

**ADVANCING TECHNOLOGY TRANSFERS FOR SUSTAINABLE DEVELOPMENT IN SOUTH AFRICA**

**UNITED NATIONS ECONOMIC COMMISSION FOR AFRICA (UNECA) SURVEY REPORT**

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## Table of Contents

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<b>LIST OF FIGURES</b> .....	<b>3</b>
<b>LIST OF ABBREVIATIONS</b> .....	<b>4</b>
<b>ACKNOWLEDGEMENTS</b> .....	<b>5</b>
<b>EXECUTIVE SUMMARY</b> .....	<b>6</b>
<b>1. INTRODUCTION</b> .....	<b>8</b>
1.1 TECHNOLOGY TRANSFERS IN SOUTH AFRICA: BACKGROUND .....	9
1.2 PREVIOUS REVIEWS OF TECHNOLOGY TRANSFERS.....	11
1.2.1 <i>Disclosures</i> .....	11
1.2.2 <i>Patents, Technologies, and Licenses</i> .....	12
1.2.3 <i>Capacity in Public Sector OTTs</i> .....	12
1.3 <i>Technology Transfers in the Private Sector Reviews</i> .....	13
1.4 <i>Technology Transfer Models</i> .....	15
1.5 SCOPE AND APPROACH.....	15
<b>2. STRATEGIC ISSUES TO ADVANCE TECHNOLOGY TRANSFERS: CASE STUDIES</b> .....	<b>16</b>
2.1 CASE STUDY ONE: MARKING ENGINEERING (PTY) LTD.....	19
2.2 CASE STUDY TWO: INDABUKO INSTITUTE (PTY) LTD.....	22
<b>3. STRATEGIC ISSUES TO ADVANCE TECHNOLOGY TRANSFERS: FOCUS GROUP DISCUSSION</b> .....	<b>27</b>
3.1 TT MANDATES .....	27
3.2 TT ECOSYSTEM .....	28
3.3 TT INFORMATION/DATA AVAILABILITY .....	30
<b>4. ADVANCING TECHNOLOGY TRANSFERS FOR SUSTAINABLE DEVELOPMENT: SURVEY RESULTS</b> .....	<b>32</b>
4.1 TECHNOLOGY TRANSFER MANDATES.....	32
4.2 TECHNOLOGY TRANSFER ECOSYSTEM .....	35
4.2.1 <i>Sources of funding for Technology Transfers</i> .....	36
4.2.2 <i>Who do organisations work with on TT activities in the ecosystem?</i> .....	38
4.2.3 <i>Perception of the value of Offices for Technology Transfers (OTTs) in the public sector</i> .....	38
4.2.4 <i>Perception of the value of government policy and other TT initiatives</i> .....	39
4.2.5 <i>Factors that influence Collaboration with other organizations in the ecosystem</i> .....	39
4.3 TT RELATED INFORMATION/DATA ACCESS OR AVAILABILITY .....	41
<b>5. RECOMMENDATIONS</b> .....	<b>42</b>
<b>6. CONCLUSION</b> .....	<b>44</b>
<b>REFERENCES</b> .....	<b>45</b>

## List of Figures

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Figure 1: Priority Technologies – 2022 Onward	33
Figure 2: TT Output in Rand Value	34
Figure 3: TT Mandates and Output	35
Figure 4: TT Funding R1m and below	36
Figure 5: TT Funding between R10m and R20m	36
Figure 6: General Experience with TT Funding	37
Figure 7: Responsiveness of Funding Sources to Technology Transfers	37
Figure 8: Who do Organisations prefer to work with on TT Activities?	38
Figure 9: Factors that influence Collaboration	40
Figure 10: Data/Information needed on TTS	41

## List of Abbreviations

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**CAGR** - Compound Annual Growth Rate  
**CeSTII** - The Centre for Science, Technology and Innovation Indicators  
**COVID-19** – Corona Virus 19  
**CSIR** – Council for Scientific and Industrial Development  
**DG** – Director General  
**DSI** – Department of Science and Innovation  
**DTIC** – Department of Trade, Industry, and Competition  
**ECA** – Economic Commission for Africa  
**ESG** – Environment, Social, and Governance  
**GERD** - Gross domestic expenditure on R&D  
**HEIs** – Higher Education Institutions  
**HSRC** - Human Sciences Research Council  
**IDC** -Industrial Development Corporation  
**IP** – Intellectual Property  
**IPR-PFRD Act** - Intellectual Property Rights from Publicly Financed Research and Development Act No. 51 of 2008  
**MD** – Managing Director  
**ME** – Marketing Engineering  
**NIPMO** – National Intellectual Property Management Office  
**NRF** – National Research Foundation  
**NSI** – National Systems of Innovation  
**OTTs** – Offices for Technology Transfer  
**PLC** - programmable logic controller  
**(Pty) Ltd** – Private Company Limited  
**R-CTFL** - Retail - clothing, textile, footwear, and leather  
**R&D** – Research and Development  
**SMEs** – Small and Medium Enterprises  
**SMMEs** – Small, Medium, and Micro Enterprises  
**STI** – Science, Technology and Innovation  
**STI4CE** - Science, Technology & Innovation for a Circular Economy  
**THRIP** - Technology for Human Resources and Industry Program  
**TIA** – Technology Innovation Agency  
**TT** – Technology Transfers  
**TTFs** – Technology Transfer Functions  
**TRIP** - Trade Related Aspects of Intellectual Property  
**UK** – United Kingdom  
**UNECA** – United Nations Economic Commission for Africa  
**UP** – University of Pretoria  
**USA** – United States of America  
**Wits** – University of Witwatersrand  
**WTO** – World Trade Organization

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We also appreciate all institutions and organisations in South Africa engaged and pioneering technology transfers. We know and understand the magnitude of the task of venturing in uncharted territories and becoming source of information and leader in this field. We do hope very soon you will be counting the extent to which your virtues are increasingly saving and prospering lives, as we recently seen your collective efforts in dealing with COVID-19 pandemic.

The fast-changing environment brought by worsening economic conditions, climate change, global geopolitics and competition, the recent COVID-19 pandemic, and ever-changing technologies requires that organisations, especially businesses in South Africa, adapt and be adept at adopting or acquiring new and better technologies. The campaign against COVID-19 pandemic has extraordinarily displayed the ability of South Africa's leadership and institutions in the public, private, and civil society to work together to achieve immediate and policy responsive technology transfers contributing to shaping the regime to mitigate the devastation of pandemics in the continent.

This survey has identified three strategic issues that are critical in advancing technology transfers for sustainable development in South Africa. These findings and recommendations could contribute to the lessons that can be learnt elsewhere in the continent by policy makers and leaders of organisations involved in technology transfers. The three issues identified were: organizational mandates alignment to technology transfers and outputs; awareness and collaboration in the technology transfer ecosystem; and access to information or data that can enable organisations to advance technology transfer processes and output.

The South African government has shown significant interest in advancing technology transfers with the promulgation and coming into effect of the Intellectual Property Rights from Publicly Financed Research and Development Act in 2010. The intention of government was to ensure that it encourages technology transfers from the public sector to the society, and protect intellectual property from publicly financed research. With this complementing various government initiated technology and innovation activities including Research and Development. There are two main surveys of technology transfers that have been published so far up to the period when this survey was conducted i.e. (*South African National Survey of Intellectual Property and Technology Transfer at Publicly Funded Research Institutions – Inaugural Baseline Study: 2008-2014*); and the *South African National Survey of Intellectual Property and Technology Transfer at Publicly Funded Research Institutions–Second National Survey: 2014 – 2018*). These surveys reflect significant progress in many areas regarding the implantation of technology transfers and IP from the public sector in areas such as disclosures, technologies, licenses, patents, and the capacity of offices for technology transfer.

However, there is much more scope to improve the coordination of technology transfer activities between the public and the private sector as established in the case studies of two small businesses Marking Engineering (Pty) Ltd and Indabuko (Pty) Ltd. Both the case studies reflect the deficiencies in the technology transfer ecosystem, the importance of government in enhancing the ecosystem in relation to funding processes, and much more responsive collaboration by different stakeholders. The focus groups discussion reflected deeper on the strategic issues providing further context such as technology transfer mandates that are not funded and not part of the core business of the Universities as per the Higher Education Act; the funding environment that is not conducive technology transfers, in particular at the pre-revenue and early stage, and lack of understanding of risks, trust, and nature of businesses or markets; and lack of data brokers and access to information critical for technology transfers.

The survey respondents consisted of 46 organisations, 36 (84%) of which were Research and Development, and Commercialisation Support Organisations (Universities/HEIs, and Technology Hubs); and 10 (16%) of which were Small and Medium Enterprises.

The survey makes the following seven findings:

**Finding One:** The extent to which TT mandates are promoted, does not effectively translate into corresponding TT outputs or outcomes across organisations with 73% confirming that their mandates promote technology transfers; 66% confirming that they do have TT strategy and policy; whilst analysis of the output from TTs indicate 15% performance results.

**Finding Two:** South Africa's technology transfer (TT) funding system still shows signs of underdevelopment, with 47% organisations perceiving it as poor, and 65% if we include those who have no experience or who have not received funding.

**Finding Three:** Most organisations prefer or do work with Universities/HEIs and Local Businesses on most of the TT activities, including technology licenses and patents (73%), experts and facilities (73%), new enterprises (62%), trademarks/copyrights (58%), and new products (43%).

**Finding Four:** Most organizations believe that OTTs are making good progress within the context of strategic ecosystem perspective, with most respondents perceiving OTTs as strong on Technology Licensing and IP Management support (79%).

**Finding Five:** Organisations in the TT ecosystem have a positive experience and perception of Government policy and programmes on Technology Transfers, with government scoring 3.3 out of 5 stars.

**Finding Six:** While costs and funding are always a key consideration, it is clear that organisations are primarily focused on ensuring a high quality technology transfer process based on trust and understanding of the business and markets, as well as relevant capacity and innovative technologies that will result in long-term success.

**Finding Seven:** There is need for relevant information/data that will enable organizations to advance technology transfers.

Based on the above findings the following recommendations are made:

- The stakeholders should consider developing a strategy for technology transfer that includes both public and private sector role-players and is aligned with the industry needs in accordance with the sectoral master plans.
- There is a need for the government and stakeholders to undertake a comprehensive review and reconfiguration of the funding environment and infrastructure that inculcates the imperatives for technology transfers and coordinating various institutional mandates in the public and the private sector.
- Different technology transfer organisations or institutions, in particular funding institutions and Universities/Higher Education Institutions need to improve their responsiveness to technology transfer needs in South Africa.
- In order to improve the scale of collaboration between R&D and Commercialisations support organisations with local businesses, it is essential to implement initiatives that will improve trust, understanding, and capacity across the country and institutions.
- Government to ensure that its programs and policies (such as procurement policies) are able to adapt and evolve as new technologies are developed, and encouraging technology transfer so that new technologies can be implemented on a wider scale.
- Government and role-players should look at creating systems to digitalise technology transfer programs.
- It is essential that stakeholders consider a data governance framework and social contract on technology transfers.

## 1. Introduction

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The campaign against COVID-19 pandemic has extraordinarily displayed the ability of South Africa's leadership and institutions in the public, private, and civil society to work together to achieve immediate and policy responsive technology transfers regime to mitigate the devastation of the pandemic in South Africa and the entire continent of Africa. This fit was attained by stakeholders in different fronts, namely in three areas. Firstly, through international policy on intellectual property and technology transfers lobbying; secondly, through partnership between public, private, and civil society for technology transfer; and thirdly, through localisation of production related to COVID-19 products.

The government of South Africa and India led the fight for the rights of developing countries to manufacture the COVID-19 vaccines in World Trade Organization (WTO) on Trade Related Aspects of Intellectual Property (TRIP) – at the heart of the argument was patent waivers for developing countries to health products and technologies including diagnostics, therapeutics, vaccines, medical devices, personal protective equipment, their materials or components, and their methods and means of manufacture for the prevention, treatment or containment of COVID-19.

Secondly, the World Health Organization (WHO) and its COVAX partners worked with a South African consortium comprising Biovac, Afrigen Biologics and Vaccines, a network of universities and the Africa Centres for Disease Control and Prevention (CDC) to establish its first COVID mRNA vaccine technology transfer hub in South Africa. The move followed WHO's global call for Expression of Interest (EOI) on 16 April 2021 to establish COVID mRNA vaccine technology transfer hubs to scale up production and access to COVID vaccines. The consortium worked with the Government of South Africa and public and private partners inside the country and from around the world.

Thirdly, JSE Limited listed Aspen Pharmacare Holdings Limited (APN), a South African global multinational specialty pharmaceutical company, its wholly-owned South African subsidiaries, Aspen SA Operations (Pty) Limited ("Aspen SA"), reached agreement with Janssen Pharmaceuticals, Inc., and Janssen Pharmaceutica NV, two of the Janssen Pharmaceutical Companies of Johnson & Johnson ("Johnson & Johnson"), to manufacture and sale of an Aspen-branded COVID-19 vaccine throughout Africa.

Similarly, there are many other examples where technology transfer innovation mandates driven by the public sector that are showing great promise in dealing with mitigation and adaptation to climate change for an example, that is renewable energy; the hydrogen technologies; fuel cells; and circular economy amongst others are showing great promise.

Despite recent advancements in technology transfers, particularly in public sector, and through recent COVID-19 response initiatives, technology transfer activities between public and private entities continue to be a challenge in South Africa like in other African countries. In order to gauge the effectiveness of technology transfer activities between public and private entities in South Africa, this survey considered a strategic national perspective on what could be opportunities to advancement of technology transfers for sustainable development, taking lessons from recent COVID-19 initiatives.

Through analysis of previous national surveys as well as existing literature, case studies and focus group discussion helped to focus the survey to pertinent questions practitioners and policy makers are grappling with around the technology transfer mandates, ecosystems, and data and information access. A number of findings are made that are critical to ensuring that stakeholders and role-players are aware of critical strategic issues that need attention.



A number of recommendations are made in order to improve technology transfer activities so as to further sustain inclusive and sustainable economic growth in South Africa. These recommendations included among others, developing a technology transfer strategy taking into account industry needs; review and reconfiguration of the technology transfer funding environment and infrastructure, providing more incentives for private entities to engage in technology transfer activities; bringing in more initiatives that will improve trust and understanding of public and private sector technology needs; and building a strong data governance and social contract between stakeholders.

## 1.1 Technology Transfers in South Africa: Background

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The technology transfer is understood as a planned and deliberate movement of a specific technology between two or more entities, in which the transferor and the recipient are identifiable, and their respective motives and purposes are clear. The technology transfer process can involve several steps, including the identification of potential technologies, the assessment of those technologies, the negotiation of agreements, and the implementation of the technology in a new setting. Technology transfer can be an important tool for businesses, as it can help them to quickly commercialize new technologies and bring them to market. When done effectively, technology transfer can also help to create jobs and spur economic growth.

The inspirations from the Western economies and east-Asia have contributed to technology transfer efforts that were advanced post 1994 period in South Africa as is the case in many developing countries. Inspired, in part, by the USA Bayh-Dole Act of 1980 and the United Kingdom (UK) Patent Law in 1978, South Africa adopted the Intellectual Property Rights from Publicly Financed Research and Development Act No. 51 of 2008 (IPR-PFRD Act), which came into effect on 2 August 2010. This was inevitable since South Africa is relatively a small and open economy that already participates in global value chains. While it's important to acknowledge and learn from others how technologies have been transferred in developed countries over time, especially since 1940's until recent times; South Africa is aware of its need to find and advance technology transfer models that address local needs and dynamics such as the need for socio-economic transformation, gender equality, job creation, and poverty alleviation (see IPR-PFRD Act, e.g. Section 2 (1)a). The model is entrenched within the National Systems of Innovations.

In South Africa, although some Universities, particularly former white Universities had started technology transfer offices and commercial entities by the 90s, and science councils like the Council for Scientific and Industrial Research (CSIR) were already revered for their technology transfer activities as early as the 1950s, more was required to transform society from racist laws to democracy. Fast-forward to the 1996 White paper on Science and Technology positively fuelled the efforts to advance technology transfers in South Africa introducing the concept of the National Systems of Innovations.

South Africa, therefore, has a rich history of technological innovation, but the process of transferring these innovations to the marketplace post 1994 has been slow compared to socio-economic developmental and growth demands. The post 1994 transformation opportunities required an intensely coordinated and structured approach to advancing technology transfer for a more inclusive and sustainable development that can result in many valuable innovations making it to the markets.

It was in 2002 when the National R&D Strategy was released that various key science and technology sectors came up with their own strategies under this policy e.g. Biotechnology; Nanotech

etc. Also a proposal was contained in the National R&D Strategy to introduce measures to encourage better protection and exploitation of IP arising from publicly funded research projects.

A major shift then occurred in 2006 when the Framework for Intellectual Property Rights from Publicly Financed Research was published (DST, 2006). This saw the proclamation of the IPR-PFRD Act in 2010 and the establishment of the National Intellectual Property Management Office (NIPMO). Today, Technology Transfers in South Africa are carried out through a variety of mandates and mechanisms as set by various organisations. For example these include: mandates of the Science Councils, Technology Innovation Agency (TIA) and the Offices for Technology Transfer within Universities or Higher Education Institutions (HEIs), and Science Councils.

Technology transfers play an important role in sustainable development initiatives in South Africa, allowing local businesses and communities to access the latest innovations and tools needed to improve their quality of life. Technology transfers are a key component of South Africa's effort to build an innovative, inclusive and sustainable economy. The country has made significant progress in recent years in establishing institutional mechanisms to promote technology transfer within the public sector. However, challenges remain in terms of financing and commercialising research and development (R&D). There are a number of barriers that can and do impede the effective transfer of technology, including limited funding, a lack of resources and infrastructure, political or regulatory hurdles, and other challenges. To overcome these barriers and support sustainable development efforts in South Africa, it is necessary to adopt a range of effective strategies based on evidence that support implementation of those strategies.

One strategy that has shown promise in advancing technology transfers for sustainable development in South Africa is the use of innovation mandates. These are government-mandated targets and incentives that promote technological innovations that address specific societal needs or challenges e.g. THRIP; Hydrogen South Africa Program; Science, Technology & Innovation for a Circular Economy (STI4CE), and many others. By providing a clear focus and direction, innovation mandates can facilitate the transfer of technology by prioritizing research activities, encouraging collaboration between institutions, and facilitating access to funding.

One example of the recent successful technology transfer related innovation mandate is the joint efforts to detect and control the spread of COVID-19, which has received international acclaim. This includes initiatives such as campaign in global platforms encouraging free transfer of IP rights related to vaccine manufacturing, engaging with global pharmaceutical companies, increasing domestic manufacturing capacity, and localizing clinical trials. Overall, these efforts have highlighted the immense potential that exists within South Africa for driving advances in technological innovation that can benefit society at large.

Similarly, there are many other examples where innovation mandates driven by the public sector that are showing great promise in dealing with mitigation and adaptation to climate change such as renewable energy; the hydrogen technologies; fuel cells; and circular economy amongst others.

Despite these efforts, challenges still remain when it comes to advancing technology transfers in South Africa. These include lack of awareness about the importance of technology transfers among key stakeholders and limited investment in R&D and worse in technology/innovation commercialisation. This is evident in performance of key industries particularly those that are key to South Africa's manufacturing capacity such as steel, and energy.

The importance of technology transfer for sustainable development has been recognized by various organizations, including United Nations Economic Commission for Africa (UNECA). Through its

series on technology transfer for Africa's development works with governments, industry, and academia to promote knowledge sharing within and across borders and facilitate access to essential technologies that can address social needs. Lessons learnt in South Africa and many parts of Africa lies at the core this UNECA survey.

## 1.2 Previous reviews of Technology Transfers

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The first technology transfer survey, published in April 2017 by the Department of Science and Innovation, is considered an inaugural baseline study that captures data between 2008-2014 ((DST, 2017). This study is important because it provides a starting point for measuring technology transfer activity in South Africa. The survey focused on public sector institutions, specifically Universities and Science Councils as per the requirements of IPR-PFRD Act. The survey focused on the structures, capacity, and output of the "Technology Transfer Functions" (TTFs) of these institutions.

The second technology transfer survey published in 2021 focused on the data for the period covering 2014 to 2018 providing insight into changes over time as well (DST, 2021). It found that there has been a significant increase in technology transfer activity over the past few years. This is attributable to a number of factors, including institutions opening dedicated offices for technology transfers, and the increasing awareness. It can be argued that South Africa's public sector performance has been successful evidenced by steady progress in key variables measured; in particular, the following variables: *disclosures; patents, technologies and licenses; capacity in the public sector OTTs; new ventures/start-ups; and revenues generated through intellectual property.*

### 1.2.1 Disclosures

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The IPR-PFRD Act requirement is that public sector research and science institutions must disclose any potential technologies and intellectual property to NIPMO office in terms of Section 5 (Management obligations and disclosure duties). The TTFs in public institutions have reported a steady increase to actionable disclosures since 2008 to 2018 from about an average 227 actionable disclosures between 2008 to 2014 to an average of 567 from 2015 to 2018; representing an 40% increase rate during the survey periods.

### 1.2.2 Patents, Technologies, and Licenses

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Likewise the increase in the new patent applications, and technologies, licensing has shown steady progress. For example new patent registered increased at average 159 patent per annum from 2008 to 2018. Whilst, technologies declared increased at 848 per annum; and licensing agreements increased by 21 per annum between 2008 and 2014 and by increased 140 per annum between 2015 and 2018 representing 667% increase over the two survey periods.

In terms of revenues out of the technology transfer activities in public sector institutions, the revenues are still limited, and can be regarded as at infancy compared to the total investments made in relation to R&D expenditure. Second survey reported about R54 billion R&D expenditure and revenues from technology transfers are in the region of average R33m per annum (from 2008 to 2014) and averaged R46m from 2015 to 2018.

### 1.2.3 Capacity in Public Sector OTTs

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The IPR-PFRD Act also makes it mandatory for public research/science institutions to establish the Offices for Technology Transfers (OTTs) under section 6 [Establishment of office of technology transfer at institutions]. The two surveys conducted do provide a glimpse of their capacity. Almost all universities and science councils have established the OTTs.

The baseline survey paid attention to qualifications and structure of the OTTs, and the second survey put emphasis on the capabilities based on experience and the technology transfer processes and transactions.

Firstly, on the structure of OTTs most institutions have a dedicated office, however, at declining level - the baseline survey found dedicated offices at 75% between survey period 2008-2014, and at 54% in the second survey. The decline may be associated with evolving nature of OTTs as they continue to define their role within the institutions, as 46% became part of a department and function in the period between 2014 and 2018.

Secondly, the strength of OTTs activities was reported to be on prosecution as opposed to monitoring and litigation on infringements side of technology transfer activities. The OTT reported activities include among others receiving disclosures; managing process of IP registration, prosecution, and maintenance; administering funding; and conducting training/awareness workshops and seminars.

Technology Transfers in South Africa are also enabled by various legal instruments including Patents, Trade Marks and the Copyright Act No 98 of 1978 to name a few. Through these mechanisms Technology Transfers have positively contributed towards advancing sustainable development in South Africa. For instance, advances have been made in areas such as renewable energy, biotechnology, nanotechnology etc., benefiting industries, public sector institutions and communities at large.

Overall, the South African government is committed to advancing technology transfers for sustainable development in the country. Through its policies and initiatives, it aims to promote innovation across all sectors and facilitate access to funding resources for entrepreneurs and SMEs. By fostering collaboration between public, private, research institutions, and other stakeholders, we can unlock the potential of cutting-edge technologies to address some of the biggest challenges facing South Africa today.

With this focus on transformative technologies that have a positive impact on society and the environment, the country is well positioned to advance the goals of long-term prosperity and sustainable development for future generations.

The Department of Science and Innovation entrusted with the function of technology transfers acknowledges the fact that technology transfer is not a linear process. However, the reporting within the IPR-PFRD Act framework inevitably reflects a traditional approach to technology transfers; current structures based on requirements of IPR-PFRD Act presupposes traditional flow from suppliers of knowledge, that is, universities or science council for new technologies/innovations which are then patented by these institutions in order to make them available as proprietary goods only after extensive research has taken place leading up until they reach maturity levels where businesses and the market or consumers can purchase without any hindrance from competitors by incurring an input costs covered through licensing fees.

### 1.3 Technology Transfers in the Private Sector Reviews

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In recent years, technology transfer has become an increasingly important topic in the business world. As countries seek to increase their competitiveness in the global marketplace, many have begun to look to the private sector for help in developing and commercializing new technologies. South Africa is no exception. While there has been some work on technology transfer in the public sector, there has been little focus on the private sector. This is likely due to the fact that technology transfer is a relatively new concept in the business world, especially the SMMEs in South Africa, and businesses are still working to understand what it entails. However, as businesses become more aware of the importance of technology transfer as distinct from internal innovation, it is likely that we will see increased participation and interaction between the private and public sectors.

Although technology transfer is often associated with the public sector in South Africa because of the recent policy strides, there is a growing body of work that demonstrates the importance of technology transfer in the private sector. In South Africa, for example, businesses are increasingly turning to technology transfer as a way to improve their competitiveness. Research and Development surveys indicate that technology transfer is becoming an important part of the business landscape in South Africa. As businesses become more aware of the benefits of technology transfer, it is likely that we will see even more technology transfer activity in the private sector.

The South African government has conducted two important national surveys that provide valuable insights into technology transfer activities in the private sector. The first survey is the regular South Africa National Survey of Research and Experimental Development conducted by Statistics South Africa, provides information on research and development activities undertaken by both public and private companies. The second is the Business Innovation Surveys conducted by The Centre for Science, Technology and Innovation Indicators (CeSTII) based at Human Sciences Research Council (HSRC), provides data on innovation activities undertaken by firms. Both surveys offer useful insights into technology transfer related activities and trends in South Africa.

### *1.3.1 R&D Activities*

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Previous studies have shown that businesses in South Africa are the dominant investors in research and development (R&D). However, their expenditure is linked to general economic conditions prevailing in the country, as recent survey has shown decline that can be associated with decline in health of the economy to sub-investment grade by rating agencies, low levels of growth, and the COVID-19 pandemic which has had drastic effect to the private sector and other sectors among others.

Gross domestic expenditure on R&D (GERD) declined in both nominal and real terms. Gross domestic expenditure on research and development (GERD) for 2019/20 was R34.485 billion. GERD in constant 2015 prices fell from R31.367 billion in 2018/19 to R28.140 billion, which represents a year-on-year change of -10.3% in 2019/20. GERD as a percentage of gross domestic product (GDP) at current prices was 0.62% in 2019/20, which is seven basis points lower than the 0.69% recorded in 2018/19 (Statistics South Africa, 2021).

### *1.3.2 Business Innovations Survey*

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The Centre for Science, Technology and Innovation Indicators (CeSTII) based at Human Sciences Research Council (HSRC) conducts comprehensive business innovation surveys on behalf of the Department of Science and Innovation. Since 2005, CeSTII has conducted four rounds of the BIS, covering the periods 2002-2004, 2005-2007, 2010-2012, and 2014-2016 (including farming, forestry and fisheries (2016-2018)). In February 2022, CeSTII announced the start of fieldwork for the 2019 - 2021 round.

The Business Innovation Survey (BIS) is one of the most important tools for understanding the state of technology transfer in South Africa. The latest version of the survey covers the period from 2014 to 2016, provides a wealth of insights into the state of technology transfer in the country. The survey covers about 41 535 companies in 15 517 in industries, with 26 018 in Services (DST, 2020) .

One interesting finding from the survey was that while businesses in South Africa are active in technological innovation, only about one-fifth (20.8%) of innovation-active businesses reported collaboration activities as part of the development of their innovations. The five most widely reported reasons to collaborate were access to new technology (61.5%), access to new markets (60.3%), access to new customers (58.7%), reduction of costs (57.9%), and access to new financing (57.1%). This suggests that there is still a lot of room for improvement when it comes to technology transfer in South Africa.

In South Africa, technology innovation is an important part of the country's economic development strategy. The government offers a number of incentives to encourage technology innovation, including tax breaks and financial support for research and development. As a result, many businesses are now engaged in innovation activities. This is further confirmed by the level of awareness of government programmes that support innovations. One third of businesses that engaged in innovation activities (33.6%) were aware of government financial support for innovation. By contrast, only one tenth of non-innovation-active businesses (10.1%) were cognisant of the support available. The vast majority of innovation-active businesses are therefore aware of the government's support for their activities, suggesting that the policy is having its intended effect.

Furthermore, very few businesses used one or more of the suite of intellectual property (IP) rights protection strategies to safeguard, or generate revenue, from their innovations. The most preferred strategies were trade secrets or confidentiality agreements (innovation-active businesses: 16.5%; non-innovation-active businesses: 4.7%) and trademark registration (innovation-active businesses: 12.4%). Only 14.8% of businesses reported increased IP revenue as a highly successful outcome of their innovation activity, while only 5.1% of innovation-active businesses granted a licence on any intellectual property resulting from an innovation. Only a few businesses viewed IP rights as a barrier to innovation (innovation-active businesses: 4.3%; non-innovation-active businesses: 6.2%). These results suggest that there is room for improvement in terms of technology transfer and the use of IP rights protection strategies in South Africa.

#### 1.4 Technology Transfer Models

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It would seem, based on the observations, strategic technology transfer discussions are still framed in what resembles the appropriability, the dissemination models of 40s and 70s respectively; and the 80s knowledge utilisation models (Wahab S.A et al., 2009). There is a strong need to revisit and reframe the discourse on technology transfer so that it is able to capture the true complexities of the contemporary world where technology is created, used and consumed within global ecosystems. A more nuanced understanding of technology transfer is required that takes into account different contexts, actors and processes. Such an understanding needs to be underpinned by a robust theoretical framework that can guide policy and practice. Only then can we hope to create an advanced and fast paced enabling environment that advances innovation and support the effective use of new technologies for sustainable development

The authors of previous survey reports are mindful of the fact that technology transfer is not a linear process. However, the policy implementation is still early stage and provides opportunities for further studies and review. Linear models have limitation in transferring technology across organizational boundaries. For convergence and technology transferability across organizational boundaries a much more nuanced model needs to be implemented to deal with complex challenges facing South Africa's socio-economic circumstances.

#### 1.5 Scope and Approach

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The technology transfer landscape in Africa has been understudied, despite the continent's increasing focus on developing its own technologies and capabilities. This report aims to contribute to the body of knowledge on technology transfer in Africa by identifying challenges and neglected areas at a strategic level in different countries in order to learn lessons and contribute to the advancement of technology transfers for sustainable development.

To the extent possible within circumstances of each country, this ECA led study, undertake reviews of existing and emerging trends, policies, regulations, administrative processes and infrastructure designed to promote technology transfer; rigorously assess the impact of emerging national and international trends and institutional changes likely to have a negative or positive impact on technology transfer; and identify and review institutional requirements at firm, and other players (e.g. technology hubs, incubators, parks, zones, clusters, funders etc) where appropriate for the successful technology transfer in the country, region or continent.

Specifically, the work focuses on three communities: firm level practices on technology transfer; practices of academia and research and technology organisations on diffusion of publicly funded technologies; and public sector support for technology acquisition by firms and other institutions. The work also looks at the effect of both the practices and measures on technology acquisition and impact on economic, social and environmental impacts.

The data generated will aid national and regional efforts to strengthen institutional arrangements to drive technological and non-technological innovations at firm levels; enhance diffusion of public funded technologies and; encourage entrepreneurship to boost job and wealth creation, and competitiveness in trade.

The data was gathered through the following methodology:

- Literature review,
- Case Studies,
- Focus Group Discussion, and
- Online Survey.

The survey report on Advancing Technology Transfer for Sustainable in South Africa offers key findings that provide insight into areas of concern where special attention is required to advance technology transfer. The results stem from 2 case studies and a focus group discussion, whose inputs were tested in an online poll completed by respondents from two main communities i.e. Research and Development, and Commercialisation support (HEIs, Science Councils, Tech Hubs) as well as the businesses/firms in the public and private sectors respectively. The purpose here was not only to establish what organisations think but also find out how they feel about these issues and how their organisational environment and relationship are being perceived currently.

This report seeks to supplement the previous national surveys by focusing on perceived barriers that prevent advancement of technology transfer between public and private sector organisations. The problems outlined include challenges faced by industries, such as those involving alignment issues or opportunities for coordination among various agencies involved with technological transfer; while looking at all other forms made-known since then (and continuing) progress has been slow going despite efforts from many parties who want nothing more than an easier way to collaboration.

## **2. Strategic Issues to Advance Technology Transfers: Case Studies**

There are a number of important observations to be made from the current Industry Masterplans. We analysed three Industry Masterplans i.e. Automotive Industry Masterplans; Steel and Metal Fabrication; South African R-CTFL (Retail - clothing, textile, footwear and leather); and (DTIC, 2019, 2020 2021). In general we summarise issues common in masterplans as follows:

- The COVID-19 pandemic and worsening economic conditions has resulted in a sharp decline in both domestic economic competitiveness with the decline in production and demand across industries, presenting significant challenges;
- Many industries are largely in survival mode, which means that cost-cutting rather than investment in new technology, new plant and improved processes is dominating the thinking
- The lack of domestic demand has been aggravated by an increased market share from imports in many industries. This has led to a decline in South Africa's manufacturing output and exports, as well as employment.



- As we looked at the three Masterplans, we noted that there is an opportunity to “green” the industries by investing in technology transfers that reduce emissions and conserve water and other resources.
- The Masterplans emphasises the importance of collaboration amongst various role-players and stakeholders in order to create an enabling ecosystem for businesses to operate and flourish. This is evident in the three Industry Masterplans that have been released by DTIC, namely the. All three masterplans recognise that collaboration amongst various role-players and stakeholders is central to the successful implementation of the respective industry masterplan. For example, the Steel and Metal Fabrication Masterplan notes that “there is a great deal of excellent R&D capacity available within the steel industry value chain” but that there is a lack of coordination between these various entities. The masterplan therefore plan puts forth a number of recommendations with regards to creating a more collaborative environment within the steel industry value chain in order to unlock this R&D potential. Government plays a crucial role in coordination of stakeholders to deal with technological challenges and opportunities
- There is strong government policy push for local content (localisation) in all industries which requires concomitant development of technology transfer strategy e.g. the objective of the automotive sector in its vision 2035 is the attainment of 60% true local content in South African assembled vehicles by 2035, with a lower objective of 50% for high technology, high value passenger vehicle assembly strategy - The overall objective of the automotive sector to develop "an ecosystem that provides an environment where local suppliers can design, engineer, test, validate and manufacture quality components and systems in order to participate in the global value chain on a cost competitive basis".
- The National Development Plan also has a specific mandate for the Department of Trade and Industry to develop appropriate industrial policy initiatives that will increase levels of domestic value addition across a range of manufacturing sectors. In this way, the move towards greater localisation can be seen as part of a larger effort to develop industries and create jobs through an expansion in industrial activity.

From the above we make observation in particular that there is a disjuncture relevant for the technology transfer ecosystem and solutions. Firstly, technology transfer is not given the prominence it deserves in any of the Masterplans. Secondly, there is a lack of clarity around what technology transfer actually entails and how it is deliberately promoted. Thirdly, there is a need for better coordination between government, private sector and academia in order to improve the technology transfer ecosystem for industrial competitiveness in South Africa. These are all important observations that need to be taken into account in order to improve the technology transfer landscape in South Africa.

In order to understand the role that technology transfer plays in South African businesses, we randomly selected two small businesses - one that is linked to the public sector technology transfer ecosystem, and one that is not. Under normal circumstances when we look at case studies we associate them with success stories, of which there are plenty such cases in South Africa. However, in this instance we wanted to not pre-judge our case studies, but wanted to randomly select businesses, one that is linked to TT setting in South Africa and the other one that is not linked. We targeted small businesses because of the desirability to capacitate small businesses whose growth and competitiveness is a national imperative and will do well if they benefit effectively from technology transfers.

The business selected not linked to public sector ecosystem is in the engineering services and the other one that is linked to the technology transfer ecosystem is involved in lithium ion battery solutions for renewable energy industries.

The case studies indicated that businesses that are linked to the public sector technology transfer ecosystem tend to have a better understanding of technology transfers and how they can benefit their businesses. These businesses receive support from the government and other institutions, which can help them to scale up their operations and become more sustainable. On the other hand, businesses that are not linked to the public sector technology transfer ecosystem often have a less favourable view of technology transfer.

They may be less likely to invest in new technology or take advantage of government support. However, this does not mean that technology transfer cannot benefit these businesses. With the right support and knowledge, any business can use technology transfer to improve their performance and become more sustainable.

Our case studies observations, however, showed that there are challenges regarding how businesses interact with government and its agencies as well as understanding of the services and products offered by various agencies in the ecosystem to the detriment of the effectiveness of technology transfer.

## 2.1 Case Study One: Marking Engineering (Pty) Ltd

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### **Background**

Marking Engineering (ME) is a niche business that provides marking solutions and equipment to businesses predominantly in the automotive sector. Pin marking technology is one of the most versatile, low-cost investment marking solutions on the market today and their marking equipment capabilities range from simple requirements to completely integrated solutions for marking directly onto fabricated and other components. Their range of products include laser marking technology, inkjet marking and coding systems, robotic systems, and scanning and conventional systems.

Initially, ME offered pin marking and laser marking services to a few customers. From its humble beginnings with only one pin marker and laser machine in place, Marking Engineering expanded its services also to be used in the metal, steel, engineering, automotive, medical, book of free online pharmaceuticals, corporate clothing, and packaging sectors.

ME is 35years old, established in 1987 by a white male originally from Germany, as a one-man operation in Boskruin, Randburg, Gauteng. Current owner thinks when he started the company, he was servicing BMW since he himself was German and was to supply them the marking machines. That's why even today the company is strong in the automotive sector. In 2014 it was sold to 2 black South African guys; they ran it until this year (2022) when the current owner took over (current owner has served as a CEO of the company since 2017).

The global coding and marking equipment market size is expected to reach USD 22.1 billion by 2028, registering a Compound Annual Growth Rate (CAGR) of 5.5% from 2021 to 2028, according to a new report by Grand View Research, Inc.

The global laser marking machine market size is expected to reach \$4.7 billion by 2027, rising at a market growth of 7.6% CAGR during the forecast period. A laser marking machine refers to mechanical equipment utilized for printing permanent laser marks on a surface. This machine utilizes a beam of concentrated light to make marks by a green, fiber, ultraviolet, YAG, or CO2 laser machine.

Before 2014 the turnover of the business was R16m/ya; from 2014 it has been dropping significantly. Currently the business turnover is at about R9m. Various factors contributed to that: prior to 2014 the technology was still owned by few companies internationally in the US and Europe. When other countries like China started manufacturing prices started to drop. For example, a laser machine in 2007, a 30watts machine would cost R2m, today it costs R200 000.

The most unfortunate part of this industry is that all technologies that are used not only by ME but even big competitors are directly imported from Europe, US, and Asia especially China. Some of the technologies are emerging in India. South Africa with its established R&D infrastructure does have the capability that can produce these technologies locally, however, due to costs and regulatory barriers the local industry is not able to.

### ***Technology Transfer***

The owner of the company is not fully aware of what entails technology transfers and defines it as “form of transfer of intellectual property through licensing and other forms of agreements” with relevant partners. Even though they fully acknowledge the gap in local market and the potential ME could explore, being small players in the market without government support it would be difficult for them to invest in Research and Development and the entire technology transfer process. The company is small and has limited resources.

According to the owner ME suppliers are the ones who are leading them when it comes to technology transfer. For instance, when there is new product with new technology ME technicians get trained on that product, but only on the services side, not on the details of the technology e.g., why this fiber is able to generate 50watts, what innovation is inside. It’s like a trade secret that they don’t share with the agent. They only give ME as much as is relevant to services, because of trade secret. That is more an upstream activity with universities and research institutions in those countries where ME suppliers are based.

Currently, there is increasing pressure to use technologies that are less invasive in terms of carbon emissions. ME is closely working with suppliers in order to promote cost effective environmentally friendly technologies.

The owner mentioned 3 distinct opportunities where he attempted to create opportunities for technology transfer for his company.

***First opportunity*** was when he attempted to approach the CSIR’s (the South African Science Council) senior researcher who was widely acknowledged with his patents in the laser technologies, seeking to explore opportunities for collaboration. When ME spoke to him, he said, “they only do research, that’s why they need people in the industry to come on board and commercialize these technologies”.

A few meetings were held and ideas on how collaboration could happen, but the discussions did not end-up anywhere, and the communication was lost. Neither the owner nor the CSIR’s researcher were aware and could refer to the Office for Technology Transfer that public sector institutions do have, and how to access them to support possible collaboration.

***The second practical example of an opportunity*** for technology transfer that was lost in South Africa in relation to ME business was when the company had challenge with the cable that transmit information to the programmable logic controller (PLC). The owner explains:

“I’ll make one example in the project that we are busy with at Ford Motor Company. We installed the machine; we did all alteration asked, we were 100% sure everything was okay. We were using a 5m cable that was transferring data from our machine to their plc machine to start working. Then they said they need 20m cable so we can be able to mark 20 meters down the line. We provided that 20m from our supplier, we brought it and started using it. We discovered that the 20m cable communication is not functioning. We went back to the supplier, and they said they tested everything the cable is functioning. It was a big fight. We then tested that ourselves how far the cable goes, we discovered it goes up to 7m. Ford even tried to find local supplier or innovator who can provide the 20m cable to no avail. We went back to our supplier in Germany, they had to redesign the cable and add some wires in a space of a week. The new cable is working properly”.

The owner indicated his knowledge regarding the extent to which their suppliers especially in China work with research organizations and Universities to come-up with solutions that are business specific almost on a daily basis. The owner is adamant that according to his experience most of the innovations come as a result of solving practical workplace problems. If you deal with traditional technology transfer it would take years to find solutions to immediate challenges. "It means someone designed the cable at university and thought it would work on any size. It only came from our application on the ground that we were able to advise them of the problem and the need for intervention". This talk to importance of equal partnership where we are all equally involved in the innovation and technology transfer with our suppliers.

**Thirdly, and finally the owner has his own innovation** that he has attempted to promote to government for collaboration. The idea is to have an innovation [the specificities cannot be disclosed for IP protection] that will save huge costs for government as a result of pervasive theft that happens on government property. The owner has met several government officials who seem to like the idea but cannot secure a buy-in.

The stumbling block can be summarized as follows: lack of the buy-in from government. Without buy-in ME will not have the space to test the technology. Also, the ME has no capital yet to bring in the technology. The government procurement process does not provide for engagement with innovations; this may be due to corruption where unsolicited bids have been abused and create reluctance to engage innovations in procurement.

#### **The Owner's view on what needs to be done to advance technology transfer**

- The Owner of the ME believes that government should assist innovators and provide space for collaboration within procurement regulations, and furthermore train officials to deal with the aspect of technology innovation and procurement. An example is Defense Department which can offer a place where innovations from industry and academia are tested and commercialized.
- The business community has a unique perspective on what needs to be done because they are most often in contact with customers every day. Businesses can provide insight into challenges and opportunities that researchers may not otherwise come across, such as how technology or competitors could affect demand for their products/services. Government and universities often come to business with an agenda, but we understand the needs of our customers better. We should work as partners in finding solutions for both parties involved so that everyone can succeed together.
- The world of work, technology and businesses is changing, and companies need to be ready. The average businesses do not have sufficiently trained workforce and relevant technologies at hand - and businesses need to do more to develop new skills and technologies like artificial intelligence! A platform or portal where all stakeholders in each industry can register their profiles so they know which projects require an expert in certain areas and which institution has relevant technologies would help improve technology and skills transfer to improve productivity.

## 2.2 Case Study Two: Indabuko Institute (Pty) Ltd

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### **Background**

Indabuko is a private business that operates as an R&D facility for energy storage systems. The intention was to start by producing lithium-ion batteries for South Africa and later serve foreign markets, the African market in particular. Lithium-ion batteries are in demand in South Africa and throughout the world. So, the intention is to produce them for Africa.

Indabuko was started in 2016 and formally incorporated in 2017 by a group of young scientists who hold PhDs in Engineering and Physics from Universities in South Africa. The company is 100% owned by black people initially started with five directors who were also shareholders. Currently the company has three active directors who are shareholders. Other 2 Directors resigned due to potential conflict of interest.

In terms of size, the company is a small business with a turnover of less than R10 million per annum. However, since it started it is still reliant on finance from government to survive, i.e., government grant that supports R&D to be specific. The company has not yet started to trade; in other words, there are no sales as yet. The company anticipated to start trading by 2021. However, due to some challenges, trading has not started.

In total the company employs 9 people; the five directors were fully employed, and all have PhDs in engineering and sciences. In addition to that there are 4 interns, 1 holding a PhD and three others with master's degrees. When the company started, directors had combined experience of some 30 years. This experience was in energy theory and practice.

Indabuko is committed to technology transfer and the development of local capabilities in South Africa. In terms of technologies used by Indabuko in the production of lithium-ion batteries, the technology that is used to produce batteries as part of R&D are the same technologies that are commonly available in the industry. The chemical technology for example is used intensely to make the battery work better, including its design and its shell. The company also uses different technologies to test the battery's performance, safety, and quality. As such, Indabuko is able to utilize existing technology platforms and infrastructures to develop locally produced batteries that are competitive with those produced internationally. This commitment to technology transfer and local development ensures that South Africa remains at the forefront of battery technology and manufacturing.

Finally, the company has set up a full laboratory with the equipment for assembling battery cells. Basically, the laboratory is set up as the entire production process. In this case the trick is always the chemical content of the battery and that's where Indabuko expertise creates an advantage in terms of value addition.

It must be noted that Indabuko sources its equipment from America, yet America relies on China for manufacturing; but officially Indabuko sources from the United States. The company supplying technology is very well known as it supplies most of local companies in this industry. The advantage with this company is that they also do skills transfer. They teach you how to use lab equipment.

In terms of environmental sustainability, Indabuko products do negatively affect the environment to a large extent. The industry does try to minimize the impact. It is very difficult to import battery cells because of strict regulations around the contents of battery cells. So, they do affect the environment a great deal. However, this industry plays an important role in the circular economy, its batteries are recycled for the same purposes and many other uses. For example, lithium can be re-used to make ceramic tiles. France is actually one of the leading countries when it comes to recycling of used batteries. This is one of the projects that Indabuko wanted to expand on in relation to what its business. Indabuko made a proposal to the Industrial Development Corporation (IDC), a development finance institution, to fund a recycling project for batteries in South Africa.

### ***Technology Transfer***

According to the Managing Director (MD) of Indabuko, their understanding of technology transfers is more along the lines of building the capacity and capabilities of human capital or human resources. He claims, that is the thrust of Indabuko project as we are funded by the Department of Trade and Competition, by their project called Technology for Human Resources and Industry Program (THRIP).

Indabuko technology transfers has four linkages: firstly, a relationship with equipment technology suppliers. Secondly, a relationship with universities; thirdly, a relationship with a science council in this particular case the CSIR; finally, a relationship with the funder under the THRIP program of the DTIC.

### ***Relationship with Supplier***

Indabuko according to the MD has an excellent relationship with its suppliers. The main supplier of technology is well known and major supplier of equipment in this industry. The equipment Indabuko buys from them is manufactured in China under their tutelage, however, they buy directly from them in the United States. The purchase agreement includes the intellectual property section. To a large extent the IP provide for sharing of the know-how of the technology equipment particularly in relation to the aspects that Indabuko tackles in its R&D in the process. In addition to sharing intellectual property, they do offer free training only on the use and maintenance of the technology equipment.

### ***Relationship with Universities***

The relationship with universities is threefold. Firstly, Indabuko provides experiential learning opportunities for students from universities. In this instance it works closely with three universities i.e., University of Witwatersrand (Wits), University of KwaZulu-Natal (UKZN), and the University of Pretoria (UP). Indabuko signs contracts with universities and in the processes, assign each student to a specific unit of the operations in relation to their study interest. In turn Indabuko provide stipends to students and provide supervision working with their own professors. This has been a very smooth, successful, and highly effective process. There are numerous postgraduate students that have benefited already in the past five years.

The second part to the relationship with universities is the sharing of intellectual property. As part of the contract, Indabuko agrees on the percentage share of interest in the IP that will be co-created working with their professors, and thirdly agree as well on the amount that is payable for the use of their own intellectual property.

Indabuko dealt mostly with the enterprise outfits of universities (their commercial entities that create 3<sup>rd</sup> stream income for universities) like Wits Enterprise, UP Enterprises etc. The MD of Indabuko stated that when they entered into contracts with these universities it was a huge learning experience for them because they had neither prior experience nor capacity to enter into intellectual property agreements. Amongst all universities they dealt with Wits University was particularly more difficult to deal with and their demands were quite cumbersome. For example, they asked for an upfront payment of R1m before they engaged in specific terms of execution. With hindsight and experience they are a bit wiser now and could be more alert in entering into such agreements.

#### ***Relationship with Science Council***

The third relationship is with Science Councils. In this case Indabuko worked closely with one particular Science Council, the CSIR. Besides their experience of working with scientists from CSIR, Indabuko is privileged to also be leasing office accommodation at the CSIR. So, CSIR is both the landlord as well as a science partner. As their landlord, the relationship is normal, they are renting a 100m<sup>2</sup> space at a reasonable discount, paying about R17 000 per month. CSIR as their science partner share interest in the IP they co-create. What is more beneficial is the CSIR does not expect Indabuko to pay any fee upfront. With them they enjoy an excellent working relationship.

The estimate percentage cost breakdown from these TT processes from the 3 stakeholders from highest to lowest?

- Suppliers (Technology Equipment) - 40%
- Universities – 20% [amongst universities we found Wits to be more expensive]
- CSIR Partners – 0%
- CSIR as Accommodation – 5%

#### ***Relationship with Funder***

The relationship with funders (government program) was fine at the beginning. Indabuko is funded by the DTIC, under the program called THRIP. The THRIP program has two types of officials, the ones that provide the R&D administration support, and the ones that are responsible for processing claims (Finance administration). Indabuko MD claims that they worked very well with the R&D support staff. They understand the significance of the project and its value to society, including the various dynamics involved in the project of this nature. Whilst on the other hand the claims administration (finance) officials are very different and kind of ruthless and not well versed with the project dynamics and became a stumbling block to the success of the project.

MD contest that “there is a thin line between genuinely upholding compliance standards to the prescripts than being not supportive and bordering on personal vendettas that are very destructive to the project”. The MD says he can cite several examples of challenges they faced with claims officials. For example, unspent travelling funds, which were earmarked for the later part of the project, they were told by claims officials that they had to return those funds. Fortunately, the R&D support officials were able to advise them to arrange with travelling agencies for advanced payments.

Indabuko was also not sure how much and when they would receive ultimately on any claim they make. For example, during first year they understood that they will get 40% of the claim as part of the rules; but on the second year they were paid 5 months late and were paid R860k instead of R1.2m as claimed and budgeted for. In every claim they would not receive immediate feedback, they will only get feedback six months later, in that instance they would infer from their questions that the claims officials are just starting to consider their claim by asking questions like, why is your Identify Document not certified? They will also not give them an indication as to when they are likely to receive payment.



The attitude of the claims officials created huge challenges with Indabuko suppliers and other stakeholders as they could not meet deadlines. Indabuko submitted claim, on the basis misunderstanding of an audit query, the claims officials decided to stop payments.

Because of these challenges Indabuko leadership was left with no choice but to approach the Director General (DG) of the Department of Trade, Industry, and Competition (DTIC). Whilst the claims team responded positively after the complaint to the DG, after the DG's term ended and he left DTIC, the claims team (especially the Director) "came for Indabuko". They decided to cancel the project and never gave Indabuko team a room to present its side of the story. Even when they approached the Chief Director (senior to the Director), who was more understanding, he couldn't do anything as he said he relied on the Director on matters in his portfolio.

This became the biggest challenge as the claims officials had no idea of the value of the project and how important is their support. It is the view of the MD that the attitude of the claims officials resemble those from our history of oppression where any black is regarded as not trustworthy of support and are deemed not capable or qualifying of achieving the highest standards of success in any projects.

#### ***The Owner's view on what needs to be done to advance technology transfer***

The view of the MD of Indabuko, an engineer by profession, **is that these processes (public sector funding programs) should be systematized and be devoid of excessive human bias**. TT processes are still more human managed and controlled, and most of these processes are conducted manually, and subject to bias. For example, sometimes you will submit one document over and over again because the official will keep on saying he never received it.

Regarding how the private sector could assist in the TT process, the MD indicated that there is so much scope for support from big businesses and multinational companies. For example, Indabuko worked very well with a local supplier who provided training and enterprise support. That's what is required from local big business and MNCs when working with small businesses. Indabuko sometimes need to borrow on short-term basis the equipment that it cannot afford to buy and the equipment that has no use for long-term; **local big businesses and MNCs must be prepared to assist and create conditions for access by small companies**. Institutions such as the Innovation Hub, the MD feels, could also be of assistance, but unfortunately, they only cater for their own registered members or residents.

Finally, the MD says with on-time information and data, they can go a long way to advance growth of their business. He notes that the National Research Foundation (NRF) is trying to advance open data platforms in the country, especially around science data. We do need data on intellectual property, technology equipment, access to scientific data. Basically, the entire TT ecosystem must be anchored on good data governance and access by entrepreneurs and practitioners.

#### ***Preliminary assessment of issues to advancing Technology Transfer based on Case Studies***

Based on the engagements with the two small businesses we made the following assessment regarding the issues that relate to advancement of technology transfers within businesses/firms (SMEs in particular) in South Africa:

- Government support for small businesses is necessary to effect technology transfers. This can be done by way of linking current public sector mechanisms, which would allow these companies greater opportunity in investing into R&D and Innovations as well as other activities that may not generate immediate returns but lead them towards success later on down the line.

- Foreign suppliers of technology (import technologies) play a dominant role in South Africa, which can stifle local technology transfers regardless of whether businesses are linked to public sector TT mechanisms or not. This is because imported technologies come with conditions that limit IP use and access to technology knowledge that restrict the development of strong local technology ecosystems, which are necessary for effective TT. In order for local businesses to access technology, they need to be able to interact with other companies and research institutions that are engaged in similar activities. This interaction is essential for exchanging ideas and knowledge, and for developing new technologies. However, if most of the technology providers in a country are foreign-owned, then it is difficult for local businesses to establish these important linkages. As a result, they may be unable to keep up with the latest developments in their field, and they may miss out on opportunities to transfer of technology to other sectors. Therefore, it is essential for South Africa to develop its own technology providers in order to encourage more effective TT.
- Businesses in South Africa are under pressure to respond to climate change and adapt their technologies accordingly. This is because all companies, regardless of whether they are linked to public sector technology transfer programmes, need to address the issue of climate change. The South African government has been proactive in technology transfer, with the aim of helping businesses adapt to the changing environment. In order to support this, the government has established a number of technology transfer programmes. These programmes provide funding and other resources to businesses so that they can develop and deploy new technologies that will help them respond to climate change. The pressure on businesses to respond to climate change is therefore high, and they need to make use of these programmes in order to stay ahead of the curve.
- In South Africa, there is a sharp conflict or misalignment of culture and perceptions between the public and private sector regarding the understanding of what challenges and solutions are required to form the basis of technology transfer and collaboration between the public and the private sector. The South African government has been trying to encourage technology transfer and collaboration between the public and private sector for many years now, but there has been little success. This is because businesses in South Africa generally do not see the need for technology transfer and collaboration with the public sector, as they feel that they can develop their own technologies. However, the South African government believes that technology transfer and collaboration between the public and private sector is essential for the development of the country. Technology transfer and collaboration between the public and private sector can help to create new jobs, develop new technologies and improve the quality of life for all South Africans.
- In recent years, TT has become an increasingly important tool for businesses, governments and other organizations seeking to commercialize research and develop new products and services. However, the TT process can be complex and time-consuming, and it is often difficult to find reliable information on potential partners or technology opportunities. In South Africa, there is a need to systematize and digitalize public sector TT programmes and mechanisms, and also ensure adequate supply of TT information and data. This will help to reduce the risk of failure and increase the chances of success for businesses and other organizations engaged in TT.

### 3. Strategic Issues to Advance Technology Transfers: Focus Group Discussion

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Flowing from the above discussion of the issues that need attention to advance TTs for sustainable development in South Africa on the 5<sup>th</sup> of April 2022 we convened a focus group discussion in collaboration with the Department of Science and Innovation in South Africa.

After presentations on the Technology Transfers review reports (IP&TT Surveys and Business Innovation Surveys), focus group discussion was framed on the following three generic questions in order to solicit issues that are strategically pertinent within the TT ecosystem:

- I. How to increase the critical mass of technology transfer activities in general in public and private sector collaboratively, in the context of deficient outcomes as reported in the TT Survey (2014-2018), R&D Report (2019), and STI Indicators Report (2021) among others; as well as COVID-19 pandemic related slump?
- II. Do we have the same level of trust and understanding of the best TT model and what can be done to ensure that businesses are more open to working with Universities and Research Councils?
- III. Can methodologies to detect demand for technologies and innovations be understood and harmonised between public and private sector especially during and post-COVID-19 period? Are there opportunities for collaborative data governance between public and private sector on technology needs/demand?

The analysis of inputs from discussants who are experts and experienced practitioners from key stakeholders in the TT ecosystem, were clustered based in the strength of facts; critical analysis; opinion; emerging thoughts; and new ideas. From these inputs, including those from case studies and literature we then formulated questions for the survey. The clusters under which issues arose were ultimately narrowed down to three as follows:

- TT Mandates
- TT Ecosystem
- TT Information/Data Availability

#### 3.1 TT Mandates

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In South Africa, there is a strong view that technology transfer is not fully part of the mandates of universities and businesses. For example with Universities, it is argued that technology transfer is not provided for in the Higher Education Act, it is not part of the core business of the university, and it is not currently funded and not generating returns for universities. However, technology transfer is seen as a strategic issue for universities in South Africa, as it can help to commercialize research and bring in external funding. As such, many universities are working to develop technology transfer policies and procedures. While there are challenges involved in technology transfer, it is an important activity for universities in South Africa to undertake.

In the same vain, technology transfer is not always easily understood for businesses and firms especially SMEs, and there are a number of challenges that need to be overcome. In South Africa, for example, many firms lack the resources, capacity, and leverage to engage in technology transfer. This is often due to financial constraints or a lack of understanding of the technology transfer processes. As a result, many firms miss out on opportunities to improve their competitiveness and contribute to economic growth. It is therefore essential that policy-makers take steps to address these challenges and create an environment that is conducive to technology transfer.

The questions the survey sought to explore along the lines of the technology transfer mandates was the extent to which organizations involved or having a potential to be involved in TTs are having their core businesses promoting technology transfers, and to that extent that they would have actual policies and procedures in place; and that there is evidence of results and impact to that effect.

### 3.2 TT Ecosystem

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The technology transfer ecosystem includes all the organizations involved in technology transfer, such as university OTTs, government agencies, funding organizations, and private companies. Good et al. (2019) note that research on the technology transfer ecosystem is largely lacking, and they call for more research on this topic. In particular, they suggest that future research should focus on how to improve technology transfer in developing countries. In South Africa, the technology transfer process is often hampered by a lack of understanding of the technology transfer ecosystem by all stakeholders involved.

The focus group raised an number of issues that can be related to the technology transfer ecosystem, issues that are also captured in the previous reviews and case studies above, but more sharply emphasised as follows:

- South Africa's National System of Innovation (NSI) is characterised by a number of disparities, one of which is **the declining uptake of research and development (R&D) in the private sector in general, and SMEs in particular. In contrast, the public sector spends relatively less on commercialisation** (expenditure and funding, around R50 billion was spent on R&D, with R315 million spent on TT operations and R265 million spent on IP registration and maintenance costs). This imbalance has implications for technology transfer and the country's competitiveness. There are a number of reasons for the disparity in R&D uptake. Firstly, the South African private sector is relatively small and lacks the scale to conduct large-scale R&D projects. Secondly, many private firms are focused on immediate profit maximisation rather than long-term investment in R&D. Thirdly, there is a lack of collaboration between the public and private sectors, which hampers technology transfer. The government has attempted to address this imbalance through a number of initiatives, such as the establishment of technology parks and incubators. However, more needs to be done to encourage private firms to invest in R&D. This could include providing incentives, such as tax breaks, or increasing funding for technology transfer programmes. addressing this issue is essential for South Africa to compete in the global economy.

- The focus group noted the **lack of incentives for technology transfer and commercialisation in different sectors in higher education as well as in the private sector. Funding models of institutions in the technology transfer (TT) ecosystems need to be looked at to ensure they promote commercialisation and do not hinder new start-ups and products/services in the market.** In South Africa, the technology transfer function has predominantly been within the research and development (R&D) domain of universities, with little interaction with industry. There is a need to build awareness among all stakeholders of the benefits of technology transfer and to create an environment that is conducive to technology transfer and commercialisation. This would require a concerted effort by all stakeholders, including policy-makers, funding agencies, academia, industry, and service providers. A number of issues have been identified as being critical to the success of technology transfer and commercialisation in South Africa. These include: the role of technology transfer offices in South African universities; the level of university-industry interactions; the nature and extent of training and support available to technology transfer practitioners; the absence of an enabling regulatory environment; and the low level of investment in research and development. It is clear that there is a need for a comprehensive approach to technology transfer and commercialisation, including a need for “calls for commercialisation”.
- There is a pervading feeling in the **technology transfer (TT) space in South Africa that offices for technology transfer (OTTs) are not operating optimally.** This is particularly apparent in Higher Education, where TT offices are often seen as simply "paper pushers" with little to show for their efforts. Even worse, this is often the case in Historically Disadvantaged Institutions (HDIs), where the lack of understanding of how commercialisation / TT works is even more pronounced. There is a need for the Department of Science and Innovation (DSI) and the National Intellectual Property Management Office (NIPMO) to go back to the drawing board and come up with a more holistic and integrated approach to technology transfer. Only by doing so will we be able to truly realise the potential of our world-class research institutions. There is a need to build capacity in the TT ecosystem: commercialise, preparation, networks, IP, etc. Commercialisation boils down to needs of the industry and having networks in those industries.
- The technology transfer process is often complex and can be hindered by a number of factors, including divergent mandates, a lack of communication, and a lack of trust. In South Africa, technology transfer between the public and private sectors is often limited by these same obstacles. As a result, **many innovations are researcher-pushed rather than market-pulled.** This can lead to a disconnect between the needs of industry and the products that are being developed. To overcome this challenge, it is important to align the mandates of both the public and private sectors in order to create an environment that is conducive to technology transfer. By doing so, South Africa can ensure that relevant innovation throughputs from the public sector to the private sector, and vice versa. Commercially viable technology innovations and originations are essential for the success of any business. In technology transfer, for example, a company must have the ability to generate new technology solutions that can be quickly adapted and used by commercial entities. The DTIC conducted a study on what are the factors that affect commercialisation in South Africa and based on the study, the DTIC and the DSI developed a commercialisation strategy that both the Department are co-owning. The strategy focuses on improving technology transfer by addressing four strategic issues: awareness, technology selection, absorptive capacity, and financing. Through this strategy, the DTIC and DSI hope to increase the number of commercially viable technology solutions coming out of South Africa.

- Commercially viable technology projects and innovation are critical for technology transfer in South Africa. **A lack of understanding of risk and viability, as well as public sector institutions that are not responsive or efficient in delivering support causes misalignment on technology transfers.** In order for technology transfers to be effective, there is a need for business minded innovations and origination. The public sector needs to create an environment that is conducive to private sector participation in order to ensure that technology projects and innovation are commercially viable.
- **A primary strategic issue for the technology transfer eco system in South Africa is the lack of funding for new ventures in the public sector.** This lack of funding results in a lack of uptake for pre-revenue stage and start-ups, as well as less investment in technology transfer overall. This chasm between the need for funding and the available resources creates challenges for technology transfer organisations in South Africa. While there are some programmes in place to assist with funding, such as the Technology Innovation Agency's (TIA) technology transfer programme, the requirements by the funding ecosystem are not conducive to successful technology transfer. There is a huge funding gap for pre-revenue ventures and start-ups in South Africa. There is no coordination on plugging the gaps between different DFIs. There is information asymmetry and mandate crips. The gap between TIA and other DFIs is becoming a big problem. VCs also want post-revenue. The funding landscape does not support TT ecosystem pre-revenue. it assumes a very mature markets. No incentives for e.g. postgraduate students towards commercialisation. A big challenge that is how to get technology transfer from university research labs into the hands of industry, where it can be commercialised successfully. Incentives are needed to make this happen, as well as improved coordination between different organisations involved in technology transfer. The current landscape does not support technology transfer adequately, and this is hampering the development of new businesses in South Africa. For example, after receiving TIA funding, the Public Investment Corporation (PIC) is often reluctant to invest further in the company due to the high risk associated with early-stage companies. As a result, many technology transfer deals fail to materialise, due to a lack of continued investment. This issue needs to be addressed in order to improve the technology transfer ecosystem in South Africa and encourage more investment in new ventures.

The approach to survey questions was to probe the elements of the technology transfer ecosystem identified in the case studies as well as the focus group discussion above. These included questions on the funding and levels of satisfaction regarding sources of funding; quality and nature of relationships between different role-players in the ecosystem and factors that are important in enhancing collaboration especially between the TT public institutions and businesses.

### 3.3 TT Information/Data Availability

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In 2021, the World Bank published the World Development Report themed "Data for better lives" (World Bank, 2021). The report demonstrated explicitly the importance of social contract in data governance to underpin efforts towards sustainable and inclusive growth and development in developing countries in particular. Collaboration between public, private, civil society, households, and individuals as data suppliers and users is important to produce relevant and quality data. An important part of technology transfer is the process of moving technology from the sender (country or organization) to the receiving country or organization. In order for technology transfer to be successful, it is important that there is a good match between the two. The technology must be appropriate for the needs of the receiving country or organization, and there must be a willingness and ability to use it.

The discussants noted the following issues regarding information/data sharing as key to improving technology transfers in South Africa:

- In South Africa, the **technology transfer environment is characterized by a lack of knowledge brokers**. These are individuals or organizations that act as intermediaries between the private and public sectors, facilitating the flow of information and knowledge. As a result, the two sectors have little knowledge about each other and the information that is available is often out of date or inaccurate. This can lead to strategic issues, as businesses may make decisions based on outdated information. In addition, the lack of knowledge brokers can create a barrier to entry for new businesses, as they may be unaware of the technology transfer process and the opportunities that exist. Ultimately, this can hinder economic growth and innovation.
- One of the biggest challenges facing South Africa is how to encourage private sector participation in technology transfer and uptake of public sector intellectual property (IP) and innovations. **One way to overcome this challenge is through information/data sharing**. By making sure that technology transfer is well understood and that products are in the market, South Africa can start to attract the private sector investment needed to support its economic development. While there are many challenges associated with technology transfer, it is an essential part of South Africa's economic strategy and should be given the attention it deserves.

The approach to questions was to ascertain the nature of information and data requirements on the basis of the needs that were expressed in previous surveys as well as case studies and focus groups discussions.

## 4. Advancing Technology Transfers for Sustainable Development: Survey Results

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The Survey on Advancing Technology Transfer for Sustainable Development in South Africa was based on qualitative and quantitative observations in the literature, case studies and focus group discussion, and outcomes of an online survey. **The aim of the survey was to identify strategic issues related to technology transfer for sustainable development in South Africa.** A total of 46 stakeholders participated in the survey, including representatives from universities, science councils, technology hubs, and businesses (SMEs), answering 16 questions.

The survey respondents consisted of 46 organisations, 36 (84%) of which were Research and Development, and Commercialisation Support Organisations (Universities/HEIs, and Technology Hubs); and 10 (16%) of which were Small and Medium Enterprises (11% Agriculture and related operations; 11% Construction; and 33% Other). The population for the survey whose invitation was issued by Department of Science and Technology was fully representative of the public sector organizations. The response rate from businesses was of a major concern with invitations having been issued by the department directly through emails, and through online social media calls. This could be a confirmation that the invitations to participate on the subject “Technology Transfers” is still a public sector notion not yet popular amongst businesses/firms. The survey results will be important in indicating what needs to be done to make businesses more receptive to participating in technology transfer activities. It is important to have a good understanding of how businesses currently view technology transfer so that the necessary steps can be put in place to increase their participation.

The response completion rate was 50% on 3 thematic areas i.e. Technology Transfer Mandate, Ecosystem, and Data/Information Access/Sharing.

### 4.1 Technology Transfer Mandates

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There is still concerns regarding the full embracing of the TT as a process that enables and generate a variety of benefits for stakeholders in particular in the small and medium enterprises (SMEs) sector.

#### **Finding One: The extent to which TT mandates are promoted, does not effectively translate into corresponding TT outputs or outcomes across organisations.**

The TT process is a journey that demands strategic focus and planning if its full potential is to be realized. It is encouraging to note that the overall level of positivity amongst respondents was high, with 73% indicating that they were satisfied with the extent to which their organizations promote TTs. This suggests that there is a willingness amongst both SMEs and public sector organisations to engage with the TT process. With the right support and guidance, it is hoped that more organisations will begin to develop TT policies and procedures, enabling them to realise the full potential of their technology transfer journeys. In spite of this, this survey has found that of the SMEs surveyed less than half (44%) had TT policies or procedures in place. This compared to three-quarters of the public sector research and development (R&D) and commercialisation support organisations surveyed.

In South Africa, **technology transfer (TT), in particular with IPR-PFRD Act requirements, is identified as a key driver of socio-economic development and transformation.** This study has found that the benefits of TT are perceived to be on top developmental & CSI (70%), inclusion and diversity (63%), and productivity & efficiencies, and revenues & profitability at 60% and 61% respectively. Businesses surveyed as well indicated benefits of Technology Transfers to be more on development, transformation, as well as trade.



A serious concern observed is the perception of Environment, Social, and Governance (ESG) and Trade trailing behind in general at 50% and 22% respectively. This is more so as policy imperatives have identified these outcomes as areas of opportunities for inclusive and sustainable growth.

The results of the survey showed that digitalisation is the top priority for respondents when it comes to modern technologies (77%) in 2021 moving forward. This is followed by artificial intelligence/robotics/software, with 67% of respondents confirming that these technologies are a priority for them and they are involved or leading in their advancement. These results are significant as they also illustrate the importance that South Africans are placing on green technologies and its role in sustainable and inclusive growth envisaged. Technology transfer is a critical part of ensuring that these technologies are accessible to all and South Africa is committed to playing a leading role in this process. These results confirm the importance of technology transfer in relation to modern technologies, and highlight the need for continued investment in these areas.:

- Digitalisation (77%)
- Artificial Intelligence/Robotics/Software (67%)
- Renewable Energy and Green Technologies (61%)
- Cloud Computing (48%)
- Machine Learning (43%)

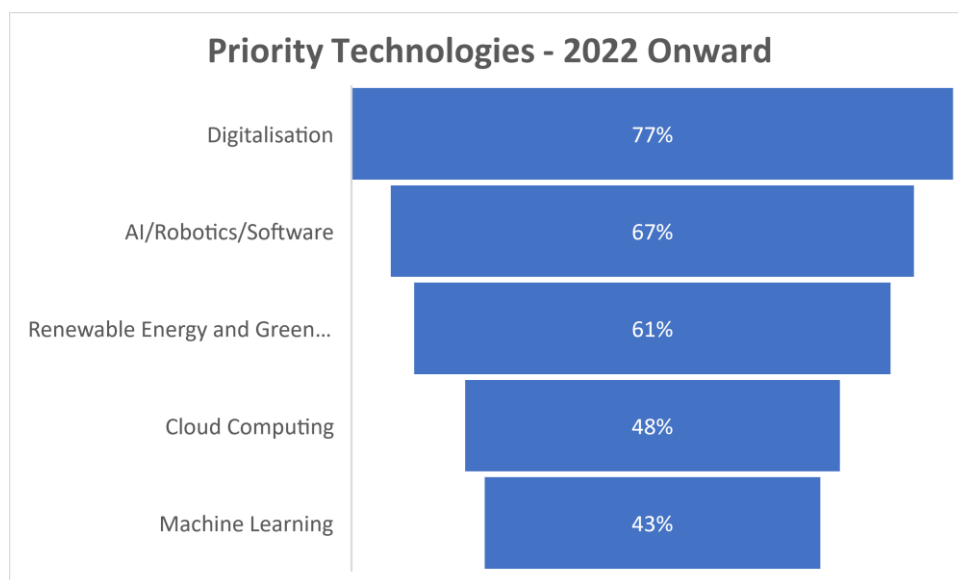


Figure 1: Priority Technologies – 2022 Onward

The study looked at a range of technology transfer outputs or outcomes for 2020/21, i.e.

- **Technology Licenses** - 30% have 0 technology licenses concluded; and 52% have less than 5 licenses secured
- **Patents** - 25% have 0 Patents; and 58% have less than 5 patents; 1 organisation had 27 patents
- **Trademarks** - 41% had 0 trademarks; and 41% had less than 5 trademarks; 1 organization had 12 trademarks
- **Copyrights** - 43% had 0 copyrights; and 29% had less 5 copyrights; 1 organization had 20 copyrights
- **New Products** - 38% had 0 new products; 48% had less than 5 new products; 1 organization had 10 new products
- **New Enterprises** - 48% had 0 new enterprises; 39% had less than 5 new enterprises

In general:

- About average 38% of the respondents had 0% TT outputs;
- About average 80% of the institutions have less than 5 outputs per TT activity
- Only 1 organization produces between 10 to 27 per TT activity e.g. 1 organization produced 27 patents
- Estimated output rate is 15%

When it comes to the currency (South African Rand) value of the TT transaction mentioned above the following findings were made:

- About 40% realised zero income or value on all TT activities
- About 38% realised less than R1m per TT activity
- About 8% made between R1m to R5m per TT activity
- Av 3% made between R5m to R10m per TT activity
- Av 3% made between R10m to R20m per TT activity
- 1 organization made between R50m to R100m
- 3 organizations made more than R500m

Of the businesses surveyed about 50% have concluded technology licenses and have patents, however the value is not ascertained and either at zero and/or less than R1million.

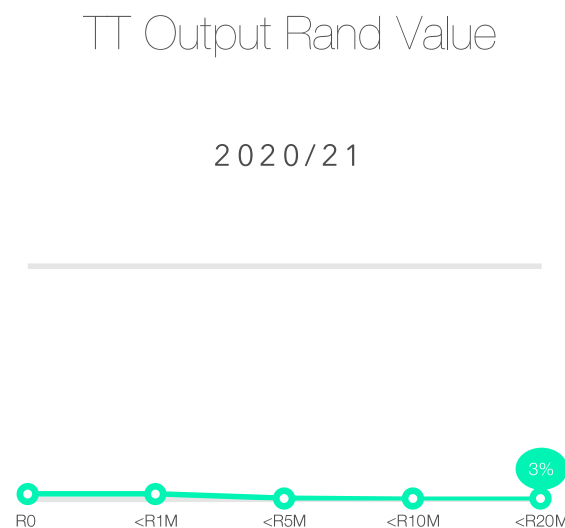


Figure 2: TT Output in Rand Value

Also, most rand value realised by the number of originations in each TT output/outcomes was through Technology Licenses followed by Patents, and New Products and Enterprises.

**The extent to which TT mandates are promoted as indicated above, does not effectively translate into corresponding TT outputs or outcomes across organisations.** The survey found that there is a disconnect between the extent of promotion of TTs per mandates as indicated above and TT output or outcomes.

## TT Mandates and Output

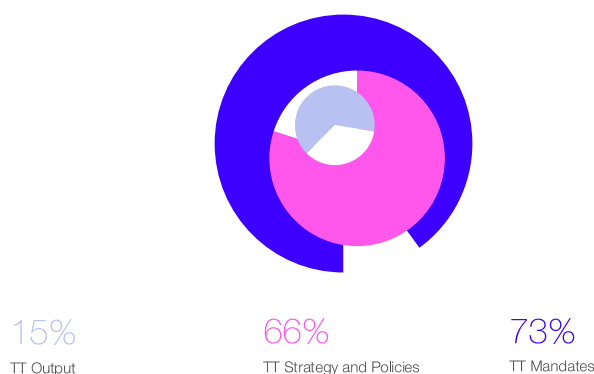


Figure 3: TT Mandates and Output

The findings are consistent with the previous surveys/reviews (DST, 2017 and 2021) that had observed that whilst there has been steady increase in the new technologies, licensing, and patent applications, the base is still very low. For example new patent registered increased at average 159 patent per annum from 2008 to 2018. Whilst, technologies declared increased at 848 per annum; and licensing agreements increased by 21 per annum between 2008 and 2014 and by increased by 140 per annum between 2015 and 2018 representing 666% increase over the two previous survey periods. The reports noted more than 80% of the licenses were produced by 5 institutions.

In terms of revenues out of the technology transfer activities in public sector institutions, the revenues are still limited, and can be regarded as at infancy compared to the total investments made in relation to R&D expenditure. Second survey reported about R54 billion R&D expenditure and revenues from technology transfers are in the region of average R33m per annum (from 2008 to 2014) and averaged R46m from 2015 to 2018.

## 4.2 Technology Transfer Ecosystem

The technology transfer ecosystem in South Africa is complex, with many different stakeholders involved in the process of commercialising research. In order to better understand the nature of these relationships, the survey explored the existence, quality, and value of relationships between different key role-players such as funders, HEIs, SCs, Government, and Technology Hubs. The findings indicated that there is a need for more effective communication and collaboration between all stakeholders in order to maximise the impact of technology transfer in South Africa. While there are some positive examples of technology transfer in operation, there is also a need for improvement in many areas. The study highlights a number of strategic issues that need to be addressed in order to ensure that technology transfer plays a more significant role in driving economic growth and development in South Africa.

#### 4.2.1 Sources of funding for Technology Transfers

**Finding Two: South Africa's technology transfer (TT) funding system still shows signs of underdevelopment** and requires attention if the country is to build its capacity, grow and compete globally. The survey found that only half of the respondents had received any funding for TTs. Of those who had received funding, the majority had received less than R1 million, with 32% coming from own funding sources and 28% from government programmes and agencies. For TTs requiring funding between R5 million and R10 million, only 11% was from venture capital and 6% from DFIs. The study also found that the South African government was not doing enough to support TTs, with only 22% of the respondents saying that they had received funding from development finance institutions. This lack of support could have serious implications for the country's ability to compete in the global marketplace.

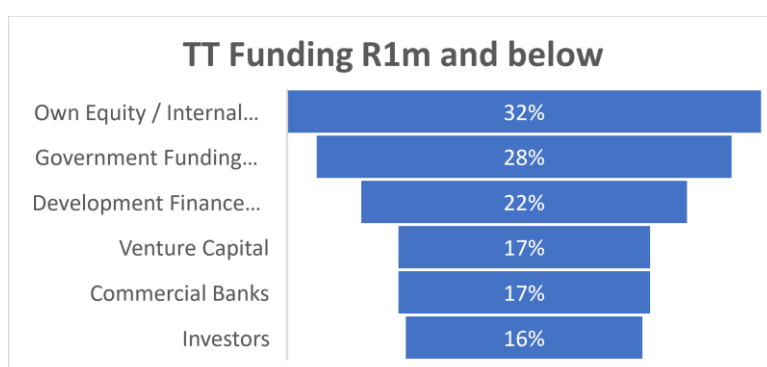


Figure 4: TT Funding R1m and below

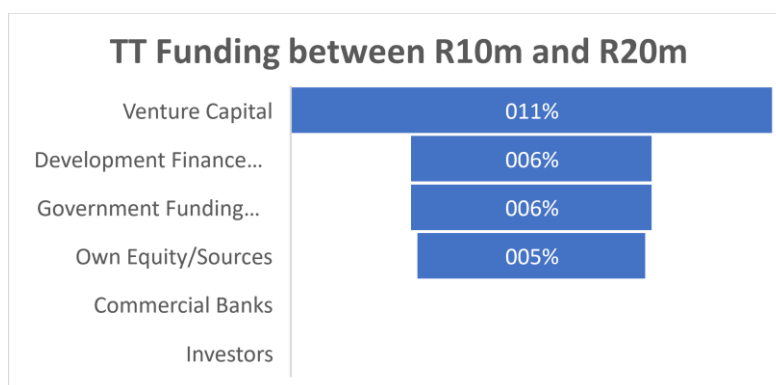


Figure 5: TT Funding between R10m and R20m

The survey also found that the majority of technology transfer organizations including business surveyed are not confident in the funding environment, with only 35% expressing confidence in the current funding institutions. The majority of organizations involved in technology transfer in South Africa have negative experiences with funding institutions. This survey, found that 47% of respondents had negative experiences with funding institutions, and that this figure rose to 65% when including those with no experience of funding from these institutions.. This lack of confidence is likely to cause further delays in the transfer of new technologies to the market, and may ultimately lead to companies and individuals losing out on the benefits of these innovations. Technology transfer is a critical process for ensuring that new technologies are commercialized and made available to consumers and businesses. It plays a vital role in South Africa's economy, and it is essential that funding institutions

provide adequate support for technology transfer organizations. Otherwise, we risk falling behind in the global race to develop and deploy new technologies.

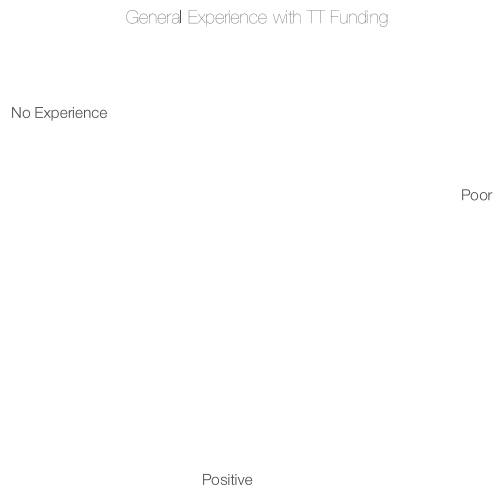


Figure 6: General Experience with TT Funding

Regarding organizations involved in TT’s experience of different funding sources, most institutions are positive about Government funding programs (74%), followed by non-profit funding agencies (53%), and tax incentives (32%). The overall picture shows that commercial funding institutions are perceived to be less responsive to technology transfer funding with DFIs, Venture Capital, and Commercial Banks at 26%, 21%, and 10% respectively.

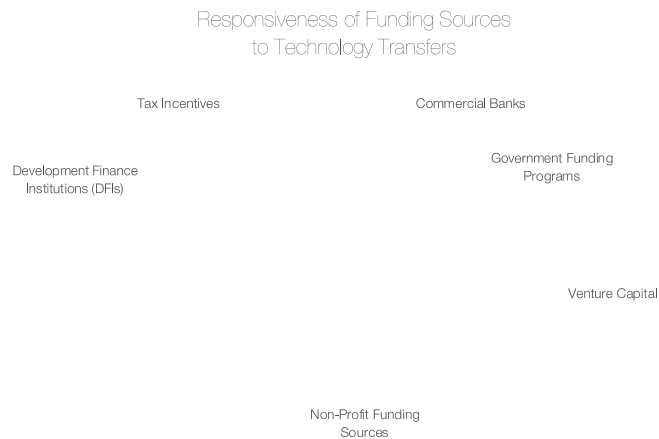


Figure 7: Responsiveness of Funding Sources to Technology Transfers

#### 4.2.2 Who do organisations work with on TT activities in the ecosystem?

##### **Finding Three: Most organisations prefer or do work with Universities/HEIs and Local Businesses on most of the TT activities**

The survey found that most organisations in the TT ecosystem work with Universities/HEIs on a variety of issues, including technology licenses and patents (73%), experts and facilities (73%), new enterprises (62%), trademarks/copyrights (58%), and new products (43%).

On the other hand, Science/Research Councils are often government organizations that support applied research. They are more likely to be involved in Experts/Facilities/Equipments (40%), Technology Licenses and Patents (33%), and New Products (21%). Technology Hubs are more likely to work with Technology Licensees/patents (20%), New Enterprises (15%), New Products (14%).

The survey also found that businesses surveyed are particularly active in the areas of new commercial products (43%), technology licenses and patents (40%), experts/facilities/equipments (40%), new enterprises (38%), and Trademarks/copyrights (33%). Many companies are now looking to foreign markets for technology transfer opportunities. The survey found that foreign companies appear to be strong on Technology Licenses/Patents, New Commercial Products (21%), and Experts/Facilities (20%).

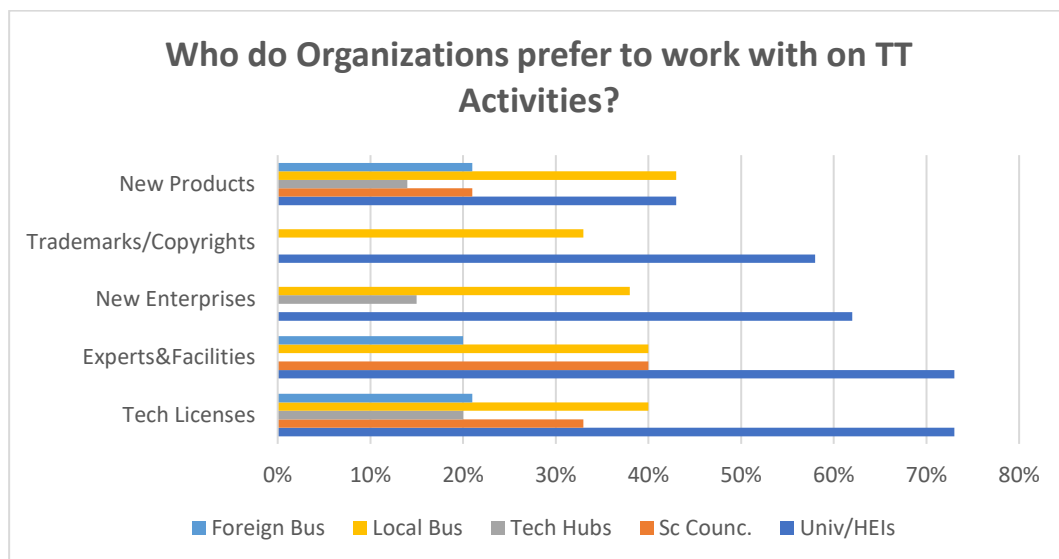


Figure 8: Who do Organisations prefer to work with on TT Activities?

#### 4.2.3 Perception of the value of Offices for Technology Transfers (OTTs) in the public sector

OTTs are a relatively new concept in the South African public sector, and as such, there is still much to learn about their value and effectiveness. The IPR-PFRD Act also makes it mandatory for public research/science institutions to establish the Offices for Technology Transfers (OTTs) under section 6 [Establishment of office of technology transfer at institutions]. The two previous provided surveys conducted do provide a glimpse of their capacity. Almost all universities and science councils have established the OTTs.

The baseline survey (DST, 2017) paid attention to qualifications and structure of the OTTs, and the second survey (DST, 2021) put emphasis on the capabilities based on experience and the technology transfer processes and transactions.

Firstly, on the structure of OTTs most institutions have a dedicated office, however, at declining level - the baseline survey found dedicated offices at 75% between survey period 2008-2014, and at

54% in the second survey. The decline may be associated with evolving role of OTTs as they continue to define their role within the institutions, as 46% became part of a department and function in the period between 2015 and 2018.

Secondly, the strength of OTTs activities was reported to be on prosecution as opposed to monitoring and litigation on infringements side of technology transfer activities. The OTT reported activities include among others receiving disclosures; managing process of IP registration, prosecution, and maintenance; administering funding; and conducting training/awareness workshops and seminars.

In order to get a better understanding of how these offices are perceived by those who use and run them, we sought to get the views of organizations in the ecosystem.

**Finding Four: Most organizations believe that OTTs are making good progress within the context of strategic ecosystem perspective, with most respondents perceiving OTTs as strong on Technology Licensing and IP Management support (79%),** followed by linkages with relevant institutions (68%), and New Ventures, and Product Commercialisation Support. Although these findings do not confirm or reflect whether businesses as role-players in the ecosystem do have knowledge, access, and the level of satisfaction with public sector OTTs. Of the businesses surveyed, the finding is that they are generally perceived as weak in commercialisation and in facilitating linkages, and half of the businesses regard them as “good” on technology licensing and IP management information and support.

#### 4.2.4 Perception of the value of government policy and other TT initiatives

**Finding Five: Organisations in the TT ecosystem have a positive experience and perception of Government policy and programmes on Technology Transfers**

The government offers a number of incentives to encourage technology transfer, including tax breaks and financial support for research and development. As a result, many businesses are now engaged in innovation activities. Regarding organizations’ experience of government TT related policies and initiatives, respondents were positive about government receiving overall 3.3 stars out of 5 stars rating.

Regarding businesses awareness the BIS surveys confirmed the level of awareness of government programmes that support innovations. **One third of businesses that engaged in innovation activities (33.6%) were aware of government financial support for innovation. By contrast, only one tenth of non-innovation-active businesses (10.1%) were cognisant of the support available.**

The vast majority of innovation-active businesses are therefore aware of the government's support for their activities, suggesting that the policy may have intended effect.

#### 4.2.5 Factors that influence Collaboration with other organizations in the ecosystem

**Finding Six: While costs and funding are always a key consideration, it is clear that organisations are primarily focused on ensuring a high quality technology transfer process based on trust and understanding of the business and markets, as well as relevant capacity and innovative technologies that will result in long-term success.**

Technology ecosystems are complex systems of people, organizations, and technologies that interact with each other to create new products, services, and business models. The factors that influence collaboration are critical to study further in order to enable stakeholders to make informed decisions when investing in processes to advance TTs. Based on the outcomes of the focus group discussions we probed six clusters of factors that influence organizations, particularly businesses to work with other organizations include access to Funding/Facilities/Infrastructure; Contribution to Policy Compliance; Costs; Location Advantage; Relevance and Quality of Capacity, Innovations and Technologies; and Understanding of Our Business/Industry/Market/Culture.

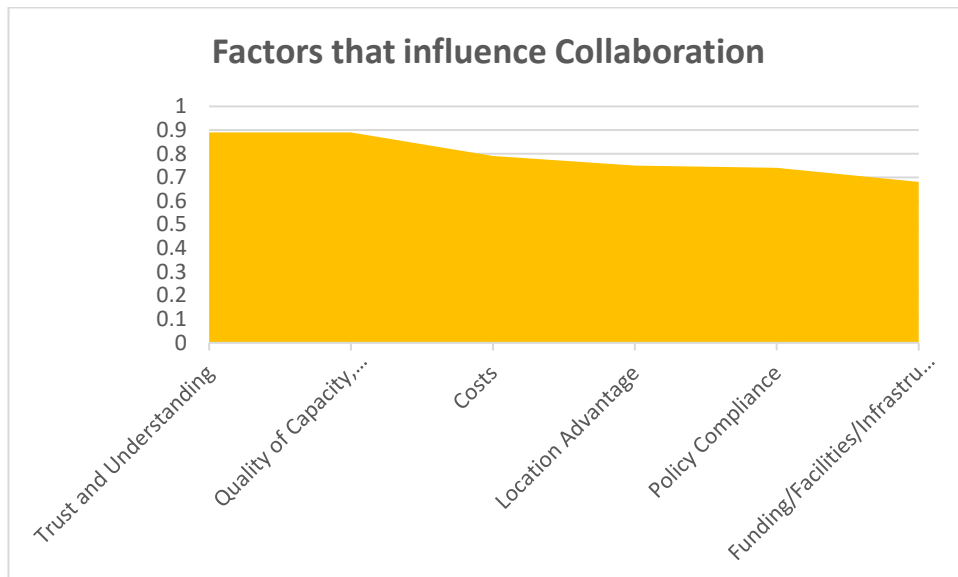


Figure 9: Factors that influence Collaboration

By understanding the key markets, businesses, and cultures, organisations can more effectively develop the necessary capacity and innovative technologies needed to be successful. While costs and funding are always a key consideration, it is clear that organisations are primarily focused on ensuring a high quality technology transfer process based on trust and understanding of the business and markets, as well as relevant capacity and innovative technologies that will result in long-term success.

This is consistent with Business Innovation Survey’s finding that while businesses in South Africa are active in technological innovation, **only about one-fifth (20.8%) of innovation-active businesses reported collaboration activities as part of the development of their innovations.** The five most widely reported reasons to collaborate were access to new technology (61.5%), access to new markets (60.3%), access to new customers (58.7%), reduction of costs (57.9%), and access to new financing (57.1%). This suggests that there is still a lot of room for improvement when it comes to technology transfer in South Africa, as stakeholders and role-players continue to find each other and harness their capacities.

Similarly regarding the public sector OTTs in the IP & TT surveys the two reports (DST 207and 2021) distinguished between internal enablers to external enablers. External Enablers

- A forum to discuss national technological needs
- A national forum to showcase technologies
- OTTs engagements with industry (formal or informal)
- An international forum/platform to showcase technologies

The above enablers variables are significant when it comes to the successful and effectiveness of the operations of OTTS/TTF in the public sector working with the private sector. This is reflected in the



results in both TT surveys where the majority of the OTTs in the public sector scored above 84% and 70% of these enablers respectively as very important. **Noteworthy regarding the external enablers which forms an important part in the TT ecosystem is the perceived partial or absence of external enablers in both TT reports at 82% and 85% respectively.**

#### 4.3 TT related Information/Data access or availability

**Finding Seven: There is need for relevant information/data that will enable organizations to advance technology transfers.**

Technology Transfer (TT) involves the process of sharing organizational knowledge and expertise with other organizations for the promotion of inclusive and sustainable economic development and growth. In that context, information or data is fundamental throughout the facets of technology transfer ecosystem. The survey sought to establish critical information needed by organizations in the TT ecosystem based on literature, case studies, and focus group discussion. The survey presented six information/data areas relevant to TTs i.e. information/data on calls for innovations, commercialisation, and market opportunities; skilled practitioners/experts; collaboration and networking opportunities; funding opportunities; and relevant technologies.

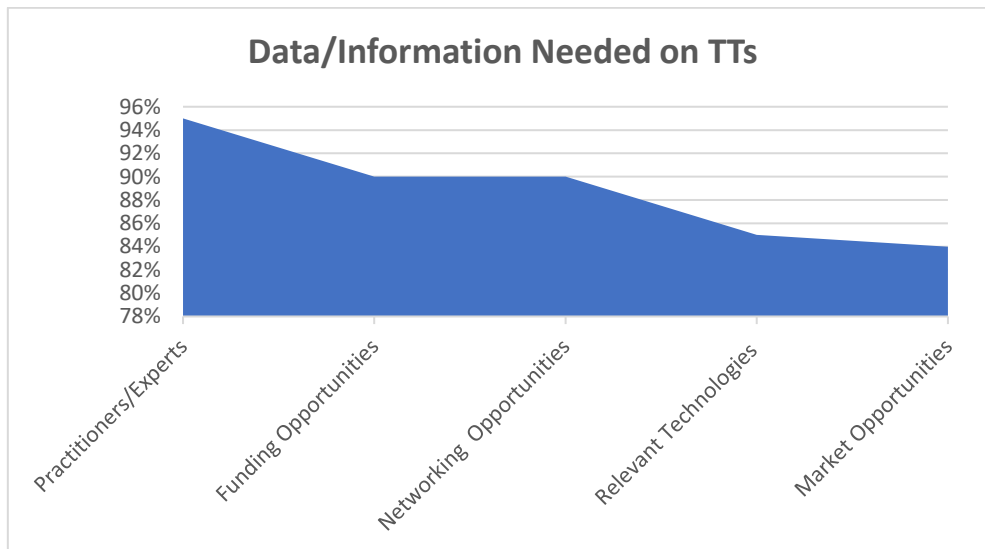


Figure 10: Data/Information needed on TTS

TT needs to be carried out within a supportive ecosystem that provides the necessary resources and infrastructure. The finding in this survey is that TT practitioners or organizations indicated that there is a clear need for information or data on skilled practitioners/experts (95%); funding opportunities and collaboration (90%); relevant technologies (85%); and calls for innovation and commercialisation (85%). This information is essential for TT practitioners to be able to identify potential collaborators, access funding, and find the right technologies for their needs.

Businesses that were surveyed also indicated strongly the need for skilled practitioners and experts (67%), and calls for commercialisation and market opportunities at (67%).

Furthermore, it is clear that effective TT requires a strategic approach that takes into account the specific needs of the organisation and the ecosystem in which it operates. Without this, TT will not be able to realise its full potential as a driving force for innovation.

## 5. Recommendations

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In the final analysis, on the basis of the above findings, we make the following recommendations:

- I. **The stakeholders should consider developing a strategy for technology transfer that includes both public and private sector role-players and is aligned with the industry needs in accordance with the sectoral master plans.** There is a need to develop a strategy that will enable technology transfer between the public and private sector. The strategy should be designed to address the following: create awareness about technology transfer; identify critical technologies for transfer; develop an institutional framework for technology transfer; create incentives for technology transfer; establish mechanisms for monitoring and evaluation. The strategy should also take into account the following: legal and regulatory framework; infrastructure; financing arrangements; and human resource development.
- II. **There is a need for the government and stakeholders to undertake a comprehensive review and reconfiguration of the funding environment and infrastructure that inculcates the imperatives for technology transfers** and coordinating various institutional mandates in the public and the private sector e.g. **Funding models of institutions in the technology transfer (TT) ecosystems need to be looked at to ensure they promote commercialisation.** The technology transfer process is essential for the economic growth and development of South Africa. The lack of technology transfer has been identified as a significant constraint to the growth of many firms in South Africa. Funding is a significant barrier that need to be addressed.
- III. **Different technology transfer organisation or institutions, in particular funding institutions and Universities/Higher Education Institutions need to improve their responsiveness to technology transfer needs in South Africa.** In South Africa, there are a number of technology transfer organisations and institutions, including funding institutions and Universities/Higher Education Institutions. However, there is room for improvement in terms of their responsiveness to the technology transfer needs of businesses in South Africa. There are a number of areas that could help to improve the situation. For example, they could also provide more targeted support to small businesses in specific sectors, such as the mining or agriculture sectors. In addition, they could improve communication and outreach efforts, to make sure that businesses are aware of the services that they offer. By taking these steps, HEIs and funding organisations can play a more active role in promoting technology transfers in South Africa.
- IV. **In order to improve the scale of collaboration between R&D and Commercialisations support organisations with local businesses, it is essential to implement initiatives that will improve trust, understanding, and capacity across the country and institutions.** Continue to intensify the capacity of OTTs enabling them to play a much more strategic role coordinating with the private sector. This may also include intensive awareness campaigns with local businesses.
- V. In this day and age, it is essential for the government to intensify keeping up with the ever-changing landscape of technology such green technologies, in order to stimulate industrial competitiveness; local business participation in global value chains; and international trade. **One way to do this is to ensure that its programs and policies (such as procurement policies) are able to adapt and evolve as new technologies are developed, and encouraging technology transfer so that new technologies can be implemented on a wider scale.** Only by taking these steps can the government hope to keep up with the rapidly changing world around us.

- VI. The efficient and quality technology transfer process is essential for ensuring that new ideas and innovations are able to reach the marketplace. However, the current system is often slow and inefficient, leading to delays and lost opportunities from the business perspective. In order to minimise these problems, **the government and stakeholders should look at creating systems to digitalise technology transfer programs.** This would help to reduce human error and subjectivity, and also allow for a more efficient and streamlined process. In addition, it would also allow for better tracking of technology transfer programs, making it easier to identify areas where improvements are needed. By taking these steps, South Africa would be able to improve its technology transfer process and better compete in the global marketplace.
- VII. In recent years, technology transfer has become an increasingly important topic of discussion among stakeholders internationally in the business world. As technology advances and becomes more complex, the need for effective transfer of technology between R&D and Commercialisation support organisations and businesses increases. However, technology transfer can be a difficult and sensitive process, as it often involves sharing confidential or proprietary information. As a result, **it is essential that stakeholders consider a data governance framework and social contract on technology transfers.** Such a framework would provide guidance on what data and information should be shared, as well as how it should be shared. It would also help to ensure that all role-players in the technology transfer process are aware of their responsibilities and obligations. By putting such a framework in place, stakeholders can help to ensure that technology transfer is conducted in a safe and efficient manner.

## 6. Conclusion

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Despite of recent strides to stimulate technology transfers in the public sector, and extraordinary efforts displayed by stakeholders in dealing with devastating impact of COVID-19, more lessons can be learnt to advance technology transfers within an ecosystem perspective.

This study reflected on the previous reviews, case studies, and focus group discussion in order to identify key strategic issues that need attention of policy makers and leaders of organisations in the TT ecosystem. The survey illuminated the significance of these strategic issues to advance TT. These include mandates, ecosystem, and information/data sharing or access. Technology transfer mandates are important as they provide guidance on how technology should be transferred. It is also essential to consider the ecosystem when transferring technology as this can impact the success of the transfer. For example, a technology transfer may be more successful if it takes place in an ecosystem that is already receptive to new technology. Furthermore, data sharing or access is another key issue as it can help to facilitate the transfer of technology. By taking into account these strategic issues, we can ensure that Technology Transfer is advanced in a way that is beneficial for all parties involved.

In South Africa, the Technology Transfer (TT) function is governed by IPR-PFRD Act, which mandated the establishment of the Offices for Technology Transfer (OTTs) overseen by the National Intellectual Property Management Office (NIPMO) within the Department of Science and Innovation (DSI). The OTTs are responsible for coordinating TT activities across the public sector; however, not much coordination within the private sector and across public and private sectors has been visible. This survey identifies TT role-players and assist to explore strategic issues that can enable advancement of TTs in the ecosystem in South Africa. Strategic technology transfer planning that facilitates buy-in from all ecosystem actors is required to ensure successful implementation of the technology transfer mandates.

The study also showed that data on successful TT initiatives between different role-players in the ecosystem is often not captured or made available, making it difficult to track progress and learn from past successes and failures. In order to maximise the impact of TT in South Africa, it is essential that all stakeholders work together to create an ecosystem that is conducive to innovation and transfer of technology. Only by taking a collaborative and coordinated approach will South Africa be able to realise its full potential in this area.

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