initiative of the Ministry of Foreign Affairs of the Netherlands that supports young entrepreneurs with innovative solutions to local challenges across Africa, Asia and the Middle East.

The incubation programme run by ideiaLab is six to seven months long. It is aimed at providing business advice, training and visibility for market access through social media. Market access is also enabled through the Orange Corners headquarters in the Netherlands and the alumni community. Since 2022, micro-, small and medium-

sized enterprises have had access to the Orange Corners Innovation Fund for their financial needs. The interventions are sector-agnostic and span from the ideation stage to bringing a product to market.

ideiaLab supports entrepreneurs and micro-, small and medium-sized enterprises by focusing on innovation as an essential factor in competitiveness and long-term success. Through its incubation programme, it provides a range of services, including strategic and organizational consultancy to help micro-, small and medium-sized enterprises grow, access to finance and other vital resources, information and knowledge management tools required for innovation, capacity-building, mentorship, networking events, continuous learning and partnerships.

The incubation is not aimed at technological innovation per se, and ideiaLab operates not as a technology incubator but rather as a business incubator.

Separate from the incubation programme it runs for Orange Corners, it also offers other programmes geared towards supporting micro-, small and medium-sized enterprises, such as FemTech, which targets women-led businesses that have been running for at least two years and are aiming to grow. This is a three-month to four-month intervention comprising intense workshops and mentorship. In between the workshops, ideiaLab offers mentorship by facilitators of the programme. It also runs five-day boot camps for entrepreneurs.

Other system considerations

It would appear that there is very little technology incubation in Mozambique. Indications are also that there are weak linkages between universities or research institutions and incubators to support entrepreneurs and micro-, small and medium-sized enterprises requiring access to technological assistance during their entrepreneurial journey. There is a lack of information on entrepreneurship and on incubators in Mozambique, presumably owing to language issues, with most of the literature possibly being in Portuguese.

6.9 : Namibia

Namibia has played host to both phases of the Southern Africa Innovation Support Programme since 2011. The Programme was focused on strengthening innovation and incubation systems in several Southern African countries. Notwithstanding the efforts made through the Programme, the incubation system in Namibia appears to still be nascent.

Over the years, several government-backed technology incubation initiatives have been linked with the two leading universities in Namibia – Namibia University of Science and Technology and the University of Namibia.

Namibia Business Innovation Institute

The Namibia University of Science and Technology established the Namibia Business Innovation Institute as a business incubator for students and faculty of the university, with a focus on supporting researchers from the university who wished to commercialize their research results or technologies. The Institute provides training,

mentoring and business support services to university-linked entrepreneurs, students and faculty members seeking to establish their own companies.

The Institute runs an 18-month incubation programme (pre-incubation programme and accelerator programme) aimed at capacity-building. Full incubation is focused on providing mentorship and coaching and financial and inventory management.

Another programme linked to the Namibia University of Science and Technology is the FABlab Design and Technology Centre, which was established to provide technological support to university students, faculty members and micro-, small and medium-sized enterprises through access to equipment and machinery (Ayemoba, 2017). Upon its establishment, this facility was the first advanced manufacturing, prototyping and design laboratory in Namibia and the largest FABlab in Africa. It provided access to new technology, machinery and design, primarily to university students and faculty members, to enhance local product competitiveness. This programme is critical for bridging the technological divide and providing competitive education, skills and new product creation and spurring innovation to strengthen the number of micro-, small and medium-sized enterprises incorporating technology into their businesses.

As of early 2023, the FABlab was no longer available to micro-, small and medium-sized enterprises but only to the university community, the main reason for this being a lack of funding. Whereas the Namibia Business Innovation Institute was still operational, owing to funding constraints it lacked critical capacity and engagement with micro-, small and medium-sized enterprises.

University of Namibia

The University of Namibia established the Chancellor's Innovation Fund as an incubation programme to support young entrepreneurs in the development of their innovative ideas. According to the University website, the programme is for university staff, students and researchers and provides mentorship, capacity-building, product development and innovation ideation for a period of 12 months. The University of Namibia established the Fund with financial support from Telecom Namibia and with support from the University of Turku, Google and the UNDP Accelerator.

The other focus areas of the University of Namibia incubator are agroprocessing, artificial intelligence applications in agriculture, green hydrogen, climate change and financial technology (fintech). As of March 2023, there had been limited engagement with or support of micro-, small and medium-sized enterprises from outside the university, owing to financial constraints.

Bokamoso Entrepreneurial Centre

The city of Windhoek established the Bokamoso Entrepreneurial Centre as an initiative to support micro-, small and medium-sized enterprises in various sectors, including textile, arts and crafts, joinery and innovative business (e.g. solar panel installation and maintenance and information-technology-related business).

The Centre operates not as an incubator but rather as a business hub, providing space for micro-, small and medium-sized enterprises to develop their businesses. Regarding its operations, it conducts a needs assessment of the enterprises before leasing space to them. It determines the specific types of training and interventions that the enterprises require to grow their businesses over the course of three years

and then works with partners to make some of the interventions accessible to the enterprises.

The Centre does not have specific capabilities, nor does it provide typical services, such as free Internet connectivity, mentorship and coaching, that one typically finds in an incubator. It relies on service providers who have signed a memorandum of understanding with the city of Windhoek.

According to statements made during the interview held with the management of Bokamoso, the Centre is meant to be managed by a board of trustees comprising individuals identified among market leaders, such as individuals from banks (e.g. Nedbank), the city of Windhoek, the Namibia University of Science and Technology and the Namibia Manufacturers Association. However, at the time of writing of the present report, there was uncertainty regarding the board, as the term of its members had not been renewed. The city of Windhoek was reassessing the governance and operation of the Centre.

With space for 43 tenants (micro-, small and medium-sized enterprises) and a modus operandi of not accepting more than two such enterprises in the same industry, so as to promote collaboration without having an overconcentration of enterprises within the same sector, the Centre does not qualify as an incubator. It does not have the ability to provide enterprises with access to technology or finance. It has very weak linkages even with the universities, except in cases where memorandums of understanding have been concluded.

Mobile Telecommunications Company ICT Innovation Centre

The Mobile Telecommunications Company ICT Innovation Centre was established as a hub for testing, building and showcasing new business and consumer ICT applications. According to its website, it is positioned as an internal innovation centre, with a focus on incubating a range of enterprise-based services, including comprehensive fibre-optic Internet and digital cloud computing services, to spearhead digital transformation in smartphone and smart city (connected society) initiatives. The Centre is open to students and faculty members of the Namibia University of Science and Technology, micro-, small and medium-sized enterprises and the general public. It is positioned to foster collaboration between industries and academia.

Other system considerations

Other relevant mechanisms that Namibia has had in place in the past for supporting micro-, small and medium-sized enterprises with technology include the equipment aid scheme carried out by the then Ministry of Industrialisation, Trade and SME Development, which was used to provide such enterprises with financial support and with access to equipment. However, the scheme was terminated in 2015 owing to budgetary constraints. Namibia has previously had other financing initiatives for micro-, small and medium-sized enterprises, which were not operational as of August 2023. These included the Development Bank of Namibia Mentorship and Coaching Fund and the Credit Guarantee Scheme (meant to guarantee up to 60 per cent of the loan taken out by the enterprise). Commercial banks were meant to participate in the Credit Guarantee Scheme, but, in the case of the two banks that signed up, there was minimal traction from micro-, small and medium-sized enterprises owing to increased qualification criteria required by the banks.

The interviews and surveys conducted with various system players revealed that Namibia was considering establishing a venture capital fund for small and medium-sized enterprises. However, the initiative is still in its early stages, and it would require the development of a vibrant technology system with a strong pipeline of technology start-ups in order to be viable. In order for this to come to fruition, Namibia will need to have functioning technology incubators with strong capacity.

Generally, Namibia does not appear to be doing much in the area of research and development innovation. With pockets of excellence, the science, technology and innovation sector in Namibia could benefit from better coordination, an intentional focus on technology innovation and improved government funding of the incubation sector across the board, including encouragement for universities to open up their incubation programmes to the community. Namibia does not have a strong technology sector or government support initiatives to foster innovation, in particular technological innovation.

One of the more recent initiatives in this area is StartUp Namibia, a non-profit organization that was aimed at improving the conditions for establishing and growing start-ups in selected regions in Namibia. Through its two main programmes, Basecamp and the Digital Transformation Centre, StartUp Namibia provided access to co-working space, support that included pitching events, and digital tools for innovative entrepreneurs. The StartUp Namibia project was a joint Namibian-German technical cooperation project. It was implemented by the German Agency for International Cooperation with the Ministry of Industrialization, Trade and SME Development of Namibia, the Ministry of Higher Education, Training and Innovation of Namibia and the city of Windhoek. Unfortunately, this initiative was terminated in November 2022, owing to a lack of financial resources.

An important organization established by the Government of Namibia under the Office of the President is the Namibia Investment Promotion and Development Board. Established in 2020 with a focus on investment emanating from both within and outside Namibia, the Board has identified the need to develop talent and innovation in order for Namibia to be competitive. One of its main projects has been the creation of a national database of micro-, small and medium-sized enterprises to design and implement targeted support initiatives, such as digital literacy and access to Internet connectivity and electricity.

The Namibia Investment Promotion and Development Board has concluded a tripartite agreement with the Mobile Telecommunications Company and the Namibia University of Science and Technology regarding micro-, small and medium-sized enterprises. The Mobile Telecommunications Company – the country's largest such company – hosts its innovation hub at the Namibia University of Science and Technology.

Namibia, through the Namibia Investment Promotion and Development Board, is developing a "local content policy" to promote its interests with regard to the sourcing of products. This policy will compel multinationals to work with local micro-, small and medium-sized enterprises to supply certain services in the new emerging oil and gas sector and the green hydrogen sector. It may be prudent to explore the establishment of incubators to support enterprises participating in these sectors as part of the supplier development programme.

6.10 : South Africa

South Africa has one of the continent's most established technology start-up systems, as evidenced by the number of its technology incubators, science and technology parks and accelerators.

Given the size of its start-up system, South Africa is part of the "big four start-up systems" in Africa, together with Egypt, Kenya and Nigeria. Many start-up activities are located in major cities, notably Cape Town, Johannesburg, Pretoria, Stellenbosch and Durban. In total, there are estimated to be 80 technology hubs and incubators in South Africa (Giuliani and Ajadi, 2019).

Some of the notable technology hubs highlighted by Disrupt Africa (2022) in its South African Startup Ecosystem Report are Bandwidth Barn (reputed to be the oldest technology incubator in Africa, established in 2000), Innovation City, Inner City by Ideas Cartel and Workshop17 in Cape Town; AlphaCode, JoziHub and Tshimologong Digital Innovation Precinct in Johannesburg; mLab and the Innovation Hub in Pretoria; InvoTech in Durban; iHUB in Gqeberha; Cortex Hub in East London and LaunchLab in Stellenbosch.

Case study: the Innovation Hub

The Innovation Hub, a science and technology park, was established in its current location in Pretoria in 2005 by the government of Gauteng Province – the economic hub of South Africa – and ran its first business incubator, the Maxum Business Incubators, as early as 2001. Since around 2011, it has established and operated various sector-specific technology incubators at its current location and across Gauteng Province (Sibanda, 2021). These include the Climate Innovation Centre South Africa, the Maxum Business Incubators, mLab (established with the support of the then World Bank infoDev programme), the BioPark Business Incubator (BioPark@Gauteng) and eKasiLabs.

Whereas the Maxum Business Incubators are focused on ICT and advanced industries, the Climate Innovation Centre South Africa supports entrepreneurs creating green economy innovations relating to energy, water and waste. mLab, established by the Innovation Hub in partnership with the Council for Scientific and Industrial Research and other partners in 2011, is focused on enabling entrepreneurs and innovators in the development of their mobile applications and other digital solutions to address social and economic challenges, empowering the entrepreneurs to maximize opportunities in the digital economy and assisting early-stage start-ups in pursuing their next growth opportunity. According to its website, its impact includes: 200 start-ups supported; 23 million South African rand raised as funds for the start-ups; more than 300 jobs created; 500 developers trained, of which 45 per cent were women; several custom digital solutions developed; and 50 million South African rand contributed to the provincial GDP.

The BioPark@Gauteng, conversely, is a biosciences pre-commercial infrastructure and incubator that supports entrepreneurs in the health, agroprocessing and industrial sectors of the bioeconomy. Specifically, it provides business development support to micro-, small and medium-sized enterprises in the health sector, typically those related to biopharmaceuticals, medical devices and diagnostics, Indigenous-knowledge-based nutraceuticals, cosmeceuticals and cosmetics. It also supports micro-, small

and medium-sized enterprises in agriculture, with a focus on agroprocessing, food processing, bioprocessing and smart agriculture, and micro- and small enterprises in industrial biotechnology sectors. The BioPark offers a full suite of incubation services, including mentorship (technical, business and commercial), intellectual property advice, access to financing through the Innovation Hub's Start-Up Support Programme and its network of funding partners, access to markets through assistance with exhibitions and the exposure of entrepreneurs to visitors, and access to technology facilities, manufacturing spaces and laboratories. Sibanda (2021) notes that, by 2018, the BioPark, which was established in 2014 with the opening of the first of three phases, had supported more than 80 start-ups, 70 per cent of which were in health (biopharmaceuticals, nutraceutical, cosmeceuticals, medical devices and diagnostics), 23 per cent in industrial sectors and 7 per cent in agricultural biotechnology, and it had also had a few successful exits, including such companies as Makhamisa Foods, PortiaM Skin Solutions, Altis Biologics and SmartSpot Quality – a university start-up that commercialized tuberculosis diagnostics tests.

The Innovation Hub also runs a specialized technology incubator focused on the green economy – the Climate Innovation Centre South Africa. This initiative was part of the World Bank infoDev programme on climate innovation centres, which included such centres in Ethiopia and Kenya, among others. Supporting entrepreneurs and micro-, small and medium-sized enterprises creating innovations in water and sanitation, energy (with a particular emphasis on renewable energy), sustainable mobility, environment and waste management, food security and other forms of green technology and innovation to address carbon emissions, the Centre's incubation offering is based on five pillars: (a) access to financing (proof of concept grants and seed funding); (b) technical and business advice (comprising mentorship, access to information, market intelligence reports, etc.); (c) policy and advisory services (concerning standards setting and the regulatory environment); (d) access to facilities (offices, incubation spaces and prototype manufacturing); and (e) access to regional and international networks.

According to the Innovation Hub's responses to the survey, the incubation services provided to start-ups in all its incubators include business advice and skills development, mentorship (technical and commercial), access to markets, networking opportunities, infrastructure (dry and wet laboratories, prototyping and pilot manufacturing, FabLab equipment, gaming and other digital tools and 3-D printers) and access to funding.

UVU Africa

The incubation programmes in Cape Town are anchored mainly by UVU Africa (previously known as the Cape Innovation and Technology Initiative), a non-profit company established in 1999. UVU Africa has several incubators, including the Bandwidth Barn, Injini and UVU Bio. It was established with a focus on technology and innovation in Cape Town, primarily digital technology, from both a skills and entrepreneurial point of view.

The Bandwidth Barn has been one of the anchor projects of UVU Africa. According to the UVU Africa website, it has successfully incubated over 100 companies since its inception. Like other incubators, it provides infrastructure support mainly in the form of shared working spaces, meeting rooms and board rooms and connectivity, in addition to business support services, including access to mentors for technology and technology-enabled businesses. A vital aspect of the Bandwidth Barn is its ability to

connect technology entrepreneurs and micro-, small and medium-sized enterprises to the innovation system and companies in the Western Cape Province, centred around Cape Town and Stellenbosch.

Another project carried out through UVU Africa is UVU Bio, established in 2019. It is a specialized biotechnology incubator providing world-class biotechnology laboratory facilities to support biotechnology start-ups that are late in the research cycle and early in the product cycle. The incubation programme lasts from 12 to 36 months and is focused on providing mentorship, training, peer-to-peer support and access to a range of networks, including funders, industry experts and start-ups at pre-seed stages to get them angel-investment-ready.

UVU Africa also started Injini as a business incubator in the education technology sector, which has since transitioned to become an accelerator. According to its website, from 2017 to 2020 it successfully incubated 29 early-stage education technology start-ups from 10 African countries, with a high survival rate of nearly 90 per cent.

The role played by UVU Africa in Western Cape Province – the second largest economic hub in South Africa – is similar to that played by the Innovation Hub in Gauteng Province, the most significant economic hub in South Africa.

Tshimologong Digital Innovation Precinct

The University of the Witwatersrand established Tshimologong Digital Innovation Precinct as its digital hub or technology incubator to support the commercialization of research from the university and innovations emanating from students, alumni and other young people in Johannesburg. Its facilities include a fully fledged co-working space equipped with uncapped Internet, meeting rooms, a coffee shop and ample opportunities for networking and learning through community events and training initiatives. According to its website, since its launch in 2017 it has incubated 105 start-ups and 172 entrepreneurs. It is located in Braamfontein, Johannesburg, adjacent to the main university campus.

The technology incubator is focused on digital skills training (in coding, networking and animation), technology validation, market validation, business case development and market linkages. It targets technology entrepreneurs and micro-, small and medium-sized enterprises developing smart cities solutions and digital creatives (working in animation, gaming and extended reality), who gain entry into its programmes through advertising, hackathons and game and animation jams. Regarding the application process, the shortlisted applicants are interviewed by a selection panel and scored against set criteria, including whether they possess a digital innovation focus, alignment with corporate procurement needs (where required), an idea that addresses a real need, a business model, a team, an innovative or disruptive industry solution and market validation. Tshimologong Digital Innovation Precinct supports emerging entrepreneurs in the development of their concepts and prototypes for market testing. Through the Tshimologong Makerspace, it also exposes entrepreneurs to various technology solutions.

Although established as a university incubator and substantially funded by the university, Tshimologong Digital Innovation Precinct operates as a for-profit technology incubator and charges for the services it offers to micro-, small and medium-sized

enterprises. The incubation process lasts for a minimum of 3 months and a maximum of 12 months, depending on the extent of technology validation and development required.

According to its response to the survey conducted as part of the present study, it provides a range of services to support technology entrepreneurs and micro-, small and medium-sized enterprises, which include hot-desking, meeting rooms, coffee and canteen services, a maker space, an animation studio, a video game studio and mentorship. Other services provided include ICT and Internet connectivity, the facilitation of partnerships, business training services, workshops, laboratory and prototyping services, events and other networking services, linkages to researchers at universities and research institutions, pitching workshops and assistance with pitching, virtual incubation services and innovation competitions among the incubated enterprises. The competitions are run at least once a year, with the prize being just under $30,000 in cash and the opportunity to be assisted with product development and piloting. Regarding the cash award, while the spending of it is not monitored, the money is expected to go towards developing the project or prototype.

With regard to market access, the incubator provides support for travel to and accommodation at local and international festivals, trade shows and markets, as well as international residencies for digital content entrepreneurs. Internationalization is enabled through the pan-African Digital Lab Africa accelerator programme, with entrepreneurs having the opportunity to meet at festivals. Tshimologong Digital Innovation Precinct also has partnerships with companies and hubs across Africa and partnerships in France that support entrepreneurs in developing their service offerings and create links to the local value chain. It also has strong linkages with other players in the system. For example, it manages a studios collective through which it procures work and subcontracts it to entrepreneurs it has incubated. This allows the enterprises to earn income quickly, build a portfolio of evidence of delivering quality work to client deadlines, and benefit from piggybacking off the credibility of the technology incubator's brand.

In addition to the Precinct's own research unit, the incubated enterprises also have access to Wits University facilities as required.

Tshimologong Digital Innovation Precinct provides support to micro-, small and medium-sized enterprises related to concept development, prototyping, technology validation, the showcasing of their work at the annual Fak'ugesi African Digital Innovation Festival and partnerships with other festivals and markets. It actively contributes to transforming the animation and gaming industries by linking an African aesthetic and content to local and international value chains. The hub measures impact using the university-based incubator index (UBI Global, 2023) and its contribution to the attainment of Sustainable Development Goals 5, 8, 9, 10 and 17. Tshimologong Digital Innovation Precinct is of the view that its work in the gaming and animation industries has exceeded expectations, and this is supported by the fact that the technology entrepreneurs it incubated during and after the COVID-19 pandemic lockdown have demonstrated a high survival and growth rate (those in the Ya Basadi in 4IR Programme,[2] for example, have a 100 per cent survival rate). In

2 Through this programme, women-owned or women-led businesses are provided with business, technical and financial support. The programme is run by Tshimologong Digital Innovation Precinct in partnership with JPMorgan Chase (Tshimologong Digital Innovation Precinct, 2020).

particular, growth has been seen throughout the entire cycle of commercialization of research. Tshimologong Digital Innovation Precinct prototyped its enterprise development programming for postgraduate researchers only in 2022, and its model for entrepreneurial orientation with academic staff, researchers and faculty engagement is not yet fully developed.

Regarding what could be done to enhance the effectiveness of its incubator, the management of Tshimologong Digital Innovation Precinct identified the following measures:

- On-time payment of services by the Government and government agencies
- Access to a broader pool of early-stage investors
- Funding provided by university departments for the support required to enhance student innovation
- Measures to address the fact that, since start-ups cannot afford to pay to be incubated, attention was dispersed in pursuit of revenue streams, reducing the focus on the core work

Small Enterprise Development Agency Atlantis Renewable Energy Business Incubator

The Small Enterprise Development Agency Atlantis Renewable Energy Business Incubator, an incubator established in 2013 and supported by the Small Enterprise Development Agency, is located in the town of Atlantis within the Western Cape Province of South Africa (Small Enterprise Development Agency Atlantis Renewable Energy Business Incubator, n.d.). The Incubator specializes in the green energy sector, with a focus on energy and resource efficiency. It supports green technology start-ups in various developmental stages. Entrepreneurs can enter the pre-incubation support programme from "an ideation or concept phase" and then graduate to the incubation phase of the programme to gain access to a variety of support offerings, comprising shared office space and business support in accounting, human resources and labour-related functions. The Incubator's strong linkages with global supplier and distribution networks and strategic partnerships with multinational enterprises provide market access to entrepreneurs by creating opportunities for economic activity and market participation. According to its website, it has supported nearly 190 entrepreneurs and micro-, small and medium-sized enterprises through various interventions since its inception. As of July 2023, it was actively supporting 48 entrepreneurs in its incubation programme (Invest Cape Town, n.d.).

Wot-if? Trust – Father Louis Blondel Centre

The Wot-if? Trust – Father Louis Blondel Centre was established in 2013 and is strategically located in the Diepsloot township in Johannesburg with the aim of strengthening the township's economy. It is a women-dedicated incubator that provides support to young entrepreneurs across various sectors and is focused on such industries as waste management, ICT, digital technology and the creative arts. According to its website, Wot-if? provides co-working space, business resources, training and coaching.

Wot-if?, like other women-dedicated township incubators, is faced with numerous challenges relating to, among other things, access to funding and sponsorship, which leads to operational and support difficulties for the incubator and the entrepreneurs, respectively, a lack of mentorship and coaching capabilities required for effective entrepreneurial support (Muriithi, Ndegwa and Juma, 2018), and a low level of quality among entrepreneurs, as many women in the township face educational challenges and significant socioeconomic vulnerabilities (Sofianos, 2022).

Impact Amplifier

The Impact Amplifier, founded by Max Pichulik in 2011 and headquartered in Cape Town, provides a range of business incubation, training and acceleration programmes to support and facilitate social enterprise development in such sectors as agriculture, biotechnology, the green economy and health. It offers an "investment readiness" accelerator programme with a duration ranging from 3 months to 12 months. The programme covers market identification and analysis, financial modelling and strategic growth planning.

The Impact Amplifier also offers virtual mentorship, ad hoc help with gaining access to markets and linkages to research institutions through such programmes as the Irish Tech Challenge South Africa, administered by the Impact Amplifier on behalf of the Embassy of Ireland, the Department of Science and Innovation of South Africa and the Technology Innovation Agency. According to the Impact Amplifier website, the Challenge is aimed at helping South African technology-related micro-, small and medium-sized enterprises to scale globally by strengthening partnerships with the Irish technology system. The focus is on providing a platform for mutual cooperation and supporting impactful technologies by forging stronger ties and cross-collaboration between the technology and entrepreneurship systems in Ireland and South Africa (Impact Amplifier, 2023). The Impact Amplifier uses the Sustainable Development Goals to measure and monitor its annual impact. In 2021, it reported its outcomes as being the results of long-term acceleration work with entrepreneurs across various sectors and social issues, supporting 67 social enterprises and facilitating 24 million South African rand of grant and debt funding to social entrepreneurs. However, it has experienced challenges in acquiring and providing access to business capital in its acceleration programmes. According to the Global Impact Investing Network (2013), this can be attributed to the lack of high-quality, early-stage start-ups and adequate support for the creation of later-stage investable businesses.

LaunchLab

LaunchLab is a start-up technology incubator established by Stellenbosch University. It offers various forms of incubation support for university spin-outs, industry spin-outs and start-ups in the ICT, clean technology, agriculture and education sectors.

Startup Hatchery

The Startup Hatchery, located in Belville, Cape Town, was established in 2017 to support start-ups and early-stage entrepreneurship. It offers an online, step-by-step entrepreneurship programme and is focused on developing and implementing enterprise and supplier development solutions to increase the participation of Black-owned small and medium-sized enterprises across various corporate supply chains.

The Startup Hatchery offers a pre-incubation programme, a 3-month online full-incubation programme, a 12-month acceleration programme designed to support entrepreneurs by providing mentorship training and an environment conducive to innovation, and a 6-month virtual business mentorship programme.

The virtual incubator does not provide office space or similar facilities commonly offered by traditional business incubators, but conversely its impact potential is not limited by geographical barriers. Furthermore, it provides help with gaining access to the market through its established networks.

Case study of a blue economy incubator: OceanHub Africa

OceanHub Africa is a specialist incubator focused on the blue economy, with its head office in Cape Town. According to its website, it operates as an ocean-impact catalyst aimed at connecting, inspiring and supporting entrepreneurs and other system stakeholders to accelerate the development and adoption of new, sustainable ocean solutions across the continent.

It runs an acceleration programme through which it provides micro-, small and medium-sized enterprises with personal, product and business development mentorship support. That support is in the form of an eight-month online incubation programme, run for cohorts of up to 10 of the most promising impact-for-profit start-ups focused on preserving and restoring the health of the ocean while developing equitable and sustainable livelihoods. The interventions provided include an in-person training boot camp in Cape Town; one-on-one tailored business skills training and personal development coaching; sales, product development, communication and business development support; access to its network of scientific, business, impact and investment experts; legal and financial advisory services with its vital partners; potential non-dilutive funding of up to $10,000 from OceanHub Africa, including investment readiness support; and access to potential clients and market leads.

The terms under which it provides support include levying a success fee of up to 3 per cent on the next fundraising for the duration of the programme plus two years and a success fee of up to 10 per cent on commercial contracts secured following introductions by OceanHub Africa.

Other system considerations

South Africa has a very robust innovation and technology incubation system. There are several specialized and industry-focused hubs and incubators financed and supported by public-private partnerships that support start-ups from the developmental phase to commercialization with market linkages. There are more of these types of incubators and hubs in South Africa than in any of the other countries in Southern Africa and possibly on the rest of the continent, which has tended to be more focused on ICT and digital technology.

A suggestion made by one of the incubators in response to the survey conducted during the present study was that corporations should support their staff who wish to spin out their ventures and should subcontract and mentor them at the start-up stage. This would create a safety net for new entrepreneurs and ensure that real problems were addressed with an understanding of the market they were operating in, as well as providing networks and a value chain to take their solution to market.

At least 25.7 per cent of the ventures tracked by Disrupt Africa (2022) in the South African Startup Ecosystem Report 2022 had been in an incubation or acceleration programme. Many of these ventures were in the digital sector, with fintech accounting for most, followed by e-commerce, retail technology, e-health, education technology, and artificial intelligence and the Internet of Things.

South Africa is different from many other countries in the subregion in that many initiatives, in particular in Gauteng and Western Cape Provinces, are either initiated or supported by the Government of South Africa, which provides more support than other Governments. Other government initiatives to support micro-, small and medium-sized enterprises include those led by the Department of Small Business Development. For example, the Small Enterprise Manufacturing Support Programme assists micro-, small and medium-sized enterprises in various sectors, including: food and beverage; agroprocessing; clothing, leather and textiles; petroleum and chemical products; furniture and other manufacturing; electrical machinery; green technology, digital technology and three-dimensional technology; and printing (Department of Small Business Development, n.d.). The Programme is aimed at strengthening the manufacturing sector and building an industrial base with a focus on localization. The support provided includes funding to purchase machinery and equipment, working capital for various manufacturing sub-sectors, accreditation and testing. The Department of Small Business Development also runs an incubation programme through its agency, the Small Enterprise Development Agency. A review of this incubation support programme conducted in 2014 (Genesis Analytics, 2014) resulted in interesting findings relevant to the present study, which included the following:

Substantial cost-efficiencies could be realised through better identifying and prioritising industries that are demonstrably more successful in creating successful SMMEs. The cost of successful incubation must be considered. Manufacturing and metal jewellery incubation incurs higher costs, while agriculture, construction and other jewellery industry incubators produce higher numbers of successful SMMEs at a lower cost. Rather than trying to meet a high target of new incubators established (the current priority indicator), the STP Incubation Unit should focus on the success of its existing incubation models and enhance the capacity of established incubators to deliver results in line with the proposed performance measures. These measures relate to the success of technology-oriented SMMEs still in existence three years after graduation, and to economic growth-oriented indicators.

Another government department, the Department of Trade, Industry and Competition, runs a critical equipment support scheme through which it supports micro-, small and medium-sized enterprises in acquiring infrastructure that is deemed to be critical, thus lowering the cost of doing business (Department of Trade, Industry and Competition, 2020).

The Department of Trade, Industry and Competition also has other instruments in place, such as the Support Programme for Industrial Innovation, for supporting early-stage technological development by micro-, small and medium-sized enterprises and other technology and innovation support programmes, as shown in table 12.

Other financial and non-financial support for technology development by micro-, small and medium-sized enterprises is provided through the Technology Innovation Agency. The Technology Stations Programme, for example, offers non-financial, technology-

Table 12: Innovation and technology support instruments in South Africa

Discovery (research)		Discovery and pre-commercialization				Commercialization		
Basic research	Applied research Design and engineering	Technology development Prototype	Technology and market validation	Product or process development	Small-scale manufacturing	Market entry or launch	Market development	Business growth
Research and development tax incentive			Commercialization support fund		Manufacturing Competitiveness Enhancement Programme			
Technology venture capital								
Technology development fund		Small Enterprise Development Agency technology programme incubation fund						
	Industrial Development Corporation							
Technology and Human Resources for Industry Programme								
Support Programme for Industrial Innovation					Strategic Partnership Programme	Small Enterprise Development Agency Technology Programme – quality and technology transfer		
Seed fund					Enterprise Incubation Programme			

Source: Department of Trade, Industry and Competition (n.d.).

based services through the technology stations and institutes for advanced tooling i.e. transfer centres hosted at higher education institutions that support entrepreneurs and micro-, small and medium-sized enterprises, including large corporations and relevant industrial sectors. Located at the universities of technology, the technology stations programme services include testing and analytical services, rapid prototyping and manufacturing, consultation, a technology audit and feasibility study, process or product improvement, applied development, engineering and design, research and development, and technology demonstration and training.

There is some private sector involvement in the development of micro-, small and medium-sized enterprises in South Africa, driven mainly by the legislated enterprise and supplier development programmes, which are aimed at redressing the structure of the South African economy resulting from apartheid. Most are not technology-driven, although some are, in particular in the technology and manufacturing sectors. Within the fintech sector, one notable private-sector-led initiative is AlphaCode, which was established by Rand Merchant Investments and Workshop17.

As of August 2023, there was a national dialogue (Modise and Adeyemi, 2023) on the proposed Startup Act. Some incubators believe that incubators must be engaged to test and validate the relevance of the content in the Startup Act.

6.11 : Zambia

Zambia has several technology incubators – the National Technology Business Centre, BongoHive, Jacaranda Hub and the Zambia Information and Communications Technology Authority.

National Technology Business Centre

The National Technology Business Centre was established as a public entity under the Ministry of Technology and Science to assist citizens in becoming economically sustainable and to improve their well-being through access to technology.

The Centre carries out its mandate by financing science, technology and innovation prototyping and the piloting of ideas and by supporting innovators by providing collaboration opportunities and physical spaces to develop and commercialize their ideas. The focus is on innovative micro-, small and medium-sized enterprises and cooperation with other public entities focused on micro-, small and medium-sized enterprises in general. Most enterprises that approach the Centre are looking for finance but also need other types of support, including technical business development, and often require a great deal of assistance across the spectrum. Usually, there is a lack of even the technological know-how needed to operate specific, specialized equipment that the enterprises might have acquired or intend to acquire.

The Centre also supports micro-, small and medium-sized enterprises regarding technology transfer, as the adoption of technology is challenging for most of them, including some in established industries in Zambia. Often, the technology does not come with the necessary know-how to utilize it effectively. The main challenge most industries in Zambia face, in particular micro-, small and medium-sized enterprises, is bridging the skills, know-how and capacity gap to manage the technology they have acquired. To that end, the Centre assists such enterprises with technology needs assessments to ensure that they obtain the right technology and have the right skills to implement the technology once acquired.

Given the positioning of the National Technology Business Centre to assist with the technology needs of micro-, small and medium-sized enterprises, other agencies and incubators in Zambia collaborate with the Centre in relation to technology needs assessments, the identification of appropriate technologies and assistance provided to micro-, small and medium-sized enterprises to help them gain access to technology. The technology business development fund, managed by the National Technology Business Centre on behalf of the Government of Zambia, supports entrepreneurs through small grants of up to $25,000. The challenge regarding the fund, other than the small size of the grants, is that, despite it being managed by the Centre, there is a committee chaired by the Ministry that must approve the recommendation of the Centre. Micro-, small and medium-sized enterprises perceive this as being overly bureaucratic. The grants are not paid to the enterprises but are instead disbursed to service providers on the basis of agreed milestones or deliverables.

Case study: Women's Entrepreneurship Access Center (Zambia)
An interesting case study is that of the Women's Entrepreneurship Access Center in Zambia, which was established to address gender barriers in the entrepreneurship system in the country by offering a holistic way of supporting female entrepreneurs.

According to responses obtained through the interview and survey conducted as part of the present study, its interventions include business capacity development (training, coaching and mentorship and incubation), networking (whereby women are able to connect with various opportunities and be around like-minded people), finance (creating a pipeline of investment-ready female entrepreneurs by exposing them to rigorous tools of finance access), and market development across various sectors (including agriculture and agribusiness, with 39 per cent of entrepreneurs coming from the agricultural industry, biotechnology and biodiversity, mining, tourism, communications and logistics).

The Women's Entrepreneurship Access Center has existed since 2015. As of March 2023, it had a team of nine people, six of whom were women. Initially, it was set up by the United States Department of State to support women-led businesses. Over 700 women have walked through the Centre since it launched, and demand for its programmes is high. Since 2022, the Center has supported 30 businesses. It operates on the premise that, in order to address gender parity in entrepreneurship and incubation, interventions must be focused on the idea and the business and must develop and support the founder. Its mentors and coaches, other than those involved with the WeInvest Programme, do not receive any remuneration and are only reimbursed for the costs they incur.

The Women's Entrepreneurship Access Center business model tool kit, finance tool kit and impact tool kit are used across the following three support stages:

a) **Early stage**. The incubation period ranges from 15 weeks to 24 weeks. Exit is based on assessment and an understanding of what the enterprises' specific needs are. Some of the enterprises enter the early stage just for support. Most do not necessarily intend to become technology businesses but rather to develop their products and ideas.

b) **Minimum viable product**. During this pre-acceleration stage, support is provided for the commercialization of the businesses and the development of minimum viable products to go to market. The Women's Entrepreneurship Access Center issues a call for applications to identify micro-, small and medium-sized enterprises that show signs of being coachable and could produce a minimum viable product to move forward.

c) **Growth stage**. This is an acceleration process, in which the Women's Entrepreneurship Access Center supports 15 businesses as a cohort with various mentors and coaches. Out of this programme, the Center launched the WeInvest Programme accelerator, which is a very specialized commercial arm and a separate company established in 2020 that runs an investment programme for women, with a focus on developing the founder and the business. Businesses that are accepted into the WeInvest Programme pay $40 in fees for about four months. With regard to what it takes to support a growth stage business so that it can have meaningful access to investment and market opportunities, the Center offers a series of interventions, including an 18-month knowledge and investment stage comprising a call for applications, roadshows and master classes. This is followed by an investment facilitation stage with a smaller, focused group.

The Women's Entrepreneurship Access Center has identified several gaps regarding the integration of technology by women-led businesses. With regard to product development, there is a lack of infrastructure to support women in developing their businesses and products that integrate technology. When they develop specific products from the laboratory into the market, they receive very little support from the universities. In addition, there are few industry experts that can mentor these businesses. The way in which they relate to universities and research entities is somewhat flawed, and often there are minimal opportunities to build a system of support. The biggest drawback is the rate at which these businesses are scaling and growing. This is primarily because of the fragmentation of different entities within the system, with most being thinly spread out, poor policies on supporting technology businesses, and insufficient investment, in particular by the Government. As such, the focus tends to be on quantity rather than quality, with the result that most micro-, small and medium-sized enterprises do not build solid foundations for growth. Another challenge is that some partners and donors do not understand what it takes to achieve positive results. As such, they expect output with minimum investment, as the tendency is to focus on numbers. Furthermore, the entrepreneurial system lacks coordination, and Governments often do a poor job of providing it.

Specific lessons that the Women's Entrepreneurship Access Center has learned are that, initially, incubation was about the number of enterprises incubated, as this was an important performance indicator for most donors to justify providing funding. However, the Center has had to go deeper and ask what it means and what it takes to support women in developing sustainable businesses. Women often lack access to digital tools and the ability to undertake research and development on their prototypes so as to move beyond them. In some instances, the Center has partnered with the National Technology Business Centre and has developed a very structured way of engaging to ensure that women-led businesses have access to technical support provided by that Centre, while the Women's Entrepreneurship Access Center focuses on the founder and the business.

From a sustainability point of view, the Women's Entrepreneurship Access Center has had to broaden its resource mobilization from simply engaging with international organizations and various donors to becoming a service provider to various corporations by supporting and enabling women-led businesses that could become part of the corporations' supply chain development.

The Women's Entrepreneurship Access Center has supported micro-, small and medium-sized enterprises in various technology sectors, including the green economy, water management, renewable energy, ICT, cosmetics and agroprocessing. The Center's successes include:

- Establishing a platform where women entrepreneurs feel empowered to take advantage of opportunities they see. Women who have gone through its programmes access more opportunities as they become more empowered entrepreneurs.

- Significantly contributing to gender parity within the entire system in Zambia. The Center has a voice as an organization and is recognized by the Government as an entity that provides critical resources for women.

With regard to what is missing in the innovation or entrepreneurship system in Zambia, according to responses received during the interview conducted with the Women's Entrepreneurship Access Center, there was a low level of investment in the system through various components of business support infrastructure. In addition, some corporations had a large number of mediocre partnerships and treated them almost as a box ticking exercise. As such, in order for Zambia to move forward into a mature stage of entrepreneurship, there was a need for better collaboration and investment. It appeared that important stakeholders, including the Government and the private sector, underestimated the importance of investment. More could be done, and there was a need to question the traditional approaches to assess their suitability for addressing challenges faced by businesses operating in Africa that wanted to incorporate technology into their products and services and to determine how best to support female-led companies. Doing so required greater coordination, a deeper understanding of what it took to grow specific sectors and the necessary level of commitment from the public and private sectors to develop new sectors. The Center emphasized the urgent need to increase the space in which entrepreneurship was carried out and to take the programmes outside the major cities to more remote areas, so as to build an inclusive entrepreneurship system.

BongoHive

BongoHive is probably the oldest private incubator in Zambia. It was established in 2011 on the premise that providing a physical space where like-minded people could interact, learn from each other and share ideas as a stepping stone towards bringing ideas to market would strengthen its position in supporting technology entrepreneurs in Zambia. All of its founders have a strong technology background, with experience in multiple countries outside Zambia. BongoHive has thus always seen technology as a cross-cutting theme and enabler. When it was established, Zambia did not have an environment or system in which technology ideas could thrive, so the founders took a bottom-up approach and sought to build a strong technology community, which could be the driving force for developing a vibrant entrepreneurship system.

Established on the principle of leveraging any infrastructure its founders could access, such as a room provided by a former employer of one of the founders, it has evolved from providing unstructured interventions to building a technology community in Zambia with a physical space, which has become home to BongoHive in Lusaka. At the time of establishment, there were no mobile application development laboratories at any of the country's universities. As such, BongoHive was focused on developing the requisite mobile application development skills as a priority, in order to take advantage of the mobile technology wave. It organized a mobile applications training programme, supported by a grant and boot camp for 25 developers. It has always focused on skills training and was careful not to play the role of a university, while ensuring that it was tapping into the right institutions. Over time, BongoHive has enabled the technology community in Zambia to gain access to big technology companies, as evidenced by the fact that it runs the largest Facebook developer community in the subregion.

While initially just providing space, it evolved to focus on other support interventions, such as having the right mentors and access to the market through such platforms as "Mobile Monday" and other events where entrepreneurs could pitch their ideas to chief executive officers and decision makers.

Over the years, BongoHive has made significant shifts in its business model to stay relevant and assure sustainability. One of these was a shift from the perception that its customer was the entrepreneur to providing value to institutions and corporations that wanted to collaborate with entrepreneurs. As a result of this shift, it started to work with banks in Zambia and other corporations. Consequently, it has shifted towards innovation and has established an innovation team that comprised three people as of June 2023. This has helped BongoHive to support entrepreneurs and businesses in understanding the why – that is, the opportunity in the market – and to support corporations with its internal innovation programmes, thereby translating entrepreneurship into intrapreneurship.

BongoHive has 30 full-time staff members, a third of whom are developers, and is thus also able to build technology, if necessary. Start-ups that do not know how to develop their own platforms or technology can now get assistance from BongoHive, which also provides this service to corporate clients that do not have internal capability.

It has established its venture fund, Bongo Venture, which is anchored by a network of high-net-worth individuals who participate in the system. The funding gap has been challenging for many start-ups, which tend to move from one entrepreneurship programme or incubator to another in order to gain access to financing. BongoHive has also established significant partnerships with one of the oldest legal firms in Zambia, which provides legal advice to the micro-, small and medium-sized enterprises it supports, and with PricewaterhouseCoopers for accounting services and Liquid Telecom for connectivity, as a way of adding depth to its offering.

BongoHive has a few large start-ups to strengthen interactions among its members within its physical space. Its core strength appears to be its ability to analyse what is being done in other markets and then adapt that to the local context, owing to its up-to-date understanding of the country's stage of development and what is required to move it forward.

Concerning entrepreneurship and technology talent, BongoHive boasts the advantage of having in-depth knowledge of the developers and a strong relationship with the technology community in Zambia. Whenever there is a need to hire, it is capable of attracting good talent.

BongoHive offers a structured mentorship programme, which includes mentoring and support for mentors to become angel investors. It advertises and reaches out to people in the community to join the programme as mentors, and conversely, people who want to become mentors also reach out to BongoHive. It prefers to offer non-monetary gifts at the end of the mentorship programme (e.g. a gift voucher or fruit basket) as a thank you for the time provided by the mentors, as opposed to monetary payments. In this way, BongoHive gets deeper engagement, hires those who have successfully gone through its mentorship programme and compensates them for further engagement.

Its incubator funding model relies on running programmes for corporations, consulting, co-working and renting a few offices. It does not receive any funding from the Government. The BongoHive incubation process is a three-month programme followed by at least three months of post-incubation support. While it has attempted to charge for its services, it is of the view that this does not always work. Regarding its

revenue model, BongoHive adopts the approach that the client is not the entrepreneur but rather the corporation, or whoever wishes to run entrepreneurship programmes.

BongoHive's "true north" will always be digital technology, given the context of its establishment, as evidenced by some of the projects it has had an impact on in the areas of agriprocessing, agro-dealership and marketing. In relation to agriprocessing, BongoHive worked with the World Bank to introduce a Zambian-built enterprise resource planning system to address the problem of record-keeping, which was affecting the ability to raise working capital. It recruited finance interns and provided them with training on how to use an enterprise resource planning system. Regarding agro-dealership, it offered training on how to improve record-keeping, which resulted in improved quality of the business and a high impact on the farmers. As for marketing, BongoHive worked on improving the ability of micro-, small and medium-sized enterprises to market their products and services using social media and integrate it into their operations. In essence, it is critical to enable such enterprises to leverage technology tools and incorporate appropriate technology into their business.

BongoHive has signed a memorandum of understanding with another crucial player in the system, the National Technology Business Centre, regarding access to technology support for its entrepreneurs. The challenge it faces is the limited amount of funding available from the Government to support entrepreneurs.

In addition to the direct support it provides to micro-, small and medium-sized enterprises and larger corporations, BongoHive is also involved in advocating on behalf of start-ups with national and subregional policymakers. For example, BongoHive has contributed to related policies in Zambia, including those that cover e-commerce and micro-, small and medium-sized enterprises. It is currently in conversation with the Government regarding the adoption of start-up legislation. It is also actively involved in local and subregional support communities focusing on innovation and entrepreneurship, such as the Southern Africa Venture Partnership.

According to BongoHive, the micro-, small and medium-sized enterprises it has supported have raised an accumulated total of $5 million offered in equity investment and grants, and 49 per cent of the ventures it helps are female-led. With regard to indicators for measuring their impact or success, it considers their average revenue growth, the average amount of capital raised, and the average number of customers served or products sold by the enterprises.

Jacaranda Hub

Jacaranda Hub was founded in 2017. According to its website, its main objective is to enable innovators and entrepreneurs to navigate the development of new solutions and to build a start-up culture in Zambia. It is a social enterprise with a focus on ICT. Jacaranda Hub runs several programmes and provides start-ups and micro-, small and medium-sized enterprises with incubation support, including infrastructure, specialized tools and equipment for shared use. Its StartUp Village programme provides enterprises with co-working spaces and access to a supportive network.

Jacaranda Hub runs both physical and virtual incubation programmes. It operates an innovation hub in Solwezi in the North-Western Province of Zambia, where it works with corporate partners, such as Absa Bank Limited. Its incubation process is eight weeks long and entails training in business basics, strategy, pitch deck preparation

and mentorship. It targets its alumni as mentors. Applicants pay a nominal application fee of 50 Zambian kwacha.

Its second programme, Next Generation National Youth Incubation Challenge, targets young people 18 to 35 years of age and walks them through the ideation, validation and scaling up of new products and services essential for building successful start-up companies. The focus is on capacity-building, training and mentorship, business development, governance and compliance, and e-commerce platforms.

Its third programme, GreenGen, is focused on smart agriculture, spanning the entire agriculture value chain (from farm to fork) with a spotlight on environmental sustainability. Positioned as a pre-incubation programme, it is aimed at encouraging farmers to treat farming as a business and making agriculture appealing to young people. The focus has been mainly on goat and legume value chains.

Jacaranda Hub also runs an investor readiness programme, Mosi-oa-Tunya Pitch, through which it matches and connects viable start-ups with investors. This programme is focused on investment readiness and is targeted at start-ups with high growth potential.

Zambia Information and Communications Technology Authority

The Zambia Information and Communications Technology Authority is a statutory body established by the Government of Zambia to regulate the ICT sector. Its incubation programme appears to be part of the Zambia Information and Communications Technology Authority ICT Innovation Programme, which provides business and technical developmental support services to ICT-related innovators, start-ups and entrepreneurs who have innovative, viable and scalable ICT-related ideas or business ventures through which they attempt to solve current challenges relating to any sector of the economy.

The focus is on developing and commercializing technology-related innovations or projects into tangible, value-adding products or services. The programme, run annually following a call for applications, targets business ventures or innovative solutions in the following sectors: (a) agriculture; (b) education; (c); health (d); banking and digital financial services; (e) e-commerce; (f) e-government services; and (g) environment, climate change and sanitation. According to its website, the support is provided for a minimum of four months, comprising business development advice, technical development support, mentorship opportunities with identified industry experts and entrepreneurs, business linkages with possible investors or offtakers of the participants' innovations, and financing support of up to $5,000 for the implementation of three selected innovations at the end of the cycle.

AgriEn Network

The AgriEn Network is a private, non-profit organization focused on supporting micro-, small and medium-sized enterprises in the agriculture and energy sectors in Zambia. Founded by a woman in 2020, it is a non-profit incubator funded by its founder, who was part of AgriproFocus, which closed its operations and transitioned into the Netherlands Food Partnership.

As of June 2023, it had not started its incubation process but had an extensive database of farmers and other stakeholders in the agriculture sector in Zambia. It is

envisaged that its incubation process will comprise an initial three months of business development followed by six months of coaching and one-on-one mentorship. Its infrastructure includes hot desks, individual offices, meeting rooms, coffee and canteen services and Internet connectivity.

AgriWorth Incubator Limited

Established in 2017 as a for-profit entity that charges for its services, with a focus on agriculture, the AgriWorth Incubator provides technical information to micro-, small and medium-sized enterprises and farmers in crop production and value addition. Such enterprises apply to undergo training for at least four months. Support and guidance are provided when the crops are in the field. The programme ends after the produce is sold, at which point the farmers should be ready to operate on their own. The AgriWorth Incubator trains farmers in good agricultural practices and value addition, such as the processing of tomatoes into powder and sauce.

More particularly, the support includes providing access to the market by establishing robust market linkages for both formal and informal market channels in and outside Zambia. Some markets have well-known retail stores in Southern Africa with whom offtake agreements are signed, such as Shoprite, Pick n Pay, Food Lovers Market and other open markets. In this way, the farmers are assured that when harvesting the crop they need not worry about whether there will be a market for their produce. According to the AgriWorth Incubator's response to the survey conducted as part of the present study, as of 2023 it had: (a) trained farmers in the production of various crops of high value; (b) delivered over 100,000 kgs of watermelons on the market in the space of two years; (c) signed memorandums of understanding and formed relationships with different institutions, such as Agribusiness Incubation Trust Limited, the University of Zambia and Natural Environment Technology in Africa, to train as many farmers as possible and also to provide an internship programme for graduating students and many other services.

Agribusiness Incubation Trust Limited

Founded in 2012 to provide technical support for the development of business models and technology transfer, Agribusiness Incubation Trust Limited is a non-profit organization that targets registered micro-, small and medium-sized enterprises as its beneficiaries. According to its response to the survey administered as part of the present study, the incubator is owned by a consortium that includes two leading public universities (with course offerings in agricultural science and natural resources), a practical agricultural college and the Zambia Agricultural Research Institute. This enables it to link micro-, small and medium-sized enterprises with these facilities, which are centres of excellence in agriculture in the country. It has incubated the AgriWorth Incubator Limited.

Its incubation programme lasts for 18 months, during which it provides hot-desking, individual offices, meeting rooms, coffee and canteen services, land, greenhouses, cold storage, tractors and transport, including tricycles. Each incubated micro-, small or medium-sized enterprise is assigned a mentor from the industry and a permanent coach from the organization. The incubator identifies viable markets, enters into agreements and mobilizes the supply chain to ensure product volume and quality or facilitates the sharing of market information and linkages. According to its response to the survey, it fosters collaboration among its enterprises through networking

meetings and by identifying bidding opportunities whereby the incubated enterprises can collaborate to submit bids for funding.

Other system considerations

There is a big gap in financing from the development stage to the commercialization stage within Zambia. There are also weak linkages between research and development (including institutions) and industries. Most institutions do not have intellectual property policies in place. Multinational corporations operating in Zambia refer technical and other research and development to their home headquarters rather than performing it in Zambia. These weak linkages undermine the potential to grow the technology sector and incubation programmes. Those incubators interviewed during the study and respondents to the survey highlighted that most local Zambian companies had not reached a stage where they appreciated the importance of investment in research and development and often did not have technological capacity. Most established companies did not have much trust in local researchers, presumably owing to the weak university-industry linkages.

The Zambian entrepreneurial system is relatively small, in particular the technology innovation sector. This situation notwithstanding, some of the respondents to the survey were of the view that there were too many silos and a need for better coordination. Despite having several players in the system, there is limited information on where micro-, small and medium-sized enterprises should go to get support, including help with gaining access to funding opportunities. The lack of appropriate financing and comprehensive incubation support results in some of the enterprises moving from one incubator to another. One enterprise could be supported by multiple incubators at various stages and, in some cases, simultaneously. The system does not monitor entrepreneurs and enterprises that have been supported by other partners and have not made progress, as some of them proceed to another incubator without properly accounting for their lack of progress.

In cases where capital is available, some conditions for gaining access to it are not favourable. Angel investors are not well publicized. There is very little support for research and development for micro-, small and medium-sized enterprises and very little access to research and development or technical capacity in research institutions. This area needs more attention from the Government.

Whereas there is a need to ensure inclusivity within the system, attention should be focused on those with high growth potential in order to achieve impact, rather than focusing on many entrepreneurs at once.

Stronger linkages to universities and research institutions could improve the system. Achieving this may require the Government or the universities to have a more explicit policy on supporting micro-, small and medium-sized enterprises, including a more defined technology transfer or commercialization process whereby it is ensured that research and development undertaken at these institutions is relevant for industries and can be commercialized through micro- , small and medium-sized enterprises.

Some tax reforms may be helpful, including the removal of tax requirements for micro-, small and medium-sized enterprises in their early growth stages, or the provision of tax concessions for establishing incubators and building their capacity. This notwithstanding, there is a need for increased government support, including

incentives for start-ups in relation to revenue taxes and trading licences and the speed of company registration processes.

Some of the barriers highlighted concerning women-led micro-, small and medium-sized enterprises include access to technology, computer devices, tools and connectivity, in particular for women in rural areas. This lack of access also limits women's training opportunities. Other challenges identified are the fear of failure coupled with the fact that most women are juggling their family life and professional career or business. It is important to have progressive programmes that can help women achieve the right balance that will enable them to succeed in business. Women often find it more challenging to gain access to funding than their male counterparts, which is another factor that results in the widening of the gender gap.

There is a lack of institutional and financial support for incubators in general, let alone technology incubators, in the country. Other gaps to be addressed include a lack of capital for promising micro-, small and medium-sized enterprises, limited access to technology transfer and to equipment for value addition, to which several enterprises could share access, and limited access to viable markets locally.

With regard to enhancing incubation, some recommendations include:

a) Providing an environment (incubator) with some equipment in selected agribusiness value chains to which micro-, small and medium-sized enterprises have access, so as to provide them with an easy start, as equipment and technology transfer poses a challenge in terms of the cost and expertise required; such provision would also address the challenge of bulking volumes by micro-, small and medium-sized enterprises for those markets to which it is not possible to gain access owing to low and inconsistent volumes, which are typical challenges faced by such enterprises;

b) Enhancing the role of incubators by providing technology or shared equipment coupled with shared expertise by incubators to assist micro-, small and medium-sized enterprises;

c) Strengthening market access by developing a brand that would serve as a symbol of quality assurance by providing inspection and product aggregation; the success of these market access linkages would attract financers to the micro-, small and medium-sized enterprises, as repayments would be guaranteed through the incubator.

6.12 : Zimbabwe

Zimbabwe has a nascent technological system. There has been increased activity at higher education tertiary institutions and research institutions, with the establishment of several innovation hubs as part of the Government's education 5.0 policy, in which innovation and industrialization are emphasized. The policy was launched by the Ministry of Higher and Tertiary Education, Innovation, Science and Technology Development. A few private incubators and entrepreneurial organizations are operating in the country. Below is a description of selected technology incubators operating in Zimbabwe.

Chinhoyi Innovation Hub

Chinhoyi University of Technology Innovation Hub was established by the university as part of the education 5.0 policy in 2012 to serve as a bridge between the research being done within the universities and institutes and that performed by individuals and innovators within the community and the industrial park. Hence, the focus areas are broad. It supports students, university researchers and staff members, innovators and micro-, small and medium-sized enterprises from the community across several sectors.

Entry into the Chinhoyi University of Technology Innovation Hub is granted following an assessment in which the factors taken into account include the uniqueness of the business idea, the viability of the business model, the existence of a committed team and a defined market opportunity. The incubation period is 12 months.

In response to a survey question about how the incubator contributes to the development of micro-, small and medium-sized enterprises and industrialization in general, the Chinhoyi University of Technology emphasized that its incubator accepted ideas from individuals and companies that it assisted by offering technology support, business advice and network facility support until the stage where it was convinced that the ideas were feasible and that the enterprises could be sustainable commercial entities. Those ideas mainly responded to national needs, as informed by the national development strategy. The incubator also incorporated ideas that responded to the Sustainable Development Goals.

National University of Science and Technology Innovation Hub

According to its website, the National University of Science and Technology Innovation Hub is the interface between the research and innovation efforts of the University community on the one hand and the private and public enterprise sectors in the country on the other hand. The University is located in Bulawayo, the second largest city in Zimbabwe, which used to be one of the most industrialized cities in Southern Africa. The Innovation Hub has excellent potential for reindustrializing the now de-industrialized city of Bulawayo (Masarakufa, 2022).

The Innovation Hub caters to different types of innovations within and outside the institution, including in the fields of software development, agriculture solutions and manufacturing. Currently under incubation are a mobile laboratory for schools in disadvantaged communities, crop doctor solutions for farmers and others. Established in 2018, it caters for students, university researchers and staff members, and innovators and small and medium-sized enterprises from the community.

Target beneficiaries are requested to submit a concept note outlining the project to be incubated. The project is assessed and validated to determine its suitability, potential for problem-solving, novelty and business viability. The prototype is produced, tested, modified and evaluated if it is a new design. Successful projects are then incubated on the basis of a partnership agreement with the university, typically for two years. The Hub also assists micro-, small and medium-sized enterprises with intellectual property registrations.

Harare Institute of Technology Innovation Hub

Harare Institute of Technology Innovation Hub, located in the capital city, has been developing an array of homegrown ICT applications, systems and start-ups in

response to specific technological needs of various government departments. The Hub caters for students, staff members, faculty members and innovators from the community. The requirement for entry into its programme is for an entrepreneur, student, faculty member or micro-, small or medium-sized enterprise to have a minimum viable product or an innovative business concept with market readiness in finance, science, technology or engineering. The business idea should be scalable, and the commercialization should demonstrate financial viability. Like at most of the hubs in Zimbabwe, the incubation period ranges from three years to five years (in particular for biotechnology and pharmaceutical innovations), with ICT innovations requiring much shorter periods. To date, the Hub has incubated several micro-, small and medium-sized enterprises with innovations such as deionized and bottled water, household and industrial detergents, industrial tools and chicken incubators.

The Harare Institute of Technology also hosts the Indo-Zim Workshop, which offers various machinery and services to innovators and micro-, small and medium-sized enterprises, including milling machines, blow and injection mould design manufacturing, computer numerical control machining on lathe and milling machines, plastic injection moulding toll manufacturing, hardness testing, spark eroding, engraving machining, heat treatment, drilling, and metal fabrication and welding. The Workshop also provides linkages to researchers at the Harare Institute of Technology for external micro-, small and medium-sized enterprises.

On the basis of feedback from some of the enterprises that have engaged with the Harare Institute of Technology, and also the visit to its exhibition stand at the Zimbabwe International Trade Fair in April 2023, it is understood that the incubation assistance provided includes office space and facilities (i.e. a conducive environment with state-of-the-art facilities and meeting rooms), ICT and Internet connectivity, intellectual property protection and commercialization services (i.e. assistance concerning the registration and commercialization of intellectual property), access to finance (i.e. strong partnerships and linkages with various government funding agencies, NGOs and other local and international funding institutions), the facilitation of partnerships, business training services and workshops, laboratory and prototyping services, and manufacturing support, including access to equipment as described above.

Great Zimbabwe University Innovation Hub

The Great Zimbabwe University Innovation Hub is focused on agriculture, biotechnology, manufacturing, ICT and the green economy (energy, renewable energy, water and climate change). The target beneficiaries are students, university researchers and staff members, innovators and micro-, small and medium-sized enterprises from the community. It accepts anyone with an innovation that has potential for commercialization, and it provides a three-month incubation programme for projects and a three-year programme for start-ups. Incubation assistance is similar to that offered by the Harare Institute of Technology. In addition, the Innovation Hub provides linkages to researchers, facilities and services at universities and research institutions for external entrepreneurs and small and medium-sized enterprises and runs innovation competitions.

Elevate Trust Science and Technology Incubation Hub

Elevate Trust Science and Technology Incubation Hub, located in Harare, was established by a woman in 2021 to support entrepreneurs in the technology sector, with a particular emphasis on agriculture and manufacturing. It is a non-profit organization funded by one or more donors, including the Government. Its beneficiaries include high school students, university students and entry-level start-ups at the ideation stage, who are selected through pitching sessions. Much of its focus has been on supporting students, rather than micro-, small and medium-sized enterprises, to establish businesses.

Its one-year incubation process starts with scouting ideas through pitching competitions. This is followed up by an intellectual property audit, registration, matching of the entrepreneur with mentors, assistance with prototyping, a search for investors and, lastly, a brief accelerator.

The incubator also offers separate business incubation training that covers but is not limited to intellectual property and law, financial literacy and going to market. For access to the market, it has partnered with Buy Zim, an organization focused on promoting the purchase of local goods with strong retailer support.

Other system considerations

The innovation hubs at State universities in Zimbabwe are disruptive interventions for the innovation system and demonstrate the potential of strong linkages between academia and the market, focusing on the commercialization of university research and the industrialization of the economy. Some innovation hubs are more advanced than others. One of the challenges that survey respondents highlighted was the need to manage the perception of competition among the hubs and, in particular, ensure proper coordination, specialization and sharing of resources, especially technical equipment and machinery. The innovation hubs contribute to developing, refining and commercializing technology products and services and facilitate linkages between industries and academia. They also upskill micro-, small and medium-sized enterprise owners and workers with technology and entrepreneurial skills.

The survey revealed a significant gap in financing from the development stage to the commercialization stage within Zimbabwe, coupled with very weak linkages between research and development (including institutions) and industries. However, there is great potential for the hubs to strengthen the linkages.

Some of the recommendations for strengthening the system, as contained in the survey responses, include the following:

a) Ensure the existence of a system that provides sound mentorship and also teaches the human capital in innovation hubs how to grow ideas;

b) Establish a start-up basket that offers risk capital for the innovators and entrepreneurs to prototype their ideas;

c) Improve mentoring and advisory support, especially relating to legal agreements, valuation, intellectual property protection and commercialization;

d) Increase co-working spaces and laboratory facilities for developing ideas;

e) Ensure better partnerships and collaboration with organizations that have laboratories and other technical equipment;

f) Increase the focus on promoting and establishing value chains, linkages and markets, as well as funding strategies to strengthen the system;

g) Increase government support for start-ups and micro-, small and medium-sized enterprises in general, especially with tax incentives or tax holidays, to enable the start-ups to become sustainable.

On the question of how incubators can reconcile the need for building a critical mass of technology entrepreneurs and innovators with the ambition to "leave no one behind", one of the survey respondents suggested that incubators should make their calls for applications wide but the selection strict. However, systems should also be established for teaching enterprises about the innovation cycle, so that even those who were turned down could still develop their passion into a sustainable prototype. There also needed to be a wide spread of incubation hubs in remote areas, as currently many were just in capital cities.

One respondent observed that, whereas there had been an increase in the number of competitions and pitch sessions in Zimbabwe, there was minimal follow-up, and the quality of pitches was unfortunately also feeding into the already existing survival entrepreneurial space, whereby people began start-ups not in search of growth or problem-solving but merely to earn enough money to get by from day to day.

The survey respondents also highlighted that, whereas there had been an increase in the establishment of incubation hubs, in particular those sponsored by the Government at higher education and tertiary institutions, unfortunately many of the people who ran them did not have the expertise to handle innovations, nor did they have business experience, leading to the risk that the money being invested could potentially be wasted.

On the sustainability of technology incubators at higher education institutions, some survey respondents emphasized the importance of increasing linkages between those institutions and business, while others recommended creating a reserve fund that the incubators could access on the basis of the number of micro-, small and medium-sized enterprises they successfully incubated.

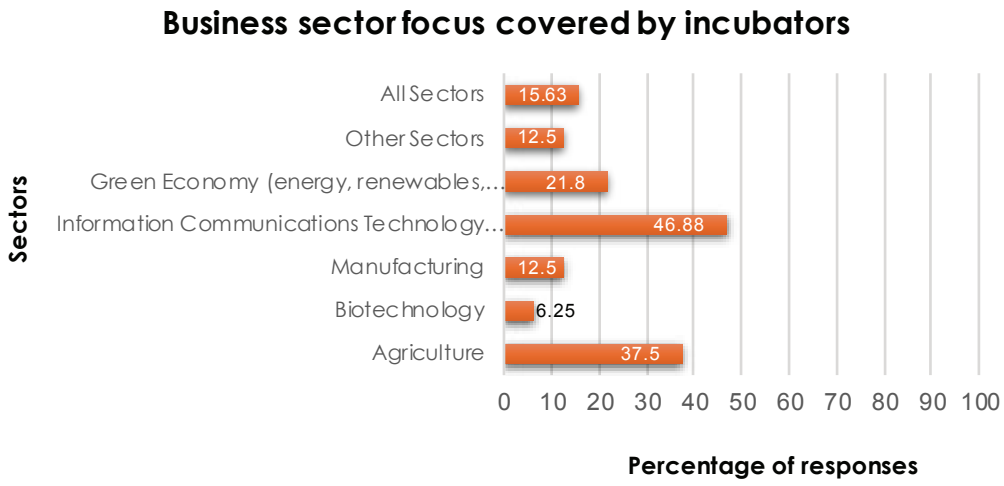
7: Survey and interviews with incubators in Southern Africa

7.1 : Overview

As indicated in section 3 above, 33 incubators responded directly to the survey, and interviews were held with several incubator managers in countries in Southern Africa.

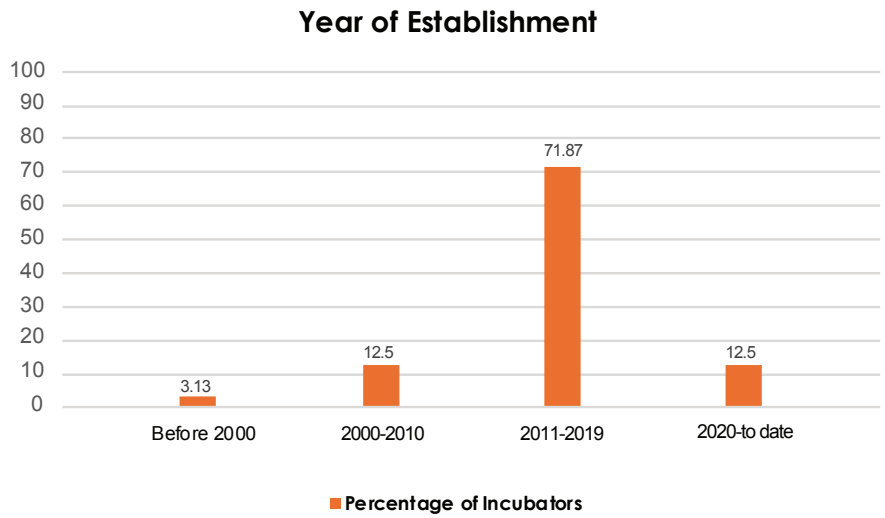
As illustrated in figure VIII, ICT and other forms of technology were the primary business focus for many of the incubators. Other sectors supported by the participating incubators included Indigenous knowledge systems, creative sectors (film, design, animation and music), entertainment and social enterprises.

Figure VIII: Incubator business sector focus



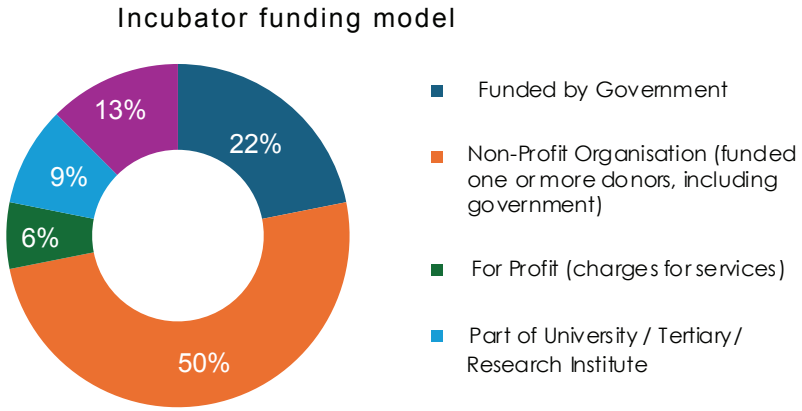
Source: Author-generated on the basis of responses to the incubator survey.

Figure IX: Year of establishment of the incubators



Source: Author-generated on the basis of responses to the incubator survey.

Figure X: Incubator funding model *(Percentage)*



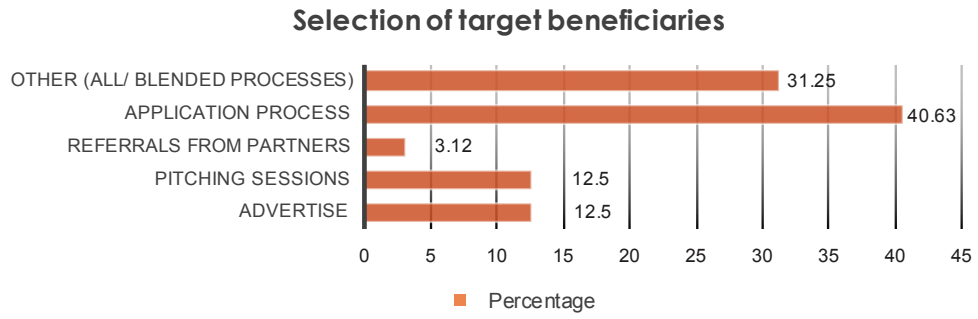
Source: Author-generated on the basis of responses to the incubator survey.

Close to three quarters of the incubators that participated in the present study had been established between 2011 and 2019 (see figure IX).

More than 50 per cent of the participating incubators are funded by programmes and grant schemes awarded by donor agencies and venture capitalists (see figure X). In 50 per cent of the cases, this is the primary (and only) funding source. In other cases, it is supplemented by government funding and revenue collected from services charged, categorized here as blended funding.

While owners of micro-, small and medium-sized enterprises, start-up founders and early-stage technology developers are the most common target beneficiaries for the incubators, many also target marginalized groups, such as young people, women and individuals living in grass-roots, remote or underprivileged communities. Some incubators mainly target new graduates, while others, such as the Royal Science and Technology Park Business Incubator in Eswatini, are open to all nationals, with different programmes designed for different demographics. However, a common requirement for beneficiaries is that of having an innovative or enterprising idea.

Figure XI: Method of selection of target beneficiaries to be incubated



Source: Author-generated on the basis of responses to the incubator survey.

7.2 : Incubation process

For many incubators, the incubation process starts with advertising for entry into different incubation programmes or calls for pitches concerning particular themes or disciplines, accompanied by an application process (see figure XI). These may be virtual or physical exercises, but it is common to have an on-site on boarding process.

Pre-revenue and post-revenue support varies from incubator to incubator. In most cases, the incubation support for micro-, small and medium-sized enterprises is predicated on building networks that can facilitate incubation in one way or another. By bringing together actors in the innovation system, incubators can bridge gaps and unlock opportunities to which entrepreneurs may not have access independently.

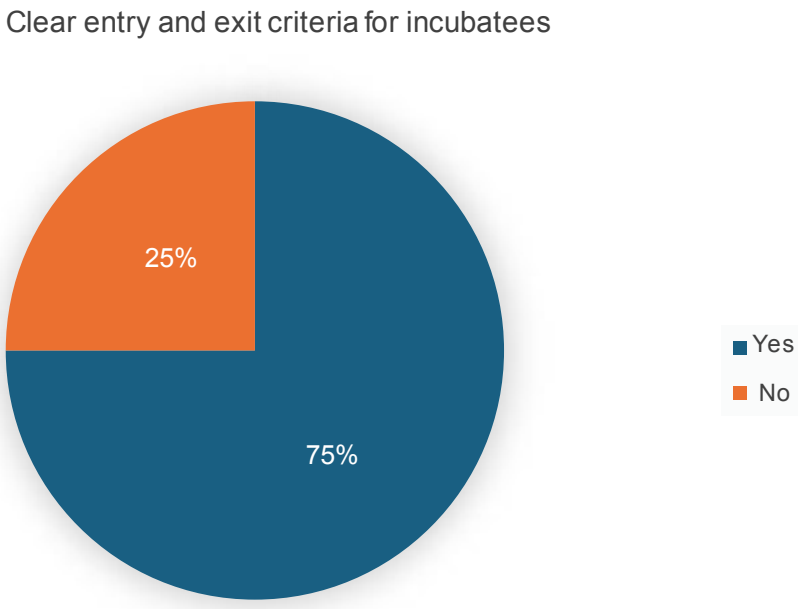
The technical support offered may include legal and administrative support, mentorship or training in entrepreneurship and other business aspects identified as being critical for a given programme or cohort.

Business advisory services covering such elements as business registration, financial management, fundraising, product refining or prototype development and networking, among others, are also commonly offered at various stages of the incubation process.

This type of support may be tailored to address specific business needs and offered in the form of self-paced courses or mentorship programmes, as is the case with the StartUp Hatchery in Cape Town, or offered through practical learning and training sessions in such fields as digital computing and fourth industrial revolution technologies, as is the case with the Siyafunda Community Technology Centre.

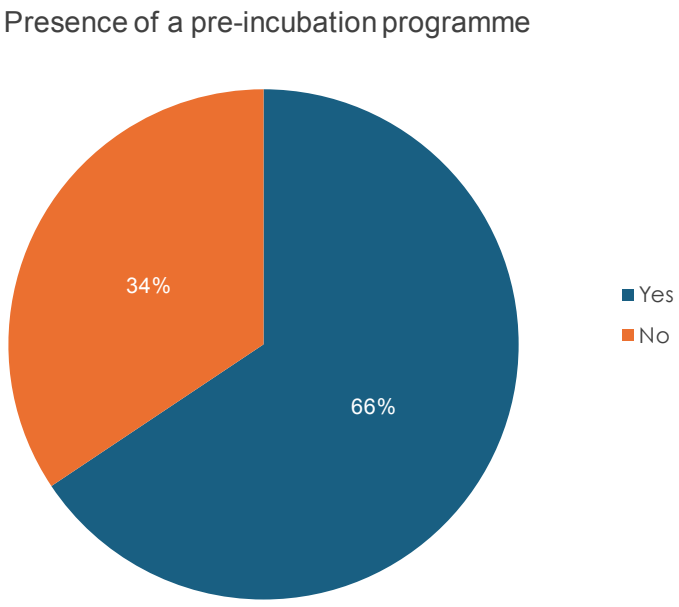
At least 75 per cent of the respondents had established clear entry and exit criteria for participants in their incubation programmes (see figure XII), while the remaining 25 per cent had not. In some cases this was because their programmes were run for sponsors who had different criteria, whereas in other cases, while there were clear entry criteria, neither the incubation period nor the exit criteria were clearly defined, as collaboration between the incubated enterprises and the incubator continued even after the expected graduation period, such as in instances where the incubated enterprise had a tenancy agreement with the incubator.

Figure XII: Incubators with clear entry and exit criteria for incubated enterprises *(Percentage)*



Source: Author-generated on the basis of responses to the incubator survey.

Figure XIII: Incubators with a pre-incubation programme *(Percentage)*



Source: Author-generated on the basis of responses to the incubator survey.

Details about the entry criteria are often stipulated in the call for applications. These criteria guide the selection of entrepreneurs or start-up companies for a particular programme. They can range from such attributes as demonstrated passion to having an idea that has gone beyond the proof of concept phase.

For many incubators, the end of the incubation period and hence exit from the incubator is triggered by technology prototyping and market testing, business registration, or

upon achievement of milestones for a specified incubation programme, as stipulated in the incubation contractual agreements. Early exit from incubators is triggered by failure to achieve agreed-upon milestones, although some incubators appear not to enforce this strictly.

Up to 66 per cent of the incubators included a pre-revenue training stage as part of their incubation programmes (see figure XIII). Incubators like the Impact Amplifier have third-party programmes in place through which pre-incubation training is provided. The Impact-OS investment readiness platform mainly helps entrepreneurs become grant-ready and is customizable to allow for tailoring to meet specific incubation needs.

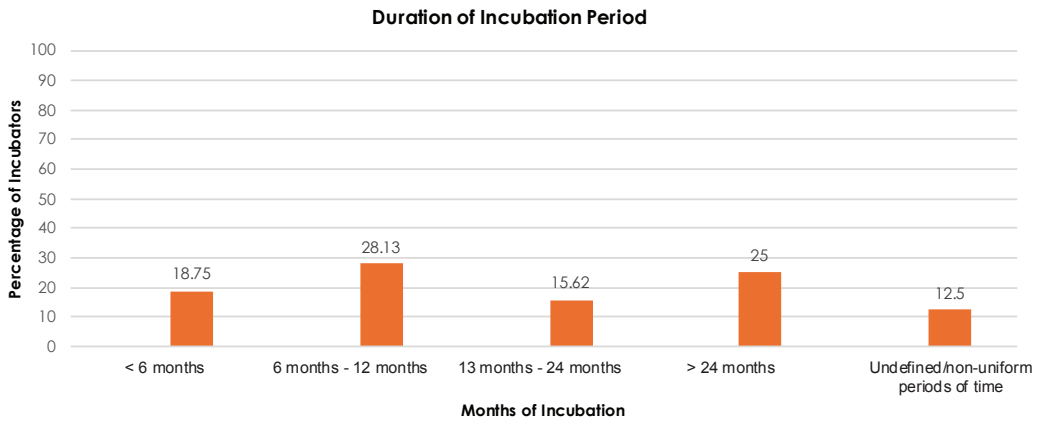
By participating in pre-incubation programmes, the enterprises can benefit from courses and mentorship interventions in the form of boot camps, virtual tutoring or one-on-one training sessions to help them refine their concepts and further develop their business ideas.

Incubation periods in the respondent incubators can be as long as four years in some incubators and as short as eight weeks in others (see figure XIV). In some cases, the enterprises are allowed (and encouraged) to remain within the incubator premises even after they graduate from the programmes, as they can provide rental income to the incubators. This is the case with incubators run by the Innovation Hub in South Africa, where the graduates from the incubation programmes are encouraged to remain in the precinct because it is seen as necessary for building a strong entrepreneurship system where there could also be collaboration among the enterprises. By contrast, in other cases this is part of the incubator's sustainability model and revenue diversification.

For hubs like TheNeoHub Innovation Lab and the Wot-if? Trust – Father Louis Blondel Centre, the incubation period is determined on a case-by-case basis after a needs assessment exercise is conducted before on boarding.

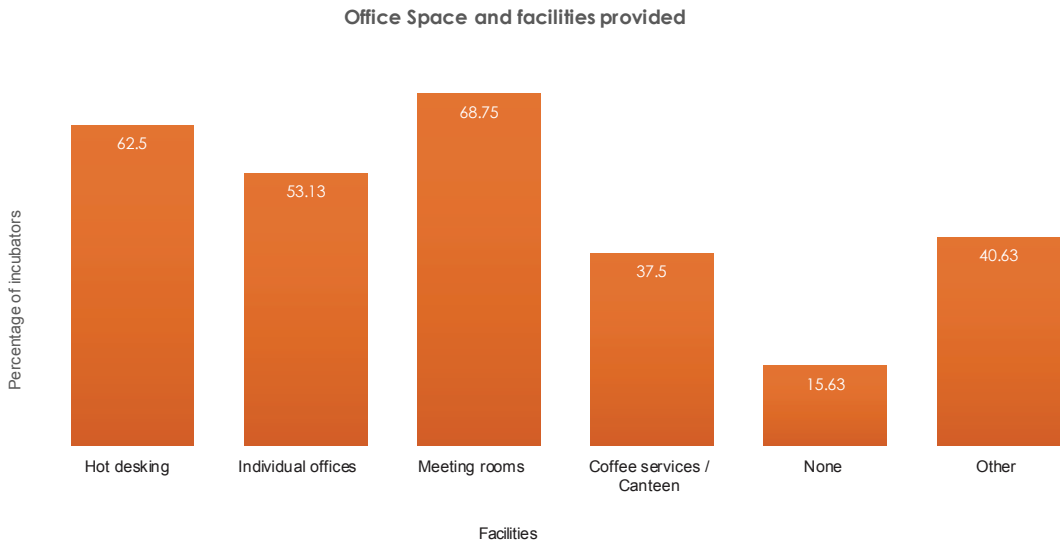
As illustrated in figure XV, besides hot-desking, individual offices, meeting rooms and coffee and cafeteria spaces, some incubators also provide maker spaces, production studios and manufacturing spaces where enterprises can gain access to state-of-

Figure XIV: Duration of the incubation period



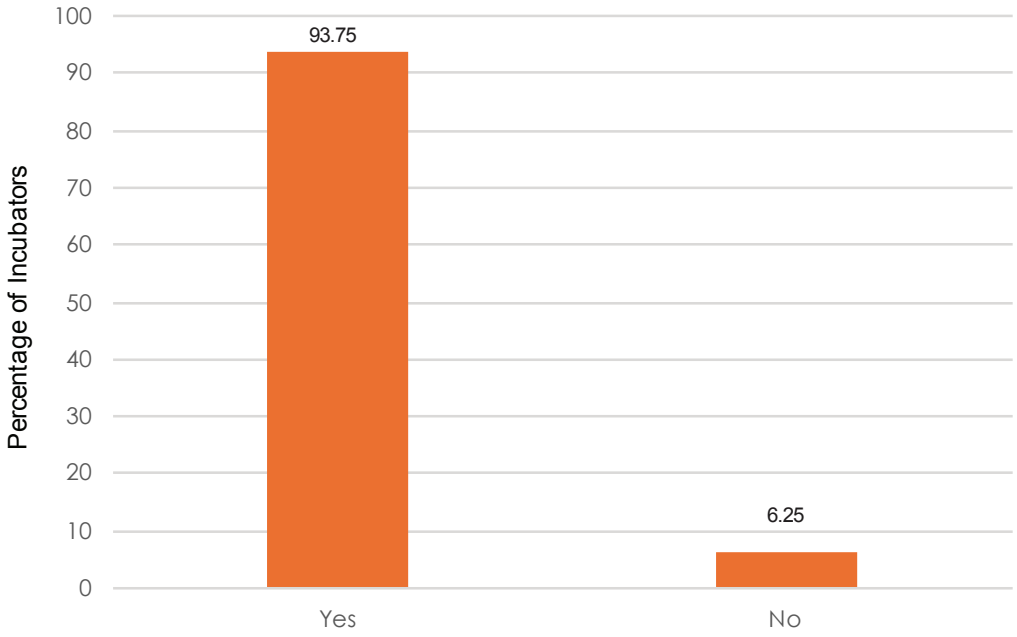
Source: Author-generated on the basis of responses to the incubator survey.

Figure XV: Infrastructure and facilities provided by the incubators



Source: Author-generated on the basis of responses to the incubator survey.

Figure XVI: Incubators providing business mentorship and coaching services *(Per centage)*

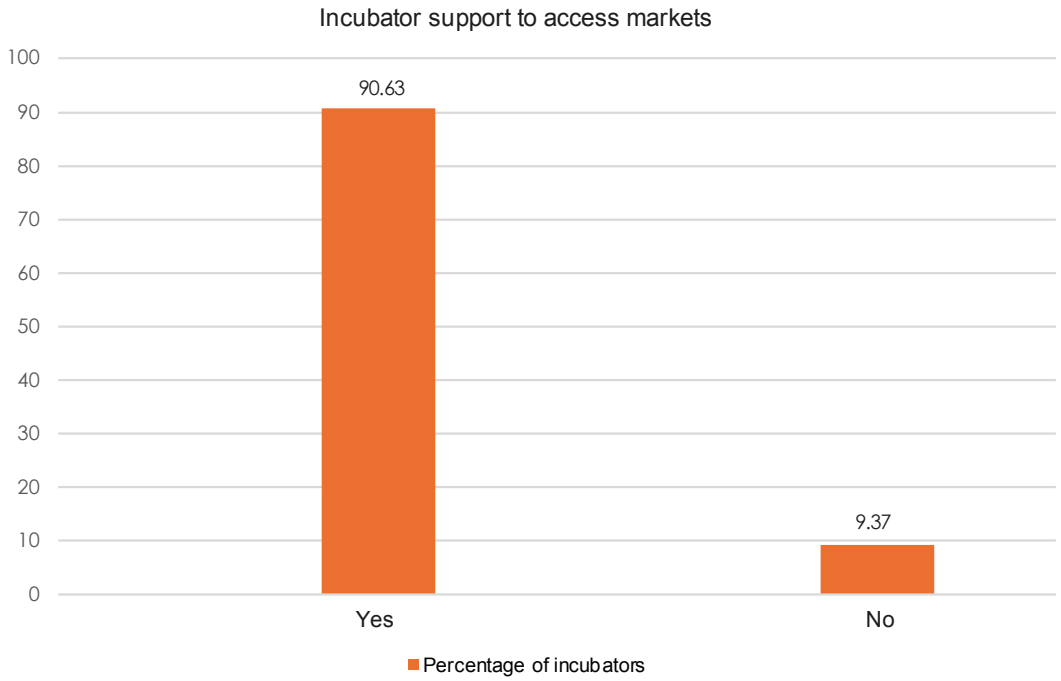


Source: Author-generated on the basis of responses to the incubator survey.

the-art equipment to facilitate the creative process. The type and composition of production and manufacturing spaces depend on the incubator's focus sector.

Almost 94 per cent of the respondents offer business mentorship or coaching to their incubated enterprises (see figure XVI). Business coaching content often includes such subjects as business planning, financial literacy, marketing, intellectual property management, value proposition, communication, branding and design thinking.

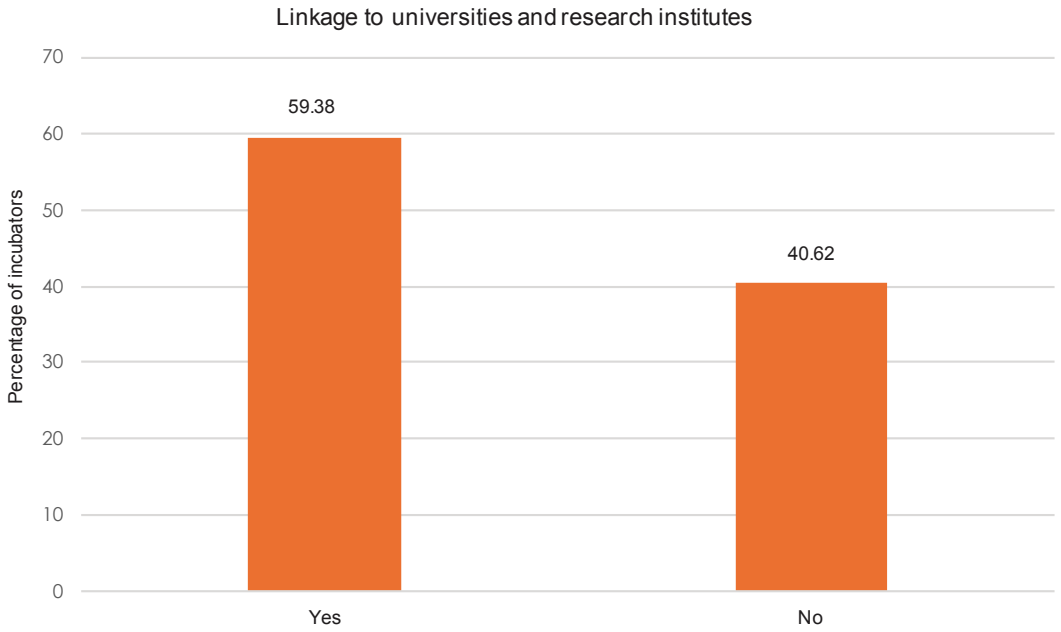
Figure XVII: Incubators providing market access support *(Percentage)*



Source: Author-generated on the basis of responses to the incubator survey.

Business mentors are often industry experts with either years of experience or vast industry networks from which the enterprises can benefit and may provide mentorship virtually or on site. In some cases, the mentorship and coaching services are outsourced in the absence of in-house mentorship and business advisory capacity, especially in instances where human resources and expertise are lacking within the incubator team.

Figure XVIII: Incubators with linkages to universities and research institutions *(Percentage)*



Source: Author-generated on the basis of responses to the incubator survey.

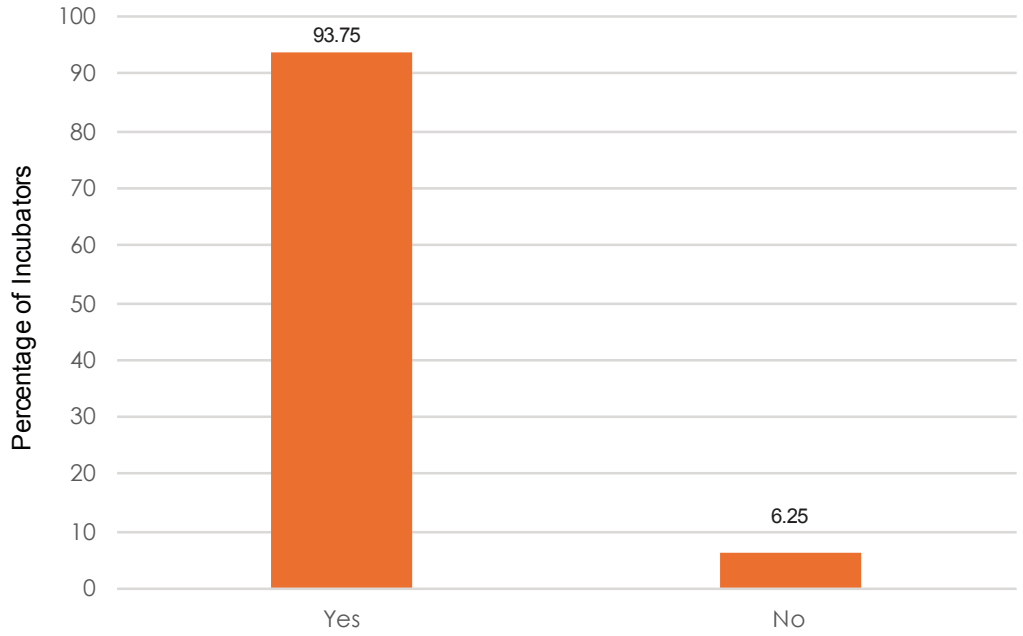
More than 90 per cent of the incubators support enterprises in obtaining market access (see figure XVII). This is done by utilizing their networks to advertise the products of their incubated enterprises in domestic and foreign markets, conducting and sharing market research, hosting marketing events or platforms, mobilizing partners upstream and downstream, facilitating corporate introductions and networking, and formalizing contractual marketing arrangements.

Nearly 60 per cent of the incubators offer linkages to facilities and services at universities and research institutions through formal agreements (contracts and memorandums of understanding) for enterprises as part of their technology development (see figure XVIII). This enables the enterprises to gain access to testing facilities, prototyping equipment and opportunities for mentorship from experts at the universities and research institutions.

In the case of Mzuzu E-Hub, this linkage provides the incubated enterprises with access to incubation laboratories and technology services offered at partner universities in the northern region of Malawi. Through the Agribusiness Incubation Trust Limited, owned by a consortium that includes two public universities, incubated enterprises are granted access to the universities' facilities, which are centres of excellence in agriculture in Zambia. The good agricultural practices innovation competitions run by the Innovation Hub in South Africa provide a vital bridge between university start-ups and their incubation programmes. Most university start-ups then gain access to resources to meet their technical needs through their host universities.

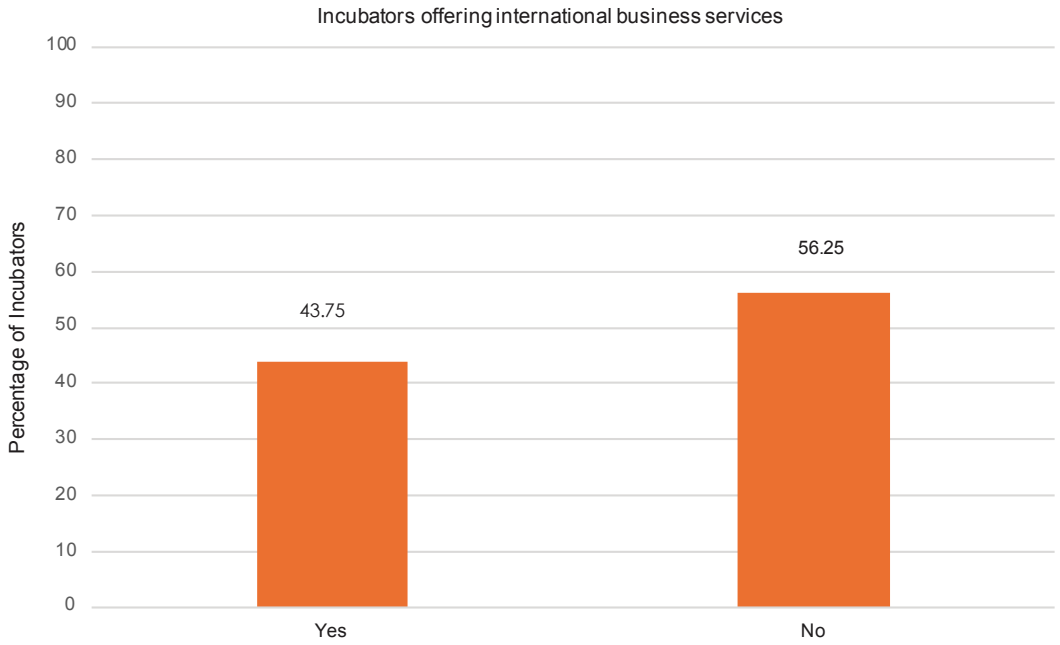
A total of 94 per cent of the participating incubators encourage collaboration among incubated enterprises. Collaboration is facilitated through the hosting of networking events, co-funding calls, marketing initiatives or peer-to-peer learning (see figure XIX). Such hubs as TheNeoHub Innovation Lab have adopted cultures that explicitly

Figure XIX: Incubators where there is collaboration among incubated enterprises *(Percentage)*



Source: Author-generated on the basis of responses to the incubator survey.

Figure XX: Incubators offering international business services *(Percentage)*



Source: Author-generated on the basis of responses to the incubator survey.

support this, following the motto "your first clients are those around you" (within the hub), whereby they deliberately encourage incubated enterprises to source the services they need from among other incubated companies.

Less than 50 per cent of the incubators offer international business support, such as linkages to foreign markets and foreign companies (see figure XX).

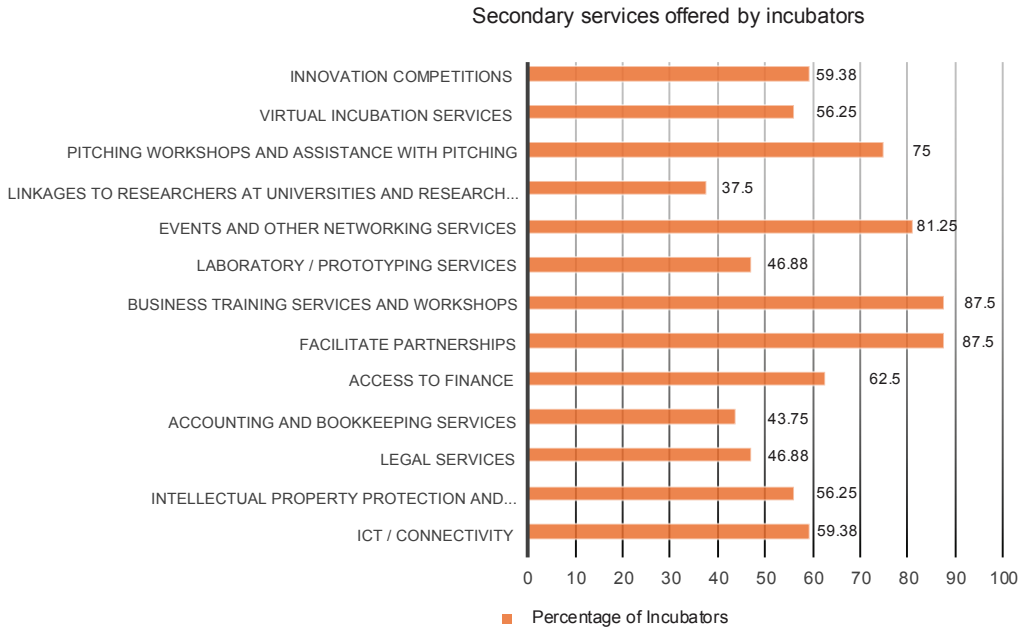
These services take the form of, or are enabled by, utilizing networks and partnerships to capture foreign markets for incubated enterprises, conducting trade promotions at international events, conducting market research in foreign countries, matching enterprises with investors, carrying out export readiness interventions, supporting local value chains, and capitalizing on membership in industry associations, such as the International Association of Science Parks in the case of the Botswana Digital & Innovation Hub, the Innovation Hub and the Royal Science and Technology Park.

7.3 : Other services offered by incubators

In addition to office space, facilities and linkages, incubators also provide additional services, as illustrated in figure XXI.

These services include ICT services and Internet connectivity; intellectual property protection services (i.e. assistance concerning the registration and commercialization of intellectual property); accounting and bookkeeping services; access to finance (i.e. strong partnerships and linkages with various government funding agencies, NGOs and other local and international funding institutions); the facilitation of partnerships; business training services; the hosting of networking events and pitching workshops and assistance with pitching; innovation competitions; legal services, including contract drafting and review; laboratory and prototyping services; and virtual incubation services.

Figure XXI: Secondary services offered by incubators *(Percentage)*

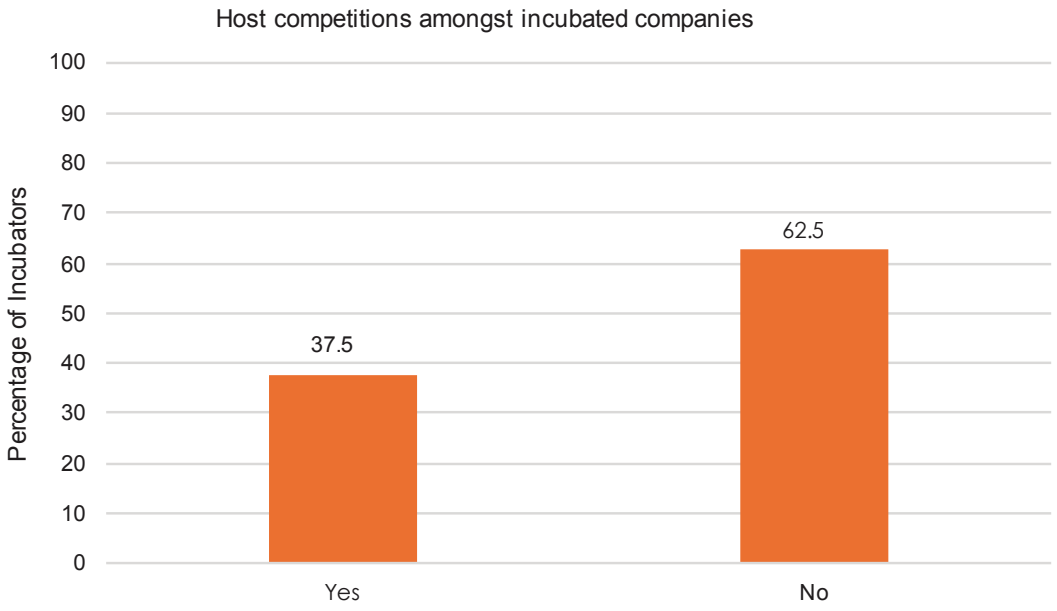


Source: Author-generated on the basis of responses to the incubator survey.

A total of 37.5 per cent of the incubators hosted competitions among their incubated enterprises (see figure XXII). For as many as 83 per cent of the incubators, competitions among incubated companies were hosted at least once a year. The prizes awarded varied and could include cash, other prizes or a combination of the two.

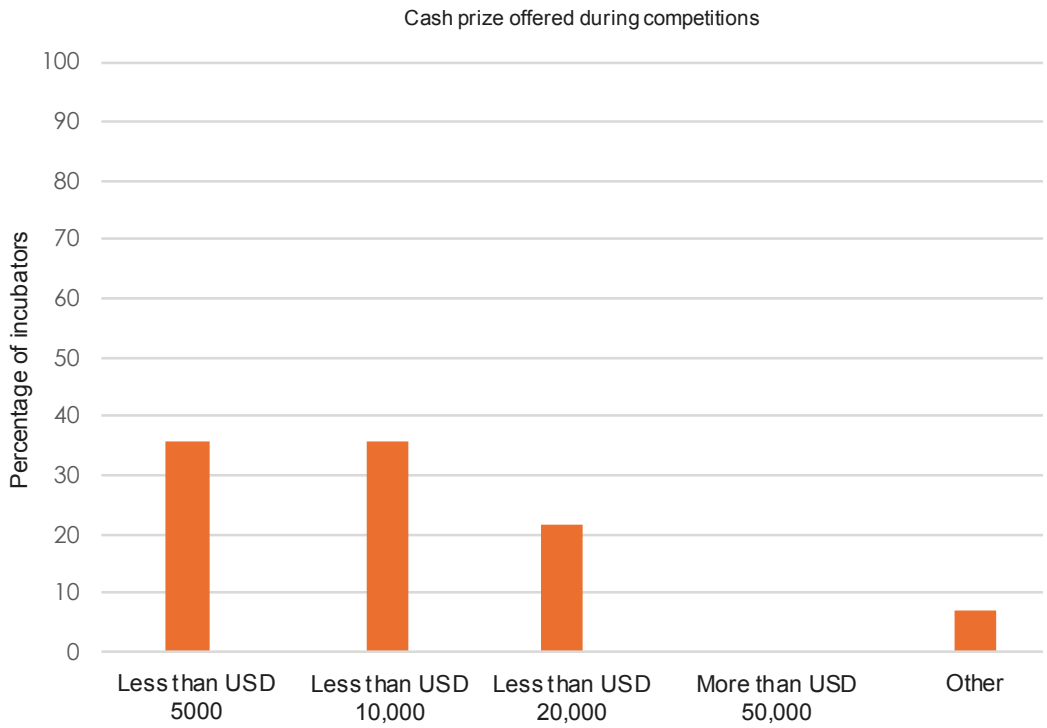
Almost half of all the incubators that hosted incubation competitions offered cash prizes, and the average amount of the cash prize was less than $10,000 (see

Figure XXII: Incubators that run competitions *(Percentage)*



Source: Author-generated on the basis of responses to the incubator survey.

Figure XXIII: Size of cash prize in competitions run by incubators



Source: Author-generated on the basis of responses to the incubator survey.

figure XXIII). None of the incubators provided a cash prize of over $20,000. Of the incubators that offered cash prizes, 75 per cent stipulated conditions for spending the prize money.

Examples of the conditions stipulated for using cash prizes include spending a significant portion of the prize money on business or product development and spending the cash prize in accordance with the milestones agreed upon in the funding agreement. In some cases, prize winners are required to develop expenditure and implementation plans for the funds received.

About 84 per cent of the respondent incubators facilitated linkages with entrepreneurship support services. These linkages were with partners that offered mobility support, market linkage and access to diverse funders, training opportunities and expert pools.

7.4 : State of the entrepreneurial system

Many respondents noted that the entrepreneurship system in their countries and in the subregion in general was still in its infancy. Some of the strengths that were highlighted included:

- Availability of infrastructure to support some innovation processes.
- Presence of strategic partnerships, which was especially fostered through networking events.
- Motivation and drive by individuals with business ideas and innovations.

- Clearly defined business formalization processes, such as company registration.
- Strong realization that entrepreneurship was an essential driver for reducing unemployment.
- Large amount of research conducted in some fields, which was a good source of knowledge for innovators and small and medium-sized enterprises.
- Sustained funding for innovation initiatives in certain countries, in particular South Africa and, to some extent, Zambia.
- Growing number of local angel investor networks and other investor networks across the subregion.

The common weaknesses identified by most respondents in their countries and across the subregion included:

- Limited market for products developed, in particular in countries with small populations.
- Lack of support from Governments in the form of procuring products and services from micro-, small and medium-sized enterprises supported by the incubators.
- Limited buy-in from the private and public sectors in some fields and countries, resulting in difficulty transitioning to financial independence by some micro-, small and medium-sized enterprises owing to a lack of market traction or access to the market.
- Inadequate seed funding and inaccessibility to some financial products for micro-, small and medium-sized enterprises because of the perceived high risk associated with start-ups.
- Lack of mentorship in specific technical fields to support emerging micro-, small and medium-sized enterprises, which often translated into their failure to survive in competitive markets.
- Limited involvement of female entrepreneurs in some innovation systems.
- Political instability and changes in political leadership in some areas, which made the continuous innovation and growth of start-ups difficult.
- Failure to meet infrastructure and knowledge or expertise requirements for innovation in some fields, in addition to a lack of information on business development in particular areas.
- Limited support for research and product development, with most countries underinvesting in research and development, far below the aspirational 1 per cent of GDP envisaged by the Heads of State and Government of the African Union.

- Absence of relevant policies and regulations for innovation and entrepreneurship in some fields or countries, as evidenced in particular by the low expenditure on research and development in many countries.

- Limited information-sharing and resource-sharing in some countries, owing to a culture of operating in silos. That situation had resulted in duplicated efforts and difficulty tracking and measuring the impact of entrepreneurship initiatives, which seemed to be a common challenge across the different countries.

- Struggles in marginalized and disadvantaged communities. According to the Wot-if? Trust – Father Louis Blondel Centre, township economies were much spoken about, but it was difficult to see how that translated on the ground. That particular challenge was prevalent in South Africa, owing to the disparities created by the apartheid system in that country before 1994.

- Overdependency on aid in most countries for the development of micro-, small and medium-sized enterprises and financial support for incubation programmes.

- Lengthy incubation processes and bureaucratic delays in some incubation programmes or in the provision of support for gaining access to technical and other services demotivated innovators and resulted in a premature exit from incubation programmes.

7.5 : Strengthening the entrepreneurial system

Some of the changes proposed by the respondents to strengthen the entrepreneurial system included the following:

- Create more funding pools for start-ups with minimal collateral requirements in order to bridge the funding gap, as traditional funding sources considered start-ups to be high risk.

- Develop supportive policies and enabling environments to accommodate the needs of innovators and product developers, especially women entrepreneurs, for example through subsidies and tax exemptions for start-ups. Furthermore, Governments could strengthen science, technology and innovation governance and provide conducive environments that leveraged national resources and capacities.

- Review the impact of what was being offered by incubation programmes regarding mentorship and coaching and exploring ways to provide sound mentorship in innovation and creativity and to build capacity in business management and “soft skills”, such as leadership, creative thinking and resilience.

- Be deliberate about providing appropriate and accessible infrastructure and equipment for prototyping and testing.

- Ensure greater collaboration to create synergies among actors in the innovation system, track progress and measure the impact of incubation initiatives.

- Consider specialization by having industry-focused and sector-focused hubs and incubators financed and supported by public-private partnerships that supported start-ups from the developmental phase to the commercialization phase with market linkages. The private sector or industry should also ensure that start-ups were solving problems that would enable market access.

Considering the current offering of the incubators in the subregion and the strengths and challenges in the entrepreneurship system, the incubators were asked to identify other necessary, additional support measures that the technology incubators should provide to achieve optimal impact for micro-, small and medium-sized enterprises in terms of competitiveness, profitability and their survival and growth. Some of the suggested additional support measures that incubators could employ to achieve optimal impact for such enterprises, according to the respondents, were as follows:

- Establish common or shared prototyping laboratories to enable the growth of the enterprises.

- Consider pooling and sharing technology, equipment and expertise among actors in the same system to improve access to various resources for micro-, small and medium-sized enterprises.

- Advocate more industry involvement in business incubation through education on the benefits of entrepreneurship.

- Create sustainable revenue streams and diversify their funding sources to better support micro-, small and medium-sized enterprises – though no concrete proposals were provided regarding what those revenue streams might be.

- Infuse technology and entrepreneurship, given the global evidence of new technologies contributing to the thriving of many enterprises.

- Support micro-, small and medium-sized enterprises with marketing, branding and the creation of linkages to regional and international markets.

- Promote peer-to-peer knowledge transfer and collaboration among incubators and support benchmarking best practices in incubation and entrepreneurship nationally and internationally.

- Build capacity in the monitoring and evaluation of the performance of micro-, small and medium-sized enterprises to keep track of the operations, finances, risk, compliance and governance of the enterprises.

- Consider formalizing supply chain arrangements for market access to support consistent production among incubated enterprises.

- Form strategic partnerships with suppliers of technologies that would otherwise be inaccessible or unaffordable, in order to support innovators.

- Provide administrative and technical support to early-stage start-ups to lower costs and the amount of time spent attempting to gain access to technologies relevant to their businesses.

The following were identified as complementary measures that needed to be taken in order for technology incubators to deliver support to start-ups and impact fully ensure their growth:

- Create enabling environments for the establishment of appropriate infrastructure to support product development.
- Provide supportive financial mechanisms to facilitate the work of incubators aside from conventional business credit or financing models.
- Establish or formalize linkages to regional and international markets for the sale of products from micro-, small and medium-sized enterprises.
- Support knowledge generators, namely, academic and research institutions with laboratories, equipment and expertise.
- Encourage collaboration and joint capacity-building among incubators and micro-, small and medium-sized enterprises to enable the sharing of best practices.
- Support capacity-building in investment readiness and matchmaking, especially in collaboration with industries.
- Ensure buy-in and more support from Governments.
- Ensure autonomy in governance, with no political interference in administration, in particular in government-backed or government-funded incubators. In some instances, the incubators highlighted the cost of reporting associated with government funding.
- Provide linkages to investor networks and research and academic institutions.

7.6 : Contribution of technology incubators to the development of micro-, small and medium-sized enterprises in Southern Africa

The respondents were of the view that technology incubators facilitated entrepreneurship in various ways, including by:

- Aggregating actors in the system.
- Creating new employment opportunities and attracting investment in local communities by incubating technology start-ups.
- Helping start-ups to raise funds for their business ideas.

- Creating spaces and infrastructure for growing and nurturing innovators and developing their skills in different fields.
- Leveraging the use and adoption of new and emerging technologies in various fields.
- Providing market linkages for locally developed products and services.
- Facilitating the dissemination of information relating to various fields of entrepreneurship.
- Advocating on behalf of start-ups with national and subregional policymakers and thus contributing to reformation of the policy and regulatory environment relevant to the development of micro-, small and medium-sized enterprises.
- Providing technical support, such as concept development, prototyping, technology validation and showcasing, to micro-, small and medium-sized enterprises.

While few incubators can assess their own impact, owing to the absence of data, limited expertise in monitoring and evaluation and inconsistent funding, some do evaluate their effect by tracking the amount of revenue generated or capital raised, the number of jobs created, the number of products put on the market, the degree of export or market penetration, the number of businesses established and their survival rate, through surveys, databases and, more traditionally, success stories.

Incubators like Mzuzu E-Hub that have existed for many years can assess impact more effectively through record-keeping. Mzuzu E-Hub has reached more than 200 entrepreneurs since its inception and has disbursed approximately $15,000 to entrepreneurs to help them start or sustain their businesses. The Innovation Hub and some government-funded incubators emphasize tracking the number of jobs created by the incubated companies, the revenue generated by them and hence their contribution to the local economy, as well as the amount of funding raised by the companies.

Others, such as the Royal Science and Technology Park Business Incubator, periodically conduct monitoring and evaluation exercises to assess the growth and development of the start-ups admitted. At the same time, incubators like the Impact Amplifier and Tshimologong Digital Innovation Precinct measure impact by assessing their contribution to the attainment of the Sustainable Development Goals.

In most cases, incubators' effectiveness is perceived as their ability to provide sustained funding and the infrastructure necessary to run incubation programmes. Some incubators measure their success on the basis of the number of start-ups created, the ability of incubated enterprises to generate revenue through product sales and the number of years that the incubator has been in existence.

The lack of adequate financing to support the development of micro-, small and medium-sized enterprises appears to be one of the significant threats to the sustainability of technology incubators in the subregion.

7.7 : Reconciling the need for building critical mass with the ambition to “leave no one behind”

One of the crucial questions the present study was aimed at answering was how incubators could reconcile the need for building a critical mass of technology entrepreneurs and innovators with the ambition to “leave no one behind”.

The respondents were of the view that that could be achieved by:

- Creating role models and sharing success stories among the incubators and entrepreneurs.
- Developing and adopting school curricula that reflected an appreciation for innovation and entrepreneurship and thus provided a sound foundation for founders of start-ups in later years.
- Scaling out incubation calls and extending networks beyond cities and towns. It was observed that most of the incubation programmes were located in cities and affluent areas. The case of the Innovation Hub’s eKasiLabs in South Africa was one example of deliberately establishing technology incubators in the most marginalized areas, namely, in what were known in South Africa as “townships”.
- Raising awareness by simplifying technology-related issues even for those who were not technology-savvy, so that budding entrepreneurs would embrace technology more widely.
- Instilling a culture of innovation and business acumen in the younger generation through targeted courses in entrepreneurship.
- Promoting consistency in incubation programmes to grow public interest.
- Diversifying the range of services provided by incubators to include more pre-incubation and entrepreneurship training initiatives in most marginalized areas.
- Adopting a sectoral approach to encourage incubation in various fields.
- Encouraging collaboration with all stakeholders, including the Government, the private sector, social entrepreneurs and community organizations, in the implementation of innovation initiatives.
- Building the capacity of entrepreneurs in digital literacy and utilizing new and advanced technologies in addition to the foundational digital skills. The Innovation Hub in South Africa had established the CodeTribe Academy to equip budding entrepreneurs with software coding skills, which would help them to build on their own ideas or to work in a start-up developing technology ideas.

7.8 : Embedding technology incubators within national and regional innovation systems

Some of the ideas advanced by the respondents with regard to embedding technology incubators within national and regional innovation systems included:

- Creating information and marketing networks among knowledge generators and knowledge users, namely, researchers or innovators and industries or communities at the national, regional and international levels.
- Advocating further on behalf of innovation and incubators.
- Allocating adequate resources to incubators from the national budgets. Those resources should also trickle down to micro-, small and medium-sized enterprises to enable them to gain access to financing for further development of their innovations.
- Creating incentives for technology incubators, for example through tax exemptions.
- Providing capacity-building for incubator managers in core aspects necessary to foster business development. Such capacity-building initiatives could be led by subregional, continental or global bodies, such as SADC, the African Union, ECA and UNCTAD.
- Facilitating peer-to-peer learning, with the understanding that "only entrepreneurs can develop entrepreneurs".
- Reorienting the focus of some incubators, as technology incubators needed to be demand focused.
- Encouraging and incentivizing the testing and adoption of technologies and products developed by local innovators.

Technology incubators and hubs should act as innovation sandboxes for the public sector, working with innovation practitioners and entrepreneurs with whom they can partner to prototype solutions on a small scale before engineering them into the institution. The public sector should provide pilot sites to a few entrepreneurs to test the solution and then procure the services with the most successful venture that can be adopted. This will facilitate market access, make incubators relevant to society and make them seen as places to which industry and the Government turn for micro-, small and medium-sized enterprises that may have solutions to their challenges.

7.9 : Sustainability of technology incubators in Southern Africa

With regard to ways of ensuring the sustainability (including the financial sustainability) of technology incubators in Southern Africa, some of the suggestions included:

- Encouraging networking, collaboration and partnerships among actors.

- Concentrating resources on high-growth investible start-ups by taking equity in such enterprises, which could be sold later on to make a profit, or dividends could be received by the incubator.

- Ensuring public investment in innovation by allocating a portion of the national budget to innovation and entrepreneurship and thereby guaranteeing a funding base for technology incubators that met specific criteria.

- Providing financial incentives, such as grants, tax exemptions and concessions, to incubators.

- Improving leadership by building management capacity in the innovation system.

- Focusing innovation on addressing subregional and national challenges and needs, thereby ensuring that incubators were supporting start-ups that were solving challenges with market potential.

- Creating a culture of giving back, whereby successful entrepreneurs could give back to the incubation programmes that had supported them. For example, the Innovation Hub obliged successful start-ups to pay a 5 per cent royalty on revenue generated, for a period equivalent to that during which incubation support had been provided.

- Conducting system mapping to better understand the needs, gaps and existing resources.

- Ensuring that the core incubator team had entrepreneurial experience and the capabilities to operationalize conceptual frameworks and business models. The value propositions of incubators should also service the real needs of the public and private sectors, not only relying on their compliance spend, but also, for example, on engagement in corporate social investment or supplier development.

7.10 : Special constraints faced by women and young people in gaining access to technology incubator services

While some incubators noted that women and young entrepreneurs faced no unique constraints, others stated that they had observed a gender-discriminatory environment shaped by social norms, attitudes, laws and gender-biased policies and programmes. In some systems, women and their efforts towards business creation are undermined by their communities. Most women founders and entrepreneurs struggle with juggling family responsibilities and putting in the long hours required to develop a successful business. In many cases, women struggle to obtain funding. As a result, they spend more time on activities that provide income for their families, in particular in the case of entrepreneurs who are single mothers.

Women and young people often face difficulties securing land access; they lack collateral, relevant skills and knowledge and access to markets and networks, which creates obstacles in their entrepreneurship journey.

In some incubators in South Africa, a lack of appropriate financial and business development services for women was noted as an impediment to their productivity in the innovation system. By contrast, in countries like Eswatini, constraints on women in technology were reported to be minimal and mainly revolved around public perceptions, such as the perception that technology was a male-dominated field. Such constraints may have no direct bearing on the success of women entrepreneurs, but they do call for more robust support systems for women and young entrepreneurs. In other cases, there was a need for flexible training and other incubator interventions that would take into account the unique circumstances of women in entrepreneurship.

Other social constraints on access to incubator services included age, digital literacy, language and information barriers, social obligations and Internet connectivity.

7.11 : Common mistakes made by micro-, small and medium-sized enterprises in incubation

The respondent incubators provided their views on common mistakes made by micro-, small and medium-sized enterprises they had incubated in the course of the incubation or entrepreneurship journey. Some of the common mistakes mentioned by the incubators included:

- Lack of motivation and drive among some innovators.
- Underestimation of capital requirements to run some businesses and the time it took to achieve success or make a profit, with the net result that many entrepreneurs ran out of the financial runway required to get their start-ups to scale.
- Failure to research the problem being solved and the required resources, to understand the type of technology to acquire and the market, and to develop a concrete business plan.
- Lack of diversity in innovation teams and limited networking or collaboration efforts.
- Overdependence on foreign aid and mismanagement of financial resources, mainly owing to a lack of financial literacy.
- Limited capacity in “soft skills”, such as communication, marketing and leadership.
- Insufficient cash flow for the business.
- Overconfidence in the ability to convert leads from their business development pipeline into customers.
- Insufficient focus on customer acquisition.

- Ineffectiveness in addressing, or simply avoidance of, conflict in the team.
- Ineffective operations for after-sales service to customers.

7.12 : Implications of the disconnect between the incubator and existing development policies

Most respondents agreed that a lack of cohesion and alignment between policymakers and implementers hampered incubation success. A lack of supportive policies makes the growth and survival of micro-, small and medium-sized enterprises difficult and diminishes motivation for innovators in that particular environment.

Another implication of a disconnect between incubators and development policies is the failure of innovators and entrepreneurs to create products that address the needs of society and, in the long run, the inability of both the incubators and the enterprises to contribute to overall economic growth and development in their systems.

7.13 : Contribution of technology incubators to the building of the green, blue and digital economies

By providing mechanisms for nurturing businesses, availing themselves of funding and infrastructure, focusing on innovation-related initiatives, creating networking opportunities and providing information on markets and technologies, incubators can contribute to building the green, blue and digital economies.

The green economy is aimed at developing industries and generating employment through interventions and investments in opportunities that reduce carbon emissions and enhance energy and resource efficiency, including the responsible use of biodiversity. The blue economy is aimed at capitalizing on opportunities provided by the ocean and inland water systems while consciously supporting initiatives that ensure the reduction and prevention of adverse effects on these systems (ECA, 2023a). These economies are not distinct economic sectors per se but rather philosophies for economic growth that are pervasive across economic sectors (Sibanda, 2021). Environmental degradation and the pollution of ocean and water systems affect people experiencing poverty, in particular in low-to-middle-income countries, and could render lives more fragile. Since many water resources are polluted with waste, this threatens living organisms, including humans. Accordingly, the green and blue economies are of particular importance for addressing and mitigating the adverse effects on the environment and water resources and unlocking entrepreneurial opportunities, which would ensure that the most vulnerable communities and countries developed sustainably. Sibanda (2021) states that "there are numerous opportunities for innovators and entrepreneurs to provide appropriate solutions that address these challenges in a more sustainable and profitable way whilst they contribute to a better world". The digital economy is predicated on the use of ICT and digital tools. Micro-, small and medium-sized enterprises everywhere, in particular on the African continent, increasingly have access to digital tools and opportunities to innovate and create products that address many challenges, including access to health, banking and education, to name a few (ECA, 2023b).

By aligning their mandates to the philosophies underlying the green, blue and digital economies, incubators can foster growth among change-makers. Technology incubators can also contribute by advocating better and more enabling environments for blue, green and digital solutions by sharing best practices in these areas and by informing research on some solutions that can be created to tackle challenges in the blue, digital and green economies.

Effective partnerships are fundamental to the success of blue economy incubators and accelerators and should be prioritized when establishing and operating such programmes. Within Southern Africa, the OceanHub in Cape Town is the only incubator specializing in the blue economy that was identified during the study. It accepts entrepreneurs and innovators from across the continent into its programmes. In addition, there are a handful of incubators focused on the green economy, such as the Climate Innovation Centre South Africa, the Small Enterprise Development Agency Atlantis Renewable Energy Business Incubator, the Agribusiness Incubation Trust Limited, the AgriEn Network, the AgriWorth Incubator Limited, the Biofuels Business Incubator and the Agribiz Hub.

7.14 : Important indicators of the success and effectiveness of technology incubators

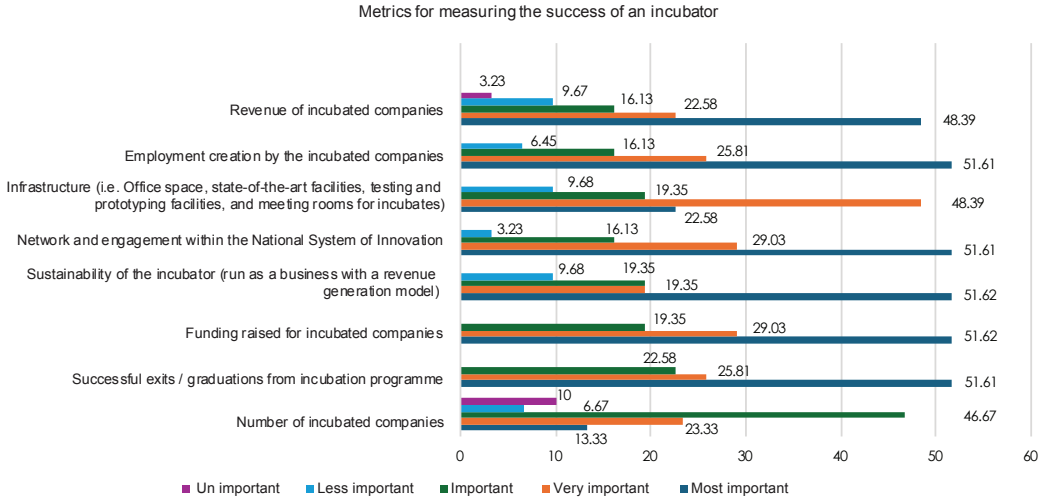
The respondent incubators were asked to identify what, in their opinion, were the indicators that should be used to assess the success and effectiveness of technology incubators as a development tool. The choices included the number of incubated companies, the number of successful exits or graduations from the incubation programme, the amount of funding raised for incubated companies, the sustainability of the incubator (whether it was run as a business with a revenue generation model), the level of networking and engagement within the national system of innovation, the infrastructure provided (i.e. office space, state-of-the-art facilities, testing and prototyping facilities and meeting rooms for incubated enterprises), the extent of employment creation by the incubated companies and the revenue of the incubated companies.

As can be seen from figure XXIV, on the basis of responses received from more than 40 per cent of the respondent incubators, the most critical indicators of success and effectiveness for technology incubators were identified as the following, in decreasing order of importance:

- Sustainability of the incubator in terms of its revenue generation model
- Successful exits or graduations from the incubation programme
- Employment created by the incubated companies
- Revenue of the incubated companies
- Funding raised for the incubated companies

Whereas more than 50 per cent of the respondents highlighted the number of incubated companies in an incubator as being important, it was deemed to be less important than the other indicators mentioned above.

Figure XXIV: Success and impact indicators, as identified by incubators



Source: Author-generated on the basis of responses to the incubator survey.

8: Survey of micro-, small and medium-sized enterprises incubated in technology incubators in Southern Africa

8.1 : Overview

A total of 31 micro-, small and medium-sized enterprises incubated by the 33 incubators that responded directly to the survey provided their opinions on the state of technology incubation in Southern Africa. The survey was also aimed at finding alignment between the perceptions of incubators and those of micro-, small and medium-sized enterprises about what was essential and identifying gaps in technology incubation, as experienced by the beneficiaries.

At least 52 per cent of the enterprises were located in South Africa, 23 per cent in Zambia, 10 per cent in Malawi, 6 per cent each in Eswatini and Namibia and 3 per cent in Botswana, as illustrated in figure II.

Most of the enterprises (74.19 per cent) employed 10 people or fewer, whereas 22.58 per cent employed between 11 and 50 people, with 3.23 per cent employing more than 50 people (see figure XXV).

Most micro-, small and medium-sized enterprises had male founders (55 per cent), with women accounting for the founders of 32 per cent of the companies (see figure XXVI). Thirteen per cent of the companies had both male and female founders. Although inconclusive owing to the randomness of the nomination of the enterprises by the incubators, the data suggest that, at least among the respondent enterprises, there were more male founders than female founders. This was collaborated by the interviews with some of the incubators in South Africa and Zambia and has been one of the reasons for the establishment of such incubators as the Women's Entrepreneurship Access Center in Zambia.

Figure XXV: Size of the micro-, small and medium-sized enterprises *(Number of employees)*

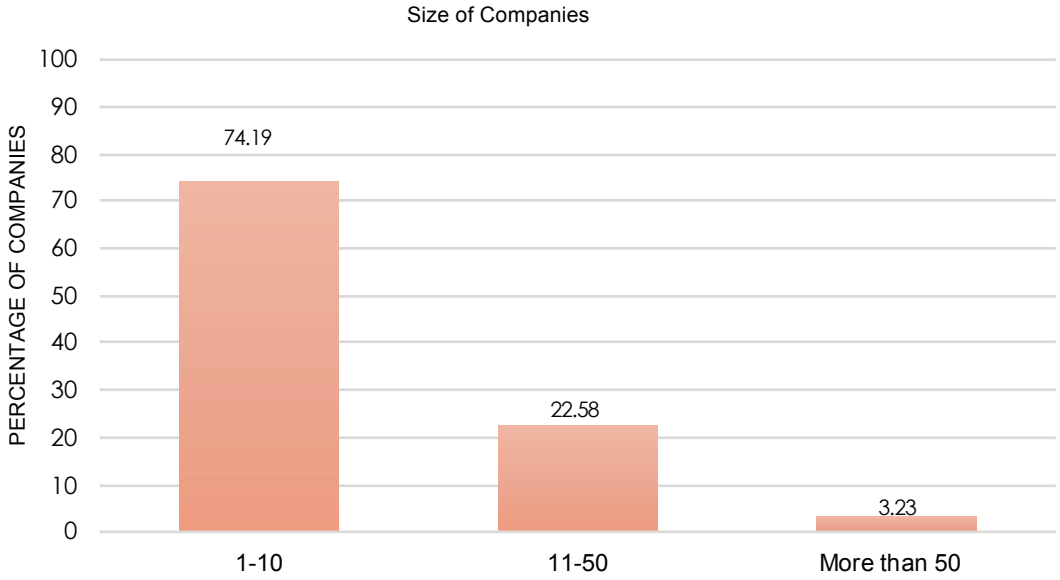
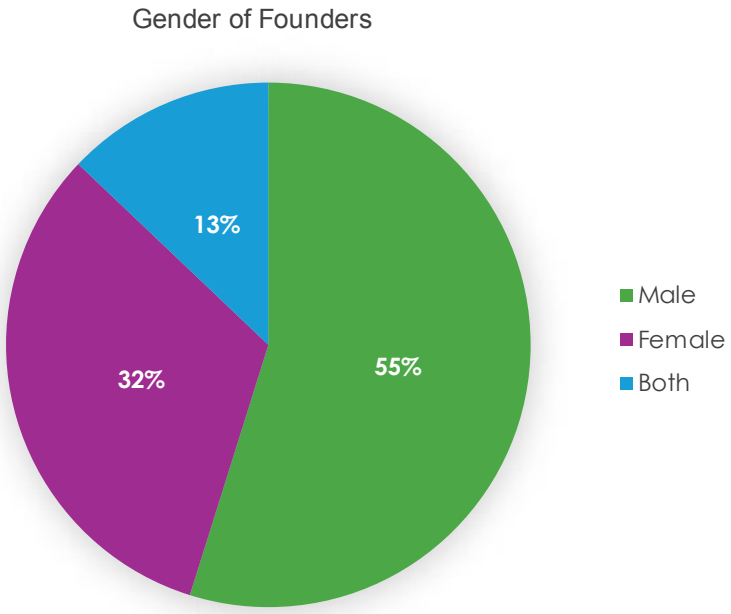


Figure XXVI: Gender of the founders of the micro-, small and medium-sized enterprises *(Percentage)*



Most of the founders of micro-, small and medium-sized enterprises nominated by the incubators were between 30 years and 50 years old, as illustrated in figure XXVII. Although it cannot simply be assumed that this would be the predominant age group across all micro-, small and medium-sized enterprises in the subregion, that conclusion is not too far off from the findings of other recent studies, which indicate that the average age of the founders of the most successful start-ups (high-growth, technology-enabled micro-, small and medium-sized enterprises) was 45 years when they started their company (Azoulay and others, 2018). This is an interesting finding,

Figure XXVII: Age of the founders of the micro-, small and medium-sized enterprises *(Years)*

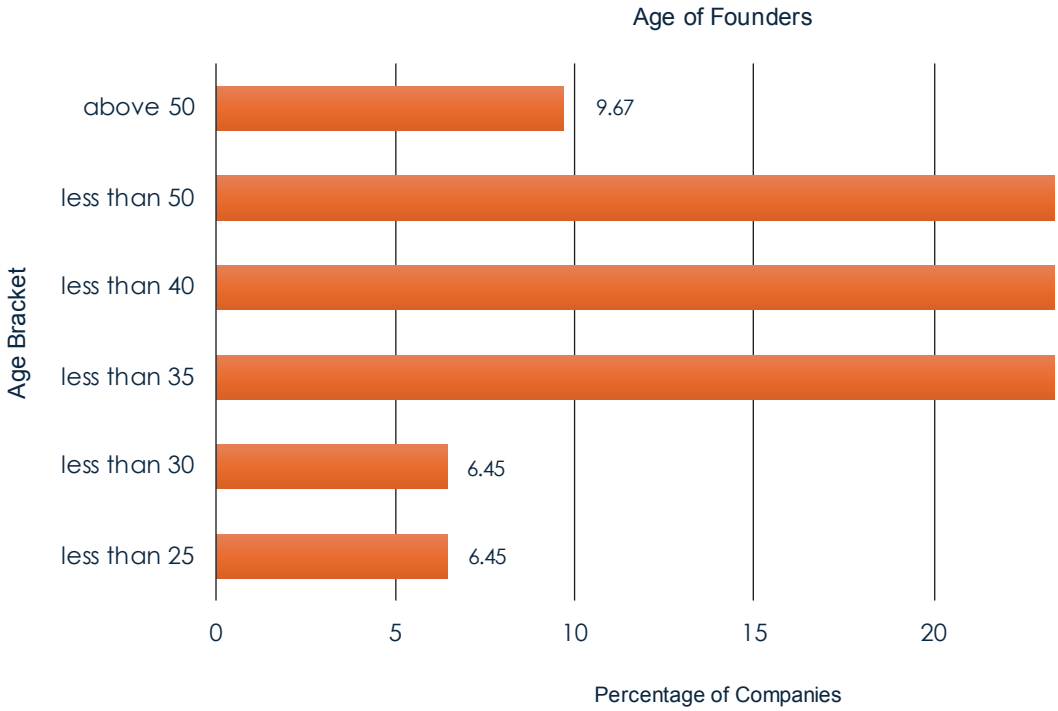
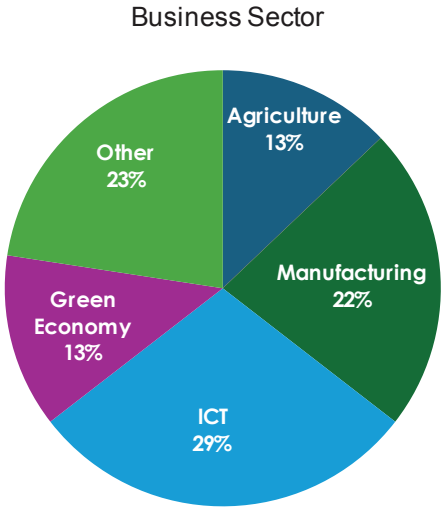


Figure XXVIII: Business sectors of the micro-, small and medium-sized enterprises *(Percentage)*



Source: Author-generated on the basis of responses to the incubated micro-, small and medium-sized enterprises survey

given the median age of 27 years (Worldometer, 2023) and unemployment rate of 32.2 per cent in Southern Africa (Statistica, 2023).

The respondent micro-, small and medium-sized enterprises worked in the sectors shown in figure XXVIII, namely, ICT (29 per cent), manufacturing (22 per cent), the green economy and agriculture (both at 13 per cent) and other (23 per cent). The "other" business sectors covered by incubated companies included water treatment

and technology development, the health sector, hybrid manufacturing, social justice, floral, event management, the food technology industry, mobility, transport and logistics and construction technology.

8.2 : Background and motivations of the founders

A total of 61 per cent of the entrepreneurs had received formal or academic training in technical fields that included agribusiness, business management, engineering, commerce and information technology at a level equivalent to or higher than the diploma level. In many cases, that training had been complemented by certifications and short courses from national and international institutions.

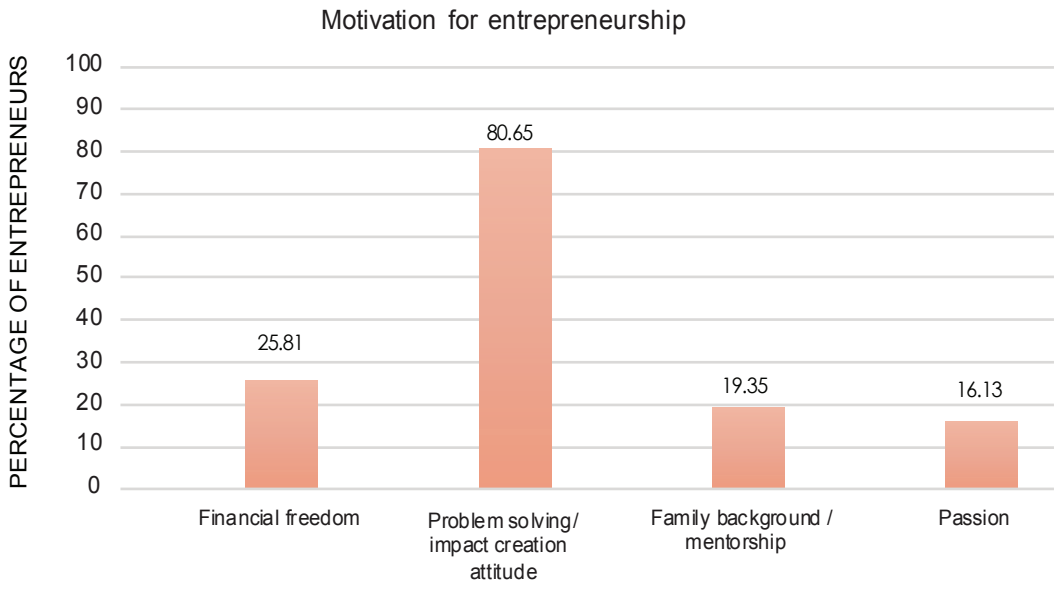
Some entrepreneurs had received global recognition for their efforts to help solve societal challenges, for example through the Mandela Washington Fellowship for Young African Leaders and other regional and national awards.

Their experience in starting or running a business ranged from 2 years to more than 20 years. For about 16 per cent of the participants, that experience specifically included experience in innovation and product development.

Their top reasons for engaging in entrepreneurship, as illustrated in figure XXIX, included the desire to attain financial freedom or have more control over their time, interest in solving societal problems or in generating solutions for others and creating impact in various fields, having a family history or background that featured entrepreneurs, and having a passion for various causes.

The majority of responding micro-, small and medium-sized enterprises (74.2 per cent) had been incubated during the period 2016–2021, with 12.9 per cent having been incubated during the period 2010–2015 and a similar percentage having been incubated since 2022. Of the respondent enterprises, 81 per cent recorded the incubation as their first incubation experience.

Figure XXIX: Motivation for entrepreneurship



Source: Author-generated on the basis of responses to the incubated micro-, small and medium-sized enterprises survey.

Reasons stated by the entrepreneurs for joining the nominating incubators included:

- Established partnerships with industry, investors and important stakeholders in the innovation system
- Access to vital networks and market opportunities
- Capacity-building, training and funding opportunities
- Availability of appropriate infrastructure and suitable expertise for business development
- Focus on special interest groups, especially women and young people
- Requirements for funding or innovation competition awards

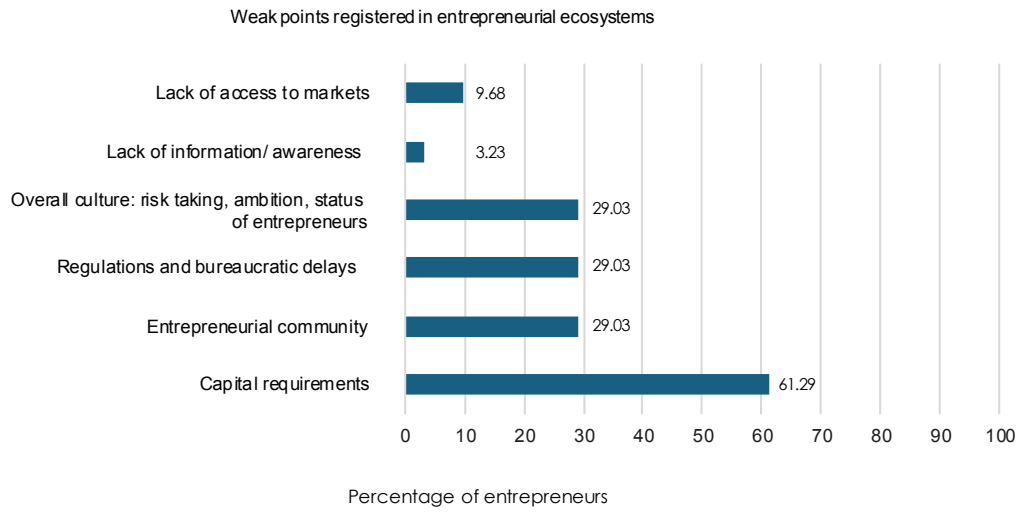
8.3 : Incubation experience and effectiveness

A total of 61 per cent of the entrepreneurs from the respondent micro-, small and medium-sized enterprises had received formal or academic training in technical fields that included agribusiness, business management, engineering, commerce and ICT prior to entering incubation, and in some cases during the incubation period.

Most of the enterprises' highlights from the incubation period were related to winning pitching competitions or securing funding, attaining certifications and recognitions, being empowered through mentorships, carrying out product launches and market penetration and networking on a global, regional or subregional scale.

When reflecting on what they considered to be the weak and strong points of the entrepreneurial system in which they operated, access to finance was identified as the most significant weakness by 61.29 per cent of the enterprises, with 29.03 per cent identifying the regulatory environment, the entrepreneurial community and

Figure XXX: Weak points in entrepreneurial systems, as identified by micro-, small and medium-sized enterprises



Source: Author-generated on the basis of responses to the incubated micro-, small and medium-sized enterprises survey.

the overall culture as weaknesses (see figure XXX). Of interest was the fact that less than 10 per cent of the enterprises mentioned market access as a weakness, thus suggesting that most were working on demand-led innovations or were solving problems that had a market need.

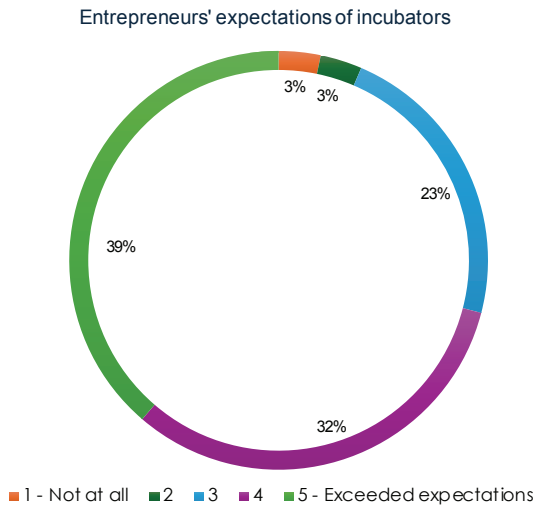
Some entrepreneurs reported that they felt like they were just numbers to incubators, with one stating the following: "My experience with incubators is they don't really care about their entrepreneurs. We are just numbers to them. There's usually no follow-up once a programme ends." This perception could result from the absence of a post-incubation programme in the case of most of the incubators that responded to the survey. In some cases, particularly where the incubators are paid to run specific programmes for third parties, the incubators move on to focus on the next cohort or on the needs of funding third parties in order to earn revenue to keep their operations going. Regardless of the reasons for this perception, it should serve as a catalyst for incubators to develop and update a database of exited or graduated incubated enterprises and perhaps to carry out a post-incubation intervention, which may even be an annual alumni event.

Others believed that the mentorship they had received from incubators was one of the most vital points of the entrepreneurial system.

Other strong points identified in some systems included a large base of ambitious risk-takers and entrepreneurs, demand for innovative products and niche markets for them, and supportive entrepreneurial communities characterized by peer-to-peer learning and mentorship.

On a scale of 1 to 5, the majority of the entrepreneurs reported that the incubator was good (4) (32 per cent) or exceeded their expectations (5) (39 per cent) (see figure XXXI). This notwithstanding, 23 per cent indicated that the incubation services were average (23 per cent), with 6 per cent indicating that they were below average or did not meet their expectations.

Figure XXXI: Extent to which incubators met the expectations of micro-, small and medium-sized enterprises *(Percentage)*



Source: Author-generated on the basis of responses to the incubated micro-, small and medium-sized enterprises survey.

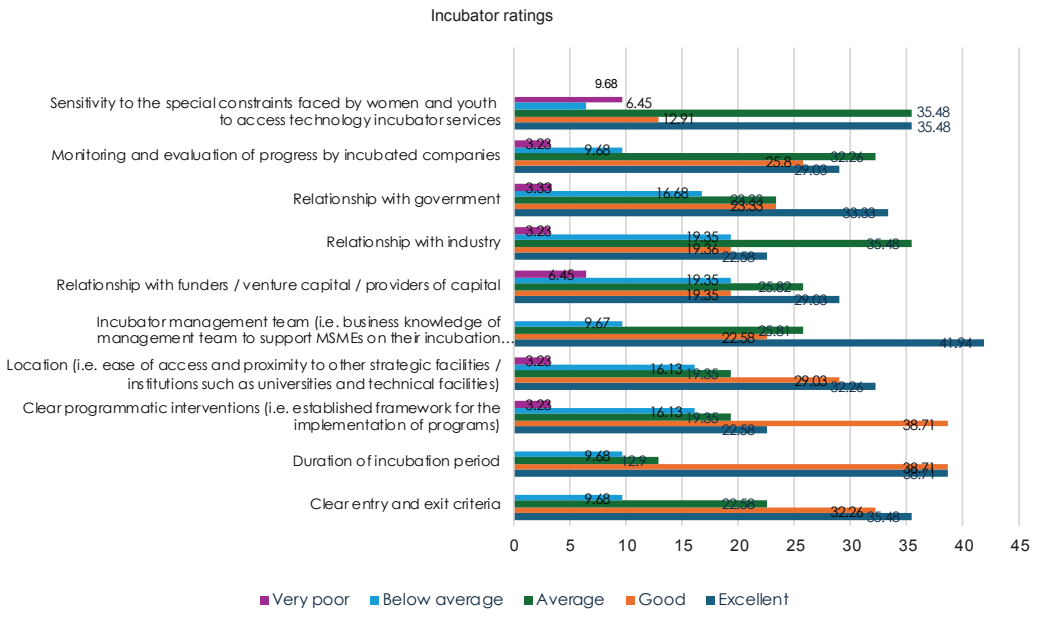
On the basis of their experience in the incubators, the micro-, small and medium-sized enterprises made the following suggestions on ways to grow the start-up community in different industries:

- Build strategic partnerships and create inspiration from success stories and mentorship in entrepreneurial systems.
- Establish more technology hubs targeting: young people in towns, remote areas and underserved areas; higher education institutions; and special interest groups, such as young women.
- Facilitate market linkages and provide more funding mechanisms for start-ups.
- Attain government or political will to support start-ups.
- Disseminate information about incubation programmes.
- Build start-up sustainability through financial literacy.
- Develop and implement supportive policies for incubation and entrepreneurship.

The enterprises were asked to rate various factors relating to their incubation programme on a scale of 1 to 5, and the results are shown in figure XXXII.

At least 30 per cent of the enterprises rated their incubators as good or excellent in the following areas: incubation period (77.42 per cent); clear entry and exit criteria

Figure XXXII: Ratings by micro-, small and medium-sized enterprises of their nominating incubators *(Percentage)*



Source: Author-generated on the basis of responses to the incubated micro-, small and medium-sized enterprises survey.

(67.74 per cent); incubator management (64.52 per cent); location (61.29 per cent); relationship with the Government (56.66 per cent); and the monitoring and evaluation of the progress achieved by incubated companies (54.83 per cent).

Areas in which the incubators were rated as average or below average were: relationships with industry (58.06 per cent); relationships with funders, venture capitalists or providers of capital (51.62 per cent); sensitivity to constraints faced by women and young people in gaining access to technology incubation services (51.61 per cent); and clear programmatic interventions (38.71 per cent).

The enterprises were also asked to rate, on a scale of 1 to 5, the quality of various services provided by the incubator that had nominated them, on the basis of their own experiences. The results are shown in figure XXXIII. More than 40 per cent of the respondents noted that the incubators conducted excellent interventions in the following areas: induction; business mentorship; business training services; events and other networking services; and pitching workshops and assistance with pitching.

The following priority areas for improvement were identified, on the basis that they received ratings of below average or poor:

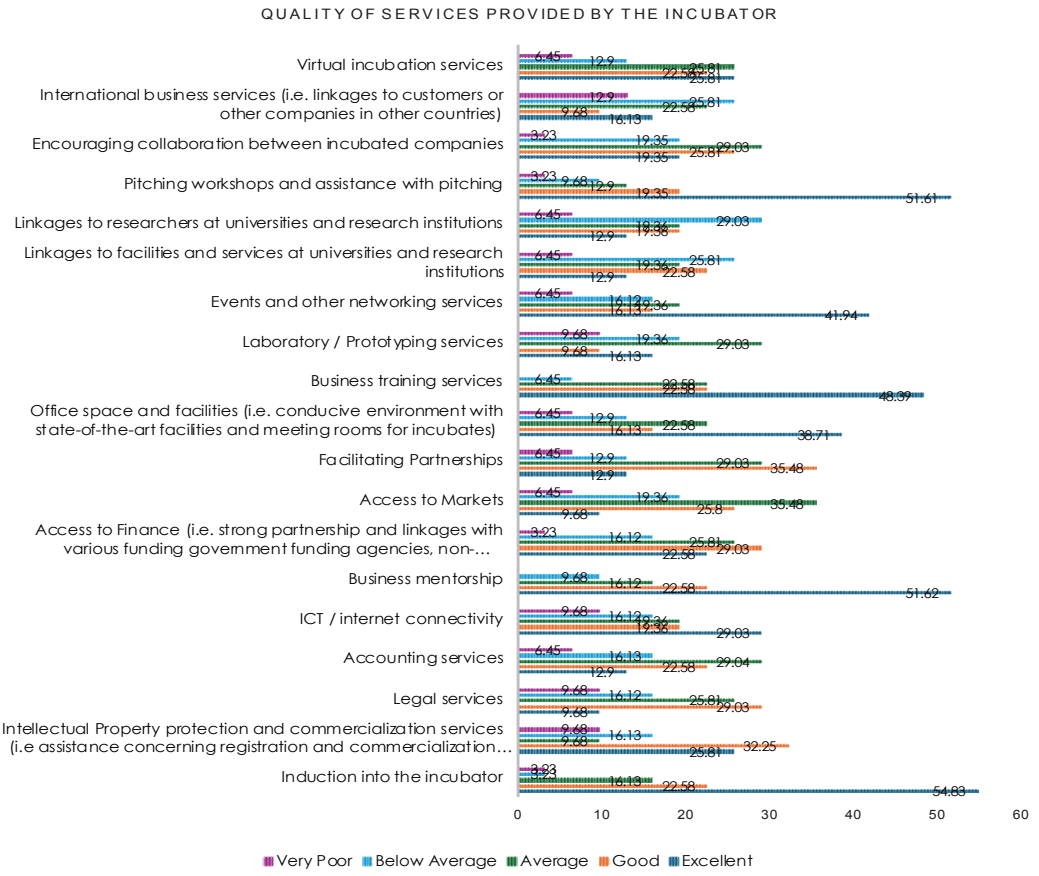
- International business services (38.71 per cent)
- Linkages to researchers at universities and research institutions (35.48 per cent)
- Linkages to facilities and services at universities and research institutions (32.26 per cent)
- Laboratory and prototyping services (29.04 per cent)
- Encouragement of collaboration among incubated enterprises (22.58 per cent)

Other secondary areas in which incubators were primarily rated average or below average included:

- Market access (61.29 per cent)
- Facilitation of partnerships (61.29 per cent)
- Accounting services (51.61 per cent)
- Legal services (51.61 per cent)
- Access to finance (45.16 per cent)
- ICT and Internet connectivity (45.16 per cent)

Some incubators provide funding to their micro-, small and medium-sized enterprises, as shown in figures XXXIV and XXXV. At least 65 per cent of the enterprises that responded to the survey had received some form of funding from their nominating incubator, with as much as 86.95 per cent of the funding being in the form of grants and 4.35 per cent each in the categories of loan, equity and hybrid. The process had

Figure XXXIII: Rating by micro-, small and medium-sized enterprises of the quality of services provided by incubators *(Percentage)*



Source: Author-generated on the basis of responses to the incubated micro-, small and medium-sized enterprises survey.

lasted 6 months or less, from the application for funding to the first disbursement of funds, for 74 per cent of the respondent enterprises and had lasted more than 12 months for 13 per cent of the enterprises.

Figure XXXIV: Entrepreneurs who received funding from incubators *(Percentage)*

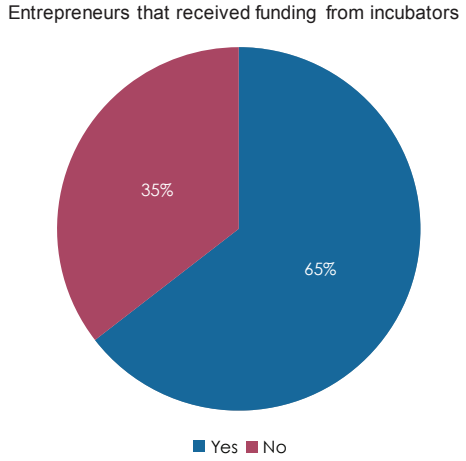
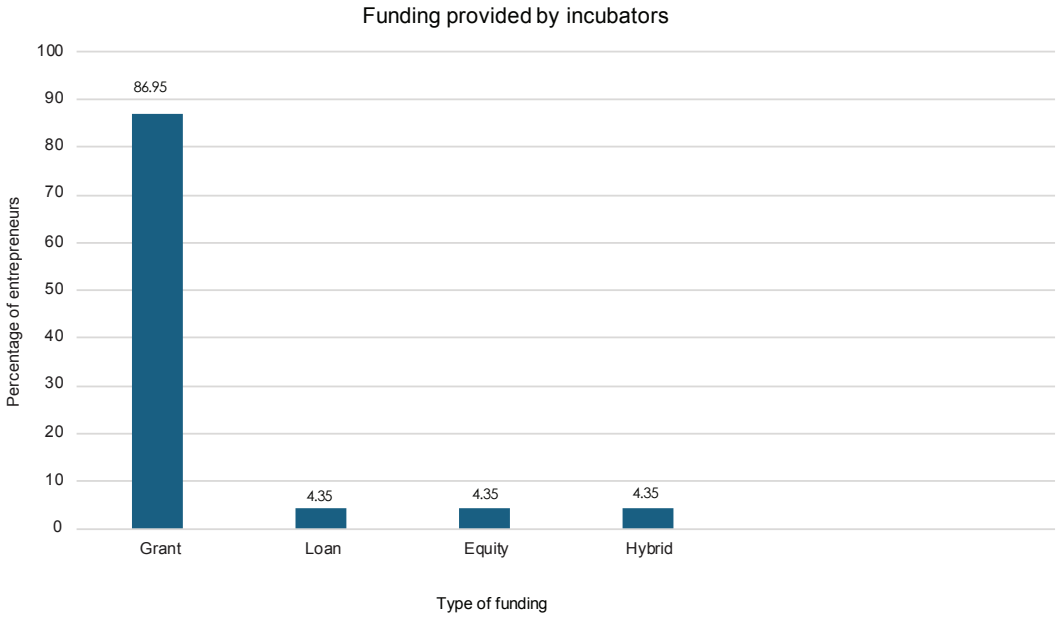


Figure XXXV: Type of funding received from incubators



Source: Author-generated on the basis of responses to the incubated micro-, small and medium-sized enterprises survey

A total of 52 per cent of the incubators ran competitions among the enterprises they incubated, with most doing so at least once a year. Some held quarterly pitching sessions. The prize was in the form of cash, in-kind or a combination of the two, as illustrated in figure XXXVI. Most of the cash prizes were less than $10,000 (85 per cent), and only 10 per cent were above $20,000 (see figure XXXVII).

In the case of cash prizes, most had conditions attached. Some of the conditions stipulated for receiving the cash prizes were the following:

- Enterprise must have a detailed workplan and a corresponding budget
- Incubator would approve expenditures only for research, product development or commercialization
- Incubator would monitor expenditures and track the progress made

Of the incubators that offered post-incubation support, according to 60 per cent of the enterprises, that support took various forms, such as the provision of workstations, networking, partnership or mentoring opportunities and continued skills development through training programmes in such subjects as financial modelling and the use of social media as an entrepreneur.

The enterprises rated the indicators by which an incubator's success should be measured on a scale of 1 to 5. The results are shown in figure XXXVIII The following indicators, listed in decreasing order of importance, received ratings of 4 or 5:

- Funding raised for incubated companies (80.65 per cent).
- Networking and engagement within the national system of innovation (80.64 per cent).

Figure XXXVI: Prizes in competitions run by incubators *(Percentage)*

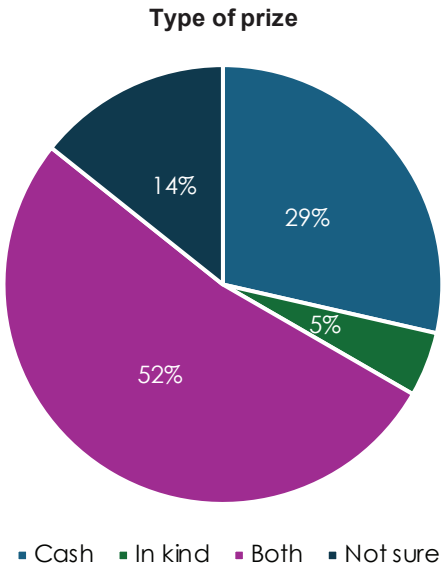
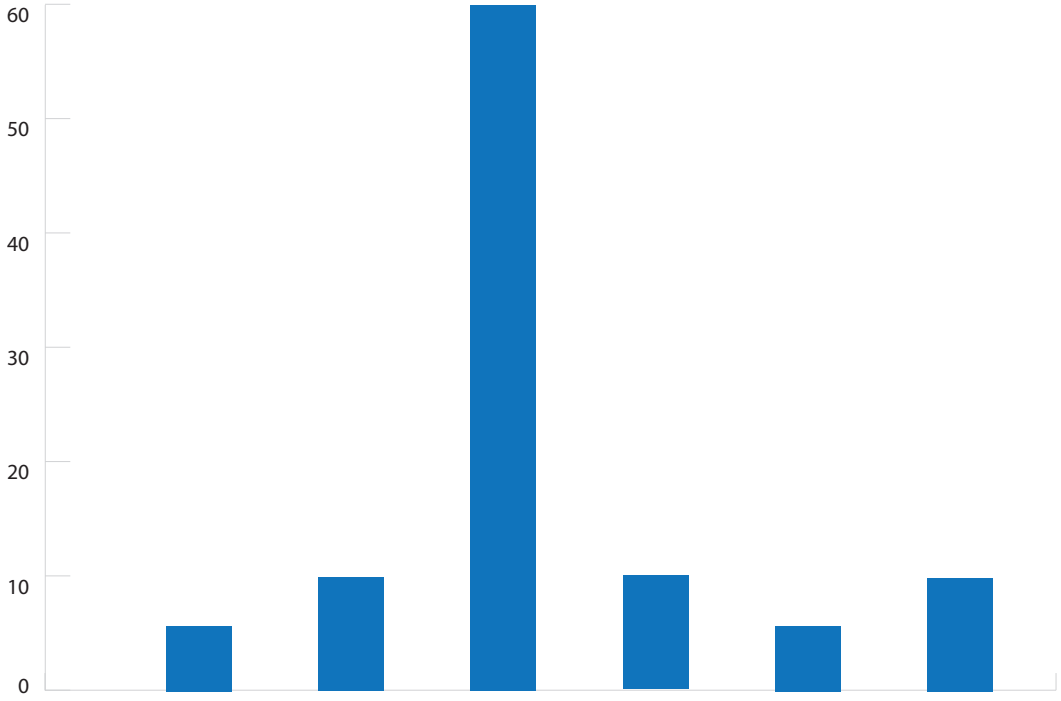


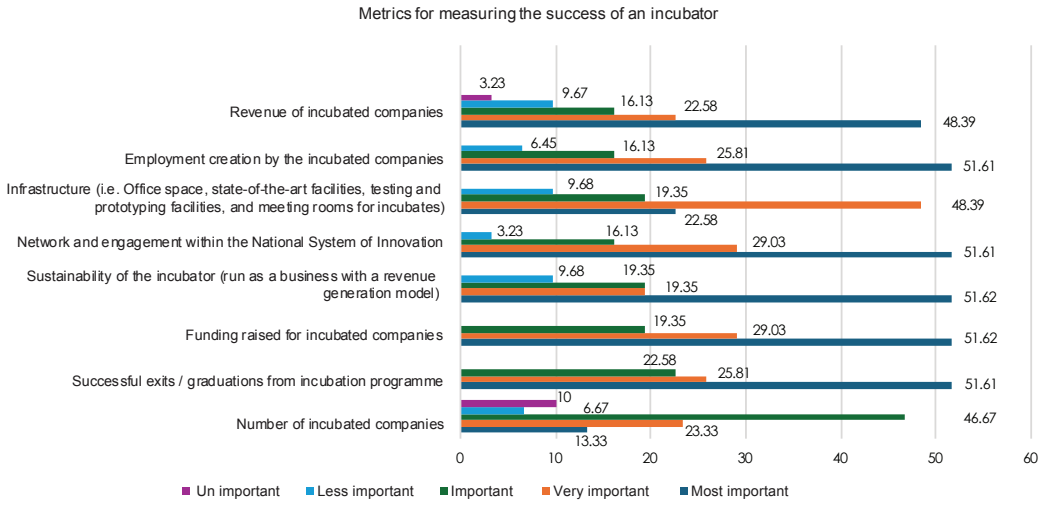
Figure XXXVII: Size of cash prizes received in competitions run by incubators



Source: Author-generated on the basis of responses to the incubated micro-, small and medium-sized enterprises survey.

- Successful exits or graduations from the incubation programme (77.42 per cent).
- Employment creation by the incubated companies (77.42 per cent).
- Sustainability of the incubator (run as a business with a revenue generation model) (70.97 per cent).

Figure XXXVIII: Importance of indicators for measuring the success of an incubator, according to micro-, small and medium-sized enterprises *(Percentage)*



Source: Author-generated on the basis of responses to the incubated micro-, small and medium-sized enterprises survey.

- Infrastructure (i.e. office space, state-of-the-art facilities, testing and prototyping facilities, and meeting rooms for incubated enterprises) (70.97 per cent).
- Revenue of incubated enterprises (70.97 per cent).
- Number of incubated enterprises (36.66 per cent).

The following were considered by the enterprises to be the most important indicators for measuring the success of an incubator (i.e. those that received a rating of 5):

- Sustainability of the incubator (run as a business with a revenue generation model) (51.62 per cent)
- Funding raised for incubated enterprises (51.62 per cent)
- Employment creation by the incubated enterprises (51.61 per cent)
- Networking and engagement within the national system of innovation (51.61 per cent)
- Successful exits or graduations from the incubation programme (51.61 per cent)
- Revenue of incubated enterprises (48.39 per cent)

9: Discussion and recommendations

9.1 : Entrepreneurial system in Southern Africa

The entrepreneurial system in Southern Africa is in its developmental stages. There are pockets of excellence, with some countries, such as South Africa in particular, having very well-developed systems, with strong tertiary educational and research institutions, significant levels of investment in research and development, the largest number of incubators in the subregion spread across multiple cities (unlike in other countries where the incubators tend to be in one or two cities only), public and private sector funding, and an enabling regulatory environment characterized by tax incentives, among other things. What makes South Africa unique in the subregion is the legislative requirement for companies to be involved in enterprise and supplier development, whereby funds are then released for incubators to run programmes for the companies.

In general, entrepreneurship has been on the rise in the subregion. Some countries with small markets, such as Botswana, Mauritius and Namibia, are also seeing an increase in start-up activities, primarily in digital innovation. The subregion has also benefited from such programmes as the Southern Africa Innovation Support Programme, which have created some linkages among the incubators and other stakeholders in the subregion. Unfortunately, both the first phase of that Programme, initiated and funded by the Government of Finland, and the second phase, co-funded by the Government of South Africa, have come to an end. Other initiatives, such as the Southern Africa Network for Biosciences, which is a shared biosciences research, development and innovation platform for working collaboratively to address some of the crucial bioscience issues in Southern Africa in health, nutrition and health-related intervention areas, such as agriculture and the environment, are very much focused on the research and development and commercialization efforts of universities and research institutions, and not so much on micro-, small and medium-sized enterprises. The Network comprises 12 SADC member States and operates on the basis of a subregional hub (the Council for Scientific and Industrial Research in South Africa) and country nodes model.

The Government of Zimbabwe, as part of its education 5.0 policy, has placed significant emphasis on the establishment of innovation hubs within higher and tertiary education institutions, with a focus on developing and commercializing products and services that address the needs of Zimbabweans (Nyikadzino, 2022). These hubs possess equipment that, as far as is understood, can be made available to innovative micro-, small and medium-sized enterprises on an agreement basis. Thus far, at least five innovation hubs have been established at State universities, with much emphasis placed on them contributing to innovation and the industrialization of the economy of Zimbabwe (Tshili, 2023). However, the focus on micro-, small and medium-sized enterprises is not explicit, other than the spinning out of companies from the universities.

As illustrated in earlier sections of the present report, the Government of Mauritius also has an incentive scheme through which it supports the establishment of incubators.

Through the surveys conducted, the author found strong, formal government and regulatory frameworks and evidence of informal institutions, such as cultural support and other sociocultural elements, encouraging entrepreneurship. These measures are chiefly implemented as an antidote to the long-standing weak economic conditions in the subregion. Although this has led to the establishment of numerous incubators intended to encourage, support and grow micro-, small and medium-sized enterprises, most of these incubators are not adequately equipped to provide the required support to entrepreneurs and enterprises, and thus do not realize the envisaged long-term returns in the form of positive contributions to the subregion's economic growth, which would essentially be facilitated by successful start-ups and entrepreneurship.

The lack of funding and financial support plays a major role in weakening the entrepreneurial system. Survey respondents reported a lack of adequate seed funding and other funding as a significant contributor to the high mortality rate of start-ups. Funding appears to be a challenge, in particular in such countries as Namibia, not only for the micro-, small and medium-sized enterprises but also for the incubators and entrepreneurship programmes, as evidenced by the scaling back of some initiatives, such as the FABlab (which used to be open to the general public and is now limited to students and faculty of the Namibia University of Science and Technology) and the Bokamoso Entrepreneurial Centre (an initiative of the city of Windhoek). In some cases, initiatives have been terminated entirely, such as the government-run StartUp Namibia and the equipment aid scheme in Namibia. In other countries, such as Zambia, there is some funding provided by such institutions as the National Technology Business Centre, albeit in very limited amounts and only for the purpose of enabling micro-, small and medium-sized enterprises to gain access to technology. There is, however, a lack of funding for the incubators' operations and entrepreneurship interventions, and some of the incubators, such as BongoHive, the Women's Entrepreneurship Access Center and Jacaranda Hub, have increasingly relied on running programmes for corporations or donors. The danger of donor-run initiatives is the potential for the focus and priorities to be skewed by what matters most to the donors. Such donor priorities tend to be primarily focused on quantity rather than on the impact indicators identified by the incubators and enterprises surveyed as part of the present study.

With a few exceptions, the overall competence of the incubators surveyed appears to be relatively average. Respondents reported a need to build capacity among incubators to enable them to facilitate effective support for the success of micro-, small and medium-sized enterprises. Such capacity-building could include significantly enhancing intermediary services, such as mentorship, coaching, access to field experts and other necessary forms of support. There are very few specialized incubators with adequate equipment and facilities to support technological innovation or to support micro-, small and medium-sized enterprises in gaining access to new technology. Strong collaboration between the incubators and tertiary education and research institutions is needed to support the enterprises adequately. This collaboration could be enabled by, among other things, establishing panels of technical mentors or coaches to whom the enterprises could have access.

It was also revealed through the survey that there is an insufficient capacity among science, technology and innovation personnel, which has a negative impact on the degree to which innovative and high-tech start-ups have adequate research and development guidance and support for product development. This is not surprising, given the low levels of investment in research and development in the subregion and the performance of countries in the subregion in such indicators as the Global Innovation Index.

The lack of collaboration among incubators limits the opportunities for creating and establishing the networks characteristic of a robust system. The siloed working culture among incubators in many countries has had a negative impact on the effectiveness of the incubators and, even more so, on the fate of supported micro-, small and medium-sized enterprises.

Affected by such challenges as extreme poverty, crime, corruption and desperate economic conditions, the quality of entrepreneurs within the system comes under scrutiny, with some of the incubators that participated in the survey reporting a lack of ambition, creativity and fortitude to endure the entrepreneurial journey. Without much-needed social support, entrepreneurs face difficulties in overcoming the challenges presented by their primary environment.

In the education structure of many of the countries, relatively little emphasis is placed on entrepreneurship, resulting in a lack of the accounting skills and business acumen that are essential for entrepreneurs. In some cases, illiteracy also hinders the impact of training interventions and skills development initiatives. Access to technology remains a challenge for a variety of reasons, including: the capacity of the incubators to provide technology support; weak linkages between the incubators and universities or research institutions; a lack of funding to acquire technology or equipment and, in cases where it exists, overly bureaucratic processes for gaining access to it, as was exemplified by the case of the technology business development fund managed by the National Technology Business Centre on behalf of the Government of Zambia; and an absence of capacity to operate the equipment or effectively embed the technology once acquired, as was highlighted by some of the incubators.

9.2 : Ways to strengthen the entrepreneurial system for start-ups

The capacity and competence of existing incubators should be enhanced, concentrating efforts on providing incubators with adequate financial resources to ensure their sustainability and effective support of micro-, small and medium-sized enterprises.

Incubators should be equipped with knowledge about technical subject matter and with market experts to enable them to offer quality services and premium support to start-ups throughout the various growth stages.

Government policies in which science and technology are prioritized, and innovation strategies that foster innovation and encourage entrepreneurship, should be developed and implemented. Some respondent incubators suggested developing policies and frameworks in which resources and efforts were focused on supporting

and establishing micro-, small and medium-sized enterprises owned by women and young people.

Another important consideration put forward by the incubators was the need to encourage a collaborative culture to forge internal and external networks, which would become tools to support market access.

For their part, most of the micro-, small and medium-sized enterprises recommended: establishing more technology hubs targeting young people in towns, remote areas and underserved areas, higher education institutions and special interest groups like young women; facilitating market linkages and providing more funding mechanisms for start-ups; and developing and implementing supportive policies on incubation and entrepreneurship.

Critical to strengthening the entrepreneurship system for micro-, small and medium-sized enterprises is the availability of funding for such support mechanisms as incubators and accelerators and for the enterprises to gain access to technology and to scale up.

Some critical lessons learned from some countries in the subregion, as well as from other countries in the global South, such as Brazil, India and Malaysia, include the importance of government support for entrepreneurship, including in the form of adequate funding and supportive policies. In this regard, some consideration could be given to establishing technology transfer or acquisition funding mechanisms coupled with the capacity to assist micro-, small and medium-sized enterprises in embedding technology into their businesses. The focus of South Africa on enterprise and supplier development initiatives that enable the unlocking of private capital and market access could be emulated in other countries in the subregion.

9.3 : Complementary measures needed for technology incubators to impactfully deliver support to micro-, small and medium-sized enterprises and ensure their growth, survival and profitability

Respondents suggested the continuous and diligent monitoring of micro-, small and medium-sized enterprises from an operation, finance, compliance, risk and governance perspective.

In addition to improving mentorship and coaching services, incubators could provide opportunities for piloting, namely, through evaluation agreements with industry partners, which would draw more profound industry and sector knowledge and help to achieve optimal impact for the enterprises. Additional insights from the enterprises suggested that there could be stronger linkages to researchers and facilities at universities and research institutions and increased availability of laboratory or prototyping services to which they could gain access, even on a shared basis.

Seeking and establishing robust external networks would provide micro-, small and medium-sized enterprises with access to the relevant market linkages to support market participation endeavours.

Respondents also suggested that, by utilizing such innovations, incubators and Governments endorsed the enterprises' products and services. In addition, encouraging such endorsement by the private sector, specifically by large corporations, would go a long way towards helping the enterprises to gain access to the market but also, more importantly, direct feedback from industry end users and possibly technical guidance during the development stages.

Other support measures needed include building flexible financial support models that complement the life cycle of micro-, small and medium-sized enterprises and providing access to adequate funding throughout the various growth stages of the enterprises. Respondents suggested focusing on building quality enterprises and supporting the growth of enterprises towards attractive investment readiness levels.

Environments that inspire entrepreneurship should be created within incubators. Access should be improved to such forms of support as office space and workspace, mentorship and coaching, industry experts and social support, in particular in township and rural economies.

Incubators could also assist in de-risking start-ups from a market and product perspective. This could be achieved by providing periodic market analysis support for informed and guided research and development and product development, thereby ensuring product-market fit.

One observation made by many incubators was that, depending on the complexity of the technology solution, financing was required at each stage of technology development, in particular for hardware, equipment, raw materials and machinery. In addition, access to skilled talent was expensive, and managing talent required further people management skills and a basic understanding of labour law as the team grew. Technology incubators could facilitate that knowledge and access.

9.4 : Contribution of technology incubators to the development of micro-, small and medium-sized enterprises in general and in Southern Africa in particular

Most incubators are focused on supporting early-stage start-ups and on encouraging innovation across various industry sectors. They provide environments that inspire and nurture entrepreneurship, albeit with some improvements that could be made to the offering, as suggested by the enterprises that participated in the survey, reflected in the preceding chapter. Respondent incubators noted that, through the incubation of micro-, small and medium-sized enterprises, a significant impact has been seen in employment opportunities stemming from successful enterprises. An impact on the neglected youth population was also reported.

De-risking support was reported to have contributed to the development of informed products and services, thus yielding product-market fit and thereby providing micro-, small and medium-sized enterprises with access to existing markets and enabling them to secure some market share. The leveraging of incubator networks and market linkages also contributed to the development of the enterprises.

Some of the enterprises noted that the training programmes and initiatives hosted by incubators had contributed to increasing their capabilities. Thus, those programmes and initiatives reportedly improved the quality of entrepreneurs and ultimately had a positive impact on the development of micro-, small and medium-sized enterprises.

Incubators focused on township economies or underserved areas reported that the support offered to micro-, small and medium-sized enterprises from disadvantaged communities was critical to enabling the development of such enterprises and start-up survival.

Incubators also play an enabling role in facilitating access to funding sources. They could be more deliberate in promoting access to technology, technological assistance and technical facilities required by the enterprises, thus contributing to a vibrant science, technology and innovation sector and the industrialization of their countries and the subregion.

9.5 : Institutional form and governance

Most incubators in Southern Africa are established as non-profit organizations and are sustained by funding from one or more sources, including the Government, donors, private organizations and individual sponsors. These are complemented by government-owned incubators and a few for-profit entities and university-owned incubators. The Government substantially funds some incubators that self-identified as non-profit.

The challenge with non-profit organizations, in particular those funded by donors, is their sustainability, as evidenced by the number of incubators and accelerators that have closed their doors, according to Briter Bridges (2021). Governments remain a crucial financier of incubators. As such, it is imperative for Governments in the subregion to acknowledge their catalytic and enabling role concerning incubation and entrepreneurship in general, integrate this role into their economic development policies and find ways to budget for it appropriately.

Most incubators have either statutory or advisory boards. In the case of government-led incubators, the boards are appointed by the relevant line ministries in accordance with their respective countries' established mechanisms for constituting public entity boards. The chief executive officers of the public sector technology hubs are appointed by the individual boards, always in consultation with or following consultations with the relevant line ministries, or directly by the line ministries. In the case of a few university technology incubators that have governance boards, these are constituted by the university, in many cases by the vice-chancellors or senior management. Ensuring some degree of autonomy in their decision-making is crucial to the operation of these governance boards. Furthermore, given the intermediary role of incubators in the national system of innovation, it is imperative that the composition of the boards also includes significant stakeholders, in particular those from the private sector, or at least members with experience in entrepreneurship or in building businesses.

9.6 : Assessing the impact of incubators on the development of micro-, small and medium-sized enterprises

Whereas all incubators keep track of the number of micro-, small and medium-sized enterprises that they support, the more critical indicator appears to be the number of such enterprises that graduate from the programmes the incubators host, as this is an accurate measure of the latter's ability to help entrepreneurs and micro-, small and medium-sized enterprises navigate the arduous early-stage entrepreneurship phase. Other indicators include the number of high-tech products and services successfully commercialized by their incubated enterprises, the amount of funding raised for the enterprises and industry linkages.

The performance of the incubated enterprises is an important indicator to assess the impact of an incubator. This includes commercialization, exports, emanating intellectual property, revenue generation, profitability and success stories in general.

Job creation is not only an indication of growth; it is also one of the most valuable indicators of the impact of an incubator.

9.7 : Embedding technology incubators within national and subregional innovation systems that support the emergence of national and subregional business systems

Technology incubators need to attract talented and quality entrepreneurs, focusing on the needs and demands of the innovation systems. Incubators also need endorsements from the private sector, and thus there is a need to establish legitimate and credible networks contributing to the embedding of incubators within national and subregional innovation systems and the involvement of government officials in incubator-hosted programmes.

For incubators to become part of national innovation and entrepreneurship systems, far greater governmental and political will is needed to support start-ups, which should be demonstrated by the way in which incubators and start-ups are supported financially. Such support may include tax incentives, recognition for their contribution to the economy and, where possible, government procurement of goods and services from micro-, small and medium-sized enterprises supported by the incubators.

A lesson learned from South Africa is the value of dedicated funding for incubation programmes and micro-, small and medium-sized enterprises through the Ministry of Small Business Development and its agencies, the Small Enterprise Development Agency and the Small Enterprise Finance Agency. This could be replicated in other countries, and in fact similar initiatives are in place in Eswatini through the Small Enterprises Development Company and in Botswana through the Local Enterprise Authority. The enterprises noted the need to build strategic partnerships and have mechanisms in place for disseminating success stories of incubators and their incubated enterprises to promote entrepreneurship.

A suggestion from the enterprises was the need for concerted efforts to establish more technology incubators targeting: young people in towns, remote areas and underserved areas; higher education institutions; and special interest groups like young women.

Business and entrepreneurial education could be introduced early in academic learning (i.e. in primary and secondary school). This would create a population that was fundamentally conditioned for entrepreneurship and would necessitate demand for establishing technology incubators within national and subregional innovation systems.

Ensuring access to technology incubators that are not hindered by geographical limitations but instead have a national and subregional reach could serve to embed those incubators in the innovation systems.

Partnerships and collaborations with universities and research institutions could contribute to the sought embedment. Exhibitions were also highlighted as necessary for providing a platform for raising awareness about the role of incubators.

Respondents also suggested creating networking platforms at the national and subregional levels and ensuring that technology incubators could participate in conversations within that innovation system and potentially contribute to addressing the challenges faced by the system.

An important observation from the Government of Zimbabwe was its stance on embedding innovation and technology hubs into the education system under the education 5.0 policy, thus ensuring a value chain approach in nurturing and building an innovation system that fostered modernization and industrialization of the economy.

Some respondents suggested establishing incubators that were focused on specific areas of need, such as energy or water, at a national level. Doing so would ensure that resources aimed at those particular areas were concentrated in one place, thus ensuring the success of the incubated ideas. Such national incubators could be designed to collaborate with other subregional incubators in a format akin to a hub and spoke model or a network of incubators.

9.8 : Ensuring the sustainability (including the financial sustainability) of technology incubators

Rather than establishing new technology incubators, it is recommended that priority should be given to expanding and strengthening the existing ones by increasing their financial capabilities for operational expenditure and the funding of projects. Doing so would require conducting a proper mapping of the technology incubators in each country, and the present study contributes to that effort. This mapping should extend to creating a register of all infrastructure currently available to micro-, small and medium-sized enterprises.

The incubators, together with policymakers, need to develop new business models to ensure consistent revenue and the sustainability of the incubators. To that end, one of the recommendations emanating from the present study is to experiment with shared access or open access laboratory or technical facilities or equipment

to which the incubated enterprises could gain access. In the case of some sectors, such as biotechnology or the green economy, where such facilities may be costly, the idea of shared facilities could be explored on a subregional basis. The Southern Africa Network for Biosciences has, to some extent, attempted to implement such a model, with the Council for Scientific and Industrial Research in South Africa being the anchor.

Incubators should also explore other innovative solutions, such as creating a "giving back" culture whereby successful entrepreneurs are encouraged to give back to their incubators. Providing extensive financial and resource management training to enterprises may be another intervention that could ensure the prudent use of limited resources and reduce the potential for wasteful expenditure by incubators and the exhaustion of resources.

Technology incubators should be included in government budgets to support sustainability. Financial and parliamentary grants can assist in ensuring the sustainability of incubators, as is the case for the National Technology Business Centre in Zambia, the Botswana Digital & Innovation Hub and the Local Enterprise Authority in Botswana, the Royal Science and Technology Park in Eswatini, the Innovation Hub in South Africa and the innovation hubs in Zimbabwean universities.

It is imperative to recognize that, with the growth of the youth population, which is accompanied by rising unemployment and what appears to be a greater emphasis on entrepreneurship in many countries in the subregion, Governments will need to play a more active and visible role in supporting and even regulating incubators. There is a role that incubators play, which is an institutional function that many Governments need to perform by creating work opportunities for their young people and the mix of their economic activities, given the vital role that micro-, small and medium-sized enterprises play in society. In this regard, the countries that will be successful and have sustainable technology incubators are those that receive financial and other support from their Governments. The financial support may even take the form of tax incentives, thus enabling the private sector to be more involved than perhaps has been the case.

Strategic alignment and linkages with appropriate international organizations (such as, but not limited to, ECA, UNDP, industry associations and the African Development Bank) can ensure incubator sustainability by providing access to financial support information networks that can build capacity among the leadership and management of technology incubators.

Collaboration and knowledge-sharing among incubators can ensure financial sustainability by eliminating the duplication of costs and maximizing limited resources. This could include sharing pooled technical resources or designated facilities and technical resources at universities and research institutions.

Although some incubators are considering levying a fee for their services or taking up equity in the micro-, small and medium-sized enterprises they support, this is unlikely to significantly contribute to sustainability. However, charging a royalty could contribute to the enterprises taking the support provided by incubators very seriously and holding the incubators accountable.

Some incubators that were interviewed or that responded to the survey indicated that they relied on running programmes for corporations and third parties, such as donors, thus taking a management fee from the funding received.

9.9 : Reconciling the need for building a critical mass of technology entrepreneurs and innovators with the ambition to “leave no one behind”

Reconciling the need for building a critical mass of technology entrepreneurs with the ambition to “leave no one behind” is complex. Incubators must develop distinct mandates spread out along the entire technology value chain. This should be matched with specific interventions to address both imperatives. There is a need to focus on high-potential businesses that contribute to industrialization, which could be achieved with world-class technology. Collaboration among stakeholders in both the public and private sectors could help to strike a balance, thus ensuring an appropriate allocation of responsibilities. The responsibility of local economic development, which encapsulates the ambition to “leave no one behind”, falls to the Government. The Government must assume this responsibility and not abdicate it or delegate it to private incubators without providing appropriate resources.

Incubators could have a variety of programmes focused on different sectors, with the support of the private and public sectors, providing education, training and skills development to empower entrepreneurs across various industries and fields. Incubators could also ensure diversification of the range of services and support they offer.

Mainstreaming entrepreneurship awareness and education and providing free tools, resources and digital platforms in places where access to them is available may go a long way towards ensuring inclusivity. One of the observations made by incubators and enterprises that participated in the present study was the concentration of incubation resources in the main cities. Thus, to ensure that “no one is left behind”, it is crucial to be deliberate about expanding incubation services to rural, remote and peri-urban areas.

Given the costly nature of developing innovations and being supported by a technology incubator, incubators should publish calls for proposals related to subject areas they will fully fund or support. This would allow innovators without funding to have their ideas linked with funding. Incubators should also scout for challenges or problems the industries in their subregion and countries face and connect them to innovators through these special calls. Doing so might also include the use of open innovation platforms.

Respondents expressed strong views that “leaving no one behind” began with digital literacy and with gaining confidence in one’s ability to develop solutions for one’s own context. The system needs both high-tech, data-driven innovation and foundational digital skills and practices to advance inclusive innovation. A blend of incubators is needed that addresses both pathways to developing a critical mass.

9.10 : Incubators and industrialization

A suggestion was made to set up specialized hubs that represented different sectors, design programmes to cater for micro-, small and medium-sized enterprises at the various stages of development, and recognize that some such enterprises would come from a low technological and entrepreneurial base and would require more support than others. Buys and Mbewana (2007) suggest that technology incubators can succeed only when Governments appreciate the relationship between entrepreneurship and economic growth and when they are integrated as part of a "broad-based consensus on economic and industrial policy". Given the incubators' positioning regarding knowledge transfer networks, including technology transfer, which is critical for developing industries, they are crucial for industrialization and the establishment and growth of a new generation of businesses, such as those geared towards the fourth industrial revolution (Tanakov, 2020).

Given the importance of technology transfer and new knowledge generation for industrialization, there is a need to build capacity in the management of intellectual property rights. Whereas the author did not delve specifically into this matter in the present study, some of the incubators that responded to the survey or were interviewed offered intellectual property support to incubated enterprises, either directly through in-house personnel, as was the case with the Innovation Hub in South Africa, or in collaboration with the national intellectual property office, as was the case with the incubators in Botswana, Namibia and Zambia.

9.11 : Constraints faced by women and young people in gaining access to technology incubators

Women and young people generally have other responsibilities and limitations that affect their access to incubator services, such as family responsibilities, educational challenges and socioeconomic vulnerabilities. Incubators located in townships also reported such constraints as digital illiteracy, crime and poverty.

There are comparatively more male-led micro-, small and medium-sized enterprises in the subregion's technology incubators than those led by females. Male-led enterprises are reported to be active in the area of science and technology. Recent studies have also revealed a gender imbalance in access to funding, with female-led micro-, small and medium-sized enterprises attracting far less funding than their male-led counterparts. Onyango (2022) points out that the share of investments going to female-owned technology startups stood at about 6.5 per cent in 2021, meaning that just $1 in every $15 raised in the African start-up system went to women-owned technology start-ups. Most female-owned start-ups are usually focused on the health technology, education technology and sustainable technology sectors. Unfortunately, there is not a great deal of investment available for these sectors.

Within the investor community, there is an underlying bias and a belief that women-driven ventures represent a riskier bet. This and the fact that there are fewer women in incubation programmes are other factors making it difficult for female founders to attract investments (Onyango, 2022). As such, all-female teams are less likely to receive financing than all-male teams, and, in cases where they do receive funding, they receive smaller amounts. This situation calls for dedicated female-focused incubation

and funding programmes, such as ShEquity and the Women's Entrepreneurship Access Center in Zambia. Another consideration is that of refining incubation recruitment strategies and incorporating female industry mentors and coaches.

Women entrepreneurs face additional constraints relating to access to funding and complete access to incubator services. Many female founders experience unfair discrimination based on gender, sex, pregnancy, marital status, family and age. Some respondents also reported a gender-discriminatory environment stemming from social norms and ancient African moral laws. Consequently, technology incubators should have facilities that support women who have just given birth or who have young children.

To the extent possible, technology incubators should be located close to where young people reside or along a public transport route. In addition, there is a need to establish technology incubators in peri-urban, rural and poor areas to ensure that no one is left behind.

At present, there is little consideration given to persons with disabilities or impairments in the design and programmatic interventions of the technology incubators. To ensure that no one is left behind and that inclusivity is achieved, there must be deliberate consideration for persons living with disabilities, as much as for young people and women.

In the case of young people, the major challenge is that of convincing the industry of their ability to develop viable businesses, in particular in such sectors as the green economy and the bioeconomy. Given the prospects for driving industrialization through these sectors, technology incubators must work closely with universities and other research institutions to increase access to technology by the enterprises they support or to promote the commercialization of research results attained at these institutions. Young people have higher chances of success in digital and related sectors owing to their ease of embracing and working with digital tools and technology. Digital technology and associated sectors have prospects of driving the development of new fourth industrial revolution industries. Another challenge many young people face is a lack of funding to support their own livelihood, such that they tend to prioritize earned income opportunities and drop out of technology incubator programmes if paid opportunities come their way.

The most debilitating constraint faced by women and young people is a lack of knowledge and appreciation of the existence and purpose of technology incubators and innovation hubs. In one of the countries surveyed, there was general agreement that there was an unfounded but existing myth among innovators and micro-, small and medium-sized enterprises that innovation hubs stole ideas. To address this concern, technology incubators should develop intellectual property policies that provide clarification about the ownership of any intellectual property developed by the enterprises they support and about how the enterprises should handle intellectual property issues when dealing with third parties. In essence, incubators should not own intellectual property developed by incubated enterprises. The enterprises should own the intellectual property they generate to the extent that the originality lies with the employees or founders of the enterprises. In addition, employees of technology incubators should sign a non-disclosure agreement with the incubator, under which they should be prohibited from misappropriating or disclosing to unauthorized persons

any intellectual property they encounter in their interactions with entrepreneurs and incubated enterprises.

9.12 : How technology incubators can contribute to the building of the green, blue and digital economies

Incubators need to be equipped with experts in the green, blue and digital economies. Some incubators proposed focusing their limited resources on only one economy to ensure a more significant contribution.

The private and public sectors can drive initiatives across the various economies and incentivize technology incubators to participate in and make significant contributions to building the green, blue and digital economies. The green economy is focused on transitioning to a low-carbon economy, requiring policy instruments that provide incentives for innovation. The digital economy is focused on more efficient ways of doing things. While this may also result in potential job losses, there are numerous opportunities for reskilling and creating new jobs that currently do not exist. Educating young people and members of township economies about the various sectors and opportunities available can inspire entrepreneurship, innovation and involvement in the blue, green and digital economies. Policies that foster public-private engagements to drive innovation and improve public sector service delivery are critical.

Technology hubs or incubators should provide a safe, collaborative and exciting space for people to explore ideas, make mistakes and design, build and adjust their product or service to fit the needs of the community or industry, while offering training and support in these emerging sectors of global importance. As discussed above in the present section, incubators should be encouraged to develop and implement intellectual property policies and work with national intellectual property offices and organizations in their countries to increase intellectual property awareness and education. An important consideration is for technology incubators to link science, technology and innovation and the Sustainable Development Goals to their programmatic offerings. However, this requires their countries to make parallel investments in science, technology and innovation, entrepreneurship and incubators.

Some respondents believed the lack of innovation relating to the green and digital economies to be mainly owing to a lack of information and knowledge among the population. In this respect, incubators should offer workshops and short courses to educate society on the benefits of blue, green and digital technologies.

9.13 : Extent of the specialization of incubators

Although several incubators in Southern Africa are sector-agnostic and essentially operate as business incubators with no specialization whatsoever, some are sector-focused. The technology sectors supported by the incubators in the subregion include agriculture and agribusiness, ICT, digital and other technologies, biotechnology and health, the green economy (water, waste management, renewable energy and climate change), manufacturing, creative industries and construction.

Notwithstanding the sectors in which most of the enterprises in the incubation programmes operated, most incubators did not have specific technology

interventions to support the enterprises' technological development or their access to technology. Almost half of the respondent incubators supported ICT and digitally inclined enterprises, 37.5 per cent supported enterprises in agriculture, 21.8 per cent supported enterprises in the green economy and 6 per cent in biotechnology. A handful of incubators covered by the present study incubated enterprises in the digital and green economies or specialized in those areas. For example, BongoHive, mLab, Tshimologong Digital Innovation Precinct and mHub, to name a few, had a particular specialization in the digital economy. Other incubators, such as the Climate Innovation Centre South Africa, the Small Enterprise Development Agency Atlantis Renewable Energy Business Incubator, the Botswana Digital & Innovation Hub, Mzuzu E-Hub, TheNeoHub and the Impact Amplifier, stated that they specialized in supporting entrepreneurs and enterprises in the green economy. The Innovation Hub in South Africa and the Botswana Digital & Innovation Hub were the only technology hubs that provided specialist incubation that incorporated the ICT or digital technology sectors and at least one or both of the bioeconomy and the green economy. There was only one incubator that was focused on the blue economy.

Other than the university-based incubators, most had weak linkages to universities, except those that were more focused on agriculture, which appeared to have closer ties with agriculture faculties or colleges.

9.14 : Implications of the disconnect between development policies and incubators and the development of micro-, small and medium-sized enterprises

If the policy and regulatory environment in the various countries in Southern Africa is not conducive to technology entrepreneurs, the consequence of this would be that many will increasingly relocate their businesses abroad to seek the necessary support and market access, with the result that the countries will not benefit from the related tax and other revenue. Another consequence is that incubators may remain nascent infrastructure and development tools.

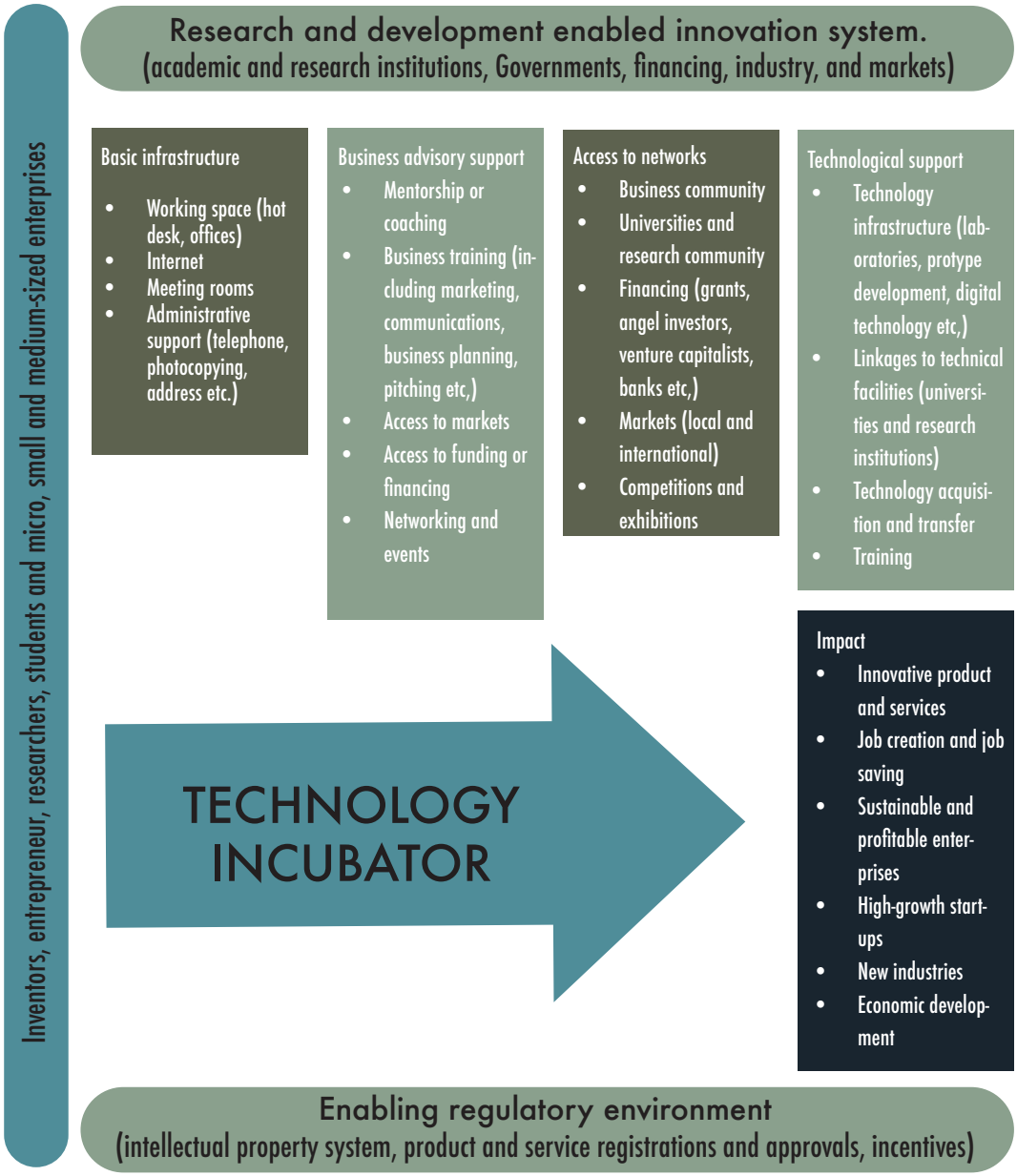
Governments must update their policies and keep them up to date with the direction of entrepreneurship development in the subregion and globally so as to prevent any disconnect between development policies and incubators and the development of micro-, small and medium-sized enterprises. A disconnect may result in enterprises failing to respond to the demands of society and incubators not being in a position to provide the relevant support.

In summary, a disconnect and lack of alignment between policymakers and incubators will invariably have a negative impact and diminish the work of the incubators.

10: Conclusion

Technology incubators are critical for developing vibrant innovation and entrepreneurship systems that contribute to the commercialization of science and technology innovations, enhancing productivity and industrialization of Southern Africa. In order for these incubators to be effective, they should go beyond providing typical business incubator services that shield micro-, small and medium-sized enterprises from the harsh realities of business, thus increasing their survival rate. They should enable access to technology by, among other things, providing access

Figure XXXIX: Conceptual framework for technology incubators in Southern Africa, developed on the basis of the present study



Source: Author-generated as part of the present study.

to critical technical equipment necessary to provide proof of concept, support manufacturing, improve productivity and help enterprises to incorporate technology into their products, services and processes.

Figure XXXIX contains a conceptual framework proposed for technology incubators in Southern Africa that is based on the outcomes of the present study.

Whereas most incubators provide basic infrastructure, business advisory support and access to financial and market access networks, most are lacking in their offer of technological support. The level of technological support is dependent on the state of the innovation system, which is often characterized by low investment in research and development, weak levels of engagement between research institutions and incubators, weak linkages between industries and institutions and poor use of the intellectual property system, as demonstrated by the low number of intellectual property registrations in Africa compared with the rest of the world (WIPO, 2022), and inadequate funding of the incubators, as well as of the micro-, small and medium-sized enterprises they support.

Southern African countries should explore the development of technology acquisition and technology transfer support mechanisms for micro-, small and medium-sized enterprises in technology incubators. The initiative run by the National Technology Business Centre in Zambia is a good case study or pilot that could be expanded upon.

BongoHive (ICT and digital technology), the Innovation Hub (ICT and digital technology, the green economy and the bioeconomy) and the Botswana Digital & Innovation Hub (ICT and digital technology and the bioeconomy) are great examples of specialization and the provision of appropriate infrastructure by incubators and can be used as good case studies.

There is consensus that the impact of the incubators should be measured using metrics that go beyond the number of entrepreneurs or enterprises incubated and should include such indicators as innovative products and services, job creation and job saving, the number of high-growth start-ups or sustainable and profitable enterprises graduating from the incubators, new industries and economic development.

The present study contributes to gaining a better understanding of the technology incubator environment in Southern Africa. The critical component of the present report is the valuable contributions and feedback provided by close to 35 technology incubators in the subregion, as well as by micro-, small and medium-sized enterprises that these incubators have incubated.

In some countries, there were perceptions of some tensions between the Government and private-sector-led technology incubators, with the Government having access to more resources with which to support entrepreneurs, even when it might not have the same level of capability as the private-sector-led incubators. Some respondents indicated that they found themselves compelled to associate with the government-led incubators, even when they did not see any other benefits of doing so, as potential local and international funders took a political position by channelling financial and other resources through government-led initiatives.

There is disparity among the countries in the subregion regarding the level of support provided by Governments to technology incubators, the number of functional technology incubators, the extent to which technology incubators support micro-, small and medium-sized enterprises, in particular in gaining access to technology or incorporating technology into their businesses, and the level of funding by Governments to enable micro-, small and medium-sized enterprises to gain access to technology. It has been made evident through the present study that there is a need for technology incubators in the subregion. There is also a close correlation between a country's level of development and the number of functional technology incubators in the country; the extent of funding provided by the Government for science, technology and innovation and technology incubators; the drive for industrialization; and the focus on technology incubators.

The sustainability of technology incubators poses a big challenge, given the lack of funding by some Governments. To remain in existence, some technology incubators resort to "following the money" and focusing on donor-funded and corporation-funded programmes. The danger of doing so is that there is likely to be a misalignment between the providers of capital or funding for these programmes and the countries' development and industrialization priorities. In addition, this approach supports the donors' agenda as opposed to contributing to the implementation of national development plans and priorities or national industrial policy or the achievement of regional and subregional development goals. Accordingly, there is a need for technology incubators to be more focused, to be integrated into national development plans, industrial policies and public budgets and to be anchored by an enabling intellectual property environment.

Annex A: Mapping of technology incubators in Southern Africa

Name	Website	Location
Acelera Angola	https://acelerangola.com	Luanda
Nossoffice & Coworking	https://africatechschools.com/school/nossoffice-coworking/	Angola
Disruption Lab	www.coworker.com/angola/luanda/disruption-lab	Angola
Botswana Digital & Innovation Hub	www.bih.co.bw	Botswana
Local Enterprise Authority: Pilane Multi-Purpose Incubator (2009) Gaborone Leather Industries Incubator (2010) Francistown Business Incubator (2011) Glen Valley Horticulture Incubator (2011) Gaborone Leather Industries Incubator	www.lea.co.bw	Gaborone
TheNeoHub Innovation Lab	www.theneohub.com	Gaborone
Market Players	https://marketplayers.africa/about-us/	Gaborone
Royal Science and Technology Park Business Incubator	..	Eswatini
Small Enterprises Development Company	www.sedco.co.sz	Eswatini
Vodacom Innovation Park	www.vodacom.co.ls/about-us/foundation/	Lesotho
NUL Innovation Hub	www.nulinnovationhub.co.ls	Lesotho
Sky Business Inc (Pty) Limited	www.skybusinessinc.com	Lesotho
ideiaLab / Orange Corners Maputo (ideiaLab is the implementing partner for the Orange Corners Maputo incubator)	https://ideialab.biz www.orangecorners.com/country/mozambique/	Maputo
MozDevz	www.mozdevz.org	Maputo
Namibia Business Innovation Institute FABlab Design and Technology Centre	http://nbii.nust.na https://ennova.africa/organizations/fablab-namibia	Windhoek
Chancellor's Innovation Fund, University of Namibia	www.unam.edu.na/cif/	Windhoek
Bokamoso Entrepreneurial Centre	https://zane-dippenaar.wixsite.com/bokamoso	Windhoek
mHub	https://mhubmw.com/contact-us/	Lilongwe
Dzuka Africa StartUp Hub	www.facebook.com/blantyrehub/	Blantyre, Malawi
Agribiz Hub Department of Agribusiness Management, Lilongwe University of Agriculture and Natural Resources	https://luanar.ac.mw/agribiz/	Lilongwe
Mzuzu E-Hub	https://update.mzuzuehub.org	Mzuzu, Malawi
Centre for Entrepreneurship and Commercialization	www.must.ac.mw/the-centre-for-entrepreneurship-and-commercialization/	Limbe, Malawi
Turbine Incubator	https://turbine.mu	Mauritius

La Plage Factory	https://laplage.io	Mauritius
UVU Africa	https://uvuafrica.com/	Cape Town, South Africa
Impact Amplifier	www.impactamplifier.co.za	Cape Town
LaunchLab	www.launchlab.co.za	Stellenbosch, South Africa
Timbali Technology Incubator	https://timbali.co.za	South Africa
Cortex Hub	www.thecortexhub.africa	East London, South Africa
Maxum Business Incubators (Maxum Smart and Maxum Digital)	www.theinnovationhub.com/business-incubators/maxum-business-1	Pretoria
Furniture Technology Centre Trust (Furntech)	https://furntech.org.za	Cape Town
Biofuels Business Incubator	https://biofuelsbi.org.za/	South Africa
Climate Innovation Centre South Africa (hosted by the Innovation Hub)	www.theinnovationhub.com/business-incubators/climate-innovation-centre-south-africa-6/#	Pretoria
Innovation Technology Business Incubator (Invotech Innovation Incubator)	https://impactsa.co.za/invotech/	Durban, South Africa
Khayelitsha Bandwidth Barn	https://uvuafrica.com/spaces/bandwidth-barn-khayelitsha/	Cape Town
Softstart Business and Technology Incubator	https://softstartbti.co.za	Midrand, South Africa
OceanHub Africa	www.oceanhub.africa	Cape Town
Tshimologong Digital Innovation Precinct	https://tshimologong.joburg	Johannesburg, South Africa
Riversands Incubation Hub	https://riversandsihub.co.za	Johannesburg
Tembisa Incubation Hub	..	Johannesburg
Startup Hatchery	www.thestartuphatchery.co.za	Cape Town
Founders Factory Africa	www.foundersfactory.africa	Johannesburg
Impact Hub	https://theimpacthub.co.za	Johannesburg
Silicon Cape Initiative	www.siliconcape.com	Cape Town
22 On Sloane	www.22onsloane.co/h/	Johannesburg
SmartXchange	www.smartxchange.co.za	Durban
Propella	https://thepropella.co.za	Gqeberha, South Africa
Siyafunda Community Technology Centre	www.siyafundactc.org.za	South Africa
Ekurhuleni Jewellery Project	https://ejewellery.org.za	Johannesburg
Ekurhuleni Fablabs (Fablab Tembisa and Fablab Thokoza)	www.fablabs.io/labs/ekurhulenifablabs	Johannesburg
Innovate Durban	www.innovate.durban	Durban
Small Enterprise Development Agency Essential Oils Business Incubator (SEOBI)	www.seobi.co.za	South Africa
Small Enterprise Development Agency Atlantis Renewable Energy Business Incubator (SAREBI)	https://sarebi.co.za	Cape Town
Central University of Technology Fablab	www.cut.ac.za/fablab	South Africa
Black Umbrellas	https://blackumbrellas.co.za	South Africa
South African Chemical Technology Incubator (Chemin)	https://impactsa.co.za/chemin/	South Africa

eKasiLabs Sebokeng	www.theinnovationhub.com/business-incubators/ekasi-labs-4	Johannesburg
Small Enterprise Development Agency Agricultural and Mining Tooling Incubator	https://vc4a.com/seda-agriculture-and-mining-tooling-incubator-samti/	South Africa
Mobile Applications Laboratory (mLab)	https://mlab.co.za	Pretoria
Small Enterprise Development Agency Ekurhuleni Base Metals Incubator (Lepharo)	https://lepharo.co.za	South Africa
BioPark Business Incubator (BioPark@Gauteng)	www.theinnovationhub.com/business-incubators/biopark-gauteng-7	Pretoria
Mobile Agricultural Skills Development and Training	www.masdt.co.za/index.php	South Africa
East London Industrial Development Zone Science and Technology Park	www.elidzstp.co.za	East London
Wot-if? Trust – Father Louis Blondel Centre	https://wot-if.co.za	Johannesburg
Innovation Hub	www.theinnovationhub.com/about-us	Pretoria
TuksNovation	https://tuksnovation.co.za	Pretoria
AlphaCode	www.alphacode.club	Johannesburg
Bakery and Food Technology Incubator	www.bicsa.co.za	Pretoria
Injini	www.injini.africa	Cape Town
Africa Beyond 4IR	https://ab4ir.org	Pretoria
BongoHive Technology and Innovation Hub	https://bongohive.co.zm	Lusaka
Zambian Centre for Agribusiness Innovative Solutions Limited	..	Lusaka
Agribusiness Incubation Trust Limited	https://agriprofocus.com/organisation/agbit	Lusaka
Women's Entrepreneurship Access Center, Zambia	https://weaczambia.org	Lusaka
AgriEn Network	https://zm.linkedin.com/company/agrien-network	Lusaka
AgriWorth Incubator Limited	https://agriworth.africa/	Lusaka
National Technology Business Centre	https://ntbc.co.zm	Lusaka
Jacaranda Hub	https://jacarandahub.org	Lusaka
Impact Hub Harare	https://impacthubharare.net/	Harare
Muzinda Hub Zimbabwe	https://vc4a.com/muzinda-hub/	Harare
Midlands State University Hub	https://hub.msu.ac.zw	Gweru, Zimbabwe
TechVillage Innovation Hub	www.techvillage.org.zw	Zimbabwe
Harare Institute of Technology Innovation Hub	www.hit.ac.zw/news/president-mnangagwa-launches-hit-innovation-hub.html	Harare
National University of Science and Technology Innovation Hub	www.nust.ac.zw/index.php/home/vice-chancellors-office/innovation-hub.html	Bulawayo, Zimbabwe
Chinhoyi University of Technology Innovation Hub	www.cut.ac.zw/welcome/directorate/2	Chinhoyi, Zimbabwe
Elevate Trust Science and Technology Incubation Hub	www.elevatetrust.org/	Harare
UbuntuLab	www.ubuntulab.africa	Zimbabwe
Great Zimbabwe University Innovation Hub	www.gzu.ac.zw/research-and-inovation/	Masvingo, Zimbabwe

Annex B: Survey for incubators in Southern Africa

The Role of Technology Incubators in MSME Development in Southern Africa

Incubators' Survey

* Required

1.1. Name of Incubator * _____

1.2. Location of incubator (City, Country) *

1.3. Business Sector Focus *

Mark only one oval.

◯ Agriculture

◯ Biotechnology

◯ Manufacturing

◯ Information Communications Technology (ICT)

◯ Green Economy (energy, renewables, water, climate change)
Other:

1.4. Year Established * _____

1.5. Gender of Founder

Mark only one oval.

◯ Male

◯ Female

◯ Prefer not to say

2.1. What does your incubation process look like? What kind of support do you provide?

_____
_____
_____

2.2. Funding Model *Mark only one oval.*

◯ Funded by Government

◯ Non-Profit Organization (funded by one or more donors, including government)

◯ For Profit (charges for services)

◯ Part of University / Tertiary/ Research Institute Other:

◯ _____

2.3. Who are your target beneficiaries?

_____

2.4. How do you select target beneficiaries /companies to be incubated?

Mark only one oval.

◯ Advertize

◯ Pitching sessions

◯ Referrals from partners

◯ Application process

◯ Other: _____

2.5. Please list up to ten (10) incubatees/ innovators supported by your incubator

_____
_____
_____
_____
_____

2.6. Of the ten (10) listed, please list up to five (5) that have gone on to become independent enterprises/ businesses? Kindly provide email contacts for these.

_____
_____
_____
_____
_____

3.1. Do you have clear entry and exit criteria for incubates?

Mark only one oval.

◯ Yes

◯ No

3.2. If 'Yes', please elaborate on the entry and exit criteria

_____
_____

_____

3.3. Do you have a pre-incubation programme? (pre-revenue stage)

_____

3.4. What is the duration of the incubation period? ***(please elaborate)***

_____

3.5. What office space and facilities does the incubator offer (check as appropriate)
Check all that apply.

☐ Hot desking

☐ Individual offices

☐ Meeting rooms

☐ Coffee services / Canteen None

☐ Other:

4.1. Offer business mentorship and coaching?
Mark only one oval.

◯ Yes

◯ No

4.2. If 'Yes', please elaborate on the business mentorship and coaching offered.

_____
_____
_____
_____
_____

4.3. Does the incubator support access to markets?
Mark only one oval.

◯ Yes

◯ No

4.4. If 'Yes', please elaborate on the support offered to access markets.

_____
_____
_____
_____
_____

4.5. Offer linkage to facilities and services at universities and research institutions?

Mark only one oval.

⬭ Yes

⬭ No

4.6. If 'Yes', please elaborate on the linkages supported.

_____
_____
_____
_____
_____

4.7. Does the incubator encourage collaboration between incubated companies?

Mark only one oval.

⬭ Yes

⬭ No

4.8. If 'Yes', please elaborate on how collaboration between incubated companies is supported.

_____
_____
_____
_____
_____

4.9. Offer international business services (e.g linkages to customers or other companies in other countries).

Mark only one oval.

⬭ Yes

⬭ No

4.10. If 'Yes', please elaborate on how the incubator offers these business services.

_____
_____
_____
_____
_____

4.11. Other services offered

(check as appropriate)

Check all that apply.

▭ ICT / Connectivity

☐ Intellectual property protection and commercialization services (i.e assistance concerning registration and commercialization of intellectual property)

☐ Legal services including contracts drafting and review

☐ Accounting and bookkeeping services

☐ Access to finance (i.e strong partnership and linkages with various funding government funding agencies, non- government organizations, and other local and international funding institutions)

☐ Facilitate partnerships

☐ Business training services, workshops

☐ Laboratory / prototyping services

☐ Events and other networking services

☐ Linkages to researchers at universities and research institutions

☐ Pitching workshops and assistance with pitching

☐ Virtual incubation services

☐ Innovation competitions

5.1. Does the incubator run competitions amongst its incubated companies?

Mark only one oval.

◯ Yes

◯ No

5.2. If 'Yes', how regularly are these competitions held?

Mark only one oval.

◯ At least once a year

◯ At least once a quarter

◯ More than 4 times a year

5.3. Is the prize cash or in kind?

Mark only one oval.

◯ Cash

◯ In kind

◯ Other:

5.4. If cash, is the amount:

Mark only one oval.

◯ Less than USD 5,000

◯ Less than USD 10,000

◯ Less than USD 20,000

◯ More than USD 50,000

◯ Other: _____

5.5. If cash, are there conditions to how this money should be spent?

Mark only one oval.

◯ Yes

◯ No

5.6. If 'Yes', please elaborate on the conditions for this support

5.7. Does your incubator have strong linkages with other entrepreneurship support structures?

Mark only one oval.

◯ Yes

◯ No

5.8. If 'Yes', what types of support do these external structures offer to your incubator?

_____
_____
_____
_____
_____

Incubation Success

6.1. How would you describe the entrepreneurial ecosystem? What strengths and weaknesses exist? (e.g regulation, availability of capital, level of ambition, culture etc)

_____
_____
_____
_____
_____

6.2. What would you change to strengthen the entrepreneurial ecosystem for startups?

_____
_____
_____
_____
_____

6.3. What are the key (additional) support measures that technology incubators should provide to achieve optimal impact for MSMEs in terms of competitiveness, profitability and their survival and growth?

_____
_____
_____
_____
_____

6.4. What complementary measures need to be in place for technology incubators to impactfully deliver support to startups and ensure their growth?

_____
_____
_____
_____
_____

6.5. How does your technology incubator contribute towards MSME development in general and in Southern Africa? ***(Please elaborate)***

_____
_____
_____
_____
_____

6.6. How do you assess the impact of your incubator on MSME development?

_____
_____
_____
_____
_____

6.7. To date, on a scale of 1 to 5, how effective has your incubator been in supporting entrepreneurs? (*1 - not effective at all, 2 - below average, 3 - average, 4 - above average and 5 - exceeded expectations) Mark only one oval.*

1 ⬭

2 ⬭

3 ⬭

4 ⬭

5 ⬭

Exceeded expectation

6.8. Please elaborate on the effectiveness of your incubator, as rated above.

_____
_____
_____
_____
_____

6.9. Any thoughts on how to embed technology incubators within national and regional innovation systems that support the emergence of national and regional business eco-systems?

_____
_____
_____
_____
_____

6.10. How can we ensure sustainability (including financial) of technology incubators in Southern Africa?

_____

6.11. How can incubators reconcile the need for building a critical mass of technology entrepreneurs / innovators and the ambition to "leave no one behind"?

_____
_____
_____
_____
_____

6.12. What are special constraints faced by women and youth in accessing technology incubator services?

_____
_____
_____
_____
_____

6.13. Do you see any patterns or common mistakes made by start-ups? If so, please elaborate

6.14. On a scale of 1 to 5, to what extent are technology incubators embedded in existing development policies (entrepreneurship, MSME development, investment, industrial, trade)? (1- very small extent, 5 - to the greatest extent)

Mark only one oval.

6.15. What are the implications of any disconnect between the incubator and existing development policies?

_____
_____
_____
_____
_____

6.16. How can technology incubators in Southern Africa contribute to the building of green, blue and digital economies?

_____
_____
_____
_____
_____

6.17. Given your experience to date, list up to five (5) things that could enhance your effectiveness as an incubator

_____
_____
_____
_____
_____

6.18. In your opinion, on a scale of 1 to 5, what indicators should be used to assess the success and effectiveness of technology incubators as a development tool?

Mark only one oval per row

	important	important	important	important	important
Number of incubates companies	◯	◯	◯	◯	◯
Successful exits / graduations from incubation programme	◯	◯	◯	◯	◯
Funding raised for incubated companies	◯	◯	◯	◯	◯
Sustainability of the incubator (run as a business with a revenue generation model)	◯	◯	◯	◯	◯
Network and engagement within the National System of Innovation	◯	◯	◯	◯	◯
Infrastructure	◯	◯	◯	◯	◯

(i.e office space, state of-the-art facilities, testing and prototyping facilities and meeting rooms for incubates)

Employment creation by the incubated					
Revenue of incubated companies					
Other companies					

Annex C Survey for micro-, small and medium-sized enterprises supported by incubators that responded to the study survey

The Role of Technology Incubators in MSME Development in Southern Africa

Incubated Companies Survey

* Required

1.1. Name of Company *

_____

1.2. Location of Company *

(City, Country)

_____

1.3. Size of Company *

(Number of employees) Mark only one oval.

◯ 1-10

◯ 11-50

◯ More than 50

1.4. Gender of Founder(s) *

Mark only one oval.

◯ Male

◯ Female

◯ Both

◯ Prefer not to say

1.5. Age of Founder(s) *

Mark only one oval.

◯ less than 25

◯ less than 30

◯ less than 35

◯ less than 40

◯ less than 50

◯ above 50

1.6. Business Sector *

Mark only one oval.

◯ Agriculture

◯ Biotechnology

◯ Manufacturing

◯ Information Communications Technology (ICT)

◯ Green Economy (energy, renewables, water, climate change)

◯ Other: _____

1.7. Briefly describe your personal background (entrepreneurial experience, education and training)

_____
_____
_____
_____
_____

1.8. What were your motivations to become an entrepreneur?

_____
_____
_____
_____
_____

2.1. When did you get admitted to the incubator? *

_____

2.2. Was this your first incubator? *

Mark only one oval.

Yes

No

2.3. If not, how many other incubators have you been part of before?

3.1. What were your reasons for joining this incubator? *

_____
_____
_____
_____
_____

3.2. What has been / was the highlight of your incubation period? *
(Please describe in 2 sentences)

_____
_____
_____
_____
_____

3.3. What do you consider to be weak and strong points of the entrepreneurial ecosystem your start up operates in? (e.g capital market, entrepreneurial community, regulations, overall culture: risk taking, ambition, status of entrepreneurs etc)

_____
_____
_____
_____
_____

3.4. Do you have any suggestions to increase the emergence and growth of startups in your industry?

_____
_____

_____
_____
_____

4.1. Rate, on a scale of 1 to 5, the quality of the following services provided by the * incubator

Mark only one oval per row.

	1 = very poor	2 = below average	3 = average	4 = good	5 = excellent	N/A = Non applicable
Induction into the incubator	◯	◯	◯	◯	◯	◯
Intellectual Property protection and commercialization services (i.e assistance concerning registration and commercialization of intellectual property)	◯	◯	◯	◯	◯	◯
Legal services	◯	◯	◯	◯	◯	◯
Accounting services	◯	◯	◯	◯	◯	◯
ICT / internet connectivity	◯	◯	◯	◯	◯	◯
Business mentorship	◯	◯	◯	◯	◯	◯
Access to Finance (i.e. strong partnership and linkages with various funding government funding agencies, non- government organizations, and other local and international funding institutions)	◯	◯	◯	◯	◯	◯

14

Access to Markets	⬭	⬭	⬭	⬭	⬭	⬭
Facilitating Partnerships	⬭	⬭	⬭	⬭	⬭	⬭
Office space and facilities (i.e. conducive environment with state-of-the-art facilities and meeting rooms for incubates)	⬭	⬭	⬭	⬭	⬭	⬭
Business training services	⬭	⬭	⬭	⬭	⬭	⬭
Laboratory / prototyping services	⬭	⬭	⬭	⬭	⬭	⬭
Events and other networking services	⬭	⬭	⬭	⬭	⬭	⬭
Linkages to facilities and services at universities and research institutions	⬭	⬭	⬭	⬭	⬭	⬭
Linkages to researchers at universities and research institutions	⬭	⬭	⬭	⬭	⬭	⬭
Pitching workshops and assistance with pitching	⬭	⬭	⬭	⬭	⬭	⬭
Encouraging collaboration between incubated companies	⬭	⬭	⬭	⬭	⬭	⬭

International business services (i.e. linkages to customers or other companies in other countries)	⬭	⬭	⬭	⬭	⬭	⬭
Virtual incubation services	⬭	⬭	⬭	⬭	⬭	⬭

4.2 To date, has the incubator met your expectations? (scale of 1 to 5) *

1 = not at all 5 = exceeded expectations

Mark only one oval.

1 ⬭

2 ⬭

3 ⬭

4 ⬭

5 ⬭

Exceeded expectation

4.3. On a scale of 1 to 5, how would you rate the incubator on the following:

Mark only one oval per row.

	1 = very poor	2 = below average	3 = average	4 = good	5 = excellent
Clear entry and exit criteria	◯	◯	◯	◯	◯
Duration of incubation period	◯	◯	◯	◯	◯
Clear programmatic interventions (i.e. established framework for the implementation of programs)	◯	◯	◯	◯	◯
Location (i.e. ease of access and proximity to other strategic facilities / institutions such as universities and technical facilities)	◯	◯	◯	◯	◯
Incubator management team (i.e. business knowledge of management team to support MSMEs on their incubation programmes and strategies)	◯	◯	◯	◯	◯
Relationship with funders / venture capital / providers of capital	◯	◯	◯	◯	◯
Relationship with industry	◯	◯	◯	◯	◯
	◯	◯	◯	◯	◯

Relationship with government	⬭	⬭	⬭	⬭	⬭
Monitoring and evaluation of progress by incubated companies	⬭	⬭	⬭	⬭	⬭
The incubator is sensitive to the special constraints faced by women and youth to access technology incubator services	⬭	⬭	⬭	⬭	⬭

5.1. Does the incubator provide funding to incubated companies? *

Mark only one oval.

⬭ Yes

⬭ No

Skip to question 23

5.2. Is this funding

Mark only one oval.

⬭ A grant

⬭ A loan

⬭ Equity

⬭ Hybrid

5.3. How long does it take from application stage to receipt of first payment?

Mark only one oval.

⬭ less than 3 months

⬭ less than 6 months

⬭ less than 12 months

⬭ more than 12 months

5.4. Is the criteria for funding clear?

Mark only one oval.

◯ Yes

◯ No

6.1. Does the incubator syndicate / collaborate with other funders?

Mark only one oval.

◯ Yes

◯ No

◯ Maybe, Not sure

6.2. Does the incubator run competitions amongst its incubated companies?

Mark only one oval.

◯ Yes

◯ No

Skip to question 30

6.2.1. How often are these competitions held?

Mark only one oval.

At least once a year

◯ At least once a quarter

◯ More than 4 times a year

◯ Other:_____

6.2.2. Is the prize cash or in kind?

Mark only one oval.

◯ Cash

◯ In kind

◯ Both

◯ Other: _____

6.2.3. If cash, what is the amount?

Mark only one oval.

◯ less than USD 5,000

◯ less than USD 10,000

◯ less than USD 20,000

◯ more than USD 20,000

◯ Other:_____

6.2.4. Are there conditions for how this money should be spent?

Mark only one oval.

◯ Yes

◯ No

6.2.5. If yes, please elaborate

_____
_____
_____
_____
_____

7.1. Does the incubator offer a post incubation support programme?

Mark only one oval.

◯ Yes

◯ No

Skip to question 32

7.2. If yes, please elaborate

_____
_____
_____
_____
_____

8.1. In your own opinion, on a scale of 1 to 5 (1 being least important to 5 being most important) rate the following in respect of metrics through which the success of an incubator should be measured.

Mark only one oval per row.

	1 = un important	2 = less important	3 = important	4 = very important	5 = most important
Number of incubated companies	⬭	⬭	⬭	⬭	⬭
Successful exits / graduations from incubation programme	⬭	⬭	⬭	⬭	⬭
Funding raised for incubated companies	⬭	⬭	⬭	⬭	⬭
Sustainability of the incubator (run as a business with a revenue generation model)	⬭	⬭	⬭	⬭	⬭
Network and engagement within the National System of Innovation	⬭	⬭	⬭	⬭	⬭
Infrastructure (i.e. Office space, state-of-the-art facilities, testing and prototyping facilities, and meeting	⬭	⬭	⬭	⬭	⬭

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