technology innovation
AGENCY
Innovating Tomorrow Together

ANNUAL REPORT
2020/21

science & innovation
Department:
Science and Innovation
REPUBLIC OF SOUTH AFRICA

87.5%
of R80 million received committed to approved Innovation Fund projects

68
projects approved with a total multi-year financial consideration of R650 million

R619.7 million
total expenditure against R603.7 million total revenue

Unqualified audit for the **10th** consecutive year

YEAR IN REVIEW 2020/21

165
Severe Acute Respiratory Syndrome Coronavirus 2 genomes sequenced

Feasibility assessment undertaken for **local vaccine manufacturing readiness**

R13 million
provided to two projects (diagnostics and antibody sequencing)

R18 million
allocated to seven new projects (reagents and test kits)

Supported efforts for alternative and innovative **COVID-19 patient ventilation, and the protection of frontline health workers** through innovative intubation and production of personal protective equipment

Investigations undertaken in two hospitals and a prison

>10,000
COVID-19 tests conducted through TIA-supported Technology Platforms

OUTCOMES

	Planned	Actual
Technologies commercialised	9	8
Bio-based technologies commercialised	9	37
Small, medium and micro enterprises accessing science, engineering and technology services	2,390	1,990

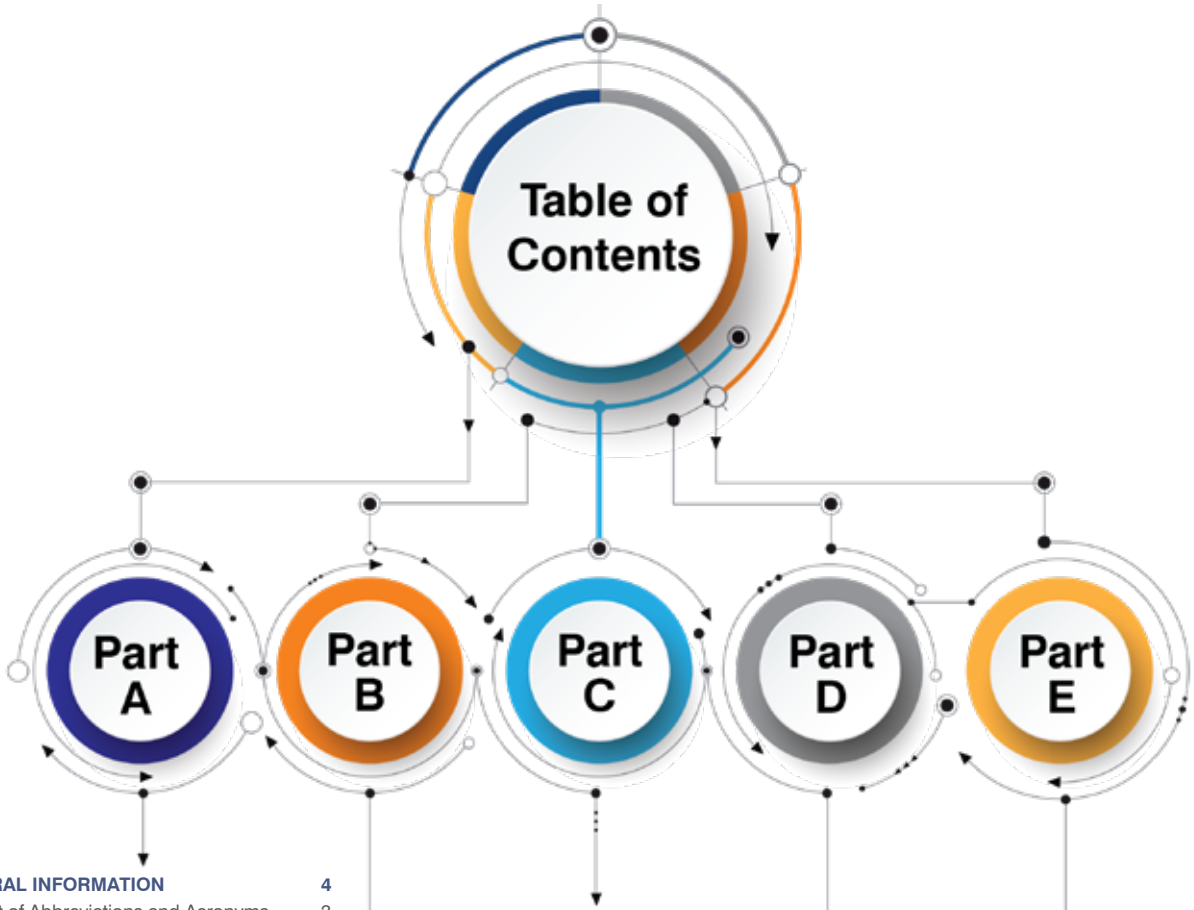
> TIA was established to promote the development and utilisation – in the public interest – of discoveries, inventions, innovations, and improvements. The objective of the agency is to support the state in stimulating and intensifying technological innovation in order to improve economic growth and quality of life for all South Africans.

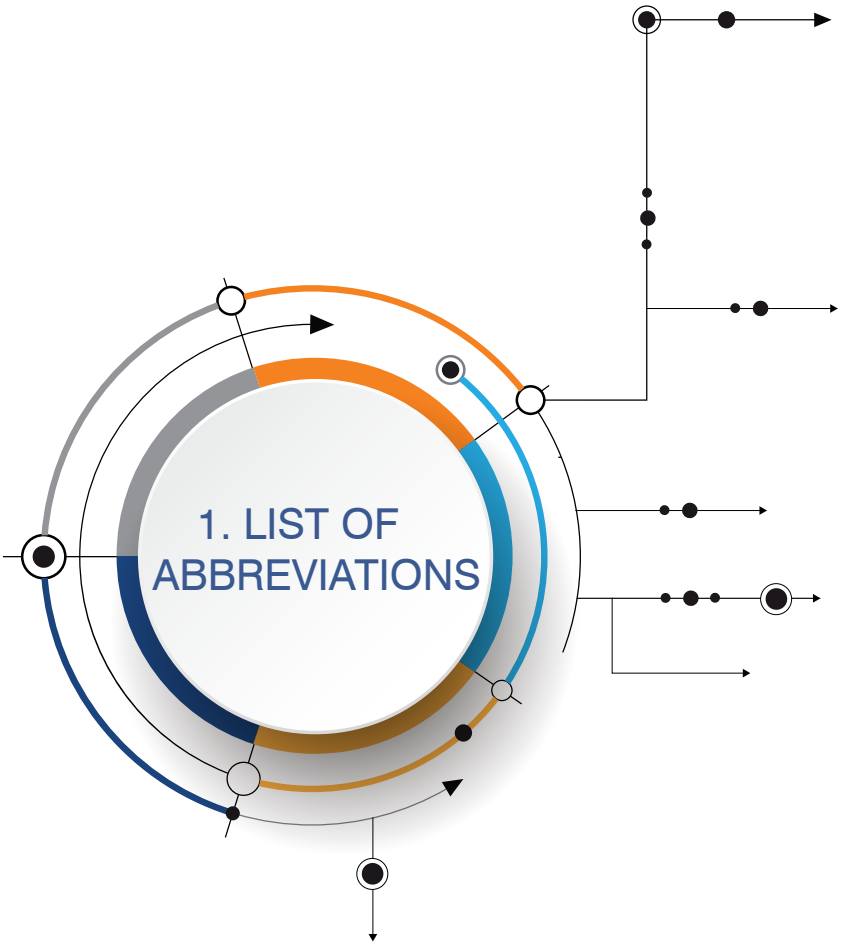
	Planned	Actual
Operational and functional Technology Stations and centres providing science, engineering and technology support	18	16
New centres providing science, engineering and technology support	1	1

OUTPUTS

	Planned	Actual
Licensed or assigned technologies	1	6
Projects involving industry in execution	6	29
Successfully diffused technologies	1	5
Products launched	13	21
Leveraged funds	R147.2m	R1,372.6m

	Planned	Actual
Successfully demonstrated bio-based technologies	9	37
Operational and functional Technology Platforms	7	7
Operational and functional Technology Innovation Clusters	5	6



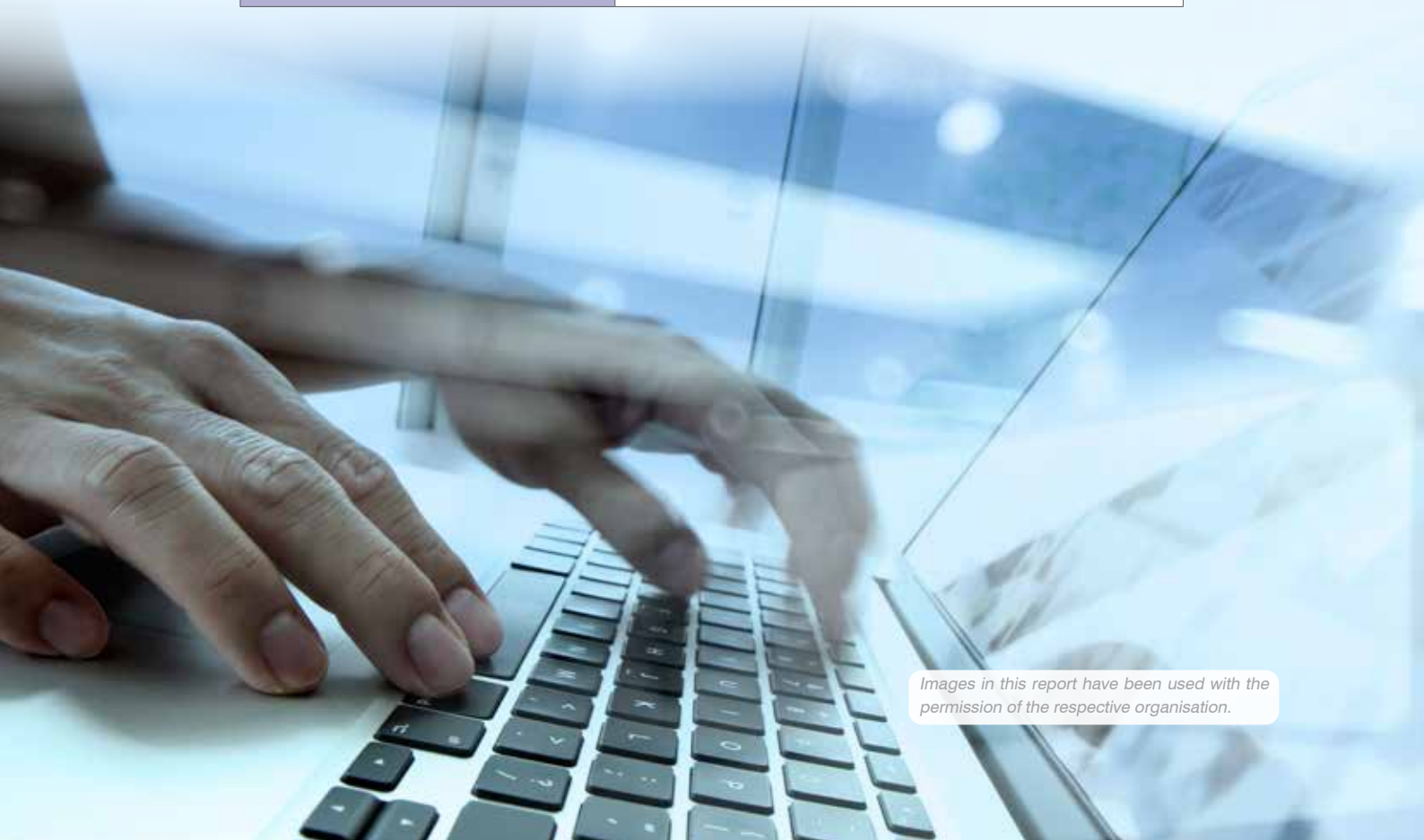


4IR	Fourth Industrial Revolution
ABIPP	Agriculture Bio-economy Innovations Partnership Programme
AFS	Annual financial statements
API	Active pharmaceutical ingredient
APP	Annual Performance Plan
A&RC	Audit and Risk Committee
ARC	Agricultural Research Council
ATMs	African Traditional Medicines
B-BBEE	Broad-based black economic empowerment
Biovac	Biological and Vaccines Institute of Southern Africa (Pty) Ltd
CEO	Chief Executive Officer
CleanTech	Clean technology
COVID-19	Coronavirus disease 2019
CSIR	Council for Scientific and Industrial Research
CPGR	Centre for Proteomic and Genomic Research
DSI	Department of Science and Innovation
GCIP-SA	Global CleanTech Innovation Programme-South Africa
GDP	Gross Domestic Product
GRAP	Generally recognised accounting practices
HIV/AIDS	Human immunodeficiency virus infection and acquired immune deficiency syndrome
HR&REMCO	Human Resources and Remuneration Committee
ICT	Information and Communication Technology
IDC	Industrial Development Corporation
IFC	Investment and Finance Committee
IK	Indigenous knowledge
IKS	Indigenous knowledge systems
IP	Intellectual property
IT	Information technology
KRISP	KwaZulu-Natal Research Innovation and Sequencing Platform
m	Million
MTEF	Medium-Term Expenditure Framework
MTSF	Medium-Term Strategic Framework
NDP	National Development Plan
NHLS	National Health Laboratory Service
NIPP	National Indigenous Products Programme
NSI	National System of Innovation
PDTS	Product Development Technology Station
PFMA	Public Finance Management Act
PoC	Point of Care
PPE	Personal protective equipment
R&D	Research and development
SA	South Africa
SAHPRA	South African Health Products Regulatory Authority
SAMRC	South African Medical Research Council
SARS-CoV-2	Severe Acute Respiratory Syndrome Coronavirus 2
STI	Science, Technology and Innovation
SMME	Small, medium and micro enterprises
the dtic	Department of Trade, Industry and Competition
TIA	Technology Innovation Agency
TRL	Technology readiness level
TSP	Technology Stations Programme
UK	United Kingdom
US	United States (of America)

PART A

General Information

Registered name	Technology Innovation Agency
Registration/constitution information	Technology Innovation Agency Act (Act 26 of 2008), read together with Sections 19-23 of the Science and Technology Laws Amendment Act (Act 7 of 2014)
Registered office address	TIA House, 83 Lois Avenue, Menlyn, Pretoria
Postal address	P.O. Box 172, Menlyn, Pretoria 0181
Telephone	012 472 2700
Email	info@tia.org.za
Website	www.tia.org.za
Social media	www.linkedin.com/company/technology-innovation-agency @tiaorgza www.facebook.com/TIAORGZA
External auditor	Rakoma and Associates Inc. Building B, Monte Circle Office Park, 178 Monte Casino Boulevard, Fourways, Johannesburg 2191
Banker	Standard Bank 30 Baker Street, Rosebank 2196, Johannesburg
Company Secretary	Kobus Louw (Board Secretariat)



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2. FOREWORD BY THE CHAIRPERSON

Butana Mboniswa
Interim Chairperson of the Board

> This annual report emphasises TIA's efforts to enhance commercialisation of technologies that address the health of our people, food security, heightening exploitation of our biological resources, and increasing investments in technologies that contribute to economic revival and reindustrialisation of the South African economy.

TIA entered the year against the backdrop of the first wave of the COVID-19 pandemic that wreaked havoc on the health of our people, their livelihoods, and the economy. In 2020/21, an estimated 152,014 excess deaths were recorded and 1,545,431 people were infected with the virus. It is estimated that tax revenues for 2020/21 declined by R285 billion, and that 42.7% of small businesses closed due to the economic impact of the lockdown. Economic activity decreased by 7% in 2020 compared with 2019; the biggest annual fall in economic activity since 1946. Unemployment jumped to 32.5% in the fourth quarter of 2020 from 29.1% in the fourth quarter of 2019.

The South African government implemented extensive measures in response to the pandemic by imposing nation-wide lockdowns and other risk-based measures. This was necessary to curtail the spread of infections and to avoid overwhelming the capacity of South Africa's health system. Economic relief and stimulus packages were also announced to mitigate the social and economic fall-out arising from such measures. Furthermore, National Treasury redirected public sector budgets towards COVID-19 related initiatives, resulting in budget cuts to all government departments. As with other government entities, TIA had to contend with budget cuts and reprioritisation of its funding and other resources towards the pandemic.

These developments put the South African National System of Innovation (NSI) to the test, helping us to assess its resilience and ability to deploy the capabilities that the government (under the stewardship of the Department of Science and Innovation (DSI)) has invested in over the years. There is no question that, in this, TIA played its part through a range of interventions delivered by its Technology Platforms Programme and Technology Stations Programme (TSP), as well as by fast-tracking the deployment of various TIA-supported technologies into the economy.

TIA is cognisant that the pandemic and its aftermaths will be felt for years to come. This being the first year of implementing the 2020-2025 Strategic Plan, TIA's focus has been on responding to the government's imperatives around COVID-19 challenges. This annual report emphasises TIA's efforts to enhance commercialisation of technologies that address the health of our people, food security, heightening exploitation of our biological resources, and increasing investments in technologies that contribute to economic revival and reindustrialisation of the South African economy.

Having proven the strategic importance of Technology Stations and Technology Platforms in responding to COVID-19 challenges, TIA worked closely with the DSI to continually invest in these capabilities; strengthening their offerings and ensuring that they continue to play a central role in the deployment of research output and support to small, medium and micro enterprises (SMMEs) and companies, thereby reducing the challenges of unemployment and joblessness that threaten the SMME sector.

Budget cuts were unavoidable as the fiscus is constrained. In this environment, the agency was challenged to intensify efforts to build partnerships that will bolster the execution of its mandate through co-funding initiatives, exploitation of resources and other forms of expertise, and capabilities that lie in other areas of the innovation ecosystem. In so doing, TIA continued to play an important role in promoting collaboration and coordination with other players in the NSI – within government and with the private sector.

The DSI's launch of the Innovation Fund represented a significant development in government's efforts to increase the rate of commercialisation of public-funded research and development (R&D) in South Africa. This will ensure that partnerships with the private sector are driven through a structured framework that is designed to increase the rate of industrialisation, leading to the creation of viable companies that will develop products, create jobs, and grow exports to international markets based on novel South African technological innovations. TIA has already built a portfolio of projects under this Fund and looks forward to this being an integral part of TIAs business into the future.

During the reporting period, TIA achieved nine of its 10 output indicator targets for the year. This result is commendable given that TIA was operating within a very challenging external environment associated with the COVID-19 pandemic.

The TIA Ministerial Review commenced in November 2020, with the aim of evaluating the effectiveness of TIA's programmes, the agency's positioning in the NSI, and to recommend measures to the Minister on ways to enhance the agency's execution of its mandate. The TIA Board and management welcomed this initiative as an opportunity to reflect and look for ways to strengthen the organisation, ensuring that it fulfils the purpose for which it was intended and is appropriately geared to respond to shifts in the innovation landscape as circumstances dictate.

I wish to thank the leadership at the DSI; in particular, the Honourable Minister Dr Bonginkosi Nzimande, the Director-General Dr Philemon Mjwara, and his senior leadership team for their unwavering support through challenging times in 2020/21. I also want to thank my colleagues on the TIA Board, and TIA's management and staff who have shown commitment and dedication to deliver results under challenging circumstances. Lastly, new Board members will be appointed in 2021/22, and I wish the new Board all the best in guiding TIA to achieve even greater socio-economic impact for the benefit of all.

I am pleased to present TIA's annual report for the 2020/21 financial year.

Butana Mboniswa
Interim Chairperson of the Board

3. THE TIA BOARD

Butana Mboniswa
Interim Chairperson of the Board

Dr Stephen John Lennon

Thabiso Gerald Ramasike

Dr Patience Lethabo Mlengana

Joy Sebenzile Matsebula

Dr Mziwandile Madikizela

Dr Jan van de Loosdrecht

Patrick Krappie
Acting CEO

4. CHIEF EXECUTIVE OFFICER'S OVERVIEW

Patrick Krappie
Acting CEO

TIA was established to promote the development and exploitation – in the public interest – of discoveries, inventions, innovations and improvements. The objective of the agency is to support the state in stimulating and intensifying technological innovation in order to improve economic growth and quality of life for all South Africans.

During the reporting period, the agency achieved nine of its 10 output indicator targets for the year, and over-achieved significantly against several of these.

TIA achieved these results against a very challenging external environment during which South Africa experienced significant economic and social challenges associated with the COVID-19 pandemic. The pandemic dictated a sharp focus on supporting government's efforts to flatten the curve in the first quarter. TIA remained an important player in these efforts throughout the year, collaborating with key partners in the innovation ecosystem and deploying its limited funding and the capabilities of its programmes to support government's response. True to its commitment of partnering and coordinating with others in the system, TIA continued to leverage off and grow its portfolio of partnerships with the private sector.

I am also proud to report that many of TIA's investees acclimatised to operating within a COVID-19 induced lockdown environment early in the year, with innovators and entrepreneurs demonstrating remarkable resilience in very challenging and uncertain circumstances.

It is pleasing to note that TIA's control environment remains sound, and that the agency continuously strives to enhance the presentation of its financial performance. In this regard, the statement of financial position has been restated based on a technical interpretation of a financial asset by the external auditors. It is noted that this restating is not expected to affect the decision of users of the annual financial statements (AFS).

The TIA Ministerial Review commenced during the third quarter and provided an opportunity for TIA to highlight its achievements, convey the challenges it experiences, and provide a perspective on how it believes the agency should be positioned within the NSI. Management also undertook a process to benchmark TIA against similar institutions globally. The outcome of this benchmarking exercise served to inform the second phase of the Ministerial Review in January 2021.

> "During the reporting period, the agency achieved nine of its 10 output targets for the year, and over-achieved significantly against several of these."

While the Ministerial Review has not yet been concluded, TIA remains confident that it is fulfilling its mandate to the best of its ability. TIA eagerly awaits the results and recommendations of the review panel, and is poised to make the necessary changes and improvements for greater operational efficiency and to achieve more impact in the NSI.

TIA demonstrated its investment capability in the fourth quarter by implementing the initial phase of the Innovation Fund under contract with the DSI. The agency was able to commit 87.5% of the R80 million funds received to approved projects in addition to finalising disbursements associated with TIA's 2020/21 Medium-Term Expenditure Framework (MTEF) allocation. TIA also approved a total of 68 projects with a total multi-year financial consideration of R650 million during the year, with 17 of these approved at the level of the TIA Board's Investment and Finance Committee.

I am particularly pleased that a significant number of technologies have been successfully demonstrated in 2020/21, both within TIA's bio-economy and industrial sector portfolios. Other notable achievements include TIA's technology development initiatives undertaken through collaboration between academia and the private sector, and an increase in the funding leveraged through partnerships and monies attracted into TIA's investment portfolio. These achievements clearly demonstrate TIA's intensified focus and capacity to increase the rate of commercialisation of invested technologies in support of the organisation's 2020-2025 Strategic Plan.

As part of its commitment to addressing the systemic challenges experienced in the NSI, the agency has put in place several new capability development initiatives to address specific challenges identified within selected priority areas. These include:

- Launching the Medical Devices and Diagnostics Innovation Cluster in partnership with the South African Medical Research Council (SAMRC); the Department of Trade, Industry and Competition (the dtic); and other relevant stakeholders within the medical devices sector;

- Approving the establishment of the African Traditional Medicines (ATM) Technology Platform at the University of the Free State; and

- Continued efforts to strengthen the Fourth Industrial Revolution (4IR) capabilities and related offerings of several Technology Stations.

These achievements, however, cannot mask areas where TIA was not successful in performing according to expectation. A few of these include challenges in supporting start-ups or existing companies to launch products and the number of Technology Stations that are fully functional and operational. From these shortcomings TIA continues to derive lessons for future improvements as these performance areas form part of TIA's 2021/22 Annual Performance Plan (APP) and for the remainder of its 2020-2025 Strategic Plan.

TIA unfortunately experienced a high staff turnover in the period under review, particularly in the fourth quarter. In an effort to retain staff, TIA management developed a full Employee Value Proposition to enhance the employee experience and improve productivity. This comprises both monetary and non-monetary elements and encompasses compensation, benefits, career advancement, the work environment, and organisational culture.

With this said, the increasingly collaborative relationship and fruitful engagements between TIA and the DSI as the agency's shareholder is encouraging and bodes well for the future, particularly in creating an increased shared appreciation of the strategic challenges faced within the NSI. The release of the DSI's draft Decadal Plan highlights the department's appreciation of TIA's important role in the implementation of the 2019 White Paper on Science, Technology and Innovation. The prospects of TIA's central role in implementing the Innovation Fund is testament to the good working relations and engagements between TIA and the DSI.

I wish to express my sincere appreciation to the Honourable Minister of Higher Education, Science and Innovation, Dr Bonginkosi Emmanuel Nzimande for his support during the year, particularly for his inputs concerning TIA's 2021/22 APP, which greatly enriched the agency's vision for the year ahead. Thanks also to the senior officials at the DSI for the many fruitful engagements that took place during the year.

I want to thank all TIA employees for their tireless efforts to make a difference to the lives of ordinary citizens under very challenging conditions, particularly during the COVID-19 lockdown periods when we needed to go to extraordinary lengths to maintain service to our clients and investees. Your contributions have not gone unnoticed. Thanks, in particular, to my fellow executive team members for your commitment and support during the year.

Many organisations were affected directly by the COVID-19 pandemic, including the loss of life of some employees. While a small number of TIA employees contracted the virus, TIA was fortunate not to have lost any of its staff members to COVID-19. My heartfelt condolences go out to employees who lost loved ones during the pandemic. These challenging times have indeed underscored the importance of time spent with friends and family and maintaining a healthy work-life balance.

Lastly, I wish to thank all the TIA Board members for executing their oversight of TIA's strategy, finances, human resources and governance systems professionally during the course of the year.

I am pleased to present TIA's annual report for 2020/21.

Patrick Krappie
Acting Chief Executive Officer

5. THE EXECUTIVE MANAGEMENT TEAM

Patrick Krappie
Acting CEO

Ismail Abdoola
Chief Financial Officer

Petro Dekker
Executive: Corporate Services

Dr Vuyisile Phehane
Executive: Bio-economy

Brian Mphahlele
Executive: Commercialisation

Tandokazi Nquma-Moyo
Acting Executive: Innovation Enabling

Ricardo Apolles
Head: Internal Audit

Annalie Woest
Head: Legal Services

Kobus Louw
Company Secretary

6. CHIEF FINANCIAL OFFICER'S OVERVIEW

Ismail Abdoola
Chief Financial Officer

The agency has maintained a sound financial performance despite the prevailing economic climate based on TIA's financial results for the period 1 April 2020 to 31 March 2021 (hereinafter "2020/21").

The impact of COVID-19 was felt on the fiscus; resulting in budget cuts to entities. The budget reprioritisation exercise that followed this saw TIA, like all DSI entities, taking a budget cut of 10% – impacting both its investment budget and operational expenditure. Two key factors in this context stood TIA in good stead. The first: savings on operational expenditure arising out of travel restrictions. The second: the Board's decision in November 2019 to redirect R50 million from operational expenditure to investment funding was timely as this contributed to an increased efficiency ratio of 75% that subsequently cushioned the organisation from the impact of the budget cuts that followed in July 2020.

Notwithstanding the tough economic climate and other challenges (such as the onset of the COVID-19 pandemic), TIA received an unqualified audit for the tenth consecutive year. This is in accordance with the agency's commitment to maintain a healthy control environment that is governed by sound financial principles and policies.

REVENUE: PARLIAMENTARY GRANT AND SPECIFIC CONTRACTED AMOUNTS FROM THE DSI

A total of R408.8 million of MTEF funding was received for the financial year, representing an approximate reduction of 7.2% from the previous year's funding received of R440.9 million. Despite such a significant reduction, total overall income was lower for the year by only 2.9% due to additional disbursements on specific programmes, including the Innovation Fund.

Specific contracted agreements recognised as income increased by 9.4%, from R147.1 million in 2019/20 to R160.9 million in 2020/21. This result is the best since TIA's inception, demonstrating the agency's ability to deliver on specific-purpose funding granted by the DSI.

INVESTMENT AND OTHER INCOME

Investment and other income decreased by 22.7%, from R16.7m in 2019/20 to R12.9m in 2020/21. This decrease is in line with the challenging economic climate experienced in 2020/21 and relates to lower loan repayments and royalties from investee companies. To address the ever-increasing demand for TIA funding there is a need for TIA to continue to identify and secure alternative sources of funding and revenue.

ADMINISTRATIVE AND EMPLOYEE COSTS

During 2020/21, administrative expenditure decreased by 18.3%. This was driven by TIA's management which permitted a portion of operational funding to be reprioritised towards investment expenditure. This enabled TIA to achieve an increased efficiency ratio, with 2020/21 being the best achieved in the past four financial years.

> To address the ever-increasing demand for TIA funding there is a need for TIA to continue to identify and secure alternative sources of funding and revenue.

Cost savings were realised through a reduction in the use of consultants. Instead, TIA relied more on its own internal expertise and capabilities. A decrease in travel expenditure was achieved by leveraging digital platforms to host meetings and other business engagements. Further savings were realised on lower facility management costs due to remote working as a result of lockdowns imposed during the COVID-19 period.

TIA's use of the National Treasury's Central Supplier Database allowed the agency to spread its purchasing reach to smaller suppliers who generally struggle with high barriers to entry into supply chains and procurement spend. TIA does not procure goods and/or services from suppliers who are not fully tax compliant, thereby contributing to the fiscus. The procurement strategy continues to focus on increasing spend with small businesses and those businesses owned by previously disadvantaged individuals in line with government priorities and objectives.

INVESTMENT AND PROJECT FUNDING

The decrease in investment expenditure is directly related to the decrease in the MTEF allocation. Considering the current investment expenditure budget constraints, the organisation has done well to disburse R1.1 million (excluding the Innovation Fund) more than what was budgeted. This was as a result of re-allocations from operational savings to TIA's core mandate-driven investment expenditure to ensure the optimum utilisation of resources across the organisation.

Notwithstanding that the public fiscus is exceptionally constrained, the DSI has established an Innovation Fund that will enhance South Africa's capacity to commercialise technological innovations. In this regard, TIA has been allocated and received an amount of R80 million. TIA has successfully committed R70 million (87.5%) of the Fund to approved projects and disbursed R25.2 million to project recipients based on the achievement of milestones.

TIA's executive management remains committed to improving its operational efficiency, particularly the allocation of operational expenditure savings to investment expenditure. Due to the lockdown regulations, travel was restricted and so too was the utilisation of TIA's facilities (including its offices), resulting in a R10 million saving for the year. These funds were directed to projects and programmes under the Innovation Enabling Division such as the Seed Fund, Innovation Skills Development, and other innovation for social impact investments and initiatives that operate with modest budget allocations. This improved the efficiency ratio from 70% in 2019/20, to 75% in 2020/21.

SURPLUS FUNDS

The agency realised a surplus of R13.9 million in 2020/21, compared to a deficit of R15.9 million in 2019/20. Technology development is inherently a high-risk undertaking due to the unpredictable nature of the intended outcomes. In such an environment, there is a high probability that investee project-related milestones will not be achieved as planned, making it difficult to forecast and deliver zero surplus/deficit actuals at the end of each financial year. At 31 March 2021, the agency had funding commitments to projects totalling R177.5 million. Section 53(3) of the PFMA stipulates that public entities must submit a request to National Treasury to retain any surplus funds.

RESTATEMENT OF FINANCIAL POSITION

During the current year, the statement of financial position has been restated because of a change in classification of a financial asset relating to the Biological and Vaccines Institute of Southern Africa (Pty) Ltd (Biovac). This reclassification was informed by a technical interpretation of contractual clauses in relation to the underlying substance of the shareholder loan asset. It is noted that this restatement between asset classes has no impact on TIA's performance in 2019/20, the previous reporting period.

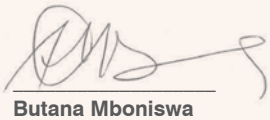
Ismail Abdoola CA(SA)
Chief Financial Officer

7. STATEMENT OF RESPONSIBILITY AND CONFIRMATION OF THE ACCURACY OF THE ANNUAL REPORT

To the best of my knowledge and belief, I confirm the following:

- All information and amounts disclosed in the annual report are consistent with the AFS audited by the external auditor.
- The annual report is complete, accurate, and free from any omissions.
- The annual report has been prepared in accordance with the guidelines on the annual report as issued by National Treasury.
- The AFS (Part E) have been prepared in accordance with Generally Recognised Accounting Practice (GRAP) standards applicable to the public entity.
- The accounting authority is responsible for the preparation of the AFS and for the judgements made in this information.
- The accounting authority is responsible for establishing and implementing a system of internal control that has been designed to provide reasonable assurance as to the integrity and reliability of the performance information, the human resources information, and the AFS.
- The external auditors are engaged to express an independent opinion on the AFS.
- In our opinion, the annual report fairly reflects the operations, the performance information, the human resources information and the financial affairs of the entity for the financial year ended 31 March 2021.

Patrick Krappie
Acting Chief Executive Officer
16 July 2021



Butana Mboniswa
Interim Chairperson of the Board
16 July 2021

8. STRATEGIC OVERVIEW

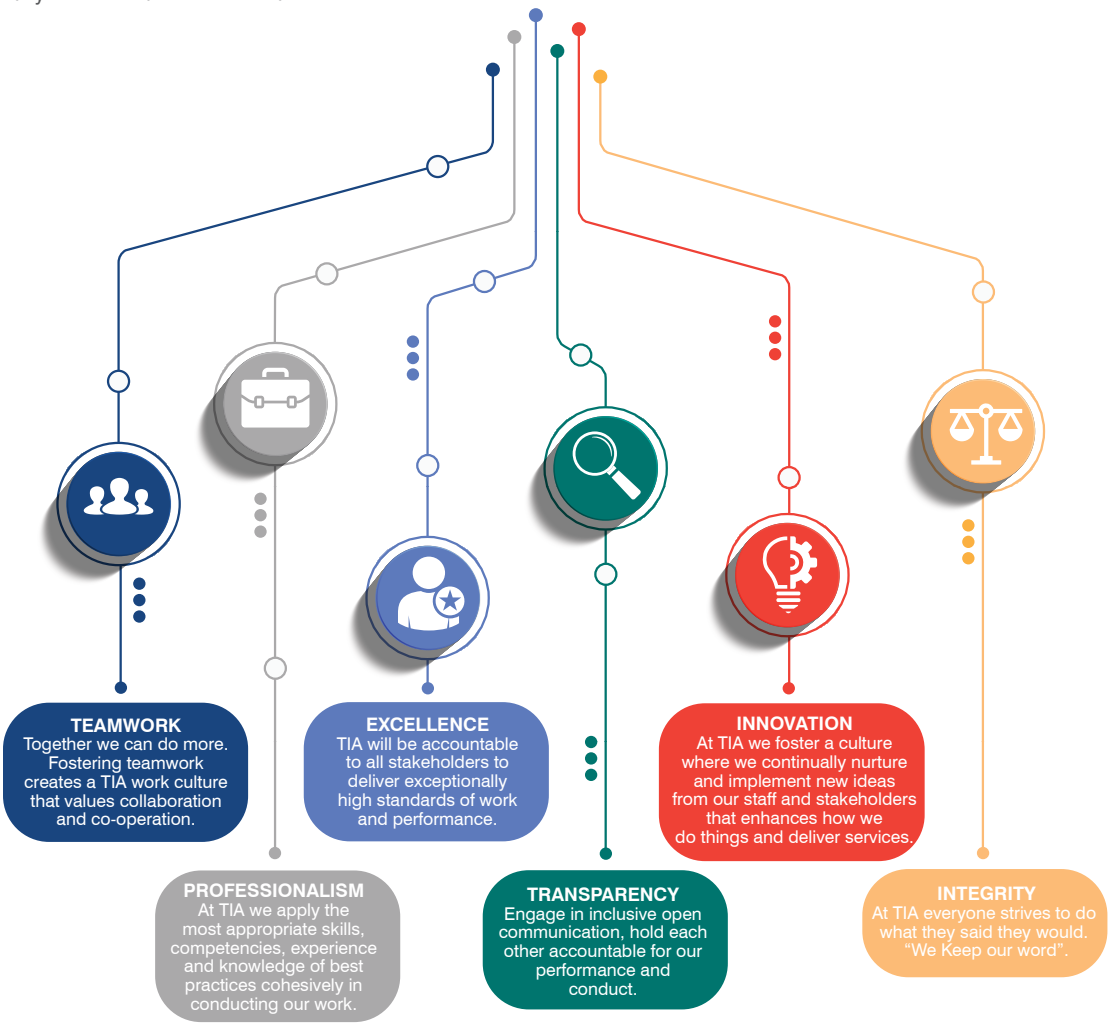
VISION

Be a leading technology innovation agency that stimulates and supports technological innovation to improve the quality of life for all South Africans.

MISSION

Facilitate the translation of South Africa's knowledge resources into sustainable socio-economic opportunities.

VALUES



In the 2015-2020 period, TIA supported a large number of innovations, but the translation and commercialisation success rate of these innovations has been suboptimal. Resultantly, TIA has sought to reposition itself within the NSI, directing a greater proportion of its resources towards the translation and commercialisation of publicly financed intellectual property (IP) emanating from higher education institutions and science councils. TIA's approach to address this situation over the 2020-2025 strategic period is based on three pillars, as depicted in Figure 1.

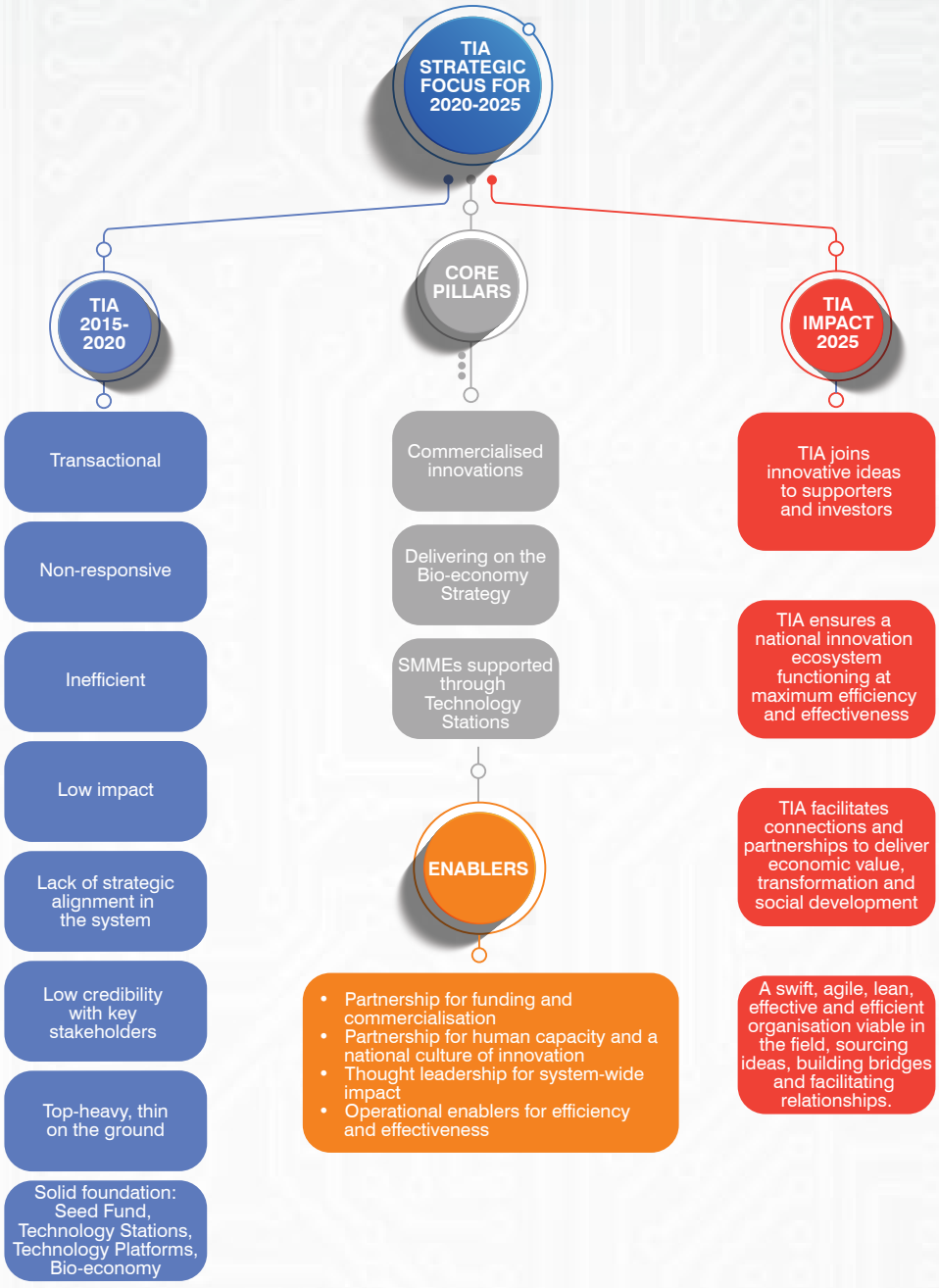


Figure 1: TIA's strategic focus for the 2020-2025 strategic period

9. LEGISLATIVE AND OTHER MANDATES

TIA's mandate is derived from the provisions of the TIA Act (No. 26 of 2008),[1] which establishes TIA as an agency to promote the development and exploitation, in the public interest, of discoveries, inventions, innovations, and improvements. TIA's objective is to support the state in stimulating and intensifying technological innovation to improve economic growth and quality of life for all South Africans by developing and exploiting technological innovations.

9.1 NATIONAL DEVELOPMENT PLAN 2030

The National Development Plan (NDP) seeks to eliminate poverty and reduce inequality by 2030 through "drawing on the energies of its people, growing an inclusive economy, building capabilities, enhancing the capacity of the state, and promoting leadership and partnerships throughout society."

The NDP recognises that developments in science, technology, and innovation (STI) fundamentally alters the way people live, connect, communicate, and transact. It identifies STI as the main drivers of equitable economic growth and development, job creation, and socio-economic reform, and emphasises that the role of STI is key to improving health systems, education, and infrastructure. The NDP states that "South Africa's competitiveness will rely on national systems of innovation permeating the culture of business and society. Innovation and learning must become part of our culture."

TIA plays a critical role in supporting the realisation of the NDP's vision through investing in and re-risking technological innovation and encouraging the commercialisation of mature technologies. Another critical role for TIA is to support the process of knowledge utilisation, particularly by providing SET support to SMMEs (especially to women, youth and people with disabilities).

9.2 2019-2024 MEDIUM-TERM STRATEGIC FRAMEWORK

The 2019-2024 Medium-Term Strategic Framework (MTSF) is the overarching government framework for the socioeconomic transformation of South Africa (SA) for the period under review. It identifies technology innovation as one of the critical policy areas required to speed up growth and transform the economy in order to create decent work and sustainable livelihoods. TIA has aligned its initiatives and contributes to the following priorities.

- Priority 2: Economic transformation and job creation
- Priority 3: Education, skills and health

9.3 WHITE PAPER ON SCIENCE, TECHNOLOGY AND INNOVATION

The White Paper on Science, Technology and Innovation was adopted by Cabinet in March 2019. This policy development signalled material policy shifts for STI to address transformation and inclusivity and the need for stronger partnerships, linkages, and coordination within the NSI. These include strengthening the culture of innovation within government and society; developing human capabilities; improving policy coherence and more effective budget and programme coordination within the NSI; implementing monitoring and evaluation systems; creating a more enabling environment that improves innovation performance; developing local innovation ecosystems; and increasing investment in technology-based SMMEs and support to grassroots and social innovation projects. There is a particular focus on the fields of food security, energy, poverty alleviation, and healthcare.

The DSI's mandate encompasses the generation and exploitation of knowledge for socio-economic development in South Africa. Within this knowledge-based economy, TIA's role is to support inclusive economic growth through technological innovation, improving the competitiveness of businesses (particularly SMMEs), and focusing on the empowerment of youth, women, and people with disabilities.

9.4 DECADAL PLAN

DSI's Decadal Plan will serve as the implementation plan for the White Paper on Science, Technology and Innovation. The draft Decadal Plan identifies the following nine priorities, framed at the level of societal grand challenges.

- The circular economy
- Education for the future
- Sustainable energy
- The future of society
- Health innovation
- High-tech industrialisation
- Information and communication technologies (ICTs) and smart systems
- Nutrition security
- Water security

The Decadal Plan brings together the grand challenges of the 2008 Ten Year Innovation Plan, the technology missions of the 2002 National Research and Development Strategy, the policy intents of the 2019 White Paper on Science, Technology and Innovation, and the thematic focus areas of the 2019 Foresight Exercise for Science, Technology and Innovation. Accordingly, it is incumbent on TIA to transition towards greater alignment

[1] *As amended by the Science and Technology Laws Amendment Act (No. 7 of 2014) and the Science and Technology Laws Amendment Act (No. 9 of 2020), with effect from 1 April 2021.*

with the aforementioned nine priority areas, particularly within a mission-oriented and inclusive approach to innovation as envisaged by the DSI.

TIA has a key role to play given the proposed implementation dimensions of the Decadal Plan as follows.

- Revitalising and modernising key sectors of the economy through improving economic competitiveness and productivity in agriculture, manufacturing, and mining.
- Leveraging off the circular economy and the digital economy as new sources of growth.
- Innovation in support of health, specifically through the optimisation of health systems, improving the quality of healthcare and the digitisation of healthcare systems.
- Energy sector innovation in support of decarbonising the economy.

9.5 BIO-ECONOMY STRATEGY

The Bio-economy Strategy provides a high-level framework to guide biosciences research and innovation investments and actions by all relevant stakeholders in the South African NSI. It seeks to use South Africa's bio-based resources to become a significant contributor to the country's economy by 2030 through the creation and growth of biotechnology-based industries. In turn, these new industries will generate and develop bio-based services, products, and innovations in which new and existing companies will provide and use such solutions. Additionally, bio-innovation would support social development and environmental protection.

TIA is one of the primary implementation actors of the Bio-economy Strategy, which now includes Indigenous Knowledge Systems (IKS).

9.6 DISTRICT DEVELOPMENT MODEL

The Cabinet-approved the District Development Model aims to synchronise planning by all spheres of government at the national, provincial, and local levels. It will enable partnerships with civil society, including communities, private industry, and labour, at district level countrywide in the development of South Africa's municipal districts and metros. The role of government under the model is to ensure greater alignment between urban and rural development, deliberately emphasising local economic development.
TIA is a member of the DSI Entities District Development Model Coordinating Committee, which has – to date – met to share information and discuss the role, governance, and reporting structures of the committee.

9.7 UNITED NATIONS SUSTAINABLE DEVELOPMENT GOALS

The United Nations' Sustainable Development Goals entails ending poverty and hunger globally; combatting inequality within and among countries; building peaceful, just, and inclusive societies; protecting human rights; promoting gender equality and the empowerment of women and girls; and ensuring the lasting protection of the planet and its natural resources. Countries committed to the goals aim to create conditions for sustainable, inclusive, and sustained economic growth, shared prosperity and decent work for all.

TIA's activities support virtually all of the 17 interlinked Sustainable Development Goals for greater economic, social, and environmental benefits for present and future generations For example, TIA provides SET support to SMMEs, particularly those that are black-owned, black women-owned, and youth-owned. TIA also supports grassroots innovators and indigenous knowledge-holders in vulnerable and marginalised communities. The agency also makes a concerted effort towards alleviating food insecurity and preserving South Africa's unique biodiversity.

9.8 AFRICAN UNION AGENDA 2063

The African Union's long-term, people-centred Agenda 2063 is a strategic framework for the socio-economic transformation of Africa. Efforts are underpinned by STI as multifunctional tools and enablers for achieving development goals on the continent. Agenda 2063 calls for diversifying sources of growth for Africa's economic performance and, over the long term, lifting large sections of the continent's population out of poverty. The strategic framework also fosters social transformation, economic industrialisation, and entrepreneurship.

TIA plays a key facilitation role through collaboration with research and innovation institutions across the continent to implement joint technology development programmes and the provision of technical competence and entrepreneurial capacity development to increase the application of knowledge outputs in stimulating socio-economic transformation.

10. ORGANISATIONAL STRUCTURE

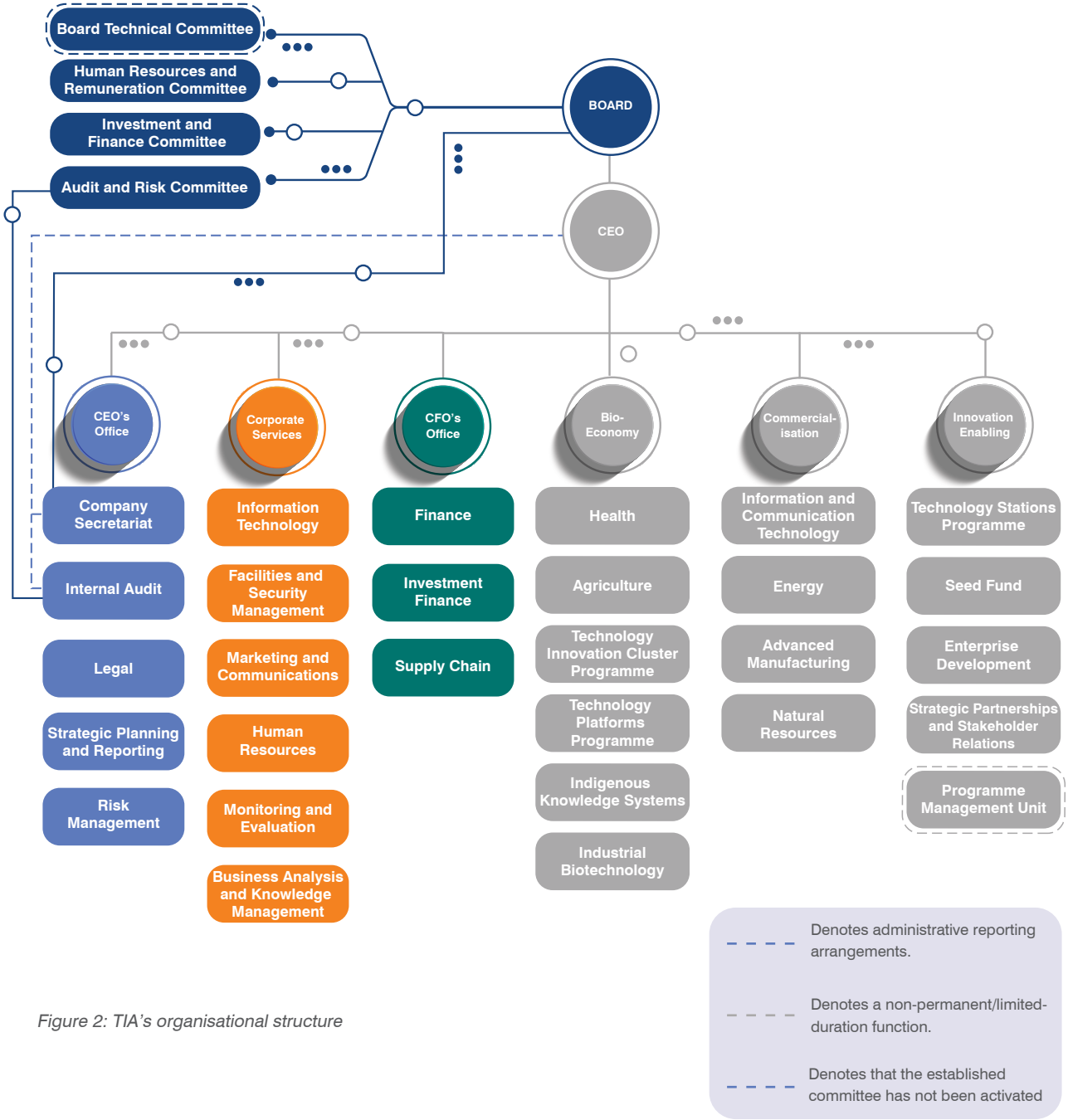


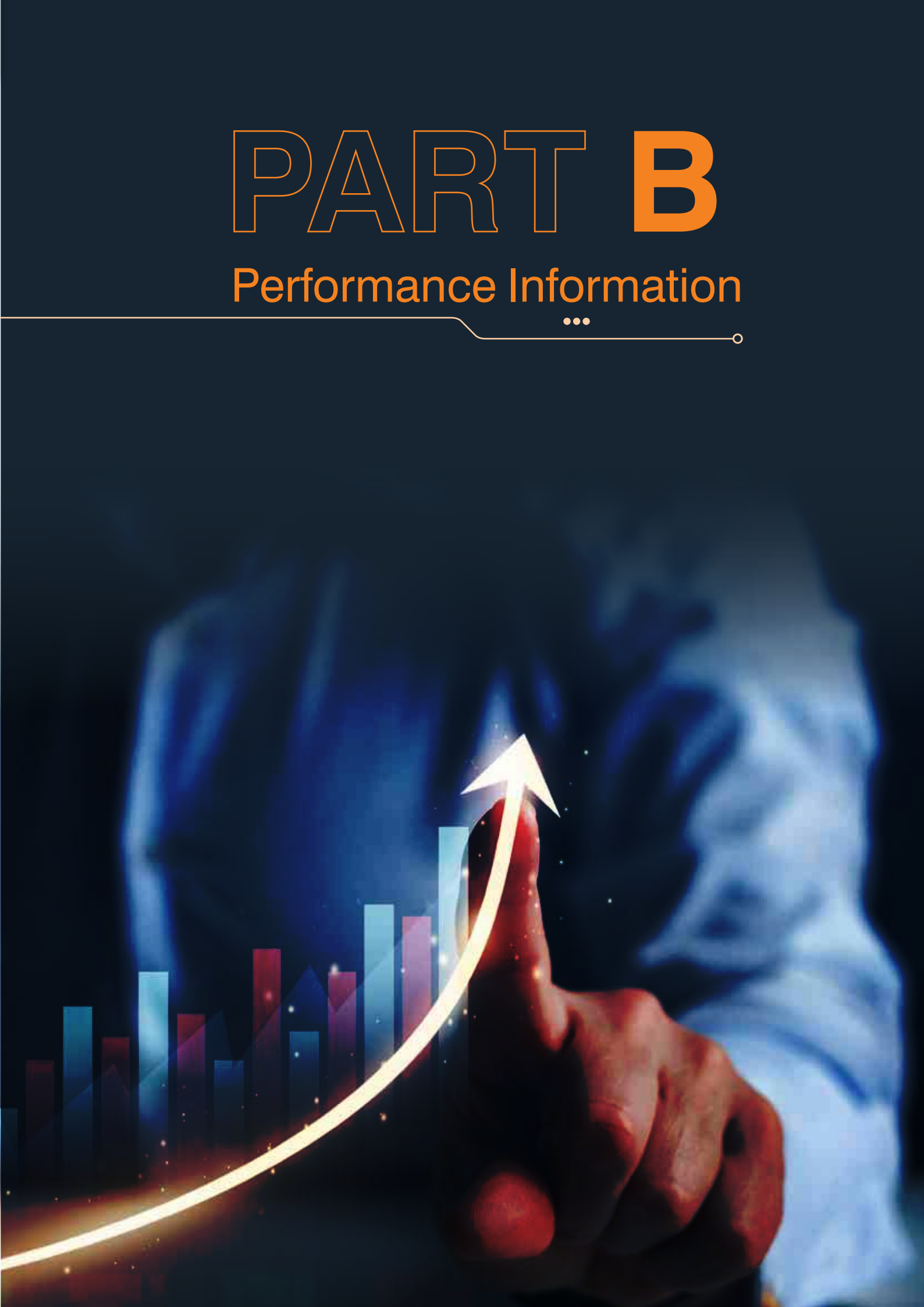
Figure 2: TIA's organisational structure

Notes

- *In addition to the three existing Board sub-committees, the Board had approved the establishment of the Board Technical Committee to serve in an advisory capacity. However, the Committee could not be activated in the year under review due to three vacancies on the Board, and restrictions on the number of Committees each Board members may serve on.*
- *The Programme Management Unit is a specialised function that hosts and manages specifically-contracted projects and programmes from NSI partners and is therefore limited in duration. It currently manages the DSI's Innovation for Inclusive Development Programme.*
- *Internal Audit and the Company Secretariat report to the Audit and Risk Committee and the Board, respectively, and only administratively to the CEO.*

PART B

Performance Information



11. SITUATIONAL ANALYSIS

South Africa has been severely affected by the global COVID-19 pandemic. The virus laid bare the fault lines in South Africa, with inequality, poverty, and unemployment worsening due to the government-imposed restrictions associated with the national lockdown. For example, while the uptake of digital technologies has accelerated phenomenally in business, education, services, and entertainment, the digital divide has widened between those with access to fast and reliable Internet connectivity and those who do not. The effects of this are profound and will be felt for years to come.

The sharp decline in economic activity and curtailment of personal movement has led to a significant decline in current and projected tax collection, necessitating appreciable cuts in public sector budgets. There has also been a rise in business closures, retrenchments, and associated job losses and loss of livelihoods, severely affecting households.

Extremely challenging economic conditions are expected to persist going forward, requiring a redoubling of efforts to support economic recovery. These efforts built on TIA's existing stakeholder network through leveraging resources in a collaborative and strategic manner.

The pandemic has demonstrated the importance of having strong NSI institutions with deep capabilities to rapidly respond to emerging national or global crises, thereby contributing to the nation's resilience. During the early period of the pandemic in South Africa, TIA's Technology Platforms were able to pivot and respond rapidly to national priorities such as COVID-19 testing and related activities. They continue to play a key part in the national COVID-19 response as well as within global efforts. This was only possible due to a long period of sustained financial support to Platforms through TIA's Technology Platforms Programme as a key pillar in implementing the Bio-economy Strategy. The Technology Stations were able to respond in a similar, albeit reduced, fashion to the needs of small or medium enterprises during the pandemic through participation in the National Ventilator Project and the continued provision of much-needed science, engineering, and technology (SET) support to SMMEs, for example.

These two instances illustrate TIA's pivotal role in the NSI to continually invest in and upgrade scientific and technological capabilities necessary for innovation and entrepreneurship. While investing in discrete technology development projects will remain an important part of TIA's mandate, it is the economy-wide capabilities to innovate which are arguably more important for sustainability and lasting impact in the medium to long term. Continued and increased investment is therefore essential to ensure deep and strong scientific and technological capabilities for South Africa's socio-economic growth and development.

11.1 SERVICE DELIVERY ENVIRONMENT

TIA started the new five-year strategic period in the context of the COVID-19 pandemic, which was characterised by a lockdown that limited the mobility and operations of its staff, stakeholders, and customers. Despite these constraints, TIA managed to ride out the storm and has delivered tangible results on key elements of its core mandate of technology development and commercialisation.

TIA's high-performance culture is evident from its achievements over the past six years as depicted in Figure 3.

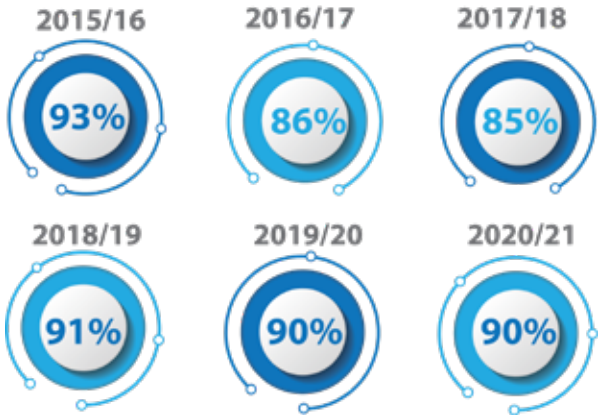


Figure 3: TIA's historical performance against strategic objectives

Focusing on the period under review, TIA performed well within a very challenging external environment during which South Africa experienced significant economic and social challenges. TIA achieved 9 of its 10 output indicator targets (90%). In addition, the agency over-achieved significantly against several of these targets. The average percentage achievement is 327% for the year. Capping each of TIA's performance indicators at 100% results in an average percentage achievement of 99% for the year.

11.2 ORGANISATIONAL ENVIRONMENT

Responding to the COVID-19 pandemic demonstrated the agility and ability to pivot as circumstances dictated, vindicating the efficacy of our mandate. The call by the Department of Planning, Monitoring and Evaluation for all government departments and public-funded entities to revise their Strategic Plans and APPs provided TIA the opportunity to embed a renewed vision to respond to the pandemic, its aftermaths, impact on the fiscus, and the economy. This was necessary due to the budget cuts imposed and the need to reprioritise key elements in the strategy to ensure that the available limited resources are directed to critical areas of need.

TIA operates with an annual budget of approximately R450 million. This is made up of a baseline of R195 million, with R215 million assigned as ring-fenced funding. As a result of depressed economic conditions arising from the COVID 19 pandemic, subsequent lockdown, and the need for budget reprioritisation, TIA saw its annual budget cut by 10% (R45 million). This resulted in TIA's funding capacity for investments being significantly reduced. However, the agency was able to redirect savings from operational expenditure to fund some of the investments. In some instances, TIA received requests from its investees for relief support in the form of payment holidays, and small bridging finance interventions.

Operating with a total funding of approximately R450 million, the fact that TIA fully disbursed these funds along with additional funds beyond the grant allocation, demonstrated the organisation's increasing capacity to manage funds. Key to this is the constant focus on improving assessment and approval turn-around times; an important issue identified through various stakeholder satisfaction surveys.

TIA's ability to quickly respond to the lockdown and remote working conditions presented an opportunity to consider possible changes in its working environment by enabling staff to work remotely. The information technology systems and other infrastructure which TIA had established and put in place beforehand helped business to largely continue as usual.

TIA filled most of its executive positions during the year, but unfortunately also experienced a high staff turnover. This was coupled with an increased number of engagements with organised labour, particularly in the fourth quarter. In an effort to retain staff, TIA management has developed a full Employee Value Proposition, which comprises both monetary and non-monetary elements, to enhance the employee experience and improve productivity (Figure 4).

Figure 4: The TIA Employee Value Proposition

11.3 KEY POLICY DEVELOPMENTS AND LEGISLATIVE CHANGES

The long-awaited Decadal Plan was released in draft form by the DSI in the period under review. As the implementation blueprint of the 2019 White Paper on Science, Technology and Innovation, this document will influence TIA's strategy and operations over the balance of the five-year strategic cycle and beyond.

The Science and Technology Laws Amendment Act (No. 9 of 2020) came into effect on 1 April 2021. Several amendments were made to the TIA Act (No. 26 of 2008). Most of the changes pertain to TIA Board members, specifically their appointment eligibility, removal, resignation, and remuneration. The amended Act restricts Board members from serving on more than two Board sub-committees at a time, the meeting quorum has been reduced from two thirds to a majority of members, and the required number of Board members entitled to demand that a special Board meeting be convened has been reduced from two thirds to one third. The Board is required to consult with the Minister with regards to appointing and re-appointing the TIA Chief Executive Officer (CEO), including the appointment of an acting CEO. Board members also need to disclose their individual interests directly to the Minister, in addition to TIA.

The restriction imposed on Board members from serving on more than two sub-committees has unfortunately already had an impact, considering that the Technical Committee has been approved but cannot be established. This restriction has impeded the Board's oversight of TIA from a technological perspective, which is regrettable given TIA's core mandate of technological development.

Other changes relate to the secondment of employees by the CEO to government departments, the determination of employees' remuneration, and the remuneration of additional sub-committee members. TIA is also now permitted to perform functions outside of the Republic of South Africa which are necessary to achieve its mandate and objectives.

TIA notes these changes and will be engaging with the DSI concerning future revisions to the TIA Act, which are believed to be necessary to enable the agency to optimally function within a sound governance framework.

12. PROGRESS TOWARDS ACHIEVING INSTITUTIONAL IMPACTS AND OUTCOMES

TIA's 2020-2025 Strategy seeks to improve the quality of life of all South Africans through innovation. To position the activities of TIA within the framework of the MTSF, the NDP and other DSI priorities, TIA's re-tabled 2020-2025 Strategic Plan and its re-tabled 2020/21 APP were structured around three outcomes which seek to direct the initiatives of agency over this period (Table 1).

Table 1: TIA's three outcomes and associated MTSF priorities supported

Outcome	Purpose	MTSF
1. Commercialised innovations	Support the development of technological innovations by translating knowledge into market-ready innovations	Priority 2 (economic transformation and job creation) Priority 3 (education, skills and health)
2. Delivering on the Bio-economy Strategy	Support the translation of South Africa's knowledge resources into sustainable bio-based solutions that address societal challenges while contributing to sustainable economic growth	Priority 2 (economic transformation and job creation) Priority 3 (education, skills and health)
3. SMMEs supported through strategically informed and regionally distributed Technology Stations	Provide access to SET body of knowledge and expertise in technology innovation, process improvements and product development to innovators and SMMEs to enable them to become competitive	Priority 2 (economic transformation and job creation)

TIA's 2020-2025 Strategic Plan was revised in response to the impact of COVID-19 on the budget. The changes made are summarised as follows.

- The target for Outcome indicator 1.1 (number of technologies commercialised) over the five-year period was raised from 100 to 175.
- Outcome indicator 2.1 was changed from "number of successfully demonstrated bio-based technologies" to "number of bio-based technologies commercialised", and the target over the five-year period changed from 60 to 75.

TIA's performance against its three outcomes is presented in Table 2.

Table 2: TIA's performance in 2020/21 against its three outcomes and associated outcome indicators

Outcome	Outcome indicator	Outcome definition	Baseline (2015-2020)	Planned five-year target	Disaggregation of beneficiaries	Actual achievement 2020/21	Comments
1. Commercialised innovations	1.1 Number of technologies commercialised	Number of technological innovations that have been introduced into the market for social benefit or commercial gain, directly or indirectly (products, processes, or services)	77	175	Women (30%) Youth (20%) People with disabilities (10%)	8 of which 1 is for a women-owned business (13%), 2 youth-owned businesses (25%) and 0 owned by a person with a disability (0%)	TIA has under-achieved against its target of 9 (88.9% achievement) for 2020/21 as well as its demographic targets. Efforts have intensified with new transformation plans to meet these targets over the balance of the five-year strategic period.
2. Delivering on the Bio-economy Strategy	2.1 Number of bio-based technologies commercialised	Bio-based technologies, products or services that have reached demonstration stage in agriculture, health, industrial biotechnology, indigenous knowledge systems, and other bio-based domains	-	75	Women (30%) Youth (20%) People with disabilities (10%)	37, of which 5 is for women-owned businesses (13.5%), 5 for youth-owned businesses	TIA has exceeded its target of 9 for 2020/21. Efforts will be intensified to take these technologies to the market (commercialisation) through interventions such as technology markets, rapid licenses, and preferential licenses to B-BBEE entities.
	2.2 Number of bio-based entrepreneurs and organisations accessing high-end SET services	Bio-based entrepreneurs and organisations accessing high-end SET support for the purposes of developing innovative, bio-based products or services through the financial or non-financial support of the Technology Platforms network	-	600	Women (45%) Youth (40%) People with disabilities (3%)	Data not available	Systems were not in place to collect the data for 2020/21. However, starting in 2021/22 the data will be collected and reported on, including retrospectively for 2020/21.
3. SMMEs supported through strategically informed and regionally distributed Technology Stations	3.1 Number of SMMEs accessing SET services	SMMEs that access SET support for the purposes of developing innovative products or services through the financial or non-financial support of the Technology Stations network	10,530	15,750	Women (45%) Youth (40%) People with disabilities (3%)	1,990 of which 709 are women (35.6%), 1,006 youth (50.6%) and 11 people with disabilities (0.6%)	TIA has under-achieved against its target of 2,390 (83.3% achievement) for 2020/21 as well as its demographic targets for women and people with disabilities.

12.1 COMMERCIALISED INNOVATION

This outcome contributes directly to TIA's mandate, which emphasises the development and exploitation of technological innovations. The planned focus for TIA's five-year strategic cycle is to fully develop and commercialise the 23 projects that are currently between technology readiness levels (TRLs) 7 and 9, resulting in revenue generation and job creation. This will, in turn, assist in addressing South Africa's triple challenges of poverty, unemployment, and inequality as per the NDP.

Through this outcome, TIA responds primarily to priority 2 (economic transformation and job creation) of government's 2019-2024 MTSF, in which the DSI has identified the commercialisation of IP from publicly funded research institutions as an important sub-outcome.

TIA has a deliberate intention to support participation by women, youth, and people with disabilities as per its 2020-2025 Strategic Plan. TIA has targeted beneficiary participation rates of 30% for women, 20% for youth, and 10% for people with disabilities within its overall target for Outcome 1.1 (number of technologies commercialised).

To a degree, headway was made in the Commercial Division wherein 13% women-owned businesses and 25% youth owned businesses were supported in the process of commercialising technologies. Efforts will be intensified with regards supporting people with disabilities in the balance of the five-year strategic period.

Opportunities to effect meaningful economic transformation have been highlighted during the year under review, the culmination of which shall be mutually symbiotic exit opportunities with broad-based black economic empowerment (B-BBEE) candidates identified in collaboration with entities like the Black Business Council.

Furthermore, the outcomes of the assessment of areas for improvement in TIA's investment practices shall be institutionalised in 2021/22.

12.2 DELIVERING ON THE BIO-ECONOMY STRATEGY

The outcome gives effect to TIA's implementation of the Bio-economy Strategy, which seeks to contribute to increased productivity across the four sectors identified in the strategy, namely agriculture, health, industry and the environment, as well as indigenous knowledge-based innovation.

TIA's commitment to delivering on the Bio-economy Strategy is articulated in the Bio-Economy Division's 2020/21 Workplan. The implementation of the Bio-economy Strategy recognises that in addition to identifying strategic focus areas, TIA must also deliver its offerings efficiently and effectively in the implementation of the Division's Bio-economy Workplan.

TIA has a deliberate intention to support participation by women, youth, and people with disabilities as per its 2020-2025

Strategic Plan. Concerning Outcome 2.1 (number of bio-based technologies commercialised), TIA has targeted beneficiary participation rates of 30% for women, 20% for youth and 10% for people with disabilities. For Outcome 2.2 (number of bio-based entrepreneurs and organisations accessing high-end SET services), TIA's targets are 45% for women, 40% for youth, and 3% for people with disabilities.

Table 3 illustrates the performance of the Bio-economy Division towards meeting the DSI's strategic outcome-oriented goals.

Table 3: The Bio-economy Division's support of DSI's strategic outcome-oriented goals

Strategic Outcome Oriented Goals	Indicators	Initial Targets	Annual Target	Status as at 31 March 2021
1: A responsive, coordinated and efficient national system	Strengthen research excellence	Number of government-industry platforms	1	1
		Number of consortia		
		Number of multi-stakeholder partnerships		
		Number of product development partnerships		
		Number of international partnership programmes		
	Coordinated agricultural sector R&D plan	Number of agriculture projects/initiatives supported	3	4
		Number of technology products, processes, and services developed	2	3
		Number of technology products, processes, and services commercialised	2	2
		Cumulative projects/initiatives supporting climate change resilience	1	5 (Wheat Breeding Platform, Plant Health Consortium, Climate Resilience Consortium, Cassava Feasibility Study, and Ukhanyo Farmer Development)
		Cumulative projects/initiatives supporting agricultural value chain development		
		Cumulative projects/initiatives developing smart agriculture		
3: Human capital development	Training support, transformation in key strategic programmes	Number of black Master's and PhD students registered	9	25
		Number of black Interns trained and/or Post Docs appointed	6	9
		Number of training initiatives/workshops etc. held	1	1
4: Utilising knowledge and innovation for economic development	Technology dissemination	Number of beneficiaries (smallholder, black farmers, communities, women, and youth)	20	142
		Number of black farmers supported for regulatory, phytosanitary, food safety and quality, and accreditation to be able to access formal domestic and international markets	3	None to date
		Number of black farmers supported and growing towards commercial scale (growing from subsistence, emerging, small scale, and commercial)	5	71
	Support to technology development, commercialisation and dissemination/ diffusion	Number of projects supported	15	27
		Number of products, processes and services developed	28	25
	Economic indicators	Number of jobs created	10	5
		Number of SME spin-out or start-ups established/supported	8	8
		Amount of co-funding leveraged and/or increased investments	R10m	R314m

The data suggests that whilst significant progress has been made towards achieving the selected goals, improvement is yet to be seen in others. To this end, the Division will continue to set up systems that allow for data collection and processing. In the case of persons with disabilities, initiatives will be established to monitor technologies, products and services made available to this category of beneficiaries, in addition to direct investment by TIA into persons with disabilities.

12.3 SMMES SUPPORTED THROUGH STRATEGICALLY INFORMED AND REGIONALLY DISTRIBUTED TECHNOLOGY STATIONS

Through this outcome, TIA contributes to priority 2 (economic transformation and job creation) of the 2019-2024 MTSF by investing in technological infrastructure. This is done in partnership with other role players in the NSI with the aim of increasing access to SET expertise for enterprises and innovators across the country. The TSP is closely aligned with relevant industrial sectors to promote innovation-led industrialisation, localisation, and the promotion of exports. The planned medium-term focus is to seek alignment with the sectoral master plans under development, led by the dtic.

TIA intends to support participation by women, youth, and people with disabilities as per its 2020-2025 Strategic Plan. TIA has targeted beneficiary participation rates of 45% for women, 40% for youth, and 3% for people with disabilities within its overall target for Outcome 3.1 (number of SMMEs accessing SET services).

TIA recorded 1,990 SMMEs accessing SET support through the TSP against a target of 2,390, an 83.3% achievement. The agency fell short of its targets for women (709 or 35.6%) and people with disabilities (11 or 0.6%), but exceeded its target for youth supported (1,006 or 50.6%). The reasons for under-achievement against outcome 3.1 related to the impact of the COVID-19 pandemic, late funding disbursements and gap funding uncertainties.

The COVID-19 pandemic kept approximately 40% of the Technology Stations inactive for more than four months of the financial year. Those Technology Stations which were able to continue operating through having some of their staff members classified as essential worker had to redirect their efforts and resources towards COVID-19 relief interventions to the detriment of targets under the TSP. Furthermore, staff members at several Technology Stations tested positive for the coronavirus, meaning that these sites needed to close down fairly regularly to disinfect facilities and retest staff members.

TIA received approximately two thirds of its budgeted funding late in the third quarter of the year (late December 2020), with disbursements made by TIA in January to Technology Stations. This naturally affected the operations of Technology Stations as they were constrained in terms of subsidised SET SMME support which could be provided.

Additionally, TIA was only able to disburse a maximum of R114.1 million to Technology Stations against a required funding budget of R133 million, translating into a shortfall of 14.2%. This uncertainty drove Technology Stations to prioritise paying clients and larger enterprises, thereby de-prioritising SET support to SMMEs to a degree.

13. INSTITUTIONAL RESPONSE TO THE COVID-19 PANDEMIC

TIA did not receive any additional budget for interventions to specifically address the COVID-19 pandemic. This notwithstanding, TIA was extensively involved in responding to the pandemic.

In terms of surveillance, 165 genomes of the Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) virus were sequenced (Figure 5), and investigations were undertaken in two hospitals and a prison. TIA-supported projects also facilitate pre-screening through mass screening recognition at points of entry, and facial recognition technology can be used to undertake automated risk and compliance monitoring of COVID-19 public health and safety protocols. Patient support can be provided through mobile-based patient referral technology, and through the remote dispensing of chronic medication, entailing no queues and without contact.

Over 10,000 COVID-19 tests were conducted through TIA-supported Technology Platforms, and TIA took part in preparations for the National Health Laboratory Service (NHLS) surge project. Furthermore, R18 million was allocated to seven new projects for reagents and test kits, and R13 million provided to two projects to address urgent diagnostics and antibody sequencing related to immunisation.

TIA supported efforts towards the provision of alternative and innovative ventilation for COVID-19 patients through scaling up the production of non-invasive ventilation helmets and personal protective equipment (PPE) at Technology Stations. Funding was also provided through the Seed Fund for prototype design, development, and testing of a low-cost, portable, non-invasive ventilator for patients experiencing pulmonary trauma and breathing difficulties. Cost-effective respiratory spacers were also made from polyethylene terephthalate bottles.

In addition to the design and scale-up of PPE at Technology Stations, TIA focused on the safety of frontline health workers through two specific projects. The first entailed the development of a novel perl intubation containment chamber to protect healthcare workers from aerosolised particles, with ten chambers tested at Tygerberg hospital. The second focused on developing a dental aerosol suction device that would limit the spread of aerosols produced during dental procedures, thereby potentially limiting the spread of SARS-CoV-2.

Lastly, TIA undertook a feasibility assessment for local vaccine manufacturing readiness, and positioned Biovac as an African vaccine manufacturing facility as part of President Ramaphosa's pledge made at the Global COVID-19 Pledging Conference.

Further details of TIA's response to the COVID-19 pandemic through its existing programmes and interventions can be found across this report, mostly within Section 15.

Figure 5: A scientist sequencing a SARS-CoV-2 genome at a TIA-funded Technology Platform

14. SPECIAL FOCUS: IMPLEMENTATION OF THE INNOVATION FUND

The DSI has established an Innovation Fund that will enhance South Africa's capacity to commercialise technological innovations. TIA was selected as one of the implementing partners during the initial deployment of the Innovation Fund by the DSI, alongside the SA SME Fund, the Public Investment Corporation (PIC) and the Industrial Development Corporation (IDC). This R150 million public-private funding instrument aims to facilitate and accelerate commercialisation and will be scaled up in the next financial year.

In the period under review, TIA has been allocated and received an amount of R80 million. The agency has successfully committed 87.5% of the Fund to approved projects (Table 4) and disbursed R25.2 million to project recipients in 2020/21 based on the achievement of milestones.

Table 4: Projects and funds approved through the Innovation Fund instrument

Project and description	Funding approved
Enzyme Technologies	R3,000,000
Local manufacture of active pharmaceutical ingredients using flow chemistry (Msizi Pharmaceutical Holdings)	R12,500,000
Precision medicine and COVID-19-Seq Solution (Artisan Biomed)	R5,000,000
National Indigenous Products Programme Fund (IDC)	R20,000,000
NovelQuip	R8,000,000
RIOT	R6,000,000
Spacedecode (Lepsta)	R3,000,000
Pelebox	R5,000,000
Smart Sensor	R5,500,000
Settle Bed Detector	R2,000,000

The Bio-economy Division disbursed and committed funding in the amount of R40.5 million from the Innovation Fund. A notable development is the commitment of R12.5 million to Msizi Pharmaceutical Holdings, a black-owned pharmaceutical company, established to manufacture and sell Active Pharmaceutical Ingredients (APIs). This illustrates TIA's commitment towards the meaningful empowerment of black professionals in developing high-end technology and market-attractive products.

TIA disbursed an amount of R21.5 million (R20 million from the Innovation Fund, plus R1.5 million from TIA's MTEF allocation, a prior commitment) under the National Indigenous Products Programme (NIPP) Fund – a partnership with the IDC, established to advance the development and commercialisation of indigenous knowledge. TIA undertook all the necessary due diligence processes to determine what interventions are required to ensure that the appropriate technical, regulatory, and commercial support is provided in addition to the requisite entrepreneur development support.

This initiative builds on the historical investments made by the DSI through identifying and supporting six indigenous knowledge projects. The collaboration between TIA and the DSI is a significant development in the NSI, as the NIPP Fund is envisaged to contribute to the coordination of national initiatives within the indigenous knowledge space, and fits appropriately with the newly-established ATM Technology Platform.

The Commercialised Innovations division disbursed R5.2 million to project recipients, equivalent to 6.5% of the total R80 million allocated to TIA, and 17.8% of the R29.5 million allocated to the division. The funds received will be utilised to drive the process of technology commercialisation in relation to various projects and businesses supported by TIA, including efforts to export technologies derived from locally-developed IP into global markets. These projects have previously been funded by TIA through the Technology Development Fund.

The much-needed additional financial support provided through the Innovation Fund will help these businesses to achieve their goals of becoming profitable and self-sustainable, and will also assist in attracting further follow-on funding from actors in the NSI, particularly the private sector.

15. INSTITUTIONAL PROGRAMME PERFORMANCE INFORMATION

TIA's 2020/21 APP was revised in response to the impact of COVID-19 on the budget, and new output indicators developed and targets set in response to a budget reduction of 10%. Significant changes in the APP were made, mainly to Outcome 1 – Commercialisation.

TIA has 10[2] output indicators based on its re-tabled 2020/21 APP. TIA met or over-performed against nine of its ten annual targets; a 90% achievement.

TIA significantly over-achieved against five of its output targets for the year, specifically 600% against output indicator 1.1 (technologies licensed or assigned), 483% against 1.2 (joint collaborations between academia and industry), 500% against 1.3 (technologies diffused for inclusive development), and 411% against 2.1 (bio-based technologies developed). Of particular note is the 932% achievement (R1,372.6 million recorded compared with an annual target of R147.2 million) against output indicator 1.5 (leveraged funds). This is testament to TIA's commitment and dedication in its pursuit of leveraging its budget through partnerships and other means through co-investment with other parties, in-kind, financial and follow-on funding.

Unfortunately, TIA did not meet its target for output indicator 3.1 (existing Technology Stations and other centres managed and supported) for the year. Two of the 18 Technology Stations did not perform adequately, mostly due to a shortage of funding for operations caused by late funding disbursements.

15.1 COMMERCIALISED INNOVATIONS DIVISION

15.1.1 DIVISIONAL OVERVIEW

The purpose of the Commercialised Innovations Division is to support the process of technological development across key economic sectors through the provision of funding and other support, thereby creating commercialisation opportunities for entrepreneurs and contributing to economic growth in South Africa.

Through this strategic thrust, TIA aims to intensify its efforts to increase the rate of translation of locally developed technologies; exploit IP from publicly funded institutions; ensure that these are commercialised in a manner that promotes economic growth and the competitiveness of industry; and respond to the imperatives of transformation and inclusive development. TIA has focused on leveraging local and global partnerships to support the translation of knowledge from higher education institutions, science councils, and the private sector into commercialised innovations that will have a positive impact on the lives of all South Africans. TIA also has sought to take advantage of the 4IR to stimulate the economy and address some of the social challenges faced by many South Africans.

DIVISIONAL PERFORMANCE

Table 5 presents TIA's performance against its targets in the originally-tabled 2020/21 APP for Outcome 1: Translation of knowledge outputs for innovation-led industrialisation, which applies to Q1. Table 6 presents the agency's performance against its targets in the re-tabled 2020/21 APP for Outcome 1: Commercialised innovations, which applies to Q2-Q4.

[2] This excludes output indicator 2.3 which has a zero target for 2020/21 and 2021/22 (there is a target of 1 in 2022/23).

Table 5: TIA's performance in 2020/21 (Q1) against Outcome 1: Translation of knowledge outputs for innovation-led industrialisation

Output (Output Indicator)	Audited actual performance 2018/19	Audited actual performance 2019/20	Planned annual target 2020/21	Actual achievement 2020/21 until date of re-tabling (Q1)	Deviation from planned target to actual achievement 2020/21	Reasons for deviations	Reasons for revisions to the outputs/output indicators/ annual targets
1.1 Technologies developed (Number of successfully demonstrated technologies)	14	11	8	6	-2	Six technologies were developed against a Q1 target of two. The over achievement is due in part to the digital nature of several of the technologies, which enabled the project teams to continue online work even though the country was under COVID-19 lockdown restrictions.	TIA revised its outputs, output indicators and annual targets in response to a 10% budget cut for 2020/21.
1.2 Technologies diffused for inclusive development (Number of successfully diffused technologies)	-	-	5	0	-5	This output did not have a target in Q1 and no performance was formally noted. Nevertheless, key activities took place in Q1 towards achieving targets in subsequent quarters.	TIA revised its outputs, output indicators and annual targets in response to a 10% budget cut for 2020/21.
1.3 Funding leveraged (Total value of signed agreements entered into with other parties)	-	-	R127m	R47.3m	-R79.7m	A total of R47.3 million in funding leveraged was recorded in Q1 against a target of zero. Most of this over performance is attributed to the Technology Platforms Programme, which contributed R40.1 million.	TIA revised its outputs, output indicators, and annual targets in response to a 10% budget cut for 2020/21.

Table 6: TIA's performance in 2020/21 (Q2-Q4) against Outcome 1: Commercialised innovations

Output (Output Indicator)	Audited actual performance 2018/19	Audited actual performance 2019/20	Planned annual target 2020/21	Actual achievement 2020/21 (Q2-Q4)	Deviation from planned target to actual achievement 2020/21	Reasons for deviations
1.1 Technologies licensed or assigned (Number of licensed or assigned technologies)	-	-	1	6	+5	This performance can be attributed to the ability of most investees to remain productive despite the restrictions imposed during the COVID-19 pandemic lockdowns. The utilisation of digital technologies for operating remotely was key.
1.2 Joint collaborations between academia and industry (Number of projects involving industry in execution)	-	-	6	29	+23	The performance can be attributed to collaborations which were initially not expected to come to fruition because of the national lockdown in response to the COVID-19 pandemic. It was uncertain at the time how the lockdown would affect the various projects.
1.3 Technologies diffused for inclusive development (Number of successfully diffused technologies)	-	-	1	5	+4	The lockdown restrictions which were implemented due to the COVID-19 pandemic introduced a lot of uncertainty. As a result, not many technologies were expected to have diffused at the time. However, the lifting of lockdown restrictions made it possible to achieve this performance.
1.4 Products launched by start-ups or existing companies (Number of products launched)	-	-	13	21	+8	This performance is as a result of the continued support provided by TIA to investees which emphasised economic recovery following the COVID-19 pandemic.
1.5 Leveraged funds (co-investment with other parties, in-kind and/or financial and/or follow-on funding) (Total value of signed agreements entered into with other parties)	-	-	R147.2m	R1,372.6m	+R1,225.4m	The over performance is testament to TIA's commitment and dedication in its pursuit of leveraging its budget through partnerships and other means, e.g. co-investment with other parties, in-kind, financial and/or follow-on funding.

PROGRESS TOWARDS PLANNED STRATEGIC INITIATIVES

As per Table 6, the number of products launched by start-ups or existing companies for the period under review totalled 21. This bodes well in progressing towards achieving the ambitious target set by TIA leadership in this regard.

With increased focus on commercialisation, deliberate efforts were made to institutionalise a full investment lifecycle management approach across TIA divisions, which will serve to intensify the organisation's efforts towards an emphasis on post-investment support. TIA initiated a model to foster closer collaboration with the research sector during the process of developing applications for funding. The purpose of this initiative is to leverage off TIA's good working relationships with industry in order to help this critical sector improve its fundability prospects. The success made under the Industry Matching Fund is evidence of the extent to which TIA has been successful in growing the pool of industry partners who either co-invested with TIA in early-stage opportunities, or funded de-risked opportunities from within TIA's portfolio.

TIA embarked on a self-assessment initiative during the period under review to benchmark its funding instruments with a view to aligning them with local and international best practice. The purpose is to position TIA to leverage follow-on funding for technologies it continues to support. The process was well-received by relevant actors within the South African NSI.

BUDGET AND EXPENDITURE FOR COMMERCIALISED INNOVATIONS

A comparison of the budget and actual expenditure for Outcome 1 is presented in Table 7.

Table 7: Budget and expenditure for Outcome 1: Commercialised innovations for 2019/20 and 2020/21

Sub-Programme	2019/20			2020/21		
	Budget (R'000)	Actual expenditure (R'000)	(Over) / under expenditure (R'000)	Budget (R'000)	Actual expenditure (R'000)	(Over) / under expenditure (R'000)
Advanced Manufacturing	15,200	18,319	(3,119)	18,000	19,815	(1,815)
Energy	14,000	18,907	(4,907)	18,000	8,109	9,891
Information & Communication Technology	20,000	25,900	(5,900)	20,768	31,777	(11,009)
Natural Resources	20,500	20,669	(169)	18,000	19,200	(1,200)
Total	**69,700**	**83,795**	**(14,095)**	**74,768**	**78,901**	**(4,133)**

15.1.2 ADVANCED MANUFACTURING

Technology innovation has been identified as one of the main drivers in enhancing national manufacturing competitiveness. The role of the Advanced Manufacturing sub-programme is to utilise technological innovations as a driver to support the development of a knowledge economy in manufacturing by accelerating both the manufacturing capability and the knowledge intensity of the industry in order to increase and sustain the competitiveness and innovation in South Africa's manufacturing industry.

Prior to the COVID-19 pandemic the South African manufacturing sector was already an ailing sector, characterised by large scale de-industrialisation, with the sector's contribution to gross domestic product (GDP) shrinking from 28% in 1990 to 14% in 2019. At the height of South Africa's nationwide 'hard' (level 5) lockdown, manufacturing production fell by nearly 50% from April 2019, to April 2020. There has been some moderate recovery since then, with manufacturing production increasing slightly, year on year.

National plans to redress this situation were already in motion, with interventions being led by the dtic. Myriad support packages (such as policy intervention, incentives, rescue package, and the like) were being rolled out with varying degrees of success.

The sub-programme has approximately R188 million of active investments under its management, together with a historical portfolio of investments of approximately R300 million. An analysis of the current focus areas indicate that the sub-programme's choices support the key building blocks required for migrating and developing 4IR technologies, products, processes, and services. Further analysis also indicates that the DSI's advanced manufacturing strategic roadmaps and the dtic's sectoral master plan choices in the areas of additive manufacturing, automation, advanced electronics, photonics, and aerostructures also seem well-aligned and timely to support projects that are 4IR based.

Figure 6: The Diagnostic Multi-camera in operation, showing how the camera enables the visualisation of corona discharge

For the year under review, Advanced Manufacturing projects which are well aligned with the commercialisation thrust of TIA were prioritised. In terms of the sub-programme's active portfolio, the majority of its projects (seven) have successfully crossed the technology development chasm, and are at the pre-commercial phase. Special focus was given to these projects to ensure that they successfully bridge the commercialisation chasm by prioritising projects for a second round of funding related to commercialisation, and by entering into partnerships to ensure uptake and commercialisation.

NOVELQUIP

The NovelQuip project is a historical TIA investment dating back to 2017. TIA has funded NovelQuip, situated in George, for the amount of R12.8 million in the year under review for the development of a fully-mechanised silviculture planting solution for commercial forestry industry that combines seedling extraction, soil preparation, gel/water application, fertiliser application, seedling planting, weedicide application, and soil firming.

The project has progressed well, resulting in field demonstration of the machine both locally and internationally. As a result of this progress, NovelQuip was approached by a global original equipment manufacturer (Finnish based company Ponsse Oyj) to further develop the technology, with a view to marketing and distributing it globally.

To capitalise on this opportunity, a tactical change in the project agreement between TIA and NovelQuip was required to accommodate this commercial partner. This necessitated NovelQuip applying for further a further R30 million of funding from TIA, for additional development work and pre-commercial activities to support the global uptake of this technology. A major condition of approval of TIA's funding required NovelQuip to commit to a B-BBEE plan that sets out clear goals for transformation at every level of the company.

DIAGNOSTIC MULTI-CAMERA

The Diagnostic Multi-camera project, which entails TIA funding of R12 million, has been successful in developing multi-functional diagnostic camera system used for fault detection on high-voltage power lines. This new technology will be used to support companies like Eskom and Transnet in the maintenance of its high-voltage powerline infrastructure, thereby improving the reliability and availability of South Africa's electricity transmission and distribution infrastructure (Figure 6).

This project is a joint collaboration between TIA, the Council for Scientific and Industrial Research (CSIR), and Eskom, who have come together to develop world-class technology to monitor potential power line failures using a phenomenon known as corona discharge. It will be an important tool in the utilities preventative maintenance activities in that it will drastically simplifying the user's abilities to quickly detect and quantify the nature of the possible failure. In 2020/21, the team made significant progress in finalising commercial terms of the licence agreement that will see the camera being produced and sold by URVICO, which is a hi-tech spin-off company of the CSIR that has the necessary experience and expertise to manufacture such cameras.

CARDIOFLOW

The Cardioflow project has developed a portable, hand-held, point of care (PoC) screening device able to identify patients at risk of cardiovascular disease, particularly in the primary health care sector (Figure 7). TIA has invested R8.8 million in the project in the year under review. The device will serve as a highly useful screening tool for the primary health care sector given its ease of use and rapid feedback process. The project has now reached the clinical trial phase, despite experiencing delays due to the COVID-19 pandemic. Upon completion it will be marketed to the approximately 4,200 primary health care clinics in South Africa. It will be of particular benefit to clinics located in marginalised communities where citizens do not have ready access to advanced health care facilities.

LODOX

The Advanced Manufacturing team also on boarded the Lodox project into its portfolio. Lodox Systems is a full-body medical

Figure 7: The Cardioflow screening device

scanner that uses ultra-low X-ray doses for the frequent and rapid scanning of people. Lodox is an IDC-owned company that was identified to support its broader re-industrialisation mandate by introducing high technology-based companies into the South African manufacturing sub-sector. The company's foundation is underpinned by a unique X-ray technology that offers a strong value proposition, putting Lodox on the path towards becoming a world-class medical devices manufacturing company.

As part of its global expansion strategy, TIA has committed an amount of R12 million for the development of Lodox's next generation X-ray machines which are cheaper and more efficient and therefore ideal for use in hospital and forensic environments. Co-funding to the value of R3.6 million has been committed by Lodox towards development of this innovative technology, and the IDC has pledged an additional R30 million towards the company's global expansion strategy.

15.1.3 ENERGY

The importance of energy security has been highlighted by the COVID-19 pandemic, both globally and in South Africa. A robust and uninterrupted power supply is crucial for South Africa's health care system to function, to maintain social welfare, and for the country's online economic activity. Security of supply remains a challenge for South Africa and threatens economic recovery efforts implemented by the government. Innovative energy technologies will be key in addressing this challenge in which TIA will play a pivotal role by supporting areas such as energy storage, distributed generation, renewables, as well as hydrogen and fuel cells.

The purpose of the Energy sub-programme is to support the development of innovative technologies within the energy sector that will result in a competitive and sustainable energy industry that promotes South Africa's transition to a low carbon economy. Currently, the sub-programme has a total project investment exposure of R231 million across a portfolio of 24 projects under management. Below are some of the initiatives supported by Energy during the financial year under review.

COMPRESSED AIR ENERGY STORAGE SYSTEM

Leaper Innovate Green Energies (Pty) Ltd is a company based in Gauteng developing a compressed air energy storage system (Figure 8) which was funded by TIA for an amount of R4.7 million. The project has progressed well with the project team in that they are now able to design and build an intensifier as well as a heat exchanger. The project team is working on improving the efficiency of the system, which is a critical aspect of the project that will provide the necessary competitive advantage in the market. The system will be demonstrated once the efficiency challenge has been addressed. As envisaged in the NDP and in the country's Integrated Resource Plan, energy storage will play a key role in enabling the effective integration of renewable energy and unlocking the benefits of local generation and a clean, resilient energy supply.

Figure 8: Compressed air energy storage system with storage containers

BATTERY MANAGEMENT SYSTEM

A company based in the Western Cape, Balancell (Pty) Ltd, has developed a battery management system which is critical for obtaining information about the performance of a battery and ensuring a longer battery lifespan (Figure 9). TIA has previously invested an amount of R11 million to develop the technology and the company has now secured R5 million in follow-on funding through the Support Programme for Industrial Innovation (an instrument of the dtic) for technology development and commercialisation activities. The role played by TIA as a funder, facilitator, and enabler made it possible for the project to attract financial support from other funders in the NSI. The technology developed by Balancell supports the country's efforts of energy storage and management.

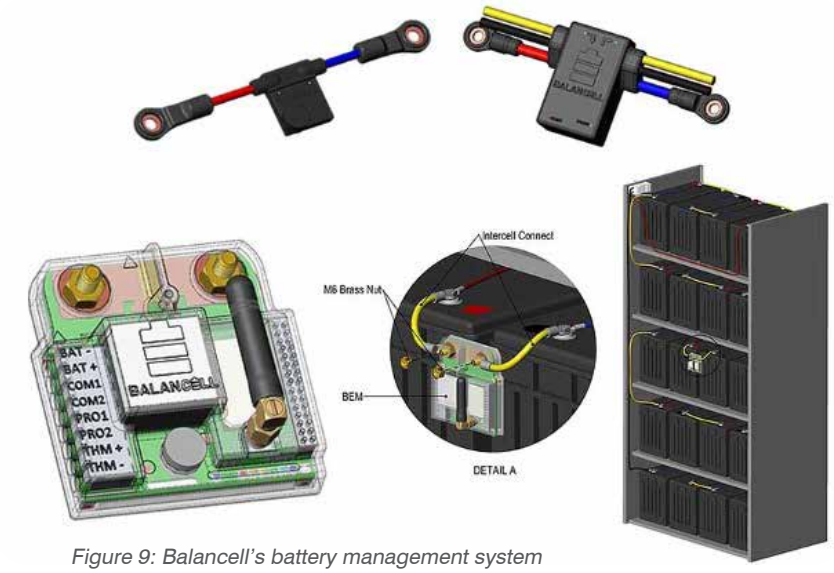


Figure 9: Balancell's battery management system

MORPHING WING

Brayfoil Technologies (Pty) Ltd is developing a morphing wing to be used in wind energy technologies for electricity production (Figure 10). The novelty of the project relates to the development of a morphing wing as compared with the traditional approach of utilising a wing with a fixed shape to generate energy from the wind. Morphing wings change their shape from symmetrical to cambered, depending on the prevailing wind conditions. The wing is symmetrical when the wind's angle of attack is zero, resulting in the generation of no lift with minimal drag. It changes to fully cambered with high lift and drag at an acute angle of attack.

The Alpha wing construction is well underway while development of the Beta wing is complete and is functioning well. One major delay experienced by the project team was a technical challenge which resulted in the project team changing the system from a vertical axis to a horizontal axis system. The project team is working on developing the horizontal axis system which will be demonstrated once it is complete. An amount of approximately R4.3 million was disbursed towards the project during the financial year.

Figure 10: Manufacturing plant for the Brayfoil morphing wing

15.1.4 INFORMATION AND COMMUNICATION TECHNOLOGY

The advent of the 4IR brought about global digital economic shifts that presented both challenges and opportunities that impacts many traditional sectors and livelihoods, including forging a greater convergence of industry sectors coupled with data sovereignty hurdles. Traditional industry sectors are now forced to adapt, recalibrate, and transform toward the digital realm to respond to global market shifts. Pertinent challenges that are experienced within developing economies such as broadband connectivity, access to information, and the provision of data services continue to widen the inequality and poverty gap and many countries wealth prospects.

The ICT sub-programme supports the country's national imperatives by supporting the development and exploitation of ICT-driven innovations with a broad social-economic impact to bridge the digital divide, access to healthcare, application of artificial intelligence, big data, and Internet of Things-based technologies to deliver high value and increased productivity outputs in many industry sectors and to address unemployment through the creation of new innovative start-up enterprises and the provision of quality social services.

The sub-programme further supports grassroots innovators and the development of technologies that will increase South Africa's competitiveness and participation in the 4IR. The sub-programme provides support to ICT innovators with projects from TRLs 3-8 that may already have companies established. The focus areas are broadband, the service economy, and industry applications.

The COVID-19 pandemic has exacerbated the universal access challenges in many under-served communities, interrupted many services in healthcare and education, and hampered the efforts of the unemployed to access employment opportunities. Small enterprises lost business and many shut down due to hard lockdown restriction. Those that did not have access to the Internet remained marginalised. The cost of data also needs to be overcome through implementation of cost-effective alternative technologies to enable many communities to access critical digital services.

The ICT sub-programme will continue to drive the diffusion of low-cost Internet services and requisite skills set that contributes toward reshaping the outlook of the country and closing the inequality and poverty gap.

SPACEDECODE SOFTWARE DEVELOPMENT PLATFORM

Lepsta (Pty) Ltd, an investee of TIA focusing on specialised software development, has developed a version control and self-managed software development platform called Spacedecode which enables collaboration and real-time sharing of source code between developers, thereby enabling coding, correction, and agile deployment of quality-assured software amongst software developers. Due to the importance of this platform in a digital world, Lepsta has secured partnership with Geekulcha and WeThink Code, which are two key players in the software skills development and facilitates of job placements for software developers in South Africa. Through this partnership Lespta will mobilise young software developers to use the platform to work on real use cases to hone their software development skills, and also enable these new partners to produce certified software developers to be absorbed by industry. An apprenticeship programme will be piloted together with WeThink code and Geekulcha, and be formalised together with academic institutions, thereby providing a steady flow of users and trainees into the Lepsta programme.

SEMICONDUCTOR CHIP, INTEGRATED CIRCUIT DESIGN AND FABRICATION

Multifractal Semiconductors (Pty) Ltd is an award-winning Pretoria-based start-up, registered in 2017, with the sole aim of commercialising IP from the University of Pretoria's Carl and Emily Fuchs Institute for Microelectronics, with a particular focus on millimetre wave technologies. The company is developing fully-integrated E-band front-ends on a single chip in silicon. This semiconductor technology is useful for building cheaper wireless communication equipment such as 5G transmitters and automotive radar systems. Multifractal is majority owned by South Africans, with 30.4% black ownership and 15.1% black female ownership.

The company was awarded US$8.5 million of in-kind services and design tools by the prestigious Silicon Catalyst; the world's only incubator focused exclusively on accelerating solutions in silicon-based applications in the lucrative semiconductor market. This award is significant for Multifractal as it will assist the company's development team with chip design and fabrication, without which this TIA-funded development would not be possible.

FUNDING THE DEVELOPMENT OF AFFORDABLE INTERNET SOLUTION FOR TOWNSHIPS

TIA has funded a Gauteng-based start-up that is developing an alternative antenna-based high-speed fixed Internet solution for low-income communities. FibrePoynt (Pty) Ltd is developing this Internet/wireless communication system that can be used as an alternative or supplementary system to fibre-to-the-home underground or overhead cable technology.

The technology not only puts South Africa on the map in terms of affordable Internet access, but also responds to the socio-economic challenges and the country's strategic broadband imperatives to make Internet accessible to everyone, irrespective of their socio-economic status and geographic location. Low to middle income, peri-urban and township households will be able to connect to the Internet, which is not possible with current technologies. The innovation will also solve signal strength problems and costs typically found in existing 'last mile' antenna wireless rollouts. The aim is to enable Internet network owners to deliver Internet to dwellings at a lower cost than currently possible.

The FibrePoynt technology (Figure 11) uses passive beam forming, beam pattern diversity, and beam shaping to get the best possible signal to the home units, which then provides Wi-Fi access for users to connect their devices to the Internet.

FibrePoynt enables the rollout of fixed wireless broadband network without trenching underground fibre in the 'last mile' connection to homes, thus reducing infrastructure costs by more than 50%. The technology promises a cost effective, faster-rollout, and high-speed alternative deployment of broadband infrastructure in areas that were previously deemed unfeasible.

This technology has been demonstrated and proven in the marketplace. The company is now finalising the last milestone of technology development and is moving towards pre-commercialisation stage to prove the commercial viability of the technology on larger scale. The FibrePoynt technology is not only backed by an innovative and sustainable business model, but an inclusive model which gives local entrepreneurs the skills and the opportunity to operate and roll out network to their respective communities. Local empowerment is a critical antidote to socio-economic ills.

TIA has been actively involved throughout the development of FibrePoynt providing both financial and non-financial support. The project has strong IP, an innovative business model, and demonstrates South Africa's contribution and competitiveness in knowledge-based economies. Non-financial support has included business development, route-to-market strategies as well as fund-raising strategies.

As part of the advancement of the initial TIA funded technology innovation, FibrePoynt has launched HomePoynt; a derivative innovation spun out of the core FibrePoynt wireless technology. This would improve access to critical services like home-schooling to a larger proportion of the population. HomePoynt is an innovative 'last mile' connectivity solution that has the potential to reduce Internet costs to as little as R89 a month for uncapped Wi-Fi. The technology has been developed with a key focus on townships, peri-urban, and small towns thus closing the digital divide in under-served areas.

In the process of market validation, FibrePoynt has developed an innovative Internet service provider model, termed Kasiwave, for the transferral of skills to the local communities in order to build and maintain the network infrastructure. The goal is to ensure that 20% of the revenue generation remains in the local communities. Through the Kasiwave model, FibrePoynt has managed to connect over 500 people, covering more than 200 houses in Tembisa, 40 in Soweto, and 40 in Tongaat.

FibrePoynt intends rolling out five commercially operating, community Internet service provider networks, one of which is already operational in the KwaZulu-Natal province. FibrePoynt is focusing on enabling entrepreneurs to deploy, operate, and manage all the physical equipment on the ground and supply all sales and support functions to be done by the local entrepreneur within the community, thereby creating jobs and empowering SMMEs.

Figure 11: A FibrePoynt antenna – customer premise equipment

15.1.5 NATURAL RESOURCES

The strategic focus of Natural Resources is ensuring availability and sustainable management of water and sanitation; supporting the development of technologies that minimise impact on the environment from waste, supporting the circular economy; supporting technologies to sustainably improve process efficiencies in the extraction and exploitation of mining resources and reduce worker exposure to hazards as well as maintain a competitive natural resources sector.

The sub-programme is managing a portfolio of 15 projects with a total financial exposure of R325 million. Most of these are in the mining sector (71%), with others in waste (15%) and water (14%). The Blue Cube Technologies, Stone Three Digital, and Advanced Imaging Technologies projects are being commercialised internationally, with TIA also receiving royalty payments from the latter two project recipients. Selected project highlights of the sub-programme are detailed below.

WATER PURIFICATION MICROFILTER

The VulAmanz water purification microfilter is a green engineering technology platform (based in Stellenbosch and majority black-owned) for decentralised water treatment and reuse which utilises technology based on a woven polyester microfiltration membrane process that is locally produced. The project has shown significant progress by completing the design of a process of the membrane pack frame and has progressed towards the completion of the filter modules construction phase. The project has also gained the interest of high-profile non-government organisations and a local scientific company that wishes to collaborate with VulAmanz on a pilot project aimed at meeting an identified need for affordable clean drinking water in deep rural areas.

ROTOWINNER

The aim of the Gauteng based Rotowinner project is to design, construct, operate, and demonstrate six rotowinners in a mobile plant unit using electrolyte from a mineral refining operation. The rotowinners are rotating stainless steel cylinders partially submerged in a bath with the electrolyte, and seeks to replace the rectangular cathode and anode electrodes in conventional electro-winning operations. The design is enhanced to accommodate the extraction of by-product minerals thus increasing the advantage of the technology. The project secured a test site at Impala Refineries in Springs where the technology will be demonstrated using electrolyte from the operation sourced from various platinum mines.

“The aim of the Gauteng based Rotowinner project is to design, construct, operate, and demonstrate six rotowinners in a mobile plant unit using electrolyte from a mineral refining operation.”

STONE THREE DIGITAL GETS THE NOD FROM LOCAL AND INTERNATIONAL MARKETS

Stone Three Digital (Pty) Ltd is a pioneering product development house that developed bespoke enterprise software engineering solutions for industry leaders. Mining companies, the sugar industry, and the pharmaceutical industry are reducing costs and want to increase the productivity of crushing, grinding, and flotation process plants (Figure 12). Stone Three Digital is based in Somerset West and is effectively 12.5% black-owned.

Between unlocking this asset in its mining industry base and significant growth in its smart sensor and process analytics business, Stone Three Digital has grown from a revenue of R8 million since inception to R50 million for the financial year that ended 30 June 2020. The company has successfully commercialised its dashboard in several international countries and has paid its first royalty payment of R170,000 to TIA.

Figure 12: Stone Three's IntelliOre Truck technology for particle size segmentation

The company has developed a real-time Process Advisory Dashboard that makes use of non-contact sensors, advanced analytics, big data, and deep process knowledge for the minerals processing industry. The Dashboard creation aims to increase the productivity of process plants in crushing, grinding, and flotation, by increasing the throughput and stability in crushing circuits, improving the energy efficiency and stability in grinding, and increasing grade, recovery, and stability in flotation.

Stone Three Digital is based in Somerset West in the Western Cape and has received R14.7 million in funding to progress its technology from TRL 4 to TRL 8. The company also received R5.5 million from the Innovation Fund to fully commercialise and expand.

The technology has undergone major development since the initial TIA funding, with additional functionality being added and existing functionality being improved to support the requirements of the Anglo American Operational Performance Management application that integrates with Stone Three Analytics.

The Stone Three Digital Remote Monitoring and Diagnostics is the preferred supplier of smart sensors to the Anglo Group worldwide and has secured installations at three mining sites in Australia. These contracts are valued at approximately R11 million.

The success of Stone Three Digital innovation has positioned South Africa favourably on the global mining sector. To date, the company has several international mining clients that deal with ferronickel, zinc, lead, silver, copper, gold, and iron in countries such as Russia, Peru, Chile, Columbia, Germany, Brazil, Uzbekistan, Kazakhstan, India, and China.

New machine learning algorithms have been deployed to Kansanshi, Zambia – the eighth largest copper mine in the world – with great success. Through this technology, false positives have been greatly reduced and positive detection has increased. On the African continent, Stone Three Digital has customers in Ghana, Morocco, Lesotho, and Botswana. Stone Three Digital has also obtained international partnerships with global giants such as Microsoft, FLSmidth, ABB, Bluecube Systems, and General Electric Wabtec.

In addition, Stone Three Digital has a foreign object detection algorithm which it has implemented and tested at Kevitsa in Finland. The Kevitsa mine represents one of the largest nickel reserves in Finland, having estimated reserves of 710,000 tons of nickel metal.

The success of Stone Three Digital is excellent testimony to the role of TIA as an enabler and an industry builder that supports development of innovations to accelerate socio-economic prosperity in South Africa.

MUNICIPAL LEAKS MANAGEMENT SYSTEM

This project entails the development and testing of an app system to be used by municipalities to monitor and manage water and sanitation faults in order to significantly impact water loss as well as improve responses to a variety of other water and sanitation faults. The app developer, City Park Trading 127 CC, is a 51% black-owned company based in Durban.

An app was developed using open-source platforms that allow members of the public and community leak inspectors to easily record the details of leaks. This includes the positions and level of urgency required, allowing municipal and community plumbers to repair the leaks and enabling municipal or community inspectors to use the app to track and verify repairs.

South Africa is considered a water stressed country and loses a substantial amount of treated water through leaking pipes and inadequate infrastructure. Data gathered in 2012 from 132 municipalities showed that the country's level of non-revenue water is estimated to be 36.5%, of which 25% is due to leaks. Some municipalities have water loss management systems in place, including leak management, but these systems rarely work efficiently due to capacity issues, the ease of use of the systems and how they integrate with other water conservation and water demand management systems such as meter reading infrastructure management or geographic information system data sets. The Expanded Public Works Programme's War on Leaks initiative is not fully effective in some municipalities. This is because although there are community workers employed to identify leaks there is no system to manage, repair, and analyse the leaks in an effective manner.

The integrated app solution provides municipal department managers and field teams with an operational tool. This contrasts with the existing municipal app, which only focusses on providing a communication link to members of the public and communities.

The app and database reporting tools allowed the eThekwini Metropolitan Municipality's Non-Revenue Water team to easily review water balance improvements by comparing bulk meter results with individual meter readings. The app is therefore able to facilitate saving significant amounts of unaccounted water, consequentially achieving appreciable operational cost savings for the municipality. Through the automated reporting system, the Non-Revenue Water manager was also able to identify fault and water loss hot spots, types of faults, and work efficiency of field staff for payment and for their portfolio of evidence for training.

The involvement of the municipality's Non-Revenue Water unit and their input in the developing and testing of the app system on their War on Leaks programme has resulted in significant contributions to their operations. The app is being utilised to identify, respond to, and repair faults attributable to water leaks, followed by verification of the actual repair. This allows for reducing water leaks and the subsequent reduction in the amount of money being spent on wasted water. The app system is also being used to generate automated reports and dashboards based on the captured field data, which is then able to be translated into a water balance which many municipalities are unable to produce due to the inefficient manner of data collection, verification, and translation.

> South Africa is considered a water stressed country and loses a substantial amount of treated water through leaking pipes and inadequate infrastructure.

The app was developed in close collaboration with the eThekwini Water and Sanitation team through several workshops, meetings, and field visits. This resulted in the development of the app addressing additional issues that were identified by this team, thus making the project a further success and the implementation of the technology more attractive for roll out within the municipality.

Key to the project's success was engagement with the head of the eThekwini Water and Sanitation IT department to obtain business approval of the system by the municipality. A business plan has subsequently been developed and approved, meaning that the integrated app solution will serve as an effective operational tool throughout municipal departments and field teams.

Besides the TIA funding, future project co-funding has been secured through the War on Leaks stipend programme administered by Rand Water, as well as through the eThekwini Water and Sanitation's budget for materials to support Non-Revenue Water initiatives. An approved municipal budget of R40 million over the next three years will serve to expand the project, whereafter the technology could be implemented in other municipalities. This technology therefore has the potential to contribute significantly to reduce the R9 billion of water lost through water leaks in South Africa.

15.2 BIO-ECONOMY DIVISION

15.2.1 DIVISIONAL OVERVIEW

The purpose of the Bio-economy Division is to support the translation of South Africa's knowledge resources into sustainable bio-based solutions that address societal challenges while contributing to sustainable economic growth. This purpose is guided by the South Africa's Bio-economy Strategy of 2013. The strategy highlights that developed capacity, existing infrastructure, industry value chains, resources, and opportunities must be harnessed and advanced in a coordinated manner that addresses the social and economic imperatives of the country. In so-doing, economic competitiveness is envisaged through the convergence of several disciplines.

The Bio-Economy Division has implemented the TIA strategy through a value-chain and ecosystem approach. This has meant that the Division's interventions in programmes have been escalated for greater impact, in addition to honouring existing funding obligations in projects. The impact of these programmatic approaches will be realised in the short to medium term.

Through this focus area, TIA's efforts have been directed towards creating new bio-based products and processes and promoting the creation of new enterprises that will ultimately lead to job creation. To this end, TIA has played the role of industry builder, and has sought to increase its efforts to grow and enhance the role of indigenous knowledge systems, amongst others, as an important sector with great potential for inclusive development and transformation.

The Bio-Economy Division's efforts and achievements towards supporting and stimulating the health, indigenous knowledge systems, agriculture, and industrial biotechnology sectors in terms of the generation of new knowledge and promoting collaboration between the public and private sectors is illustrated in the annual performance data on page 42. More specifically, the disbursement of budget towards existing and new obligations was made against those opportunities in which sector stimulation was envisaged. The generation of new knowledge is illustrated by the tangible outputs of the Division's output indicators, most notably output 2.1 (bio-based technologies developed).

DIVISIONAL PERFORMANCE

Table 8 presents TIA's performance against its targets in the originally-tabled 2020/21 APP for Outcome 2: Translation of knowledge outputs that lead to the stimulation of a productive bio-economy through innovation, which applies to Q1.

Table 9 presents the agency's performance against its targets in the re-tabled 2020/21 APP for Outcome 2: Delivering on the Bio-economy Strategy, which applies to Q2-Q4.

Table 8: TIA's performance in 2020/21 (Q1) against Outcome 2: Translation of knowledge outputs that lead to the stimulation of a productive bio-economy through innovation

Output (Output Indicator)	Audited actual performance 2018/19	Audited actual performance 2019/20	Planned annual target 2020/21	Actual achievement 2020/21 until date of re-tabling (Q1)	Deviation from planned target to actual achievement 2020/21	Reasons for deviations	Reasons for revisions to the outputs/ output indicators/ annual targets
2.1 Bio-based technologies developed. (Number of successfully demonstrated bio-based technologies)	-	-	13	1	-12	TIA met its output target of one unit for Q1.	TIA revised its outputs, output indicators, and annual targets in response to a 10% budget cut for 2020/21.
2.2 Existing Technology Platforms managed and supported. (Number of existing Technology Platforms that are operational and functional)	-	-	9	0	-9	A standards framework for what constitutes an operational and a functional Technology Platform had been developed under pre-COVID-19 pandemic conditions. Unfortunately, the lockdown restrictions imposed by government had a significant impact on the platforms' operations. Most platforms are hosted on the campuses of universities or in commercial property precincts and were required to adhere to the host institutions' COVID-19 pandemic-related rules and to national lockdown regulations. Hence, the platforms were prevented from operating, resulting in a zero performance in Q1.	TIA revised its outputs, output indicators, and annual targets in response to a 10% budget cut for 2020/21.
2.3 New Technology Platforms established and supported. (Number of new Technology Platforms in targeted regions)	-	-	0	0	0	TIA and the University of the Free State had been exploring the establishment of a Technology Platform in African traditional medicines. The initiative entered the feasibility assessment phase in Q1.	N/A
2.4 Technology Innovation Clusters managed and supported. (Number of existing Technology Innovation Clusters that are operational and functional)	-	-	8	5	-3	Unfortunately, in Q1 TIA recorded a performance of only five operational and functional clusters. Prior to 2020/21 there was a reasonable expectation that at least three additional funded clusters would be secured (contracted) out of a possible four candidate clusters. Funding intended for these new clusters was either reduced or re-prioritised by government sector partners. Accordingly, the three new clusters were not established.	TIA revised its outputs, output indicators and annual targets in response to a 10% budget cut for 2020/21.

Table 9: TIA's performance in 2020/21 (Q2-Q4) against Outcome 2: Delivering on the Bio-economy Strategy

Output (Output Indicator)	Audited actual performance 2018/19	Audited actual performance 2019/20	Planned annual target 2020/21	Actual achievement 2020/21 (Q2-Q4)	Deviation from planned target to actual achievement 2020/21	Reasons for deviations
2.1 Bio-based technologies developed (Number of successfully demonstrated bio-based technologies)	-	-	9	37	+28	The over-performance is due to the adoption of global standards for the definition of 'bio-based' in the outcome indicator's description. Accordingly, the increase in the number of bio-based technologies in Q4 was due to the reporting from the Industrial Biotechnology Unit. Overall, the greatest contribution to this target was from the Bio-Economy Division. Going forward, this target is likely to be increased due to the expectation of bio-based technologies from Agriculture and Indigenous Knowledge System.
2.2 Existing Technology Platforms managed and supported (Number of existing Technology Platforms that are operational and functional)	-	-	7	7	0	N/A
2.3 New Technology Platforms established and supported (Number of new Technology Platforms in targeted regions)	-	-	0	1	+1	TIA established and approved a new technology platform, the African Traditional Medicines Technology Platform. This was not planned in the reporting year, however, the opportunity to establish one was taken in light of the national interest in this area.
2.4 Technology Innovation Clusters managed and supported (Number of existing Technology Innovation Clusters that are operational and functional)	-	-	5	6	+1	The increase in performance is due to the additional support in funding provided by the Division in supporting an operational plan for the uYilo Cluster Programme with additional funding.

PROGRESS TOWARDS PLANNED STRATEGIC INITIATIVES

In enhancing the role of the bio-economy in economic development, the Bio-economy Division has pursued various strategic initiatives under the DSI's Bio-Economy Strategy. These strategic initiatives are derived from an understanding of the challenges and opportunities presented by the bio-economy of the country. Most prevalent of these is the recent COVID-19 pandemic, and the extent to which the Bio-economy Division has had to respond to the effects of the virus itself, economic revival, and distressed communities. To this end, the Bio-economy Division has been instrumental in launching a response to COVID-19 through its Technology Platforms Programme (surveillance of whole genomes of the SARS-CoV-2 virus), investments in diagnostics (mass pre-screening recognition at borders of entry, reagents and test kits, antibody sequencing), remote dispensing of medication, and a feasibility assessment for local vaccine manufacturing readiness.

Ensuring Food Security

The Global Report on Food Crises, released in 2021 by the Global Network Against Food Crises, reports the main drivers of global hunger are conflict, economic shocks (such as the COVID-19 pandemic), and climate change. According to the report, 155 million people are living in acute hunger worldwide. Africa accounts for 63% of the global total, with 40.4 million of those people living in central and southern Africa.

The Integrated Food Security Phase Classification analysis report determined that in the period September to December 2020, 9.34 million people in South Africa (16% of the population analysed) faced high levels of acute food insecurity (integrated phase classification[3] three or above). These people required urgent interventions to reduce food gaps and protect livelihoods. Of the nine provinces of South Africa, the KwaZulu-Natal province was classified as being in crisis (integrated phase classification three) with all other provinces classified as stressed (integrated phase classification two).

South Africa's food security is threatened by the COVID-19 pandemic, increasing food prices, drought in some areas, and overall economic decline. Many South Africans may need interventions to reduce food shortages. The Integrated Food Security Strategy of South Africa is one of several state interventions to address food security through programmes that address land reform, food production, procurement, the marketing of food, (agro-) processing, as well as storage and transportation of food.

Managing natural resources sustainably, reducing dependence on non-renewable resources, and mitigating and adapting to climate change

The National Climate Change Response White Paper presents the South African government's vision for an effective climate change response. The White Paper also articulates how South Africa will transition to a climate-resilient and lower-carbon economy and society. This White Paper guides how investment in human and productive resources will grow the green economy in order to give effect to South Africa's ratification of both the United Nations Framework Convention on Climate Change and the Kyoto Protocol.

South Africa will exceed the limits of economically viable land-based water resources by 2050. Climate change threatens water resources, and this, in turn, affects productive sectors such as agriculture and commercial forestry, that rely heavily on water availability.

Globally, agriculture is a key contributor to climate change, being responsible for about 14% of all greenhouse gas emissions. In both the agriculture and commercial forestry sectors climate-resilient sectoral plans affect those most impacted by climate change, namely; the rural poor. By being climate-resilient, issues of strategic national importance (such as food security, water, health, and land reform) are inevitably affected.

In South Africa, agriculture is the largest consumer of water (through irrigation). Accordingly, this sector will be most impacted by changes in water availability, increased water pollution (particularly from toxic algal or bacterial blooms in freshwater systems), and soil erosion. It is the under-resourced, small-scale, and subsistence farmers who are particularly vulnerable to the impacts of climate change, and will have the greatest need for new innovations in smart agriculture and access to resilient high-quality cultivars, as well as agricultural practices that render these farmers profitable.

Large commercial farmers have access to state-of-the-art technologies and funding, whilst many small-scale farmers farm on less than five hectares. To effect redress, the appropriate use of small-scale, labour-intensive agriculture techniques may reverse the present decrease in agricultural jobs, contribute to empowerment goals, promote food security, conserve soil quality and structure, and contribute to biodiversity.[4] The availability of water resource management technologies, automation, the Internet of Things and sensor technology, remote sensing, precision agriculture and smart farming, genetics (breeding), and artificial intelligence and machine learning will also transform South Africa's agriculture sector.[5] Recent outputs from national entities such as the Agricultural Research Council (ARC) have confirmed this.

Commercial agriculture, on the other hand, is a significant contributor to GDP and it follows then that crop failure, as a result of climate change events, can therefore have a significant economic impact.

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[3] Integrated phase classification describes the severity of food emergencies.

[4] The National Climate Change Response White Paper (2018).

[5] The future of the Western Cape agricultural sector in the context of the Fourth Industrial Revolution report (Western Cape Department of Agriculture, 2018).

PRIORITIES FOR AGRICULTURE AND COMMERCIAL FORESTRY TO BUILD RESILIENCE TO CLIMATE CHANGE

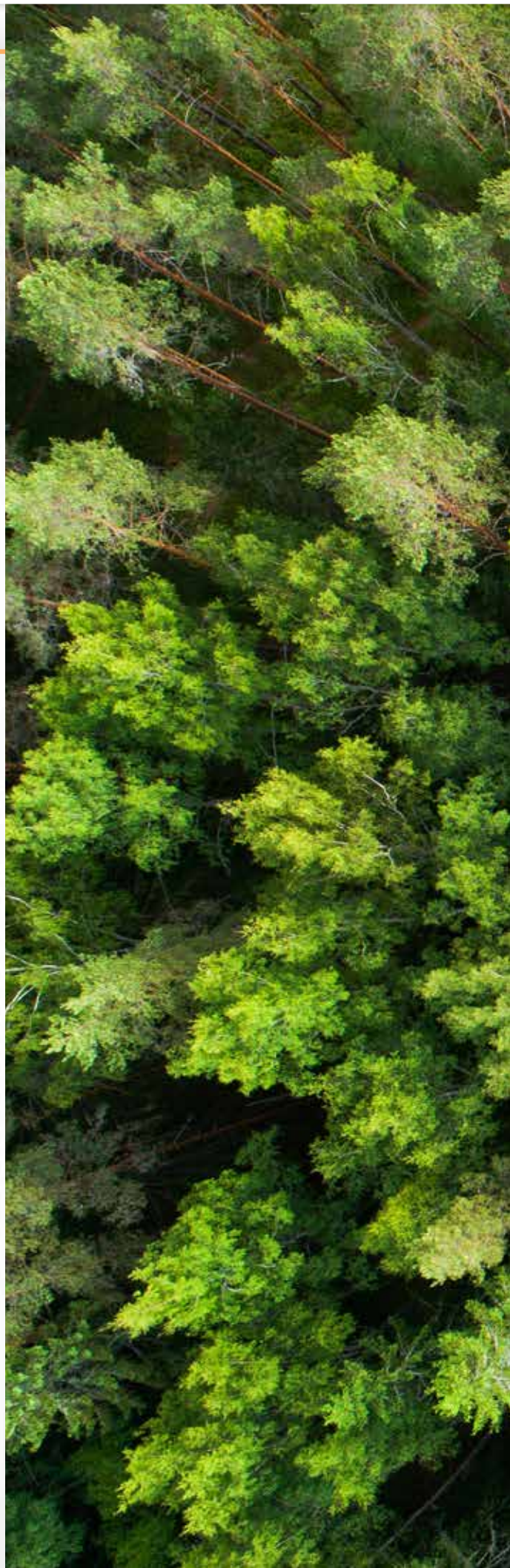
(a) Integrate agriculture and forestry into climate-resilient rural development planning to address job creation, food security, and livelihoods.

(b) Using the results of available risk and vulnerability studies, develop and update short-, medium- and long-term adaptation scenarios to identify climate-resilient land uses to support the agricultural industry's efforts to exploit new agricultural opportunities, new areas, and new crops.

(c) Invest in and improve research into water, nutrient, and soil conservation technologies and techniques, climate-resistant crops and livestock, as well as agricultural production, ownership, and financing models to promote the development of climate-smart agriculture for increased yields.

(d) Use early-warning systems of adverse weather, pest and disease occurrence as decision-support tools to assess the vulnerability of farmers.

(e) Invest in education and awareness programmes in rural areas and link these to agricultural extension activities to enable both subsistence and commercial producers to respond and adapt to climate change.[6]



[6] *Adapted from the National Climate Change Response White Paper (2018).*

Investing in knowledge, innovation and skills

South Africa strives to make the transition towards a knowledge-based economy and become less reliant on natural resources to drive its economy. For this transition to be realised, the NSI has emphasised knowledge generation, and an increase in the number of highly-skilled STI personnel, through increased investment into higher education institutions and science councils. This deliberate investment is in recognition of the inseparable relationship between economic prosperity, a skilled workforce, the generation of new knowledge and IP, as well as business innovation to respond to increasing competition from global competitors and open capital markets.

The research, development, and innovation programme (extensively elaborated upon in the draft Decadal Plan for Science, Technology and Innovation) prioritises interventions in both crop and animal improvement to revitalise the economy and promote its competitiveness. It also recognises the need to invest in the appropriate skills by prioritising specialised skills development programmes, viz. analytical skills, skills in digital and precision agriculture platforms, the development of Masters and Doctoral students, entrepreneurial skills, as well as SMME development.

Ensuring participative governance and informed dialogue with society

TIA and AfricaBio NPC have collaborated concerning the establishment of an active participation in the regional chapter of international BIO Conventions, namely; the BIO Africa Convention ("BIO Africa"). To formalise this collaboration, the parties entered into a Memorandum of Understanding with the broad objective of stimulating the NSI for a vibrant bioeconomy, as well as creating an enabling environment for new entrants. This initiative has yielded benefits ranging from an informed society, new research and innovation collaborations, renewed visibility of South Africa's research and development community to new initiatives to address systemic failures in the innovation ecosystem, amongst others.

Creating a coherent policy environment

Various thought leadership initiatives, such as the DSI's Agriculture and Agro-processing Masterplan, the Bio-economy Strategy and various other policy directives, serve to highlight the benefits of functional and participative governance and dialogue interventions with society. The 2019 White Paper on Science, Technology and Innovation responds to several pressing issues in South Africa, and builds on the progress made in the development of the NSI which, since 1996, aimed to contribute to national competitiveness and socio-economic transformation.

Creating new infrastructure and instruments, and creating jobs and improving competitiveness

The draft Decadal Plan for Science, Technology and Innovation (the implementation plan for the 2019 White Paper on Science, Technology and Innovation) refers to several key industrial sectors that are in decline, namely; the sugarcane, forestry, and chemicals industries. There is wide recognition that biorefinery and industrial biocatalysis programmes are interventions that will employ renewable biomass to produce (new) bio-based chemicals, biomaterials, food and animal feed products, and manufacturing technologies that are cost effective and have environmentally-acceptable attributes.

South Africa ranks as the third most biodiverse country in the world, and is home to 95,000 known species. A diverse range of biomes, from forests to desert estuaries and marine systems, exists. Accordingly, biodiversity, ecological infrastructure, and several ecosystem services support the country's economy in areas such as tourism farming and industrial development, which contribute to job creation, sustenance, and security.

However, due to fragmented initiatives, a historically-disjointed innovation ecosystem, lack of adequate investment and a regulatory framework that is not supportive of transformation, access to services and inclusivity of marginalised communities, the country has not optimised the development and commercialisation of its rich indigenous knowledge heritage. This is beginning to change, as the DSI-supported Indigenous Knowledge(IK)-based platforms gain traction to be able to support African medicines, IK-based nutraceuticals, IK-based health infusions, and IK-based cosmeceuticals platforms.

To this end, critical systemic failures in technology development and commercialisation value-chains have been identified and are being addressed through interventions such as the establishment by TIA of new high-end infrastructure platforms, such as the recent ATM Technology Platform, to deliver high-end services and support to IK holders. This requires the orchestration of various players, ranging from the IK holders themselves, science councils, universities, funders, regulatory bodies such as the South African Health Products Regulatory Authority (SAHPRA), as well as commercial industry and markets. The overall outcome is the creation of jobs in rural economies, responding to the call by the government to revive depressed rural economies, whilst improving the competitiveness of developed technologies.

The increased collaboration between actors such as TIA and the IDC has started to deliver tangible results, for example the establishment of the NIPP Fund. This fund was established to provide technical assistance and commercialisation support for enterprises in the indigenous natural products sector. Funding was made available by the DSI through its Innovation Fund instrument.

The Agriculture Bioeconomy Innovation Partnership Programme (ABIPP) Phase 1 was successfully concluded by the Agriculture sub-programme. Strategic and collaborative partnerships, consortia, and platforms were able to deliver on the development of breeding production technologies, technologies to manage plant pests, weeds and pathogens of economic importance. Specific interventions in human capital development delivered scarce skills for farmer development, especially smallholder farmers. Farmer development was also realised through government's Agri-Parks programme.

Several industry commodity programmes were established, such as the Soybean Food and Nutrition Development Programme, and the Bio-innovation Aquaculture Programme. Several industry value chains were enhanced, through the development and application of postharvest technologies. Feasibility studies were conducted toward the implementation of the next phase of ABIPP. These feasibility studies focused on the canola value chain for South Africa, market opportunities for sorghum in South Africa, a National Rice Cultivar Evaluation Programme as well as an agro-innovation hub model for agro-processing projects. Identified TIA cluster initiatives are to be included in the ABIPP Phase 2, namely; the Animal Health Cluster, the Beef Genomics Programme, the Dairy Genomics Programme, as well as the Livestock Identification and Traceability System.

The Health sub-programme strengthened its partnership with the SAMRC through the joint management of COVID-19 diagnostics projects concerning the development of test kits and diagnostics, and issued call for applications in health-related projects at universities and science councils, in medical devices, diagnostics, and digital health. The investments by TIA in the Health sub-programme are aligned to the Foresight Exercise for Science, Technology and Innovation report, which identified three STI thrusts, namely; the optimisation of health systems, improving the quality of healthcare, and the digitisation of healthcare systems, which are to be supported by new and disruptive 4IR technologies and platforms to deliver affordable, PoC technologies to aid in the delivery of health care interventions, especially to people in remote areas of the country.

The IKS sub-programme has been allocated funding from the Innovation Fund in the order of R20 million, to be augmented with R51 million through the NIPP Fund – an initiative of TIA and the IDC which aims to support indigenous knowledge holders and SMMEs with technical assistance and commercialisation. Opportunities in the four thematic areas of African traditional medicines, cosmeceuticals, nutraceuticals, and health infusions have been earmarked for investment.

The DSI conceptualised the establishment of the Industrial Biocatalysis Hub to serve as a technology platform that adds value to South African chemical and biotechnology industries by supporting biocatalysis-related technical development in order to generate new technologies and new technology-driven businesses. The now-established Industrial Biocatalysis Hub (managed through the Industrial Biotechnology sub-programme) is envisaged to have a significant impact on the manufacturing sector through technology-based renewal of chemical and related industries, environmental and resource sustainability, international competitiveness, and industrial diversification. The CSIR was selected as the host after a competitive process.

The Hub will support a biocatalysis technology value chain that will increase the chances of commercial success for biotechnology and chemistry processes; develop new cutting edge biocatalysis technologies for enhanced competitiveness and encourage private sector investment in biocatalysis technologies. In addition, it will establish active and long-term partnerships with industry to encourage the licensing, successful technology implementation and commercialisation of biocatalysis R&D and innovation outputs. It will create a platform for institutional relationships, collaborations and industry partnerships to facilitate technology uptake by Industry, as well as develop human capital that can be absorbed by the industry.

Through the Strategic Industrial Bio-innovation Programme, a programme managed by the Industrial Biotechnology sub-programme on behalf of the DSI, co-funding was received from the CSIR partner in a microbial bioprospecting project to support the development of novel Cas9 endonucleases, which are high-value industrial enzymes with commercial application in the biopharmaceutical sector.

The spike in new COVID-19 infections across the country has seen the Centre for Proteomic and Genomic Research (CPGR) and the KwaZulu-Natal Research Innovation and Sequencing Platform (KRISP) – two platforms that have been very active in since the outbreak of the pandemic – ramping up their capabilities in support efforts to combat the second wave of infections. The CPGR has expanded its capacity which is critical to ensure that the platform can meet its commitment to avail its capabilities to conduct testing, thereby supporting the NHLS. KRISP is part of a network of genomic surveillance laboratories around the country that generate sequencing data to understand emerging viruses and assist in the implementation of public health policy interventions. As part of the network, KRISP has been crucial in the identification of a new strain of the SARS-CoV-2 virus, which has made global headlines. This strain will be monitored to assess transmission efficiency, virulence, and response to immunisation.

In the Technology Innovation Cluster Programme, TIA and the SAMRC have signed an agreement for the establishment of the Medical Devices and Diagnostics Cluster. Through the South African Nuclear Energy Corporation, the Nuclear Medicines and Biosciences Programme research activities have commenced.

Table 10 maps the various focus areas in which the sub-programmes of the Bio-economy Division have contributed through investments in support of the detailed sub-programme level activities which follow.

Table 10: Alignment of Bio-economy Divisional sub-programmes with priority national focus areas

Priority national focus areas	Sub-programme					
	Agriculture	Industrial Biotechnology	Health	Indigenous Knowledge Systems	Technology Innovation Cluster Programme	Technology Platforms Programme
Ensuring food security	•				•	
Managing natural resources sustainably	•	•		•		
Reducing dependence on non-renewable resources	•	•				
Mitigating and adapting to climate change	•					
Creating jobs and improving competitiveness	•	•	•	•	•	•
Creating a coherent policy environment	•	•	•	•	•	•
Investing in knowledge, innovation and skills	•	•	•	•	•	•
Ensuring participative governance and informed dialogue with society	•	•	•	•	•	•
Creating new infrastructure and instruments						•

BUDGET AND EXPENDITURE FOR DELIVERING ON THE BIO-ECONOMY STRATEGY

A comparison of the budget and actual expenditure for Outcome 2 is presented in Table 11.

Table 11: Budget and expenditure for Outcome 2: Delivering on the Bio-economy Strategy for 2019/20 and 2020/21

Sub-Programme	2019/20			2020/21		
	Budget (R'000)	Actual expenditure (R'000)	(Over) / under expenditure (R'000)	Budget (R'000)	Actual expenditure (R'000)	(Over) / under expenditure (R'000)
Agriculture	49,100	50,100	(1,000)	20,250	26,271	(6,021)
Health	22,300	21,400	900	13,500	27,681	(14,181)
Industrial Biotechnology	0	0	0	7,200	4,625	2,575
Indigenous Knowledge Systems	0	0	0	7,200	4,000	3,200
Technology Platforms Programme	56,200	83,600	(27,400)	36,062	68,557	(32,495)
Technology Innovation Cluster Programme	15,000	31,900	(16,900)	13,950	21,446	(7,496)
BIO Africa Convention	6,700	5,742	958	4,985	3,664	1,321
Total	**149,300**	**192,742**	**43,442**	**133,079**	**185,653**	**52,574**

15.2.2 AGRICULTURE

South African farmers must adapt to a set of new challenges in the context of an ever-modernising world. Increasing urbanisation means that food security must be guaranteed for growing populations. With climate change will come increasing temperatures, changing rainfall patterns, and a growing susceptibility to drought conditions.

The Agriculture sub-programme aims to contribute to the development of high-growth and high-impact technologies, products, and services that will result in a competitive, broad-based, inclusive and sustainably growing agriculture sector in South Africa, Africa, and globally. The sub-programme focuses on breeding and productive technologies in livestock and field crops, animal and plant health and nutrition, and agro-processing and post-harvest technologies. In line with the National 2017-2022 Food and Nutrition Security Plan and the Bio-economy Strategy, the sub-programme leverages technologies that are already developed to promote food security and nutrition. To this end, the sub-programme has pursued opportunities in post-harvest technologies and storage or techniques to improve shelf-life, agro-processing technologies and the detection of mycotoxins, and soil health and agronomic technologies.

In order to promote inclusive development and rural economic transformation, the sub-programme has partnered with research institutions such as the ARC and the CSIR as well as with universities to design broad-based deployment and diffusion of technology solutions. Through this approach, the transfer of technologies and knowledge to the poor and marginalised in rural communities and the informal economy is achieved.

The Agriculture sub-programme continued its focus broadly and prioritised the following technology development and innovation areas, which were driven by industry priorities.

- Plant health and nutrition – improved crop yields, pest and climate tolerance.
- Animal health and nutrition – resilient livestock breeds, improved productivity.
- Post-harvest processing and agro-processing – agricultural manufacturing and value addition, longer shelf life
- Smart agriculture – precision, vertical and urban farming, aquaculture and hydroponics.
- Climate change and green agricultural technologies.

AGRICULTURE BIOECONOMY INNOVATION PARTNERSHIP PROGRAMME

The ABIPP was established as an instrument to contribute towards the objectives of the DSI's Bio-economy Strategy, within which the agricultural sector was identified as one of three focus areas. The objective is to strengthen agricultural bioscience innovation to ensure food security, enhance nutrition, and improve health, as well as to enable job creation through the expansion and intensification of sustainable agricultural production and processing.

The TIA-DSI contract to implement phase one of ABIPP came to an end in June 2020. Programmes and projects implemented under ABIPP have ensured that research outputs are utilised in support of industry development. Such effortsinclude increased food security (improved cultivars), the introduction of new technologies in the marketplace (aquaculture), the building of innovation value chains (marula and honeybush), and the supporting of communities with innovations which contribute to food and nutrition security (soya, nixamalisation). Funding for ABIPP totals R217 million. Of this, R53.5 million is contributed by the DSI, with co-funding (industry, TIA, and IDC) totaling R163.5 million. Remarkably, industry accounts for more than 90% of ABIPP co-funding.

The Strategic Innovation Partnership for Grains and Oilseeds is a key initiative that includes the Wheat Breeding Platform, the Climate Change Resilience Programme (maize breeding programme and other climate programmes), the Crop Protection Consortium for Grains and Oilseeds, and innovation in support of Agri-Parks. The latter project is driven by the Grain SA Farmer Development Programme which is aimed at empowering black subsistence, smallholder, potential commercial, and new era commercial farmers.

Highlights in terms of achievements in Phase I also include the launch of the Wheat Breeding Platform. Furthermore, a total of 1,155 wheat pre-breeding lines were provided to all breeding programmes, with local seed breeding companies registering 19 new cultivars in 2018 and 2019. Other achievements include the initiation of pest and disease surveys in the Eastern Cape, North West, and Free State provinces on the farms of black smallholder and commercial producers, monitoring and surveillance of Fall armyworm and the causal agents of maize lethal necrosis disease towards strengthening South Africa's biosecurity and preventing crop yield losses.

The ABIPP programme was able to contribute towards job creation through the Soybean Food and Nutrition programme. The permanent employment of nine

people (primarily women) was achieved. In addition to job creation, the project has also supported 488 small-scale black farmers in producing soybean commercially through technology dissemination to assist farmers in farming more effectively.

Over the past three years, the Soybean Food and Nutrition progamme has trained more than 9,000 community members. The Grain SA Farmer Development Programme (innovation in support of Agri-Parks) conducted 1,091 training courses (focusing on mycotoxins, nutrition, dry beans, and nixtamalisation) with a total of over 16,800 attendees. Furthermore, the nixtamalisation training courses and the development of niche value-added agro-processed products have demonstrated the most simplest form of agro-processing. Farmers were trained on how to diversify their diets by processing their home-grown maize and soybeans into different products such as soy milk, soy yogurt, maize yogurt, and maize biscuits.

Other key activities were in agro-processing value chain development. The marula value chain development project was funded to a total value of R15 million, of which 50% is IDC funding. The Aquaculture Bio-innovation Programme was initiated and four SMMEs and two projects from one university were supported with technology development. Over and above these projects, the sub-programme has been focussing on value chain analysis, specifically rice, sorghum, and canola.

The spatial footprint of ABIPP programmes and projects in the past MTEF is broad. A number of research projects are concentrated in the Gauteng and Western Cape provinces, with the Eastern Cape, KwaZulu-Natal, and Mpumalanga provinces being the focus of community-based projects for technology dissemination and demonstration.

In Phase I, a total of 30 students, five post-Doctoral researchers and one intern (a technician) were trained. The programme placed emphasis on supporting women and individuals from previously disadvantaged backgrounds, with 64% of the students being female and 58% of the students being black. Postgraduate degrees supported included 18 Masters degrees and nine Doctoral degrees.

A critical focus of Phase I was ensuring the appropriate governance mechanisms were in place to cataylse implementation. To this effect, the ABIPP Steering committee was appointed. The terms of reference for the steering committee, standard operating procedures, and key performance indicators for ABIPP were developed and approved by the steering committee. A project management unit was established and a programme manager appointed.

ABIPP Phase II commenced in the year under review and entails programmes both in crop improvement and animal improvement to revitalise the economy. Such technologies are required by both large- and small-scale farmers to increase competitiveness (to do more with less), to increase incomes, and to support GDP growth in the country. The new funding will be deployed to expand the crop improvement programmes to more crops (cotton, potatoes and cassava, sorghum, canola, dryland rice, bambara groundnuts, and macadamia nuts), focusing on breeding, climate change resilience, crop protection, farmer development support, and value chain analysis. Furthermore, additional funding will support the new cotton and potato breeding programmes – two industries that warrant further attention due to the challenges created by climate change and the need to develop cultivars/varieties resistant to pests and diseases.

Phase II will continue to support evidence-based value chain mapping to identify new crops with economic opportunity. The canola project aims to provide new opportunities and markets for canola. These initiatives coupled with support for smallholder farmers to access underutilised value chains and/or upgrade underutilised value chains to grow existing markets have significant potential to create and support sustainable new businesses in the context of much-needed economic stimulus in a post-COVID-19 world.

Building capability and access to new technology to modernise the sector is a deliberate focus in the ABIPP Phase II. Three platforms are proposed concerning smart, precision, and digital agriculture, and will leverage off the work of existing consortia and programmes in breeding, farmer development support, and climate resilience. These platforms are the Biosecurity Research Hub, a Phenomics Platform, and a Digital Agriculture Decision Support Platform. The platforms will also require the necessary specialised analytical and other skills over and above those needed in terms of technicians and advanced training at the postgraduate level.

New technologies and innovations can support the development and commercialsation of products and services for animal improvement and better management of animal health risks. Crosscutting initiatives, such agro-processing, demonstrates the opportunity to build value chains through strategic intervention and Phase II aspires to replicate the successes achieved with the marula and honeybush value chains. In addition, agro-processing will be a key driver for innovation in support of food and nutrition and the agro-innovation hubs are proposed as one of the instruments to deliver on the food and nutrition and farmer development programmes, and reduce the long term effects of COVID-19. These will be implemented through expansion of the demonstration projects on food and nutrition for rural

communities, specifically; soya, nixtamalisation, vegetables, beans and linkages to agro-food Technology Stations. These agro-innovation hubs will be coupled with farmer development support and linked to the district development model.

To ensure economic stimulation post the COVID-19 pandemic, existing initiatives with unrealised potential will be bolstered to deliver greater socio-economic impact in addition to the establishment of new programmes. It is noted that co-funding in Phase I essentially tripled the budgets of projects supported. This trend is expected to continue in the expanded Phase II. Indeed, it is estimated that co-funding will be in excess of R150 million in ABIPP Phase II. Figure 13 is a schematic of ABIPP, illustrating activities, outcomes, and impacts.

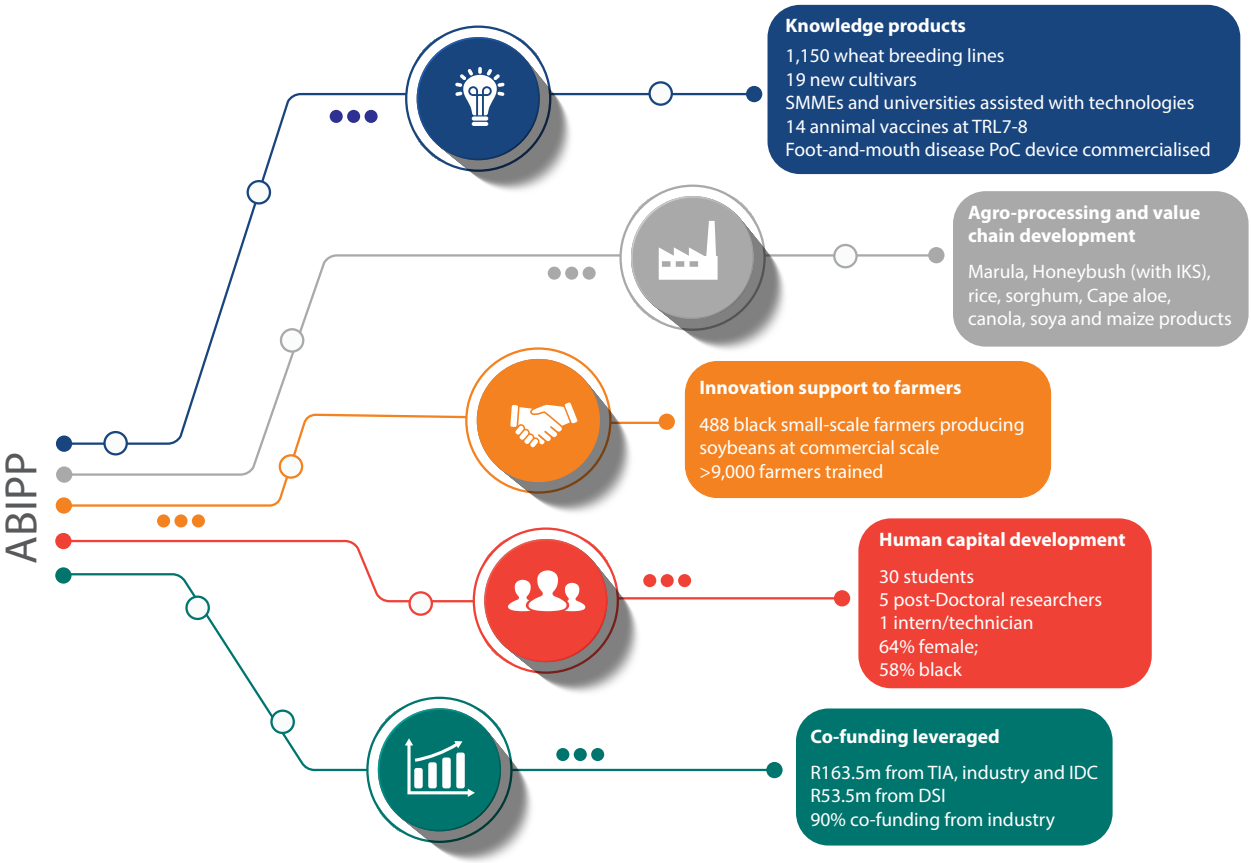


Figure 13: ABIPP activities, outcomes and impacts

Another initiative with significant socio-economic impact is the Plant Health Consortium under the Strategic Innovation Partnership for Grains and Oilseeds. This initiative was established by Grain South Africa in collaboration with experienced South African researchers to address soilborne pathogens in order to monitor disease incidence and the build-up of soilborne pathogen inoculum. Conservation agriculture was identified as a priority focus area for improving soil health and to reduce soilborne diseases while increasing crop yield.

One of the objectives of the Plant Health Consortium is to develop a digital platform to support plant health initiatives. This includes four projects to conduct surveys of pests and diseases. The surveys and diagnostic activities are important for monitoring the occurrence and impact of current and emerging plant health problems. A total of 40 black farmers have benefited from these surveys.

The ABIPP contract with the DSI was renewed until September 2021, in the amount of R21.3 million to implement phase two of ABIPP (including implementing projects which experienced delays in phase one). At end of 2020/21, 89% of funds received have been committed to approved projects and 67% have been disbursed to two projects. The Grains and Oilseed Partnership Programme (managed by Grain SA) received R13.5 million, and the Ukhanyo Farmer Development Project and Lucid Support Services project (managed by Ukhanyo Farmer Development) received R798,000.

Training delivered included production practices and requirements, cultivar selection, quality seed, soil preparation, planting, crop maintenance, harvesting, threshing storage, marketing and usage, awareness of policy, and legislation to industry and business management skills. Other crops were also included in the training program to emphasise the importance of crop rotation.

PARTNERSHIP FOR GRAINS AND OILSEEDS BENEFITS SMALLHOLDER FARMERS IN THE EASTERN CAPE PROVINCE

The Strategic Innovation Partnership for Grains and Oilseeds is a collaboration between Grain South Africa, the DSI, ARC, and TIA which was established in 2016/17 under ABIPP. The partnership focuses on optimising innovation efforts in the grain and oilseed research field through harmonisation, synergies, and partnership on areas of strategic focus in the DSI's Agricultural Bio-economy and the Grain South Africa research portfolio. The project aims to promote local production and consumption of pulses, thereby reducing hunger and poverty and ensuring food and nutrition security. There is a specific focus on exploring the participation of smallholder farmers and developing small-scale agro-dealers in rural areas of the Eastern Cape province to increase access to legume seeds.

The objective of this initiative is threefold. It is to explore the adaptability of different varieties of pulses for local registration and production, to demonstrate and create local capacity for production, and to facilitate affordable seed sorting and storage infrastructure suitable for resource-poor farming communities. Limited access to affordable and quality pulses seeds among smallholder farmers across the country remains one of the major challenges in South Africa. South Africa has approximately 2.3 million smallholder farmers, and estimates suggest that more than 90% of the seeds they utilise are saved on the farm or obtained through informal distribution channels.

Trials to demonstrate different pulses took place in Ncera near to East London in the Eastern Cape province. The first planting trials took place successfully in January 2020, and the second planting trials took place in January 2021. In that time, borehole and irrigation infrastructure was successfully installed in the trial site. The installation of the infrastructure includes 27 dragline sprinklers, making it possible to plant throughout the year. Capacity building for farmers and potential agro-dealers included training on the agronomic practices of planting pulses for 16 farmers in the Ncera area trial site in East London. Of these farmers, 13 were male, three were female, and 10 were young people under the age of 35.

EASTERN CAPE AGRO-PROCESSING INNOVATION INDUSTRY PROGRAMME

As part of the ongoing stakeholder engagements and sector surveillance by the Agriculture sub-programme, a meeting in 2019 led to the conceptualisation of an initiative to develop and deploy innovative agro-processing technologies by local agricultural entrepreneurs and leverage off the agricultural commodities in the Eastern Cape province. This developmental initiative is located in the context of the existing good working relations between TIA and the Department of Economic Development, Environmental Affairs and Tourism, and the East London Industrial Development Zone.

The parties have developed a concept centred on the commodities of the local agricultural sector to cater for increased fresh productivity, inclusion of new agricultural entrepreneurs from previously disadvantaged backgrounds, alignment of provincial priorities using multi-stakeholder models, and the implementation of the initiative. The parties collectively developed the Eastern Cape Agro-processing Innovation Industry Programme for building the agro-processing capacity for agricultural entrepreneurs, increasing primary production of the identified commodities and to secure the formal buy-in of retailers to address market access challenges of new entrants.

This programme was funded within the Industry Matching Fund, where TIA provided seeding financial assistance (R2 million per year) to new agro-processing technologies for the agricultural entrepreneurs, whilst the Department of Economic Development, Environmental Affairs and Tourism provided infrastructure and expansion capital (R20 million per year) for the agricultural entrepreneurs and industry. Retail partners provided non-financial support in the form of access to supplier development programmes for market uptake.

The programme was also centered around partnerships. Tiger Brands came on board as an anchor partner to provide retail market access for new priority products. The Buffalo City Metropolitan Municipality Fresh Produce Market is envisaged as the buyer of the fresh produce for agro-processing. Furthermore, Spar in the Eastern Cape province has committed to take value-added products from this initiative through its 'Choose Local' programme and through trade support for emerging farmers.

These initial partners were selected to address market access challenges for new entrants and to facilitate retailing of products from this initiative. More partners will be sought from local universities, development finance institutions, science councils, and the Eastern Cape Rural Development Agency. This initiative is an initial programme that will run for three years to stimulate local economic activity built on local capability, whilst building locally-competitive and sustainable industries. If successful, the roll-out of this programme will be expanded into other provinces.

BIOCONTROL SHEET

The ARC/CSIR Biocontrol Sheet project was funded by TIA to the value of R3.7 million (Figure 14). The project is located in Stellenbosch in the Western Cape province, and aims to address the problem of food spoilage – the source of significant economic losses for the agricultural sector. Current measures to minimise agricultural losses include the use of chemicals to control spoilage agents such as fungus. Chemical treatments are not sustainable and may have residue effects on produce, therefore some measures are being discontinued.

The ARC and CSIR have successfully developed a natural fumigant that acts against spoilage agents when fresh produce is transported over long distances. The ARC and CSIR have developed a natural, slow-release polymer sheet that increases the shelf life of table grapes without affecting the taste and colour of the grapes. The biocontrol sheet controls table grapes spoilage using a combination of organic oils, thereby serving an organic and 'green' method to control Botrytis cinerea. TIA is pleased to announce that the ARC and CSIR consortium entered into a materials transfer/licencing agreement with Tessara (Pty) Ltd (a South African company) for the commercialisation of the developed technology.

Figure 14: Biocontrol sheets for packaging fruit during cold storage

POINT OF CARE DIAGNOSTICS

Foot-and-mouth disease is a devastating livestock disease which affects significant herd numbers and causes negative economic consequences in South Africa, especially in the beef industry. The best response once there is an outbreak is to isolate diseased livestock from non-affected livestock in order to decrease the spread.

In response to this prevalent problem the PoC Diagnostics project was funded by TIA in the order of R7.8 million with the CSIR and TokaBio (Pty) Ltd as project partners, i.e. a public/private partnership initiative. The project is based in Centurion, Gauteng, and additional leveraged funding of R2 million has been secured.

The partnership has resulted in the development of a mobile PoC diagnostic technology which can diagnose foot-and-mouth disease in the field where livestock are kept, including remote locations. The test kit is a 4IR-enabled device that facilitates a rapid turnaround time. Results are made available in just an hour on a mobile device, enabling the farmer to minimise the spread of the disease.

The technology was demonstrated and validated in an operational environment to rapidly detect foot-and-mouth disease, even in rural and remote locations. This product is positioned to empower small-scale farmers, commercial farmers, and all livestock owners. The use of the technology will result in a decrease in the spread of foot-and-mouth disease. Furthermore, the technology is positioned to enable government regulators to be aware of the disease state of all livestock as part of their surveillance programme.

The consortium is currently completing their technology package (technology license) for local and international transfer, especially in Africa where trials were previously conducted. Outside South Africa, the PoC technology has been tested in Rwanda, Lesotho, and Zambia – where recent outbreaks were reported. The implementation and adoption of the PoC technology would enhance these countries' ability to export livestock as well as contributing to their livestock surveillance programmes.

This technology has also assisted with South Africa's response to the COVID-19 pandemic. TokaBio (Pty) Ltd has reconfigured the technology towards the detection of SARS-CoV-2, the causative agent of the COVID-19 global pandemic (Figure 15). TokaBio (Pty) Ltd obtained approval from SAHPRA in June 2020, concerning the manufacture, distribution, and related operations in respect of a nucleic acid diagnostic kit. Obtaining a medical device registration certificate from SAHPRA is a significant development not only for TokaBio (Pty) Ltd, but also for the country in its response to the global pandemic.

Figure 15: Deployment of TokaBio (Pty) Ltd SARS-CoV-2 PoC testing

15.2.3 HEALTH

The Health sub-programme aims to develop healthcare technological innovations that prevent, diagnose, and treat priority diseases in the country, thereby assisting to improve public health and the quality of life. South Africa faces a quadruple burden of disease resulting from:

- communicable diseases such as HIV/AIDS and tuberculosis;
- maternal and child mortality;
- non-communicable diseases such as hypertension and cardiovascular diseases, diabetes, cancer, mental illnesses, and chronic lung diseases like asthma; and
- injury and trauma.

The emergence of the global COVID-19 pandemic has added to the burden of disease and has necessitated that TIA's interventions in Health not only align to responding to the pandemic, but to accelerate the response to the nation's long-standing challenge of reducing the dependence on imports across the pharmaceutical and medical devices industry by stimulating local innovation and local manufacture.

South Africa needs to prioritise the development of local capacity in the development and manufacture of all components necessary for the prevention, detection, treatment, and monitoring of the nation's disease burden. This is made abundantly clear by the shutdown of pharmaceutical supply chains and subsequent shortages due to restrictions in traditional source markets (e.g. India and China), as well as the emergence of vaccine nationalism.

Through improved technology healthcare products and services, the sub-programme intends to contribute to South Africa's social and economic development. This will be done through translation of knowledge resources and R&D to products that contribute to better health outcomes for South African citizens and by advancing the country's global competitiveness in health-related areas. The focus areas are medical devices and diagnostics, pharmaceuticals, and biopharmaceuticals. Currently the sub-programme has 12 projects under management, with a total project investment exposure of R98.1 million. Below are some of the key initiatives supported by Health during the financial year under review.

PRODUCTION OF LOCALLY DEVELOPED REAGENTS AND TEST KITS TO ADDRESS COVID-19

In light of the State of Disaster, declared by President Ramaphosa, which necessitated emergency and immediate responses across various arms of the state to minimise the spread and impact of the COVID-19 within their mandates, it behoved TIA – an institution whose vision is to support technological innovation to improve the quality of life for all South Africans – to rise to this challenge.

In collaboration with the DSI and the SAMRC, a total of R18 million was awarded to seven recipients in the first quarter of the year under review in order to develop test kits and reagents for use in the diagnosis of COVID-19. Diagnostics was prioritised as a key area for intervention due to the hitherto lengthy process (24 hours normally) used to test for coronavirus infections. For this intervention, the priority was for the development of PoC test kits. Such diagnostics are used at the time and place of patient care, enabling quicker testing and faster results availability, thereby aiding the provision of accurate diagnosis not only for informing clinical outcomes, but also isolation and contact tracing – key components when dealing with a highly transmissible pathogen such as the coronavirus.

Furthermore, locally developed and manufactured diagnostic tools or kits will enable import substitution and reduce the financial burden of managing the disease for the country. This intervention served to address both disease management and economic benefits through commercialisation of the country's R&D outcomes – mainly from universities and science councils – and supporting the localisation of imported products.

Four of these projects reached demonstration stage by the end of the year under review, with successful validation of the test kits being performed at reference laboratories. Clinical samples were used for effectiveness in detecting not only the ancestral, but also new, SARS-CoV-2 variants of concern, given the genetic changes that may help the virus evade the immune system and vaccines. Test kits that effectively detect variants of concern are therefore useful to guide the public health response as well as monitoring of breakthrough infections. Breakthrough infections are cases of illness in which a vaccinated individual becomes sick from the same illness that the vaccine is meant to prevent. The submission of dossiers for these test kits for review and approval by SAHPRA is expected in the first quarter in the next financial year.

REGULATORY APPROVALS AND CERTIFICATION TOWARDS THE COMMERCIALISATION OF HEALTH TECHNOLOGIES

Two opportunities funded by TIA met significant regulatory milestones towards commercialisation in the period under review. These relate to the commercialisation of health technologies in partnership with Chemical Process Technologies Pharma (Pty) Ltd (CPT Pharma) and Altis Biologics (Pty) Ltd.

CPT Pharma

South Africa imports the bulk of the APIs used to formulate medicines locally, mainly from manufacturers in India and China. This dependence causes import and distribution challenges which can be a significant threat to the Nation's healthcare efforts. To address this challenge and solve the distribution problem faced in this sector, Chemical Process Technologies (the parent company of CPT Pharma and a major supplier of formulated animal health products) partnered with the IDC and the Health subprogramme to fund a project to develop local API manufacture capability (Figure 16). Through joint funding, a pilot plant project was established in 2015 and its construction was completed in 2017. Trial runs on two APIs were successfully completed using the company's innovative approach with novel synthesis techniques and technologies developed in-house.

In addition to a Good Manufacturing Practice certificate obtained in the previous financial year (2019) – based on the SAHPRA audit of the TIA-funded pilot plant – the CPT Pharma project was granted a licence to manufacture selected APIs for human medicine. The local production of APIs shortens the supply chain for local pharmaceutical companies and provides access to medicines – which is in support of the South African government's pursuit of import replacement – and delivers job creation, enterprise growth, and skills development in the country This confirms the plant's compliance with Good Manufacturing Practice guidelines, which describes a set of principles and procedures that – when followed – helps ensure that medicines and related substances are of high quality, safety, and efficacy.

The importance of this achievement cannot be understated, particularly in the context of constrained global drug supply chains and the stated priority of the South African government to establish local capacity to manufacture APIs which will, in turn, ensure the security of supply of crucial medicines for the country.

Figure 16: Part of the CPT Pharma pilot plant

Altis Biologics

Altis Biologics is biotechnology and medical devices company focused on the commercial production of naturally-derived bone morphogenetic proteins, novel bone-inducing implants, and collagenous matrices primarily intended for the treatment of bone injuries and bone voids in humans (Figure 17). The Altis Biologics bone-inducing (or osteogenic) products are intended as an alternative to skeletal regeneration biomaterials and traditional bone graft products, which usually involve harvesting bone from the patient's own hip, or which employ frozen donor bone supplied by bone tissue banks.

Figure 17: An Altis Biologics employee operating a high-end fast protein liquid chromatography system

Altis Biologics aims to be the first company to develop and commercialise an injectable bone morphogenetic protein product. To date, TIA has committed R45 million to the project, with the latest funding allocation dedicated to assist Altis Biologics to build a pilot plant, train an operations team, execute clinical trials, commence small-scale production and obtain CE[7] marking as well as SAHPRA regulatory approval. This 300 square metre pilot plant facility, located at The Innovation Hub and which was completed in 2019, complies with internationally-accepted standards as described by the CE and United States (US) Food and Drug Administration processes.

ISO 13485 Quality Management Systems and personnel training were implemented in 2019 and the United Kingdom Accreditation Systems body accredited Altis Biologics with ISO 14385 certification in 2020. This is a significant milestone in that it will allow the company to produce clinical study material under international standards that will be accepted by regulatory agencies in foreign markets. ISO 13485 certification indicates that the processes for designing and manufacturing medical devices are appropriate for providing consistent product quality and safety. This milestone therefore significantly progresses market entry objectives for Altis Biologics.

RESPONDING TO MARKET FAILURE AND UNDERSERVED PATIENT NEEDS

In the period under review, the Health sub-programme committed funding to two new projects.

Optishunt

OptiShunt is a novel ocular implant designed to improve the treatment of glaucoma – a leading cause of vision loss and blindness worldwide. Glaucoma is an eye disease caused by a build-up of fluid pressure in the eye, causing irreversible damage to the optic nerve.

The OptiShunt inventors aim to make the product available to the broader South African market at an affordable price. In South Africa, vision loss accounts for 32% of disabilities. Given that 97% of visually disabled people are unemployed (90% are from rural communities), and South African women are 40% more likely to be visually disabled than men, success of the OptiShunt will create broad social benefit through improved access to effective health solutions for vulnerable and poor citizens. The failure to treat blindness can lead to devastating socio-economic impact and leave the most vulnerable in a society trapped in a cycle of poverty, as blindness drastically reduces their chances to earn an income and subsequently reduces the economic prospects for the younger generation under the care of blind parents and guardians.

TIA's funding commitment of R9.4m over three years is geared towards device refinement, clinical trials, and regulatory certification of the OptiShunt. The co-funding of the project by the SAB Foundation (which invests in and provides business support to entrepreneurs and social innovators) is a testament to TIA's commitment to an ecosystem approach to funding.

Msizi Pharmaceutical Holdings

Cryptococcal meningitis is estimated to cause 200,000 deaths annually, with the majority occurring in sub-Saharan Africa. Flucytosine is recommended by the World Health Organization as part of the treatment for cryptococcal meningitis. Widespread use of flucytosine could reduce mortality in hospital by as much as 40% compared to the drugs considered as standard of care yet, due to market failure, quality-assured flucytosine remains unregistered and largely inaccessible throughout Africa and Asia where cryptococcal disease burden is greatest.

[7] Conformité Européenne – the CE mark is an administrative marking with which the manufacturer or importer affirms its conformity with European health, safety, and environmental protection standards for products sold within the European Economic Area.

TIA contracted Msizi Pharmaceutical Holdings (Pty) Ltd via the DSI's Innovation Fund to localise the manufacture of flucytosine – an antifungal used in the treatment of cryptococcal meningitis and intermediately in the synthesis of two antiretroviral drugs, lamivudine and emtricitabine via a novel continuous flow process. The patent rights for the novel flucytosine process are held by an international company, from whom Msizi Pharmaceutical Holdings seeks to obtain the technology transfer package. The TIA Health sub-programme is therefore supporting the activities Msizi Pharmaceutical Holdings would undertake to obtain the technology transfer package.

Through this project, the Health sub-programme aims to address an unmet clinical need in South Africa by enabling the supply and availability of a drug that, even though decades old, is currently not available across Africa due to high costs and market failure but is very much needed given that over 6,000 cases of cryptococcal meningitis are diagnosed in South Africa each year.[8] Furthermore, through this project, the sub-programme will support the local manufacture of APIs which ensures the security of supply and reduces imports via a black-owned pharmaceutical company and is therefore aligned with national imperatives. This project will also provide an avenue through which novel patented processes for the two antiretroviral drugs developed at a local academic institution (Nelson Mandela University) may be scaled up and commercialised in response to the burden of disease in South Africa, thus reflecting the contribution by TIA in supporting local academic institutions to commercialise publicly-funded R&D.

15.2.4 INDUSTRIAL BIOTECHNOLOGY

The Industrial Biotechnology sub-programme aims to contribute to the promotion of the green economy by focusing its efforts towards addressing national priorities and gaps in the value chain, thus contributing to the development and commercialisation of environmentally sustainable and cleaner technologies. The sub-programme is positioned to drive and contribute to industrial competitiveness through the creation of industrial products and manufacturing processes while reducing their negative impact on the environment.

The key strategic intervention areas are bioprocessing and biomanufacturing, integrated biorefineries, and bioremediation. In the year under review, the sub-programme has also supported existing bioprocessing and biomanufacturing capabilities for product development and the establishment of SMMEs. The sub-programme will continue to implement the second phase of the Strategic Industrial Bio-innovation Programme (hosted on behalf of the DSI) which focuses on supporting sector development initiatives that promote and strengthen the development of value chains for low-volume, high-value bio-based products. Currently the sub-programme has a total project investment exposure of R132.7 million across a portfolio of 27 projects under management. Below are some of the initiatives supported by the sub-programme during the financial year under review.

DECONTX MICROBICIDE

Biodx Biological Chemical Technologies (Pty) Ltd ('Biodx') commissioned the Netherlands Organisation for Applied Scientific Research to conduct an independent analysis of its DECONTX microbicide (Figure 18). The purpose was to verify the viricidal activity of DECONTX against the enveloped virus SARS-CoV-2. It was demonstrated that by applying DECONTX at a concentration of 250 parts per million on any surface, the microbicide eliminates 99.9% of infectious SARS-CoV-2 virus particles present. These positive test results are expected to open new local and global markets for Biodx's DECONTX microbicide.

Figure 18: The Biodx rapid diagnostic monitor (version three)

[8] *Source: National Institute of Communicable Diseases*

BLACK SOLDIER FLY LARVA TO PRODUCE LIVESTOCK FEED

Khepri Innovations (Pty) Ltd uses mass-produced black soldier fly larva to make livestock feed. The fly larvae are processed in modified shipping containers using patented bioconversion technologies. In the period under review, the company obtained registration of its primary animal feed product under the Fertilizers, Farm Feeds, Seeds and Remedies Act 36 of 1947. Khepri Innovations also established partnership with Urban Farms Recycling (Pty) Ltd (a company that specialises in food waste recycling) entailing the conversion of food waste into vermicompost for use as organic fertiliser and soil ameliorant.

STRATEGIC INDUSTRIAL BIO-INNOVATION PROGRAMME

The Strategic Industrial Bio-innovation Programme was established by TIA and the DSI to fund and co-ordinate multidisciplinary programmes enabling partnerships across institutions to develop new technologies, products and processes, support SMMEs, promote green economy, and create sustainable jobs. The programme is in its second year of implementation during which the following notable achievements were made.

- Registration of a patent by Rhodes University for novel enzyme formulation with commercial application as an additive in the animal feed industry under the Xylanase project.
- Development of two technology demonstrators by the CSIR for KBRT7 endonuclease under the microbial bioprospecting project. T7 endonucleases are high-value industrial enzymes with commercial application in the molecular biology reagents market and the biopharmaceutical sector.
- Incubation of three biotechnology start-ups at the TIA Bioprocessing Platform and at The Innovation Hub. These enterprises are Sawubona Mycelium, Afrobodies, and Eco Invader Solutions (Pty) Ltd.
- The Durban Green Corridor partnered with eThekwini Municipality to support a bio-residue value chain beneficiation project. The organisation has established a Biomaterials Beneficiation Centre in KwaMashu in the KwaZulu-Natal province. The eThekwini Municipality has committed to support this project during the next three years.
- As part of implementation of the Industrial Biocatalysis Hub, a call for expressions of interest to host the hub was issued in July 2020. Responses were received from six suitable institutions and the CSIR was selected to host the initiative after a competitive assessment process. A total of R11.4 million has been committed to supporting implementation of the initiative. The Industrial Biocatalysis Hub will integrate and expand its networks into a common biocatalysis value chain from idea generation to commercialisation within the South African economy. Commercialisation of technologies through existing and new industry partners will advance the green bio-economy of the country resulting in locally-produced products and an increase in skilled researchers and in job creation.

Durban currently faces layered multi-facetted challenges ranging from climate change impacts, socio-economic vulnerabilities of communities under adverse economic conditions and the impacts of the COVID-19 pandemic and the government-imposed lockdown, technological industry status quo options that have adverse impacts on climate change (e.g. the manufacture and use of Portland cement which has high CO_2 emissions), and environmental and waste management challenges (including invasive alien plants and the need to minimise waste to landfill).

The Industrial Biotechnology sub-programme has supported the Bio-Residue Beneficiation Value Chain Initiative which has been supported through the DSI initiative Strategic Industrial Bio-innovation programme. The project has received R1.5 million from TIA, and the eThekwini Metropolitan Municipality has committed to support this project during the next three years due to its direct impact in the community.

Over this reporting period, the Strategic Industrial Bio-innovation Programme has also supported the Industrial Bioeconomy Industrialisation Plan implemented by the CSIR, entailing the support of initiatives in biomaterials, bioprocessing, biocatalysis and indigenous valorisation. An investment of R6.4 million was made to support this initiative. The Strategic Industrial Bio-innovation Programme also finds excellent alignment with the NDP which articulates the key role that STI should play in contributing towards economic growth, job creation and socio-economic reform. Of relevance to this programme is the strong alignment with increased support and collaboration for the business sector, enhanced commercialisation of publicly-funded IP, and the opportunity to exploit new sources of socio-economic growth presented by the use of biotechnology.

All interventions supported in this programme have been developed in close partnership with already-identified industry partners, ensuring that the research is industry-led and aligned with industry needs. In the supported bio-economy industrial plan initiative, strong alignment is found with the sections of the White Paper on Science, Technology and Innovation. In particular with the “increase [in] support for and collaboration with the business sector”. Over and above the support provided, a leveraged parliamentary grant funding of R6.2 million has been received by the CSIR to support the bio-economy industrial plan initiative.

15.2.5 INDIGENOUS KNOWLEDGE SYSTEMS

The IK-Based Innovation sub-programme aims to harness indigenous ideas and knowledge using the Ubuntu-based bio-innovation models which seeks to mainstream and interface holistic IK-based R&D, and inclusive innovation that supports community-based technology demonstration and commercialisation models for improved quality of life and sustainable livelihood. The sub-programme's focus on African traditional medicines, IK-based cosmeceuticals, nutraceuticals, and health infusions will serve as base for technology transfer and commercialisation of IK-based innovations.

NATURAL AND INDIGENOUS PRODUCTS PROGRAMME

In the year under review, the sub-programme aimed to increase support for IKS and address gaps within IKS innovation value chains. To that end TIA secured an additional amount of R20 million through the DSI's Innovation Fund to support the implementation of the NIPP Fund established in 2020. The NIPP is a collaboration between TIA and IDC.

Since 2010, the South African government has been providing significant funding to IKS innovations through several initiatives via different institutions. Despite these efforts, none of the funded IKS projects have been successfully commercialised to date, partly because the initiatives were fragmented. The NIPP was therefore established to coordinate such activities to ensure the proper progression of projects along the innovation value chain towards successful commercialisation. To achieve this objective, TIA disbursed R20 million to implement the NIPP Fund to provide commercialisation support to IKS projects supported by TIA which had reached the commercialisation stage.

TIA has previously contributed R1.5 million in seed funding for the NIPP. To date TIA has transferred six projects to the IDC for commercialisation support under the NIPP, summarised in Table 12.

Table 12: IKS projects under the NIPP Fund

Project name	Project Description
Traditional Medicine Innovation (Mpumalanga)	Manufacturing of cosmeceutical creams to address eczema and other skin ailments
The Tooseng Agribusiness Project (Limpopo)	Manufacturing of Moringa extract and products to assist with immune-boosting, anti-ageing, and the prevention of cell damage
Machaba Herbs (North-West)	Manufacturing of medicinal products for HIV treatment
Setsong Project (Sekhukhune, Limpopo)	Manufacturing of herbal teas as natural antibiotics to treat sexually transmitted infections, and to boost immunity
Industrialising new skin tone actives for the cosmetics market using "GR active" (Mamelodi, Gauteng)	A process for extracting skin tone actives for the cosmetics market from the plant, Greyia radlkoferi
Production of Marula Fruit Wine Project (Limpopo)	Upscaling and optimisation for the industrial production of a superior Marula table wine

> "The NIPP was therefore established to coordinate such activities to ensure the proper progression of projects along the innovation value chain towards successful commercialisation."

IKS INNOVATION ENHANCED WITH ESTABLISHMENT OF AFRICAN TRADITIONAL MEDICINES TECHNOLOGY PLATFORM AND NATURAL AND INDIGENOUS PRODUCTS PROGRAMME

The ATM Technology Platform was established to support the utilisation of South African IK and the country's iconic biodiversity to produce high-quality proprietary and commercial ATM products, focusing on priority diseases. The Platform is hosted at the Department of Pharmacology at the University of the Free State under the leadership of Prof. Motlalepula Matsabisa (Figure 19). TIA funding of R17.1 million will supplement contributions by the DSI and the university to create a facility that is appropriately configured to implement quality assurance practices and standards. The total value of funding for the ATM Technology Platform is R30 million.

Figure 19: Prof. Matsabisa and scientists at the ATM Technology Platform at the University of the Free State

The platform aims to develop medicines based on South Africa's rich heritage in medicinal plant use, and ensure that knowledge-holders remain core to the process of developing and commercialising such products (Figure 20). The establishment of the platform continues TIA's increasing support for IK-based innovation and commercialisation activities. It embraces the DSI's Ubuntu-based bio-innovation model which seeks to mainstream IK-based R&D, and inclusive innovation that supports community-based technology demonstration and commercialisation activities for improved quality of life and sustainable livelihood.

The ATM Technology Platform is aimed at supporting and promoting technology development and innovation in ATM products to improve their commercialisation potential. This is a significant step towards establishing a pharmaceutical industry based on ATMs. The ATM Technology Platform would also be instrumental in building local capacity for industry-relevant R&D based on indigenous knowledge. This increase would translate to growth in revenue, job creation, and a specialised skills base in the ATM industry.

TIA's 2020-2025 Strategic Plan recognises the need to increase focus on the interventions that will stimulate IK-based innovation in the NSI and to grow TIA's portfolio of IK-based projects and programmes. The strategy further identifies the need to strengthen support for indigenous knowledge-based innovators in product development, market testing, and validation. It is on this basis that TIA supports and promotes the inclusion of indigenous knowledge holders in product development and commercialisation.

Figure 20: A scientist working at the ATM Technology Platform at the University of the Free State

15.2.6 TECHNOLOGY PLATFORMS PROGRAMME

The Technology Platforms Programme aims to facilitate access to cutting-edge technological capabilities by investing in and supporting entities to acquire appropriate technologies and expertise that in turn lowers the barriers for others to innovate. The sub-programme supports the development of technologies with commercialisation potential and contributes to the creation of a vibrant bio-economy. It also provides funding and expert support to host institutions to acquire high-end infrastructure and to develop scientific and technical expertise necessary to build long-term strategic capabilities. It supports a wide range of technology innovators within the NSI, including universities, science councils, SMMEs, and international organisations.

The Technology Platforms Programme further enables the provision of specialised training and capacity development opportunities for role-players in multiple value chains. It is a critical element of TIA's implementation of the Bio-economy Strategy.

TIA currently supports a portfolio of eight technology platforms. The capabilities of each platform are summarised in Table 13.

Table 13: Names and capabilities of the TIA-funded Technology Platforms

Technology Platform	Description
UFS UV	The African Traditional Medicines Technology Platform aims to promote the establishment and long-term growth of the pharmaceutical industry based on South Africa's indigenous knowledge base and biodiversity, centred around the meaningful participation by knowledge-holders throughout the product development value chain.
biosafety SOUTH AFRICA	Biosafety South Africa supports the development of successful innovators, effective regulation and confident consumers through supporting and ensuring the sustainability of bio-based products and to increase awareness of and confidence in the national biotechnology innovation system, including the relevant governance systems.
Cape Universities Body Imaging Centre	The Centre houses a 3T Siemens Skyra full-body magnetic resonance imaging scanner and a positron emission tomography system together with ancillary systems to support R&D and innovation for improved diagnoses and treatment monitoring across a range of areas such as tuburculosis, oncology, neurology and cardiovascular diseases.
CPGR CENTRE FOR PROTEOMIC & GENOMIC RESEARCH	The CPGR provides integrated genomic and proteomic technologies with bio-computational pipelines to create fit-for-purpose offerings for users in academia and industry and to assist in the development of unique solutions for biological problems in the human health and the agricultural biotech sectors.
H3D	The Platform is Africa's first and only integrated drug discovery and development centre that aims to translate scientific discoveries into potentially life-saving medicines in areas such as tuburculosis, malaria, and anti-microbial resistance.
krisp	The KRISP has a vision to challenge the status quo and establish one of the world's most advanced and respected genetic sequencing platforms in order to enable and support world-class genomics research and diagnostics services in Africa.
NWU National Metabolomics Platform (NMP)	The Platform exploits the application of metabolomics techniques and modelling to alleviate inherited health disorders and disorders due to infectious diseases that plague South African society.
Bioprocessing Platform	The Platform offers four dedicated bioprocessing suites designed for fermentation process development and downstream processing. It also houses the Institute for Diagnostic Research with capabilities to support product development in rapid diagnostics such as hybridoma technology, in vitro monoclonal antibody production, immuno-biochemistry, and lateral flow technology.

KWAZULU-NATAL RESEARCH INNOVATION AND SEQUENCING PLATFORM

The KRISP has reported evidence of human immunodeficiency virus (HIV) resistance to Dolutegravir – a drug recommended as the first-line of treatment for HIV in patients by the World Health Organization. Little data existed on the success of Dolutegravir against circulating strains of HIV in Africa. Working in collaboration with researchers from the United Kingdom (UK) and the US, scientists from the KRISP worked tirelessly to produce over 1,000 virus genomes in a few weeks. As expected, the presence of drug resistance substantially reduced the chances of treatment success in patients taking Efavirenz as a previous therapy. However, unexpectedly the same pattern was true for individuals taking Dolutegravir-based treatments. This result has significant implications for how HIV is treated in Africa.

The KRISP has partnered with the GISAID Initiative and Nextstrain. This partnership facilitates a better understanding of pathogen genome data, more specifically the novel coronavirus responsible for COVID-19. This is an opportunity for South Africa to participate in global initiatives towards the eradication of diseases of economic significance. Furthermore, in recognition of its technical capacity, the KRISP was invited by the World Health Organization and CEC Africa to join the Genome Surveillance Network, which was established to accelerate SARS-CoV-2 sequencing initiatives on the African continent.

FUNDING FOR INFRASTRUCTURE AND TECHNOLOGY DEVELOPMENT SUPPORT

An amount of R159.2 million was leveraged by TIA's Technology Platforms through third-party contracts. This amount was comprised of contributions by the CPGR (R57.1 million), the Drug Discovery and Development Centre (R78.5 million), and the KRISP itself (R23.4 million). The funding, primarily for infrastructure and technology development support, demonstrates strong partnerships these platforms have built in the NSI and internationally and further highlights the continuing benefits of TIA's targeted partnerships within Technology Platforms. Other partners in the innovation ecosystem through whom additional funds were leveraged include the Human Heredity and Health in Africa Consortium and the SAMRC. These initiatives have highlighted the value of international relationships in a post-coronavirus world, which is consistent with global trends.

BIO-ECONOMY SA PORTAL

The Bio-economy SA Portal (www.bioeconomy.co.za) was launched in October 2020. The portal is a web-based platform that collects information from different sources and integrates it into a single, uniform and secure user interface. The public launch is an important milestone towards improving access to and the exchange of information among all bio-innovation stakeholders to stimulate communication, improve cohesion, and promote functional integration and collaboration. The portal is hosted by Biosafety South Africa and aims to cover all the main bio-economy sectors as informed by the national Bio-economy Strategy.

KRISP PROVIDES SCIENTIFIC LEADERSHIP TO GOVERNMENT IN NAVIGATING THE GLOBAL COVID-19 PANDEMIC

As South Africa and the world were shaken by the effects of the COVID-19 pandemic, science became the beacon of hope the country looked to for guidance. Among these was the KRISP, a TIA-funded Technology Platform based at the Nelson R. Mandela School of Medicine, University of KwaZulu-Natal (Figure 21). Researchers at the KRISP provided scientific leadership to the South African government in navigating the global COVID-19 crisis since the first imported coronavirus case which was confirmed in South Africa on 5 March 2020.

Figure 21: Scientists at KRISP

On 26 March 2020, following the announcement by President Ramaphosa that South Africa would enter a nationwide lockdown for 21 days in order to contain the spread of the coronavirus, the DSI began working closely with the Department of Health. The intention was to deploy DSI-supported projects and programmes in support of the government's response to the global pandemic caused by SARS-CoV-2, which was confirmed as the causative agent of coronavirus disease 2019, commonly known as COVID-19.

The biggest contribution by the KRISP to public health this year has been qPCR testing for SARS-CoV-2 offered to provide support and unlock the backlog experienced by the state-funded NHLS. Over 4,000 samples have been tested at the KRISP facilities.

The sequencing conducted by the KRISP led to the ground-breaking discovery of the SARS-CoV-2 501Y.V2 variant (Figure 22). Through genomic surveillance, SARS-CoV-2 was identified by the Network Genomic Surveillance in South Africa through the analysis of 2,882 SARS-CoV-2 whole genomes that were collected between 5 March and 10 December 2020, nationally. The distribution and spread of 501Y.V2, along with insights from genomic analysis, suggests that the variant may be more transmissible than other SARS-CoV-2 lineages. Subsequent data showed that the variant could also impact vaccine efficacy, which means that a group of people recently infected with 501Y.V2 produced broad neutralising antibodies that neutralise 501Y.V2 and other variants.

In response to the COVID-19 pandemic, the Network Genomic Surveillance in South Africa was launched with the financial support received from the DSI and SAMRC. This is a network of laboratories, scientists and academic institutions that have joined forces to ensure that public health sector actors have access to the best possible scientific data for the country's COVID-19 response. Founding members included the KRISP, the Inkosi Albert Luthuli Central Hospital NHLS Laboratory, the National Institute for Communicable Diseases, the NHLS at Groote Schuur Hospital, the NHLS at Tygerberg Academic Hospital, Stellenbosch University, and the NHLS/University of the Free State Division of Virology.

Furthermore, and earlier at the onset of the epidemic, the KRISP led the investigation into the outbreak of the coronavirus at the Netcare St Augustine's Hospital in Durban that led to the infection of at least 135 patients and staff at the hospital. Through the investigation, the KRISP scientific team learnt that SARS-CoV-2 can rapidly spread in the hospital environment which meant that infection prevention and control systems needed to be strengthened to prevent such outbreaks. The data was subsequently shared with policymakers and managers of hospitals to ensure that they too could learn from the results that were produced by the KRISP.

In the early days of the spread of the coronavirus, the KRISP also partnered with the Bioinformatics Research Team at the University of KwaZulu-Natal's Big Data Consortium in the analysis of COVID-19 statistics. The data was also used by the national Department of Health and government broadly to track the localised outbreak of the coronavirus.

Members of the KRISP, Prof. Tulio de Oliveira and Dr Richard Lessells, made several appearances on commercial television, radio stations and social media platforms. The KRISP's key role in the country's response to the pandemic has been lauded by Minister Nzimande at the joint DSI/Department of Health COVID-19 research conference. This serves to underscore the crucial role of government through TIA in investing in the development of world-class expertise and infrastructure at the KRISP and other entities in the NSI. Without this and other investments, the development of scientific driven solutions necessary for the government

Figure 22: A KRISP scientist sequencing a SARS-CoV-2 genome

15.2.7 TECHNOLOGY INNOVATION CLUSTER PROGRAMMES

Technology innovation clusters are collaborative programmes, aimed at leveraging the strengths of multiple partners to drive a technology solution and alleviate common industry challenges, thereby lowering the barriers to innovation in the sector. Cluster interventions entail the provision of support from the proof-of-concept stage, focusing on projects that are likely to be commercialised by industry. This is enabled through the provision of funding, technical support, and business enabling services – including the development of human and intellectual capital.

TIA has adopted the Technology Innovation Cluster Programme model as a mechanism to drive coordinated multi-party R&D initiatives. As a collaborative programme, it aims to leverage the strengths of partners to develop technology solutions. TIA specifically plays a funding, connector and facilitation role and is, therefore, the catalyst for establishing and managing Technology Innovation Clusters. Its purpose is to facilitate greater collaboration within the existing ecosystem by leveraging the strengths of respective partnering groups. The main objective of the Technology Innovation Cluster Programme is to address national priorities or areas of strategic social and economic importance through the utilisation of technology innovation.

TRANS-DISCIPLINARY CHAIR IN WOOD STRUCTURAL ENGINEERING

TIA is proud to report that an agreement to establish and fund a trans-disciplinary Chair in Wood Structural Engineering has been entered into between the University of Pretoria and York Timber Holdings Ltd. This has come about after a long period of engagement by the Forest Molecular Genetics Programme Director, Prof. Myburg, with York Timber Holdings. The Chair will focus on research in genetics, civil engineering, chemical engineering, data science, and architecture towards the development of a thriving, sustainable timber-based bio-economy in South Africa. The agreement is valued at R23 million over five years.

MEDICAL DEVICE AND DIAGNOSTICS INNOVATION CLUSTER

Medical devices and diagnostics are at the core of public health interventions and play an essential role in meeting the needs of patients and providers in delivering quality outcomes. According to the World Health Organization, high-quality, safe, and appropriate priority medical devices are essential tools for the prevention of death or disability, and for managing the diseases of poverty. The use of medical devices impacts on the continuum of care under the universal health coverage strategy; their role is not restricted to diagnosis and treatment but is also required in the constant management and monitoring of on-going health.

South Africa's domestic medical diagnostic and device industry currently imports over 90% of the market by value with an ever-increasing trade deficit in excess of R14.8bn per annum. The industry is fragmented and not functioning optimally. Despite having strong academic institutions, science councils, and an organised medical devices industry, the industry remains fragmented and South Africa still struggles to successfully commercialise and drive technologies into the market to generate impact. The industry, however, has enormous potential for reducing the trade deficit as well as increasing employment and improving healthcare if the necessary processes and structures are put in place to encourage growth of the sector.

With the advent of the COVID-19 pandemic, global medical supply chains are becoming increasingly insular. South Africa therefore faces an increasing risk that it will be unable to secure critical supplies of medical equipment, diagnostics, and any new therapeutics, vaccines or diagnostics developed. Furthermore, the economic effects of COVID-19 have contributed to the depreciation of the South African currency, thus making imported medical devices even more expensive.

The medical devices and diagnostics sector in South Africa has recognised that its sustainability is reliant upon leveraging the strengths and competencies within its community. Achieving a thriving industry will require a supportive and engaged stakeholder ecosystem in which members are aligned in their focus, policies, and support. Important and significant participants in this ecosystem include all three levels of government, multiple agencies, medical device companies at every industry and sector level, academic institutions, science councils, and industry.

Constraints to the growth of the sector as identified by industry stakeholders are listed as follows, in order of priority:

- Regulatory and quality management challenges/ constraints.
- Need for greater industry/community cohesion along the value chain.
- A lack of policies that support local industry competitiveness.
- Insufficient or poorly capacitated R&D and manufacturing incentives.
- Lack of interventions aimed at maintaining and building a skilled labour force.
- Insufficient efforts and interventions aimed at stimulating local innovation and technology development.
- Lack of strategic integrated infrastructure required by the industry.

The Medical Device and Diagnostics Innovation Cluster has assumed the role of a knowledge and innovation integrator operating along the lines of a 'hub and spoke' model, assuming the mandate to support and grow the medical devices and diagnostics industry through strategic partnerships.

In response to this industry need, TIA contracted with the SAMRC to host the Medical Device and Diagnostics Innovation Cluster. TIA's investment of R13.4 million in this sector is aimed at strengthening the medical devices and diagnostics innovation ecosystem and thereby stimulate local manufacturing capability as well as decrease South Africa's reliance on imported medical devices and diagnostics. The COVID-19 pandemic has underscored South Africa's limited

ability to respond to this and other health crises, highlighting the imperative for the country to ensure the security of supply and access to critical medical supplies and equipment for enhanced responsiveness.

ACTIVE PHARMACEUTICAL INGREDIENTS TECHNOLOGY INNOVATION LABORATORY

The Active Pharmaceutical Ingredient Cluster, hosted by the North West University, has initiated the construction of an API Technology Innovation Laboratory designed to fast track the competitive API technologies and processes developed and supported by the cluster into existing pilot facilities under industrial conditions. The objective of the laboratory is to focus on process and analytical method development and to confirm the technical and economic feasibility of the technology. Technologies under development by the cluster include projects being conducted at universities across South Africa.

PARTNERING FOR ACCELERATED CLIMATE TRANSITIONS

The uYilo Programme is the lead implementer in the South Africa-UK Partnering for Accelerated Climate Transitions Country Programme in collaboration with CENEX UK. The Programme focuses on capacity building and is funded by the UK government through its International Climate Finance portfolio at the Department for Business, Energy and Industrial Strategy. The programme is directed towards building capacity, capability and knowledge for the implementation of the National Department of Transport's Green Transport Strategy to support low-carbon transition and emission reduction.

15.2.8 SOUTH AFRICAN BIODESIGN INITIATIVE

The South African BioDesign Initiative was conceptualised to create, develop and foster a cross-disciplinary research culture that bridges the divide between the biological (genomics, systems, structural and synthetic biologies), physical, and engineering sciences. These are emerging disciplines which are informing innovation and the development of smart systems that address real-life challenges. The funding is specifically aimed at early-stage research and is meant to encourage skills and professional development of young black scientists who can conceptualise and implement such projects with strong commercial potential. There are currently six funded projects which meet these criteria and, in addition, are cross-institutional to encourage skills transfer. Funds are predominantly for postgraduate student bursaries and research expenses. Sixty percent of the funded researchers and students are female and 75% are black. The funded projects are as follows:

- The Lovebird project (collaboration between North-West University and University of Pretoria) designed a genetic test to determine breed purity and other attractive traits for the animal genetics market currently worth US$ 4 billion. The project achieved many accolades as it was the first group to sequence and annotate the parrot genome. The researchers are currently researching other traits whilst a patent has been applied for the main research data. Two commercial entities are in talks with the universities to license the developed test.

- The Biodiesel Production using Immobilised Goat-gut Lipases project (collaboration between Vaal University of Technology and University of South Africa) isolated stable lipases, cloned, and immobilised them for the production of biodiesel using used oils. Two lipases that can successfully produce biodiesel and retain stability after recycling have been identified. The group is currently externally validating the lipases and commencing a commercial feasibility study for the next phase of funding.
- The Open Genome Project (collaboration between Stellenbosch University and SAMRC) seeks to identify mutations that emerge through environmental risk for breast cancer disease. The group was funded for the creation of an algorithm to manage breast cancer treatment for patients through involvement of scientists, clinicians, and genetic counsellors. The results have been impressive and have spun out into other research projects. In addition, the results have been incorporated into the guidelines used by the Department of Health for breast cancer disease management. The project is in its final phase and will seek funds for additional development.
- The Bioremediation of Mine Pitlakes project (collaboration between University of the Free State and University of Limpopo) is developing inoculum to remediate mining pitlakes. The project is nearing mid completion. In addition, the group is developing solutions for mining rare minerals from mine wastes.
- The Use of Macroalgae project (collaboration between University of KwaZulu-Natal and University of Fort Hare) to produce nutraceuticals against diabetes and cancer is in its first phase. It aims to harness macroalgal compounds for diabetes and cancer management and has successfully extracted seaweed compounds, which are being tested.
- The Biofouling Project (collaboration between University of KwaZulu-Natal and University of Zululand) aims to produce seaweed bioadditives for the marine paint industry. The project is in its first phase and has successfully isolated seaweed bacteria and produced the nanoparticles needed for assay development.

15.2.9 BIO AFRICA CONVENTION

TIA and AfricaBio NPC have collaborated concerning the establishment of – and active participation in – the regional chapter of international BIO Conventions, namely the BIO Africa Convention. The parties entered into a formal collaborative agreement in August 2018, with the broad objective of stimulating the NSI for a vibrant bioeconomy as well as creating an enabling environment for new entrants.

Over the last three years, TIA and AfricaBio NPC held successful BIO Africa Conventions for bioeconomy actors to showcase their innovations, and attract new clients, customers or partnerships. Together, they have also hosted thought leadership sessions on relevant bioeconomy opportunities and challenges by local, regional, and international experts for the bioeconomy discourse. TIA's primary role was to use BIO Africa as a platform for TIA-funded innovators to convert engagements at the convention into technology development partnerships, market access enablers or new business ventures, as well as expert contributions in discussion panels.

The 2020 BIO Africa Digital Convention was held under the theme of "Discover, Develop & Disseminate". The event was attended by 1,166 registered delegates from 52 countries, and hosted several key industry discussions with notable leaders (Figure 23). It and focused on topics in health, agriculture, environmental biotechnology, industrial biotechnology, indigenous knowledge systems, finance, investments, and market access.

The conference was successfully hosted during COVID-19 restrictions, and this speaks to TIA's responsiveness to global developments such as the pandemic. In this year's convention, TIA was a contributor to content, and demonstrated thought leadership in discussions on the establishment of an African Clinical Trials Fund (a critical intervention in the development of medical interventions), post COVID-19 recovery, and contributions to economic growth through agro-processing and industrial biotechnology as a contributor to industrialisation (in conversations with regional and international leaders in this sector). TIA also conceptualised, managed, and executed various training interventions during the event.

The benefits which accrue to TIA and TIA's investees are both financial and non-financial, and are in keeping with TIA's mandate of supporting technological innovations for socio-economic benefit. The non-financial benefits have accrued both at the investee/incubatee and the TIA Technology Platform levels, with access to regional and international technical and distributions partnerships from Mauritius, Botswana, and Ghana.

- TIA's participation at the BIO US Convention has resulted in exploratory discussions with Zoetics US, Clinvet/ Clinglobal, Pfizer Ventures, Johnson & Johnson, Research and Innovation Circle of Hyderabad, Bristol-Myers Squibb, Takeda, Bayer, US-SA Network and Philips concerning the possible uptake of TIA funded projects to their portfolio.
- Altis Biologics has entered into a non-exclusive agreement with a Botswana distributor, with R 500,000 in business having been generated from this agreement.
- KRISP raised R4.5 million over three years for its BioDurban Project. KRISP has also secured sequencing business for clinical trials in South Africa, funded by the Bill & Melinda Gates Medical Research Institute.
- The Bioprocessing Platform is engaging with the International Centre for Genetic Engineering and

Figure 23: One of the expert panel discussions which took place during the 2020 BIO Africa Digital Convention

Biotechnology concerning a partnership for the development of pegylation of recombinant human granulocyte colony stimulating factor (G-CSF), a glycoprotein that stimulates bone marrow to produce granulocytes and stem cells.

- Sawubona Mycelium has explored product development collaboration opportunities with CMD Industries. Furthermore, the CEO of Eden Gardens (Jamaica) has engaged Sawubona Mycelium concerning the development of cannabis technologies.
- The Bioprocessing Platform has entered into a training partnership with University of Malaysia. Through this partnership, Sawubona Mycelium will initiate the very first technology transfer process.
- The technical tours and training courses executed by KRISP, Biosafety South Africa, and the Bioprocessing Platform during BIO Africa have established them as leading experts at the global level.
- A partnership was entered into between TIA and SAMRC, which resulted in a transfer of R200,000 by SAMRC to TIA for the joint SMME exhibition partnership during BIO Africa.
- TIA was able to secure further exhibition space for the grassroots innovation programme from the City of Ethekwini, thereby leveraging an amount of R270,000.

Future benefits are envisaged in terms of the expansion of the partnership areas such as increased thought leadership engagements building up to the main BIO Africa Convention (this is the same model as the BIO US Convention) and creating an accelerator ecosystem through the BIO Africa Innovation Hub. The BIO Africa Innovation Hub will expand on SMME physical and virtual incubation, exposure in the Marketplace and Innovators Corner to public sector and private investors, collaborators and developmental partners, access to innovative training interventions, access to open-source tools, and expanding the social reach of the STEM base (e.g. development of STEM girls with Telkom, the Microsoft Foundation and the YES Programme).

15.3 INNOVATION ENABLING DIVISION

15.3.1 DIVISIONAL OVERVIEW

The Innovation Enabling Division aims to stimulate a culture of innovation and provide enabling support through a range of interventions that enable the development of innovative solutions that address societal challenges. Support is provided through innovation infrastructure and expertise, direct funding and skills development. A key characteristic of the division is the development of innovators alongside technology development. The division targets broader society from universities and science councils to cooperatives and communities.

More than 1,990 beneficiaries, SMMEs, and individuals received support though financial or non-financial means to develop their ideas and technologies, enhance their innovations, access training and mentorship, take advantage of market opportunities, and/or become competitive via accessing the various programmes and initiatives of the Innovation Enabling Division. To achieve impact and leverage TIA's resources, TIA has partnered with 32 organisations (universities, science councils, incubators, regional development agencies, sector education and training authorities and other government departments) in this regard. At least 71 prototypes and products were progressed, 11 bio-based technologies successfully demonstrated, two products launched, and one technology package transferred.

The changing innovation landscape has required that TIA positions its Technology Station capabilities as part of a package of support in the NSI to promote the growth of collectives and SMMEs; contribute towards innovation-led industrialisation processes; and foster inclusive development through an expanded spatial footprint and enhanced access for entrepreneurs throughout the country.

DIVISIONAL PERFORMANCE

Table 14 presents TIA's performance against its targets in the originally-tabled 2020/21 APP for Outcome 3: Build and maintain innovation infrastructure that is strategically informed and regionally distributed, which applies to Q1. Table 15 presents the agency's performance against its targets in the re-tabled 2020/21 APP for Outcome 3: SMMEs supported through strategically informed and regionally distributed Technology Stations, which applies to Q2-Q4.

Table 14: TIA's performance in 2020/21 Q1 against Outcome 3: Build and maintain innovation infrastructure that is strategically informed and regionally distributed

Output (Output Indicator)	Audited actual performance 2018/19	Audited actual performance 2019/20	Planned annual target 2020/21	Actual achievement 2020/21 until date of re-tabling (Q1)	Deviation from planned target to actual achievement 2020/21	Reasons for deviations	Reasons for revisions to the outputs/ output indicators/ annual targets
3.1 Existing Technology Stations and other centres managed and supported. (Number of existing Technology Stations and centres providing SET support that are operational and functional)	-	-	18	0	-18	TIA did not achieve the desired performance as the Technology Stations were subjected to operational constraints due to the COVID-19 pandemic and national lockdown.	N/A (only the outcome was changed)
3.2 New centres established and supported. (Number of new centres providing SET support in targeted regions)	-	-	1	0	-1	Notwithstanding a Q1 target of zero, TIA engaged with the Durban University of Technology regarding the establishment of a new energy-focused Technology Station in the form of the KZN Energy Efficient Training & Resource Centre.	N/A (only the outcome was changed)

Table 15: TIA's performance in 2020/21 (Q2-Q4) against Outcome 3: SMMEs supported through strategically informed and regionally distributed Technology Stations

Output (Output Indicator)	Audited actual performance 2018/19	Audited actual performance 2019/20	Planned annual target 2020/21	Actual achievement 2020/21 (Q2-Q4)	Deviation from planned target to actual achievement 2020/21	Reasons for deviations
3.1 Existing Technology Stations and other centres managed and supported (Number of existing Technology Stations and centres providing SET support that are operational and functional)	-	-	18	16	-2	Under-performance on this output indicator is mostly attributed to delays in finalising the 2020/21 annual plan for the Technology Stations Programme, with associated delays in disbursement to the Technology Stations and the provision of support to the beneficiaries. Additionally, the impact of COVID-19 containment measures and economic uncertainties further undermined progress due to closure at most universities that host Technology Stations.
3.2 New centres established and supported (Number of new centres providing SET support in targeted regions)	-	-	1	1	0	N/A

PROGRESS TOWARDS PLANNED STRATEGIC INITIATIVES

Positioning Technology Stations for enhanced SMME support

The TSP is closely aligned with relevant industrial sectors to promote innovation-led industrialisation, localisation, and the promotion of exports in line with sectoral master plans. In the Retail Clothing, Textile, Footwear, and Leather sectoral master plan the programme is responding to grow the local market for local clothing, textile, footwear, and leather products by contributing to the development and marketing of local brands and labels trough computer-aided design/manufacturing servicing that improves local design and manufacturing competitiveness in support of the 'buy local' campaign. In terms of value chain transformation, there is visible progress being made in retail and clothing, textile, footwear, and leather procurement to actively support B-BBEE transformation and SMME inclusion in the supply chain for specific black and worker ownership targets through broad-based and inclusive models.

Concerning South Africa's Automotive Master Plan, the network of Technology Stations provides technical solutions for the competitive manufacturing of low and medium volume steel parts. This will enable existing domestic enterprises as well as potential new investors in the steel and metal industry to develop viable business cases to invest in the next generation technology upgrades, and contribute to an increased number of accredited facilities to enable supplier development and localisation initiatives in the country across industries that are assisting to create employment.

Certain Technology Stations' product development capabilities (sensors, actuators, wireless systems, etc.) have been integrated into a process innovation capability to digitise the process and enable businesses to interact with their systems in a more predictive manner, making decisions based on inputs from data analytics in a real-time fashion and applying artificial intelligence to optimise production. In the reporting period, the TSP introduce at least one technology demonstration platform into the business to demonstrate the capability of the system to companies and businesses in digital hubs. TIA evaluated and demonstrated modern technologies, and performed in-depth techno-economic analysis to determine the benefit of the new processes and promoting it to foundries, possible investors, and casting component users.

Budget and Expenditure for SMMEs supported through strategically informed and regionally distributed Technology Stations

A comparison of the budget and actual expenditure for Outcome 3 is presented in Table 16.

Table 16: Budget and expenditure for Outcome 3: SMMEs supported through strategically informed and regionally distributed Technology Stations for 2019/20 and 2020/21

Sub-Programme	2019/20			2020/21		
	Budget (R'000)	Actual expenditure (R'000)	(Over) / under expenditure (R'000)	Budget (R'000)	Actual expenditure (R'000)	(Over) / under expenditure (R'000)
Youth Technology Innovation Programme	3,000	1,400	1,600	0	775	(775)
Innovation Skills Development	5,000	4,041	959	1,350	2,686	(1,336)
Technology Stations Programme	96,500	96,500	0	92,442	114,354	(21,912)
Global CleanTech Innovation Programme-SA	4,000	2,378	1,622	2,925	2,623	302
Seed Fund Programme	28,400	32,687	(4,287)	20,000	8,769	11,231
Total	**136,900**	**137,006**	**(106)**	**133,079**	**129,207**	**12,490**

15.3.2 TECHNOLOGY STATIONS PROGRAMME

The TSP enables academia and industry to take part in technology transfer and development by facilitating their interaction and reducing barriers to market access through subsidised services offered by a network of 18 Technology Stations, located across the country.

The sub-programme provides technology innovators in targeted industries and communities access to state-of-the-art equipment, infrastructure, and expertise in specialised fields that would not otherwise be available or affordable to commercialise their innovations. The services offered through the TSP are key to reviving South Africa's manufacturing sector. Support services provided by Technology Stations spans from prototyping up until pre-commercialisation. It includes testing and analytical services, rapid prototyping and manufacturing, consultation, technology audit and feasibility study, process or product improvements, applied development, engineering and design, R&D, technology demonstration, and training. The initiative supports mainly SMMEs, individual innovators, and researchers.

AUTOMATED ANALYSIS OF AERIAL IMAGERY TO ESTIMATE THE CAPACITY SOLAR SYSTEMS IN JOHANNESBURG

An example of the support provided through the TSP is a project which was undertaken through the Technology Station at the University of Johannesburg to enable the City of Johannesburg to identify, locate, count, and estimate the installed capacity of solar photovoltaic and solar water heater systems in Johannesburg. It entails the automated analysis of aerial imagery of the city using artificial intelligence for decision-making and energy demand-side management, thereby alleviating the drudgery of manual analysis. This novel project has the potential to be deployed municipalities. A website-based model is planned which would enable municipalities to upload aerial imagery and intelligently identify installed solar water heaters and solar photovoltaic systems, thereby facilitating an understanding of greenhouse gas emissions, installed energy reduction measures and alternative energy potential.

NOVEL WHIP PEENING PROCESS ON TURBINE ROTORS

Another example is through the eNtsa Technology Station at Nelson Mandela University, which provided technical assistance to Rotek Industries and performed serration grinding and applied the novel whip peening process on two turbine rotors. The whip peening process is used to induce a beneficial surface residual stress in very confined geometries after maintenance and repair grinding. This surface residual stress reduces susceptibility to crack formation, thus mitigating the risk of unplanned outages and repairs. This technology application allowed Eskom to apply preventative maintenance and redress operational damage in order to increase the operational efficiency and overall lifetime of two rotors which are currently back in service.

PERFORMANCE OF THE TECHNOLOGY STATIONS PROGRAMME

The 18 Technology Stations across South Africa support locally-developed technology deployment to district and local municipalities through the provision of SET support. The TSP provided SET support to 555 small or medium enterprises and to 1,325 innovators and entrepreneurs in underserved communities to innovate and access local markets and export opportunities as per Table 17 and Table 18.

Table 17: Support provided to clients of the TSP according to category

Category	Total
Registered small or medium enterprise	555
Non-registered: Techno entrepreneur	253
Non-registered: Innovators and entrepreneur	1,072
Total	**1,880**

Table 18: Support provided to clients of the TSP according to demographics

Demographics of clients supported	Total
Black and historically disadvantaged individuals	922
Women	684
Youth	922
People with disabilities	11

Selected management indicators of the TSP are shown in Table 19. The TSP performed well with respect to the number of knowledge and innovation products produced, the monetary value of services provided to small or medium enterprises, the number of customised short learning programme sessions, and the number of products or processes taken up in the market.

Table 19: Selected management indicators and performance of the TSP

Indicator	Performance
Monetary value of services provided to small or medium enterprises	R69.4m
Number of customised short learning programme sessions delivered which are accredited by the relevant sector education training authority	85
Number of products or processes taken up in the market as a result of technical support provided to entrepreneurs and enterprises	33
Income in terms of subsidies for SMME support (preferential cost recovery), other grants and industry contribution	R35.2m
Number of knowledge and innovation products produced: IP (patents, prototypes, technology demonstrators and technology assistance/transfer packages) and scientific outputs (journal papers, conference presentations, books & book chapters)	137

Technology Stations contribute towards improving the competitiveness of industry through the application of SET interventions and facilitating the interaction between industry and academia in support of small or medium enterprises (including co-operatives). The objective is for enterprises to benefit through process improvements in testing and analysis, application of research, engineering development, and innovation initiatives to improve the product quality and scale-up for market access. In 2020/21, a total of 1,004 processes were developed and/or improved, 705 tests or analysis performed for compliance to market standards or specifications, and 33 enterprises secured or maintained production contracts. The competitive improvements provided to enterprises through the TSP are shown in Table 20.

Table 20: Competitive improvements provided to enterprises through the TSP

Number of Technology Stations	Industries	Processes developed, and/or improved	Testing and analysis performed	Secured or maintained contracts
5	Agro-processing, chemicals, and cosmetics	206	200	5
7	Automotive, manufacturing, and metal fabrication	266	345	25
1	Electro-technical and electronics	127	0	0
1	Marine, aerospace, and defence	7	0	0
1	Minerals beneficiation and green industries	27	10	0
2	Plastics	160	25	3
1	Textiles manufacturing, and cut, make and trim	211	125	0
	Total	**1,004**	**705**	**33**

PERFORMANCE OF THE TECHNOLOGY STATIONS PROGRAMME (continued)

The Technology Stations aim to support and enable growth in South Africa's economy (particularly within industries in the productive sectors) through the provision and creation of infrastructure and scientific capacity, as depicted in Table 21.

Table 21: Support and enablers provided by Technology Stations to specific industrial sectors

Sector	Technology Stations: Support and Enablers
Automotive and components manufacturing	Two data sensor solution platforms have been demonstrated to firms, thereby showing the capability of such platforms to industrial sites and businesses in digital hubs as planned.
Textiles, agriculture and agro-processing	Provided access to high-end manufacturing facilities and is scaling up to provide support to other sector-specific areas such food processing. Implemented two new technology alternatives in manufacturing facilities (automotive and electronics) and live data streaming with analytics to support cycle time reduction and alternative materials for new/alternative value chains. Implementation time and cost would depend on the size and complexity of the process being measured, but the respective Technology Station will be able to assist four to six factories in the next year in support of accessing opportunities for black industrialists. Such support can be expanded to include critical areas such as agriculture, buildings, water and energy, where technological solutions can be implemented at a small scale to assist farmers with monitoring, waste reduction in food, water, and energy use, etc.
Steel and metal fabrication	The network of Technology Stations provided technical solutions for the competitive manufacturing of low to medium volume steel parts in order to enable existing domestic enterprises, as well as potential new investors in the steel and metal industry with viable business cases to invest in the next generation technology upgrades. This will also contribute to the expansion in the number of accredited facilities in the TSP from six Technology Stations providing support to eight, thereby enabling supplier development and localisation initiatives within industries that create employment. Technology Stations will be able to evaluate and demonstrate new technologies, and undertake in-depth techno-economic analysis to determine the benefit of the new processes and promoting the uptake of such technologies to foundries, possible investors and casting component users.
Chemicals and gas	Enhanced engagement took place with universities to develop a common understanding of how undergraduate training and basic research are integrated within a centre of excellence context, involving undergraduates, work integrated learning interns, postgraduates, and in-service trainees in chemical process technology. This entails the use of a host of specialised equipment for teaching and learning and research projects in partnership with industry.

TECHNOLOGY STATIONS PROGRAMME RESPONSE TO THE COVID-19 PANDEMIC

The TSP's COVID-19 response and mitigation activities were focused on the provision of SET support services to SMMEs, responding to societal and environmental impact support needs, developing alternative materials and product development initiatives. Funding support originated from the DSI TSP core grant, TIA project funding and public/private sector co-funding.

PRODUCTION SCALE-UP OF COVID-19 MEDICAL-RELATED PRODUCTS AND PERSONAL PROTECTIVE EQUIPMENT

The Product Development Technology Station (PDTS) designed and developed a reusable PPE mask and ventilator filter (Figure 24). This dramatically reduced the amount of medical waste produced in the COVID-19 pandemic. Traditionally, a filter would be replaced every 24 hours and the disposable plastic housing incorporating the filter material would be discarded. The PDTS developed a reusable filter housing and a replacement cost-effective filter disc. The mask produced in the PPE airway project can also be used as a continuous positive airway pressure mask for non-invasive patient ventilation.

Figure 24: The reusable PPE mask and ventilator filter

Support was provided to the South African Emergency Ventilator Project, a non-profit company to reverse engineer the Penlon Nuffield 200 ventilator component (Figure 25). This entailed prototyping the time control valves, designing a pressure monitoring/measuring device, designing an over-pressure limit protection system, and more.

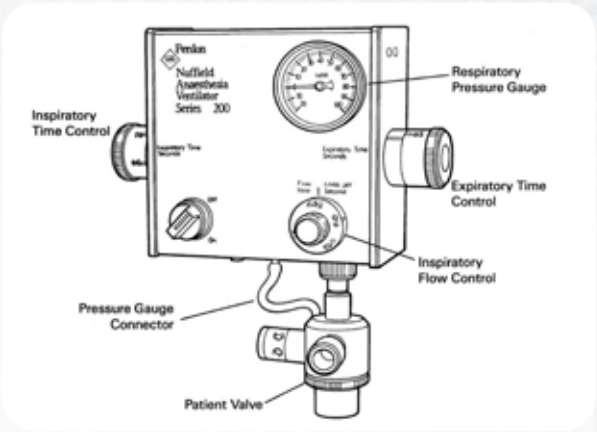


Figure 25: The Penlon Nuffield 200 ventilator

MANUFACTURING AND DISTRIBUTING SUPPORT FOR VITAL COVID-19 SUPPLIES

Vital COVID-19 PPE were manufactured and distributed to more than 24 organisations. Doctors received more than 10,000 face shields made by the network of Technology Stations. Approximately R1.4 million was secured in co-funding through local government to assist purchasing materials for the face shields.

The Technology Station in Electronics at the Tshwane University of Technology collaborated with the CSIR and the Process, Energy and Environmental Technology Station at the University of Johannesburg to produce printed circuit boards for ventilator repair and maintenance. Efforts focused on identifying decommissioned ventilators at public and private hospitals and bring non-functional equipment back into service. This also resulted in the reduction in electronic waste in support of the circular economy to support the medical engineering maintenance programmes at hospitals.

SUPPORTING WORKPLACE RE-OPENING AND COMMUNITY SAFETY

Technology Stations have been instrumental in training small firms to mix large volumes of hand sanitisers. When news of the rapidly spreading COVID-19 virus broke, the Technology Station in Chemicals at the Tshwane University of Technology immediately championed the production of the first batch of 5,000 containers (500ml) of hand sanitiser to be distributed to

TECHNOLOGY STATIONS PROGRAMME RESPONSE TO THE COVID-19 PANDEMIC (continued)

university staff and to be placed at strategic high population points on campuses and communities in support of public safety. The production of hand sanitisers will continue until the pandemic is under control, with Technology Stations continuing to investigate ways to assist vulnerable communities such as old age homes and underprivileged schools through the provision of sanitising products.

The Technology Station in Clothing and Textiles at the Cape Peninsula University of Technology was central in efforts to establish guidelines for making face masks for use by the general public. The Technology Station's recommendations have been incorporated into guidelines to manufacture cloth face masks[9] following engagements with authorities such as the World Health Organization, the national Department of Health, and the dtic.

The eNtsa Technology Station at the Nelson Mandela University supported Livingston Hospital to set up ultraviolet lamps with the intention of decontaminating goods and materials, including PPE waste optimisation.

CAPACITY AND SKILLS DEVELOPMENT IN THE MEDICAL DEVICE SECTOR

The Viro-Vent Skills Innovation Challenge was funded by the Manufacturing, Engineering and Related Services Sector Education and Training Authority to support applied research and innovation projects as key responses to the COVID-19 pandemic. The purpose of the initiative is capacity and skills development during and after the COVID-19 pandemic, thereby ensuring that the medical device sector continues to grow and meet the needs of the South African market and the African continent.

Four Technology Stations collaborated to implement the challenge, namely; the Technology Station for Materials and Processing Technologies at the Vaal University of Technology, the Process, Energy and Environmental Technology Station, the Technology Station in Electronics and the PDTS. The challenge attracted co-investment, resulting in a total budget of R30.5 million.

The key focus of the initiative was to develop local capacity to manufacture a functional bilevel positive airway pressure unit and delivery system as described by the World Health Organization standard. By implementing product development and systems engineering principles, critical skills have been developed through practical work experience and theoretical training presented on an online platform. The Technology Stations network adopted a regional approach to building capacity through knowledge transfer at the four universities involved.

In total, 125 students were supported in the programme across all four institutions in mechanical and electronics engineering, product development and industrial design, at NDip, BEng/BTEch, MEng/MTech and PhD levels. Collaboration with researchers and their students' involvement have been instrumental in developing an advanced technology skills base through a regional approach to support the medical device manufacturing sector.

[9] Recommended Guidelines in Fabric Face Masks Manufactured by South Africa's Clothing and Textile Manufacturing Industry for General Public Use, April 2020.

FEASIBLE PLASTICS – A NEW PLAYER IN TOOLING FOR LOCAL INDUSTRY

Feasible Plastics (Pty) Ltd received technological support from the Institute for Advanced Tooling based at the Tshwane University of Technology (Soshanguve campus). The support was in tooling and product development (Figure 26) that conforms to industry standards in order to be considered as a supplier to the manufacturing sector.

The enterprise is located in Rosslyn (Gauteng) and was supported with injection moulds to produce plastic plugs of various sizes for water tanks. The tanks are currently manufactured by Pioneer Plastics in Rosslyn, and Feasible Plastics has secured a new contract to produce plugs from their injection machine.

The Institute for Advanced Tooling specialises in tooling to improve the competitiveness of SMMEs in the tooling industry. It delivers a new paradigm of high-value tools and tool making business models that will reposition tool and die makers as key strategic partners in the value chain in accordance with relevant industry needs. In this way, the Technology Station contributes to the improvement of global competitiveness of the South African manufacturing industry.

Through working with the Institute for Advanced Tooling, David Bolayi (founder of Feasible Plastics) is now part of a solid manufacturing value chain, rendering his enterprise more sustainable in the long run. Feasible Plastics was matched up with an industry partner as a preferential supplier for plastic containers, effectively substituting imports of the same components. Owing to the impeccable delivery timing and SET services provided by the Technology Station, the enterprise has received an extended contract to manufacture additional tooling to localise a further 23 products in the near future.

Figure 26: An injection mould at the Feasible Plastics factory

15.3.3 SEED FUND PROGRAMME

A considerable number of new technologies do not progress beyond the proof of concept and market assessments stages as they often do not meet the requirements to attract further funding for technology development and commercialisation. This gap existed particularly at universities where applications for such funding were premature and characterised by the lack of a proof of concept, no prototypes, no clear market need, and no clear IP strategy.

TIA established the Seed Fund Programme in 2013 in order to assist researchers based at universities, science councils, and SMMEs through the provision of funding to translate their research outputs into fundable ideas for further development. The Programme provides conditional grant funding for technologies in the TRL 3-8 range.

The Programme supports innovators to achieve the following goals:

- Advance or mature research outputs and ideas to develop prototypes, proof of concept, and business cases that could be used to attract follow-on funding opportunities and for further technology development.
- De-risk research outputs for follow-on funding to attract other funders.
- Assist innovators with small-scale trials and market testing.
- Demonstrate innovation value propositions to attract commercial partners.

The Seed Fund Programme is positioned as a project preparation instrument that aims to de-risk early-stage technologies from public-funded research institutions and SMMEs to create a pipeline of technologically-feasible and commercially-viable projects for the NSI. The Programme provides funding for a set of fundable activities as follows.

- Prototype development and IP
- Detailed primary market research
- Refining and implementing designs
- Conducting field studies, piloting, and technology scale-up
- Techno-economic evaluation studies
- Production of market samples and/or associated testing
- Support of certification activities and specification sheet development
- Business plan development

The Seed Fund Programme is implemented in partnership with Offices of Technology Transfer at universities and science councils, and together with regional development agencies and incubators. The programme has 34 active implementing partners, comprising 23 universities, four science councils, two regional development agencies, and five technology incubators.

The Seed Fund Programme has played a significant role in supporting and enabling innovation from publicly-funded research outputs to ensure translation of ideas to technological products and services that solve national challenges with the potential to improve the competitiveness of South African industries. Since inception, a total of 782 technologies have been funded, of which 553 projects are from universities and science councils and 229 are from SMMEs.

Despite the Covid-19 challenges, there has been noteworthy progress made by the Programme in achieving its de-risking role and providing a pipeline of projects that are ready for follow-on funding and ensuring commercialisation.

DE-RISKING ROLE: A considerable number of projects in the Seed Fund Programme portfolio have been successful in raising follow-on funding from TIA internally and other funders. Three projects within the portfolio secured follow-on funding from TIA's Technology Development Fund, while nine have received follow-on funding from TIA's Industry Matching Fund partnerships through the University Technology Fund and the Savant Venture Fund.

ENABLING COMMERCIALISATION: The Seed Fund Programme plays an important role in facilitating the commercialisation of IP resulting from publicly-funded research. In 2020/21, the Seed Fund Programme played a role in enabling commercialisation of eight technologies, of which four stem from university-based research, one from a science council, and three from SMMEs. These technologies are poised to contribute to promoting economic growth and competitiveness. Brief descriptions of the four instances entailing the commercialisation of the university-based research follow below.

a) GenoPharm Technology

CradleOmics successfully demonstrate the GenoPharm technology at Baragwanath Hospital. This is an SMME which has received funding support through The Innovation Hub Seed Fund portfolio for its GenoPharm initiative; a clinical decision support system for clinicians and physicians. GenoPharm is a cost-effective intervention for reducing the burden of adverse drug reactions and improving the efficacy of medicines used by people of African origin. It uses a patient's genetic information to predict how they might respond to known medicines, as well as possible drug-drug interactions. The company received R369,000 to test a laboratory information management system and produce 500 GenoPharm test kits for piloting. Craddleomics successfully demonstrated its technology through a pilot test involving 500 patients at Chris Hani Baragwanath Hospital.

b) Commercialising Recombinant Proteins and Antibodies from Nicotiana Benthamiana Plants

Cape Bio Pharms (Pty) Ltd is a spin-off company of the University of Cape Town which aims to commercialise the biotechnology developed to produce recombinant proteins and antibodies from Nicotiana benthamiana plants. Often referred to as the 'cousin' of tobacco, Nicotiana benthamiana contains nicotine and similar alkaloids. The company was previously supported by TIA's Seed Fund in the amount of R500,000 in 2014/15.

c) Research Facility for Plant-made Proteins to Combat COVID-19

The European Investment Bank, the Foundation for Innovative New Diagnostics and local funding initiatives have collectively invested almost R900 million into Cape Bio Pharms to further its COVID-19 antigen and antibody research. Funding from the European Investment Bank, which accounts for 70% of total investments, will be used to open a new COVID-19 research facility in Mauritius and will be operated by Cape Biologix Technologies (Pty) Ltd, a subsidiary of Cape Bio Pharms. The Mauritius facility will consist of laboratories, processing plants and climate controlled hydroponic grow rooms to provide stable plant-made proteins to combat COVID-19. Funding from the Foundation for Innovative New Diagnostics, which covers approximately 7% of investments, will be used to scale up the pilot production programme currently underway in Cape Town. The remaining funds originate from the kENUP Foundation, South Africa's University Technology Fund, and other investors.

d) Online Livestock Auction Platform

Swift Livestock (Pty) Ltd ('SwiftVEE') is an agritech start-up that operates as an online platform for livestock auctions. The company previously received funding from TIA's Seed Fund to the value of R500,000 through the Cape Design Institute, one of TIA's implementing partners. SwiftVEE has secured US$1.5 million in investment from a consortium of private investors and Subtropico Ltd, a public investment holding company that focuses on the agricultural services sector and related value chain.

The funding will be used to expand the company's offering within South Africa and neighbouring countries (including Namibia and Botswana). It will also enable SwiftVEE to be included on Zire; South Africa's first multi-industry agricultural services platform that will provide technology services to industry stakeholders in the livestock, fruit, and vegetable sector. Zire is expected to launch in 2021 and will enable SwiftVEE to extend its market reach to new customers across multiple industries.

LOCAL SMME ENTERS THE GLOBAL COFFEE REVOLUTION

A Free State province-based SMME, MyBrew Innovation (Pty) Ltd, was supported by the PDTS at the Central University of Technology to optimise the design and manufacture the moulds to produce a unique product called the BrewSpoon (Figure 27). With the support from the Technology Station MyBrew Innovation was able to commercialise the product and supply both the national and international markets. The project was funded by the Seed Fund Programme in the amount of R560,000 in 2018.

Figure 27: The BrewSpoon, showing how the product is used to make a cup of coffee

The objective was to develop a novel coffee brewing method for the rapidly growing coffee industry. The industry has seen major growth in the past three years, with various means of brewing coffee being utilised. Most methods are time consuming and are either untidy or expensive. The BrewSpoon product solves that challenge by improving the experience for coffee enthusiasts.

This project aimed at optimising the already proven concept of the BrewSpoon. The PDTS worked on the design and development of the product as well as producing injection mould tooling. Limited run injection moulds and samples were produced at PDTS to confirm design assumptions and start market trials.

In addition, a limited run injection mould for the BrewScoop was produced and samples manufactured. The BrewScoop is an add-on to the BrewSpoon and assists in scooping ground coffee out of a coffee bag. The BrewScoop also seals the coffee bag with the designed clip, keeping the coffee fresher for longer.

In the process of developing and refining the product, the brand was established to get ready for the market. Feedback from the market entry resulted in a final box design which improves the appeal of the product in a retail setting and to protect the product during handling and logistics before it reaches the customer.

For market entry 500 samples were produced. Coffee shops that roast coffee beans and sell coffee equipment in Bloemfontein were approached. Of the five approached, four responded positively. With that success, additional independent retailers were added.

MyBrew compiled a list of 200 outlets that fit their market profile in South Africa. They have secured 24 outlets and aims to distribute to 120 outlets nationwide. To date 1,200 BrewSpoons have been sold to retailers nationwide. BrewSpoons can also be purchased online from the MyBrew website.

In November 2020, MyBrew entered the international market by exporting the product to the US. Over three thousand BrewSpoons were sent to America and were made available for online sales through www.us.brewspoon.co. The design and trademark IP has been licensed to MyBrew Innovation.

The Technology Stations' activities offer an opportunity to bridge the gap between local suppliers and industry by enhancing competitiveness of local suppliers in the global market. With collaboration between MyBrew Innovation and PDTS, TIA has been a key role-player in enterprise development.

15.3.4 INNOVATION SKILLS DEVELOPMENT AND ENTERPRISE DEVELOPMENT PROGRAMMES

TIA contributes toward innovation skills development by attracting talent and formulating strategic partnerships with private industry and academia. The objective is to cultivate innovation and to assist in producing the 4IR knowledge-based talent in response to the mismatch in South Africa which exists between an ever-evolving global economy and the existing skills base of the youth in South Africa.

The Innovation Skills Development Programme is a strategic intervention that addresses the aforementioned challenges by facilitating technology enterprise development through skills and international acceleration platforms. Furthermore, the programme stimulates a culture of innovation thinking within the NSI, thus contributing toward the translation of innovative ideas into novel technology outputs. The Programme provides focused and targeted training interventions to strengthen entrepreneurial capacity of researchers and innovators towards the commercialisation of their research outputs.

The Innovation Skills Development Programme now implements its interventions in a re-focused manner to deliver the requisite support to budding entrepreneurs and researchers through the development of skills for innovation and commercialisation, and supporting capability building within the NSI through directed support towards IP and commercialisation management. These interventions include the following:

- Innovation Skills – aimed at providing entrepreneurs, students, and graduates with SET skills through placement in industry and other technical environments (such as Technology Stations and Technology Platforms). Through this intervention, TIA aims to stimulate a culture of innovation and equip budding entrepreneurs with the requisite hands-on skills to develop their own innovations. This initiative is implemented in support of grassroots innovators, stakeholders in the South African Technology Network,[10] technical and vocational education and training colleges, further education and training colleges, and community education and training colleges.
- Entrepreneurship Skills – aimed at improving the ability of innovators to establish viable start-up companies that would facilitating their technologies to market and to raise funding.

Interventions are implemented through incubation and acceleration programmes, such as; the GAP Bioscience, Technology Top 100, the Global CleanTech Innovation Programme-South Africa (GCIP-SA), Leaders in Innovation Fellowship Programme, Swiss Venture Leaders, Silicon Valley Plug and Play Programme, Ireland SA Technology Challenge, and Brazil Incubation Support Programme.

LEADERS IN INNOVATION FELLOWSHIP PROGRAMME

The Leaders in Innovation Fellowship Programme is fully funded by the UK Newton Fund and the UK Royal Academy of Engineering. It has the primary objective of bridging the innovation gap in South Africa for long-term sustainable growth through promoting innovation and entrepreneurial skills development. The programme aims to build the capacity of researchers and innovators for entrepreneurship and commercialisation of their research or innovations, and create international networks of innovators, technology entrepreneurs, expert coaches and senior industrialists driving world-class innovations.

The seventh cohort of the Leaders in Innovation Fellowship Programme was conducted via a webinar series starting in December 2020, due to restrictions on travel and the movement of people during the COVID-19 pandemic. The cohort's fellows, selected by the Royal Academy of Engineering, were 70% black, 60% youth, and 40% female.

Successes in the period under review include the following.

- Linah Maphanga used funding received from the Royal Academy of Engineering Community Grant to train smallholder famers.
- Keneiloe Kganane, an alum of the fifth Leaders in Innovation Fellowship Programme cohort, has had her incubation period at The Innovation Hub extended by a further 12 months (valued at R60,000) in order to enable her to continue producing her innovative sorghum snacks.
- The collaboration of three Leaders in Innovation Fellowship Programme alumni, Keneiloe Kganane, Kendy Madisha and Dr Petro Erasmus, enabled the group to secure a R100,000 Royal Academy of Engineering Community Grant in January 2021, in order to establish and expand the Programme's alumni collaboration and ecosystem within South Africa.

GLOBAL CLEANTECH INNOVATION PROGRAMME-SOUTH AFRICA

GCIP-SA forms part of a global initiative aimed at promoting 'clean' or 'green' technological innovations through supporting entrepreneurs to grow their SMMEs and start-ups into viable, investment-ready businesses. Green investments (investment activities that concentrate on companies that try to preserve natural resources) help in minimising South Africa's dependence on fossil fuels, which will in turn reduce air pollution and carbon emissions. Relevant sectors include bioprocessing, clean technology, and medical devices.

[10] The South African Technology Network is a coalition of five South African universities of technology.

The GCIP-SA aims to:

- Build a local entrepreneurial ecosystem by identifying the most promising innovative local clean technologies;
- Support, promote, and 'de-risk' the technologies of participating companies;
- Promote and develop clean technologies by working with various national programmes, funds and competitions; and
- Connect the most promising start-ups with potential investors, customers and partners.

The United Nations Industrial Development Organization, the original funder and founder of the GCIP, is rolling out the second-generation of its GCIP called "GCIP 2.0". TIA has been appointed as the implementing partner for GCIP 2.0 in South Africa, which has also been formally agreed to by TIA's Executive Management Committee.

Waste Management and Recycling Digital Platform

Kudoti (Pty) Ltd offers a digital platform for waste management and recycling and is a GCIP-SA accelerator participant. Gift Lubele, the Kudoti founder, took part in the 5th BRICS Young Innovators Competition in September 2020. He was awarded first prize at the competition and received US$25,000 in prize money. This is a significant achievement for South Africa and for TIA, considering the strong competition from China, India, Brazil, and Russia. TIA most certainly played a key role in enabling Lubele to progress his innovation to the market, thereby positioning him as a strong contender in the competition.

Annual GCIP-SA Awards

The annual GCIP-SA awards evening was held in March 2021, at which the DSI's Deputy Director-General for International Cooperation and Resources, Daan du Toit, was the keynote speaker (Figure 28). He hailed the initiative as a critical contributor in advancing the circular economy, creating new knowledge and transitioning to a green economy, all of which are critical to South Africa's economic recovery plan.

The grand prize of R200,000 was won by Iraka Biotech (Pty) Ltd, an innovation start-up enterprise. Its 'green' and 'clean' vaccine production platform makes high-quality veterinary vaccines which are affordable and reliably accessible. First and second runners-up were SlideLuvre (Pty) Ltd and Sanineat (Pty) Ltd, respectively, who received R100,000 each for their innovations.

SlideLuvre is an intelligent shading system for commercial buildings. The system optimises solar energy generation, energy efficiency, and occupant comfort thus reducing energy consumption and carbon emissions by as much as 50%.

Sanineat is a green innovation enterprise that grows low-cost and drought-resistant moringa 'miracle' trees. Biodiesel, oil, powders (from the leaves), and seedcake are produced from the moringa trees, among other value-added products. The company makes a positive impact to the South African economy and society broadly by creating jobs in the local community, alleviating poverty, addressing malnutrition in children and livestock, and also contributes to the reduction of global carbon dioxide emissions and water use.

Awards were also presented by the Deputy Director-General for Technological Innovation, Dr Mmboneni Muofhe, to J. Williams from **PRECOTEC ZA (Pty) Ltd** for the most improved candidate, and an honorary award was conferred for the late Nkateko Ncube from **Sanineat.**

TIA Board members, Thabiso Ramasike and Sebenzile Matsebula, presented the awards for Innovation for Social Impact. Elijah Djan from **Nubrix (Pty) Ltd** and Nhlanhla Ndlovu from **HustleNomics (Pty) Ltd** received R50,000 each.

Figure 28: GCIP-SA 2020 gala dinner and awards evening

15.3.5 INNOVATION FOR INCLUSIVE DEVELOPMENT

The Innovation for Inclusive Development sub-programme is a ring-fenced implementation unit supporting the DSI's portfolio of projects and programmes in the area of inclusive development. The sub-programme incorporates the Grassroots Innovation Programme and the Innovation for Sustainable Livelihoods Programme.

GRASSROOTS INNOVATION PROGRAMME

This programme supports indigent and marginalised innovators who operate outside formal business and innovation systems and networks through a multi-tiered support package. This includes incubation, mentorship, and business development.

Since its establishment in 2019, the programme has seen 98 innovators recruited who developed a wide range of innovative solutions that are relevant to addressing their local and many service delivery challenges. During the year under review, TIA established two partnerships; one with the Insurance Sector Education and Training Authority, and one with the Department of Tourism to support innovators that can develop solutions that respond to their sector-specific needs. To date, the programme has successfully supported the development of 22 innovations, with 12 products launched in the market. Fifteen innovators have been selected to enter the Small Enterprise Development Agency's incubation programme through its national network of incubators throughout the country.

Skin Care Products from Waste Materials

Foi Science (Pty) Ltd is a women-owned start-up from Gqeberha in the Eastern Cape province involved in the development and formulation of skin care products to treat burns, scars, and wounds (Figure 28). These products are made from food and agricultural waste that are beneficiated into cosmetic actives. The first active ingredient is a collagen extracted from fish scales waste for the making of wound care dressings and hydrogels and film sheets for burns, surgical and caesarean section scars, slow healing diabetes wounds, ulcers, and bedsores. The second cosmetic ingredient is activated charcoal from agricultural waste to be used for alcohol poisoning, cleaning infected and necrotic wounds, and boils. During the period under review, the project progressed from TRL3 to TRL7 and sales to the value of R250,000 were recorded.

Figure 29: Foi Science products

KA–DAH Device for Visually Impaired Individuals

Developed by Tieho Tsiane of Oplene Group (Pty) Ltd in the Free State province, the Ka-Dah device (Figure 30) is a technology that assists visually impaired individuals to navigate and access the functions, controls, and apps of smartphones without the need to use the touch screen of smartphones. The technology consists of a mobile application installed on the phone, wearable hardware to assist in navigating through the phone, headset earphones, and a universal clamp for attaching the hardware onto a wheelchair or a walking stick. The Ka-Dah provides to its users a clear and simple user interface for easy selection of options and communicates easily understood instructions. The technology utilises Bluetooth or near-field communication to connect and control the smartphone and has an ability to learn the apps installed in the smartphone.

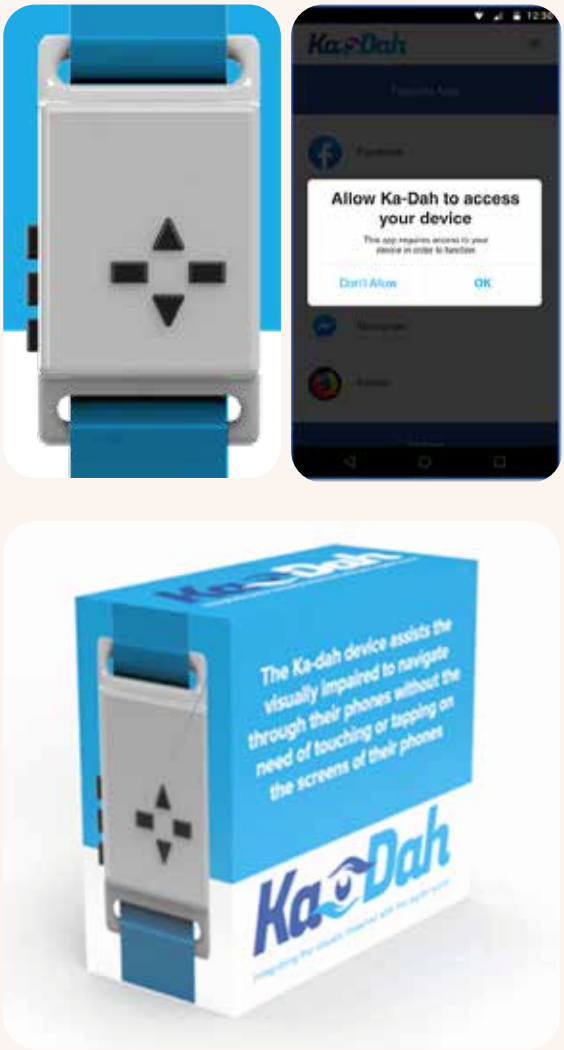


Figure 30: The Ka-Dah device

Figure 31: The Ownedby digital platform

Ownedby Digital Platform

Ownedby is a digital platform (Figure 31) that gives each appliance and devices a unique online profile and history that permanently links it to the owner. This link makes it possible for these items to find their way to the owner in case they are lost or stolen. The purpose of Ownedby is to discourage at least 10% of crime incidents that involve an appliance or device. These items affect a range of incidents including common robberies, and/or burglaries at residential and non-residential premises.

Sisanda App Universe

The Sisanda Tech App Universe (Figure 32) is a bundle of science apps (developed by 30-year-old Mbangiso Mabaso from Botshabelo in the Free State province) that allow learners to perform science experiments using only the camera of their smartphone or tablet. The app was developed by Sisanda Tech (Pty) Ltd, a company that has used augmented and virtual reality technologies to create this learning platform to bring scientific learning experience to learners from the age of eight years. The apps can be used by learners in grades four to 12, making science engaging, fun, and accessible to thousands of learners in Africa.

Figure 32: The Sisanda App Universe

AFRICAN MUSHROOM DOME

The African Hut Mushroom Dome is an innovative and alternative technology to produce oyster mushrooms (Figure 33). The inventor, Sydwell Sihlangu of Eco-Agro Enterprise (Pty) Ltd, hails from Malelane in the Mpumalanga province, and aims to diffuse the technology to small-scale farmers for social benefit. Mr Sihlangu was supported by TIA through the Grassroots Innovation Programme.

The structure provides a micro-climate that enables the production of oyster mushrooms at a lower cost than the conventional commercial mushroom production structures. It allows the fruiting of oyster mushrooms even in harsh climatic conditions without using any electricity and fossil energy and uses far less water than conventional mushroom farming.

The technology has been diffused to four smallholder mushroom farmers in the Free State and KwaZulu-Natal provinces. Each farmer has been provided with a technology package which includes the technology, training, substrate, and spawn so that they can produce the mushrooms (Figure 34). On site and online training sessions were offered to the small-holder mushroom farmers that are participating in the technology diffusion project.

The Glen College of Agriculture in the Free State province and Cedara College of Agriculture in the KwaZulu-Natal province has also expressed interest in deploying the technology to indigent farmers in the provinces. More than 60 smallholder farmers have benefitted from the training provided by Mr Sihlangu.

The project is at pilot stage and the technology is anticipated to reduce the importing of mushrooms into South Africa. With this technology, the challenges of malnutrition and food insecurity could be partially alleviated.

Figure 33: Mushrooms growing in the African Hut Mushroom Dome

Figure 34: Preparing the dome for planting of mushrooms

LIVING LABS PROGRAMME

The Living Labs programme represents the second initiative under the Innovation for Inclusive Development programme. The programme is designed to increase the spatial footprint of innovation in South Africa through the establishment of community-based co-creation innovation labs and support programmes that enable the youth and other designated groups to become innovators and local stakeholders in order to co-create solutions specific to their contexts. TIA has to date supported the establishment of five Living Labs. The programme has launched more than 200 unemployed youth in the economy through innovation skills training, supported 100 beneficiaries through a comprehensive innovation support programme, and raised more than R16 million in co-funding from an initial investment of R9.4 million.

AdNotes

AdNotes (Pty) Ltd (Figure 35) is an innovative project that is receiving support from the Smart Xchange Kwa-Mashu Living Lab through the TIA Living Labs Programme funded by the DSI.

This company is wholly owned by Nathi Mbele, a telecoms entrepreneur. The company has expanded its business into the television white spaces domain, specifically targeting audiences in the township and rural areas. AdNotes is licensed by the Independent Communications Authority of South Africa to operate and provide Internet services.

AdNotes aims to bring affordable fixed broadband connectivity for Internet users who reside in unserved (or underserved) communities. The business is at the forefront of lobbying efforts for the early implementation of television white spaces-based wireless broadband deployment in South Africa in order to ensure that the benefits of Internet connectivity can also be enjoyed by rural communities and lower-income peri-urban marginalised groups who cannot afford commercial broadband offerings.

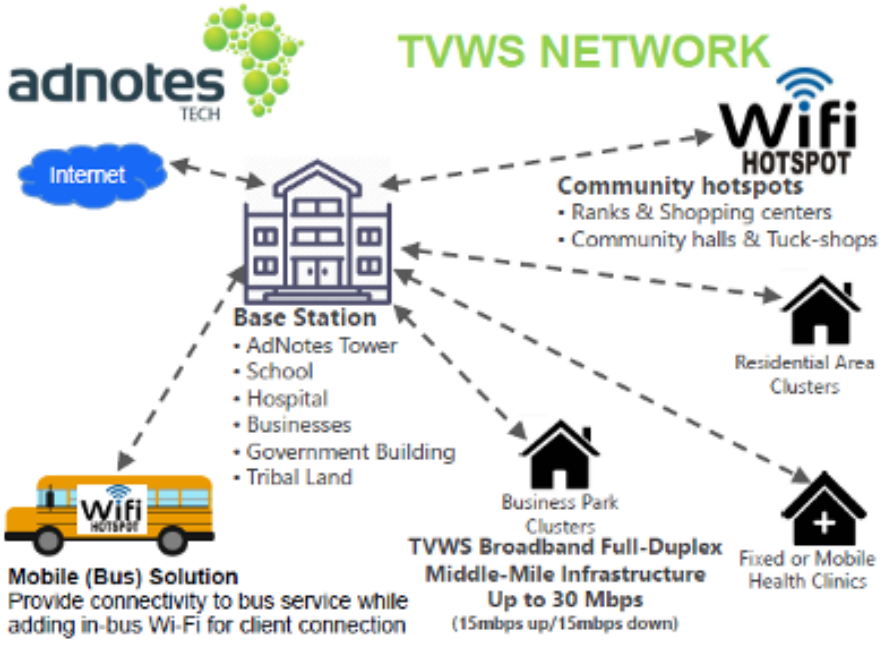


Figure 35: The AdNotes service offering

15.3.6 STRATEGIC PARTNERSHIPS

INDUSTRY MATCHING FUND

TIA's Industry Matching Fund is a risk-sharing, blended financing instrument for co-investment and follow-on funding with other private and public-sector funding entities for technological innovation projects. It seeks to accelerate the commercialisation of local technological innovations through funding support and non-financial support, such as; incubation and assistance with market access and penetration. All funds within the Industry Matching Fund structure submit independent reports and financials, hold regular investment committee meetings, and are supported by advisory boards. TIA is represented within all the funds.

The year ended in a successful contract with Locumbase (Pty) Ltd, a real-time online booking and management platform that brings the availability of verified locum medical professionals to healthcare practices, led by a female founder. In addition, TIA together with Jozi Angels contracted with Hippocampus, a black youth-owned educational technology startup. Both companies have obtained private sector funding, with Locumbase securing R507,000 and Hippocampus R148,500.

University Employment Ecosystem

The matching fund's very first investment was done into Jobox, a university employment ecosystem which connects employers, students, and graduate career offices, in partnership with Jozi Angels. Jbox competed against 188 start-ups from 15 African countries at the African App Launchpad Cup, and was awarded third prize. The competition is an African-wide platform which aims to build the capacity of youth in Egypt and other African countries and foster the establishment of sustainable start-ups in the advanced and ever-changing app and game technologies area.

University Technology Fund

TIA and the SA SME Fund are partners in the University Technology Fund. An initial investment of R3 million by the University Technology Fund into Cape Bio Pharms for the pre-commercialisation of plant-based protein products has leveraged a further R67 million in grant funding from the European Commission towards commercialisation and industrialisation. Furthermore, an application for a 'soft' loan of R46 million from the European Investment Bank to set up a factory is at the due diligence stage. These developments demonstrate TIA's critical role in early-stage, high-risk pre-commercialisation activities towards unlocking further funding for commercialisation and industrialisation. The University Technology Fund also made two investments totalling R13 million to address urgent diagnostics and antibody sequencing related to immunisation.

TIA and the SA SME Fund are also partners in the Savant Venture Fund which has a portfolio of 11 projects, of which six are TIA projects. The Savant Venture Fund has succeeded in attracting the IDC as a partner in the Fund. The IDC's commitment of R44 million in funding will serve to increase the investment capacity of the Fund, specifically to consider more and larger deals.

The Department of Small Business Development's Small Enterprise Finance Agency has signed up to the University Technology Fund, and will contribute R30 million to the initiative. This not only strengthens the partnerships between the DSI and the Department of Small Business Development indirectly, but also expands the reach and impact of the Fund.

> "An initial investment of R3 million by the University Technology Fund into Cape Bio Pharms for the pre-commercialisation of plant-based protein products has leveraged a further R67 million in grant funding from the European Commission towards commercialisation and industrialisation"

INTERNATIONAL PARTNERSHIPS

United Kingdom – Scale Out for Impact Programme

Through its co-funded collaboration agreement with Innovate UK, TIA implements the Scale Out for Impact Programme. TIA signed a collaboration agreement with Innovate UK through the Newton Fund to jointly implement the Programme which aims to build partnerships between innovative SMMEs in the UK and South Africa. The aim is to co-create new ventures in South Africa based on inclusive business models for products and services for consumers in townships and rural areas.

The programme is governed by a steering committee comprised of Innovate UK and Liminal (Innovate UK's delivery partner), the DSI, TIA, the Small Enterprise Development Agency, the British High Commission and the Black Business Council.

Participants were selected from South Africa and the UK and subsequently attended an intensive four-week capacity building course intended to match UK technology providers with South African entrepreneurs. Fifteen joint proposals were developed, with four projects subsequently securing seed funding to scale up their projects, as follows.

- Sexier Waxier: This entails the pilot production and secure distribution of an innovative high-value sugarcane wax from a biorefinery waste stream. Product adulteration is common and the integration of a UK-developed blockchain certification technology will provide sourcing provenance, reduce counterfeiting, and improve supply chain management. High-performance vegan surf wax will be the initial proof-of-concept. The project received R490,500 from TIA and £25,000 from Innovate UK and is a partnership between Sucrochem (Pty) Ltd in South Africa and BlockMark Technologies Ltd in the UK.
- SA Waste and Biomass Valorisation: The project aims to manufacture low-cost, high-quality filaments for 3D printers from waste, specifically recycled polyethylene terephthalate bottles and sugar cane bagasse bio-waste. The project received R500,000 from TIA and £25,000 from Innovate UK. The project is a partnership between SA Rebuilders (Pty) Ltd and Bluepile in South Africa and Tech for Trade, a Charitable Incorporated Organisation in the UK.
- 4IR Aqua Security: The project aims to accelerate the implementation of Sustainable Development Goal 6 (clean water and sanitation for all) through the strategic deployment of smart technologies across the South African water sector. In tandem, the 4IR-AquaTech Accelerator Programme will deliver tailored support and mentoring to entrepreneurs and innovators to deliver positive impact around water security and sustainability. The project is a partnership between ICRD Group Holdings (Pty) Ltd and Msezi Technologies (Pty) Ltd in South Africa and Hexsor Hexsor Scientific Ltd, Membranology Ltd and AquAffirm Ltd in the UK. R500,000 was received from TIA and £25,000 from Innovate UK.
- Future Matters: The project is a community engagement programme focused on material research, organic waste management, and skills creation. This pilot project aims to target the intersection of social, economic, and environmental impact through workshops and community co-creation. The project received R500,000 from TIA and £25,000 from Innovate UK. The initiative is a partnership between Big Circle Studios (a registered not-for-profit company) and Eco-Invader Solutions (Pty) Ltd in South Africa and Materiom in the UK.

PART C

Governance

TIA was established by, and derives its mandate from, the Technology Innovation Agency Act 26 of 2008 (as amended) (the TIA Act). TIA is a schedule 3A public entity under the provisions of the PFMA (No. 1 of 1999). The objective of the agency in terms of the TIA Act is to support the state in stimulating and intensifying technological innovation to improve economic growth and the quality of life of all South Africans by developing and exploiting technological innovations.

TIA is accountable to Parliament through the Parliamentary Portfolio Committee on Higher Education, Science and Technology. The Portfolio Committee exercises oversight over the TIA with the emphasis on service delivery and enhancing economic growth.

During the year under review, TIA appeared before the Portfolio Committee once, on 19 May 2020. TIA's presentation provided an overview of the organisation's Strategic Plan for the period 2020-2025, with a special focus on support provided by TIA in supporting COVID-19 health solutions, such as; access to education and health, COVID-19 pre-screening, PPE production, and the Emergency Ventilator Project.

16. EXECUTIVE AUTHORITY

Oversight by the Executive Authority rests on the prescripts of the PFMA. The Executive Authority has the power to appoint and dismiss the Board of a public entity. The Executive Authority must ensure that Board members having an appropriate mix of skills are appointed to guide the public entity.

The Executive Authority is accountable to Parliament for the achievement of the goals and objectives of TIA. The Executive Authority takes an interest in risk management to the extent necessary to obtain comfort that properly established and functioning systems of risk management are in place to protect TIA against significant risks. As risk management is an important tool to support the achievement of this goal, it is important that the Executive Authority provides leadership to governance and risk management.

TIA's Executive Authority is the Honourable Minister of Higher Education, Science and Innovation, Dr Bonginkosi Emmanuel Nzimande.

The following reports were submitted to the Executive Authority:

- Quarter 1 Report (17 July 2020)
- Quarter 2 Report (20 October 2020)
- Quarter 3 Report (19 January 2021)
- Quarter 4 Report (19 April 2021)
- Annual Report (30 September 2020)

> "The objective of the agency in terms of the TIA Act is to support the state in stimulating and intensifying technological innovation to improve economic growth and the quality of life of all South Africans by developing and exploiting technological innovations."

17. ACCOUNTING AUTHORITY

TIA's accounting authority is the TIA Board, which was appointed on 1 May 2017, by the agency's then Executive Authority, the former Minister of Science and Technology, Naledi Pandor. The Board has completed its four-year term of office, and this has been extended by the Minister in terms of section 8(4) of the TIA Act until end of October 2021, or until the new Board is appointed, whichever comes first.

The Board is, in terms of section 5 of the TIA Act, responsible for the management and control of the agency. Board members are appointed by the Minister on the grounds of their knowledge and experience in technological innovation, technology management, IP and commercialisation thereof, and business skills which – when considered collectively – should enable them to attain the objects of the agency.

The Board considers the practice of good corporate governance as a fundamental component contributing to the success of TIA's business. In the pursuit of, and in its commitment to, the highest standards of governance, the Board provides strategic oversight and effective direction by adhering to the relevant codes of best practice, principles of fairness, integrity, responsibility, accountability, and transparency.

17.1 BOARD CHARTER

A Board Charter is in place which sets out the roles and responsibilities of the Board in relation to the agency, and to govern the conduct of the Board. The Board Charter is central to determining how the Board interacts with management, the shareholder, and other stakeholders. In addition, Board members' responsibilities and limitations are primarily set out in the TIA Act, the PFMA, the King reports on Corporate Governance, and the common law of South Africa.

The Board is responsible for:

- Acting as the focal point for, and custodian of, corporate governance by managing its relationship with management, the shareholder, and other stakeholders of the agency along sound corporate governance principles;
- Providing effective leadership on an ethical foundation;
- Appreciating that stakeholders' perceptions affect the agency's reputation;
- Adoption of strategic plans;
- Appointing a suitably skilled and qualified person as the CEO of the agency, whose appointment must be made after following a transparent and competitive selection process;
- Retaining full and effective control over the agency, and monitoring management in implementing Board plans and strategies;
- Monitoring of operational performance and management;
- Ensuring that the agency complies with all relevant laws, regulations and codes of business practice;
- Ensuring that the agency communicates with its internal and external stakeholders openly and promptly and with substance prevailing over form;
- Developing a code of conduct that addresses conflicts of interest, particularly relating to Board members and management;
- Ensuring that there is an appropriate balance of power and authority on the Board, such that no individual or select individuals can dominate the Board's decision-making;
- Defining and monitoring the information needs of the Board;
- Identification and monitoring of the non-financial aspects relevant to the business of the agency; and
- Through its subcommittees, prioritise and manage risks which seek to impede the business of TIA.

17.2 COMPOSITION OF THE BOARD

Table 22 provides a detailed list of TIA Board members.

Table 22: TIA Board members and their particulars

Full name and designation	Dates appointed and resigned	Qualifications	Area of expertise	Board Directorships	Other Committees or task teams
Butana Mboniswa (Interim Chairperson of the Board)	8 August 2019 to date	MSc Biochemistry BSc (Hons) Biochemistry Corporate Governance Course Gap Biosciences Executive Education Course Personal Mastery and several management courses Advanced Leadership Programme	Leadership, Chemical bioscience, Chemical science, Technology management	Sereko Technology & Innovation Advisors, Sereko Projects, Tlokwe Health Professional Group, Inqaba Biotechnical Industries, Black Science Technology Engineering Professionals	None
Dr Stephen John Lennon	1 May 2017 to date	PhD, Physical Metallurgy MSc Engineering, Physical Metallurgy BSc Chemistry, Applied Chemistry Senior Management Programme, Prince of Wales Business & Environment Programme	Business development, Energy, Technological innovation	Shanduvan (Pty) Ltd, Yamatji Southern Regional Corporation Ltd, Yamatji Enterprises Ltd, Murujuga Commercial Ltd	None
Joy Sebenzile Matsebula (member)	1 May 2017 to date	MSc Biometrics BSc Natural Sciences, Environmental Sciences & Biometrics	Business development, Social justice, Human rights, Disability mainstreaming, Governance, Statistics & Scientific research	Dempower, Divuseni Trading and Investments, ICT SMME Chamber, Johannesburg International Airport, Kuzuko Lodge, Lanseria Airport 1993, Lanseria Airport Investments, Lanseria Holdings, Lanseria International Airport, Lindandanda Consulting Investments & Trading, Motswako Office Solutions, Ngwedi Investment Managers, Petatex, Taquanta Securities, Taquanta Asset Managers, Taquanta Investment Holdings	Centre for Alternative & Augmentative Communication, Disability Economic Empowerment Trust, Disability Empowerment Concerns Trust, First Rand Foundation, South African Development Trust for Disabled People, Presidential Working Group on Disability, The Sebenzile Matsebula Foundation
Thabiso Gerald Ramasike (member)	1 May 2017 to date	BCom BANKSETA International Executive Development Senior Executive Leadership Development Programme Certified Associate (CAIB (SA))	Businessman, Strategist, Public speaker, Philanthropist	Kwena Fund Managers, Kwena Franchise Fund, Eic Wealth Investors, Ramasike Investment Club, Thabiso Ramasike Investments, Mes Mould Empower Serve, Bushveld Crushers, African Unity Life, Tuleka Group	Member: Audit and Risk Committees of South African Revenue Service, MES, African Unity Insurance Ltd, Chairperson: Social, Ethics, Transformation & Sustainability Committee (African Unity Insurance Ltd)

Table 22: TIA Board members and their particulars (continued)

Full name and designation	Dates appointed and resigned	Qualifications	Area of expertise	Board Directorships	Other Committees or task teams
Dr Jan van de Loosdrecht (member)	1 May 2017 to date	PhD Chemistry MSc Chemistry MBA	Technology innovation, Technology management, Technology development, Technology commercialisation, IP	None	None
Dr Mziwandile Madikizela (member)	1 May 2017 to date	PhD Biochemistry MSc Biochemistry MBA BSc Hons Biochemistry Certificate in Technology Management Executive coaching, Certificate in Programme Leadership Coaching	Consultant: STI, Executive coach, Technology management research; Commercialisation, Innovation management, Regional innovation systems, Molecular parasitology, Cancer research, Clinical trials	South African Medical Research Council, Stellachem, Razocure Medical Products	Member: Audit Committee SAMRC, Expert panel member for NACI STI Indicator Report, Extra-ordinary Senior lecturer at Graduate School of Technology Management (University of Pretoria)
Dr Patience Lethabo Mlengana (member)	1 May 2017 to date	PhD in Leadership & Management Masters Degree in Information Science Honours Degree in Information Science Postgraduate Diploma in Information Science BA in Social Sciences	Information Technology, Market research, Product management, Commercial property	Tshahani Resources, Century Property Estates, Angels City, PWM Technologies, Nyathela Consulting 2, Mhlari Kulaleni Agricultural Primary Co-Operative Ltd, Inqubela Agricultural Co-Operative Ltd, Zakele Consulting, F Cubed South Africa, Cyclo Capital, PMM Property Holdings, Vi Women's Investments	None
Fuzlin Levy-Hassen (Interim CEO and ex officio Board member)	13 June 2019 to 12 June 2020	Chartered Accountant CA(SA) B Com (Hons) Accounting Post Graduate Diploma in Accounting Bachelor of Commerce Certificate in Venture Capital	Chartered accountancy, Deal sourcing, Audits, Company & risk analysis, Turnaround strategies, Technology innovation & commercialisation, Venture capital, Private equity, Investment banking, Due diligence, Post investment management, Lecturing	Zasfr Holdings (Pty) Ltd	Member: Audit Committee (Bankmed)
Patrick Krappie (Acting CEO and ex officio Board member)	13 June to date	BCom (Hons) Economics	Economic policy, International diplomacy & negotiation, Collaborative leadership, Stakeholder management, Partnership building, Strategy & execution	None	Member: Innovation Challenge Pilot Project Steering Committee, Co-Chair: Innovation for Inclusive Development Steering Committee, Member: Afrique du Sud Steering Committee

The Board convened for a total of 13 meetings in the period under review. The dates of the meetings and Board member attendance is provided in Table 23.

Table 23: Board dates of meetings and attendance record

Member	No. of meetings attended	17 Apr 2020	29 May 2020	3 Jun 2020	22 Jun 2020	17 Jul 2020	28 Jul 2020	28 Aug 2020	30 Sept 2020	20 Oct 2020	26 Nov 2020	19 Jan 2021	1 Mar 2021	13 Mar 2021
Butana Mboniswa	13	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Dr Stephen Lennon	12	✓	✓	✓	✓	×	✓	✓	✓	✓	✓	✓	✓	✓
Thabiso Ramasike	13	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Dr Jan van de Loosdrecht	10	✓	✓	✓	×	×	✓	✓	✓	✓	✓	✓	✓	×
Dr Mziwandile Madikizela	12	✓	✓	✓	✓	✓	✓	✓	×	✓	✓	✓	✓	✓
Sebenzile Matsebula	13	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Dr Patience Mlengana	7	×	✓	✓	×	×	✓	✓	×	✓	✓	✓	×	×
Fuzlin Levy-Hassen	2	✓	✓	×										
Patrick Krappie	10				✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Legend

✓ In attendance

× Not in attendance

The Board has recognised the relevance and significance of TIA's role in the NSI, and has prioritised the Bio-economy Strategy, the TSP, and commercialisation for the successful implementation of TIA's mandate. The Board met at a strategy session workshop on 22 and 23 October 2020, to define areas for improvement and determine prospective initiatives to strengthen TIA's position in the NSI.

17.3 COMMITTEES

TIA's Audit and Risk Committee (A&RC),[11] Investment and Finance Committee (IFC), Human Resources and Remuneration Committee (HR&REMCO) and Board Technical Committee of TIA have been tasked with specific responsibilities in order to effectively attend to the matters of the Board.

17.3.1 AUDIT AND RISK COMMITTEE

The A&RC is constituted in terms of section 77 of the PFMA, read with Chapter 27 of the Treasury Regulations.

The A&RC assists the Board in discharging its duties relating to the safeguarding of assets, the operation of adequate systems, control processes, and the preparation of accurate financial reporting and statements in compliance with all applicable legal requirements, accounting and auditing standards. The ethical function of a Social and Ethics Committee as envisaged in the Companies Act 71 of 2008 are incorporated into the Terms of Reference of the A&RC.

During the reporting period, the Committee monitored the effectiveness of TIA's internal controls, governance, and compliance with its risk management framework. A combined assurance plan was approved to ensure that the agency adopts a coordinated approach to all assurance activities. Whilst several material risks emerged, no internal or external audit findings have come to the attention of the Committee to indicate that any material breakdown of internal controls occurred during the year under review.

[11] The Audit and Risk Committee is normally abbreviated as 'ARC' within the TIA environment. To avoid confusion with the broadly-used acronym of ARC for the Agricultural Research Council within the South African NSI, the Audit and Risk Committee is abbreviated as 'A&RC' in this report.

The A&RC convened for a total of 11 times in the period under review as shown in Table 24.

Table 24: A&RC dates of meetings and attendance record

Member	No. of meetings attended	15 Apr 2020	22 May 2020	25 May 2020	27 Jun 2020	15 Jul 2020	18 Aug 2020	29 Sept 2020	16 Oct 2020	16 Nov 2020	26 Nov 2020	14 Jan 2021	15 Feb 2021	13 Mar 2021
Thabiso Ramasike (Chairman)	11	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Dr Stephen Lennon	11	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Dr Jan van de Loosdrecht	10	✓	✓	✓	✓	×	✓	✓	✓	✓	✓	✓	✓	✓

Legend

✓ In attendance

× Not in attendance

17.3.2 INVESTMENT AND FINANCE COMMITTEE

The IFC provides oversight and advice to the Board on issues central to the Board's core mandate. The Committee makes funding decisions in pursuit of TIA's mandate and strategic objectives within the specific thresholds determined in, and guided by, the Investment Framework Policy, as prescribed by Section 5(3) of the TIA Act.

The IFC considers investment proposals where TIA's exposure per project is above R15 million but below or equal to R30 million, and oversees the management of financial resources within its delegated authority. The Committee further considers ad-hoc matters as delegated to the Committee by the Board from time to time.

During the reporting period, the Committee approved an amount of R18.3 million towards development of a satellite technology which would make satellite communication more accessible to machine-to-machine communications and Internet of Things applications. Other projects approved by the Committee include additional funding of R6.7 million to an existing artificial intelligence project, R30.8 million towards the development and commercialisation of advanced machinery to be used in the forestry industry, and an amount of R24 million towards the development of a unique portfolio of bio-pesticides and formulation technologies that would enable profitable eco-friendly farming. In addition, the Committee provided oversight over the development of a strategy to participate in the newly established Innovation Fund and the implementation of the initial phase thereof.

The IFC convened for a total of nine times in the period under review as shown in Table 25.

Table 25: IFC dates of meetings and attendance record

Member	No. of meetings attended	14 May 2020	6 Jul 2020	14 Aug 2020	5 Nov 2020	18 Nov 2020	10 Dec 2020	15 Dec 2020	17 Feb 2021	23 Mar 2021
Dr Stephen Lennon (Chairperson)	9	✓	✓	✓	✓	✓	✓	✓	✓	✓
Butana Mboniswa	9	✓	✓	✓	✓	✓	✓	✓	✓	✓
Dr Jan van de Loosdrecht*	1	✓	×							
Dr Mziwandile Madikizela	8	✓	✓	✓	×	✓	✓	✓	✓	✓

* Resigned as member of IFC on 19 July 2020

Legend

✓ In attendance

× Not in attendance

17.3.3 HUMAN RESOURCES AND REMUNERATION COMMITTEE

The HR&REMCO derives its authority from the Board and was established in order to oversee and provide advice to the Board on issues central to TIA's human resource capability, design and strategy, as well as remuneration and succession planning.

The Committee is responsible for ensuring that TIA develops a framework, policies, guidelines, and an environment that allows the agency to employ, reward, and retain dedicated, motivated, efficient and loyal employees so as to achieve TIA's long-term strategic goals. The social functions of a Social and Ethics Committee as envisaged in the Companies Act 71 of 2008 are incorporated into the Terms of Reference of the HR&REMCO, dealing with matters such as: environment, health and safety, consumer relationships, labour, and employment.

During the period under review the Committee provided oversight over measures taken by management on a continuous basis to ensure the safety of employees in the face of the COVID-19 pandemic. The Committee also provided guidance in and approved the appointment of a number of executives, approved changes to the Organisational Structure to better align it with the Strategic Plan, approved the Corporate Balanced Scorecard for final approval by the Board, and approved an Employee Value Proposition and a revised Recruitment and Selection policy.

The HR&REMCO convened for a total of 10 times in the period under review as shown in Table 26.

Table 26: HR&REMCO dates of meetings and attendance record

Member	No. of meetings attended	12 May 2020	27 May 2020	15 Jun 2020	24 Jul 2020	12 Aug 2020	14 Oct 2020	12 Nov 2020	2 Dec 2020	19 Feb 2021	17 Mar 2021
Sebenzile Matsebula (Chairperson)	10	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Dr Mziwandile Madikizela	10	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Dr Patience Mlengana	8	✓	✓	✓	×	✓	✓	✓	×	✓	✓
Thabiso Ramasike	10	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Legend

✓ In attendance

× Not in attendance

17.3.4 BOARD TECHNICAL COMMITTEE

The purpose of the Board Technical Committee of TIA ('the Technical Committee') is primarily to provide high-level strategic and technical advice to the Board and management of TIA. The initial focus of the Technical Committee's work will be on TIA's Bio-economy strategy as it relates to knowledge-based production and utilisation of renewable resources, in order to provide products, processes and services in all economic sectors, within the framework of an economic system that is viable for the future.

The Committee may also consider matters of a technical nature which relate to other aspects of TIA's mandate, in fulfilling its goals of supporting the commercialisation of technological innovations, increasing infrastructure access for technology development, and stimulating an agile and responsive NSI. The Technical Committee also considers matters which may be referred to it by the Board or presented to it by the management of TIA. It has a strategic advisory function and does not have powers to approve transactions. Where relevant, the Committee shall operate within the specific thresholds determined by the Delegation of Authority Framework as approved by the Board. Due to restrictions placed on the number of committees Board members may serve on in terms of the amended TIA Act, and given that TIA currently has the minimum number of legislated members appointed to the Board, the Technical Committee could not function optimally during the period under review.

17.4 REMUNERATION OF BOARD MEMBERS

Board members receive fees for services they render to the Board and the executive authority in accordance with the relevant tariffs as determined by National Treasury, and which are regulated and updated from time to time, and approved by the Minister. All Board members' travel costs in relation to executing their duties as TIA Board members (such as airfare and car hire) are paid for by TIA. Board members are also reimbursed for incidental expenses such as airport parking, toll fees, and transfer fares. For the use of their personal vehicles in conducting TIA's business, they are reimbursed per kilometre as permitted by TIA's travel policy. The breakdown of each members' remuneration is presented in note 27 (members' emoluments) of the AFS, presented in Part E.

18. RISK MANAGEMENT

The A&RC provides an oversight role on the effectiveness of TIA's risk management process, which is integrated and central to its strategic planning process. TIA has an approved Risk Management Policy and risk assessments are conducted annually to determine the effectiveness of mitigation strategies and to identify emerging risks. TIA has identified, analysed, evaluated, monitored, and reported on the risk exposure emanating from the strategic and operational risks impacting on the accomplishment of its set strategic goals and objectives, in accordance with the approved Risk Management Policy.

TIA's enterprise-wide risk management activities and initiatives were consistently aligned to best international practices (ISO 31000 – 2018 International Standards, COSO: Enterprise Risk Management – Integrated Framework (September 2017), King IV Report on Corporate Governance, the Public Sector Risk Management Framework and Institute of Risk Management South Africa risk principles). Accordingly, A&RC can report that the risk management processes for the period under review were adequate.

19. INTERNAL CONTROL UNIT

Whilst the agency does not have a separate Internal Control unit, TIA's management has established and maintained an effective system of internal controls. The objectives of the system of internal control are to ensure that:

- Risks are properly managed;
- Assets are safeguarded;
- Financial and operational information is reliable;
- Operations are effective and efficient; and
- Laws, regulations and contracts are complied with.

Internal Audit assesses whether the internal controls upon which management relies to mitigate the risks to acceptable levels are appropriate and functioning as intended and develops recommendations for enhancement or improvements in the internal control environment.

20. INTERNAL AUDIT

20.1 PURPOSE AND OBJECTIVES

It is a requirement of the PFMA that an Internal Audit function must exist for all public entities. The primary objective of the Internal Audit function is to provide management, the A&RC and the Board with an independent and objective level of assurance. By partnering and collaborating with management, this assurance is designed to add value and improve TIA's operations, its internal control environment, risk management, and governance processes. In addition, Internal Audit assists TIA in accomplishing its objectives by bringing a risk-based, systematic, and disciplined approach to evaluating and improving the effectiveness of risk management, internal control, and governance processes.

The Internal Audit function remains in-house and the unit has maintained its independence by reporting functionally to the A&RC and administratively to the CEO. The unit has established processes and procedures, supported by a sound internal audit methodology. The purpose, authority, and responsibility of internal audit are encapsulated in the internal audit charter, which is approved annually by the A&RC.

20.2 KEY INTERNAL AUDIT ACTIVITIES

The primary scope of the Internal Audit function is to provide TIA with an independent capability to perform assurance audits that are consistent with the relevant legislation, responds to TIA's priorities and are aligned to TIA's objectives. The function provides value-added assurance, supports positive change within TIA and supports stewardship and accountability in the spending of public funds. Internal Audit focuses on the following key activities (amongst others):

- Risk areas are adequately identified and addressed.
- Breakdowns in key internal controls are identified and reported on, with appropriate improvements in response to these instances, that appropriate improvements can be recommended and agreed with management for implementation.
- Non-compliance with TIA's corporate governance, policies and procedures, applicable regulations, and statutory requirements are identified, with implementation plans put in place to address and resolve these matters.

20.3 SUMMARY OF WORK DONE IN 2020/21

In accordance with the National Treasury requirements, an Annual Internal Audit Plan was prepared for 2020/21, which was approved by TIA's A&RC, as required. The plan was developed to enhance organisational value by providing risk-based and objective assurance, advice, and insight through professional practices to cope with emerging challenges.

During the period under review, an annual allocation of resources to audit activities was established on the basis of a systematic risk-based assessment, taking into account various financial, operational, and strategic internal and external risks, policies, processes, the requirements of the PFMA, Treasury Regulations etc. In line with the approved Annual Internal Audit Plan, audits were conducted across various TIA functional areas. Additionally, a certain amount of capacity was utilised for ad-hoc projects, special investigations, whistle-blowing matters, and requests from management, A&RC, and the Board.

From an overarching perspective, during the period under review, the Internal Audit team completed all the planned audit activities, which includes internal assurance audits, project/programme audits, advisory assignments, and ad-hoc requests. In this regard, 100% of the agreed assurance audit activities were completed, as well as completing more ad-hoc assignments than planned. Furthermore, no evidence was presented to suggest that there were material breakdowns in, or threats to, the internal control environment and the most significant risks at TIA are at acceptable levels. A year-on-year comparison in internal audit showed a marginal improvement in the control environment, with TIA developing and implementing more stringent controls, with a significant decrease in the number of critical and major audit matters. All recommendations provided by internal audit have been appreciated and adopted by TIA management, where applicable.

20.4 COMPLIANCE WITH LAWS AND REGULATIONS

TIA has implemented sufficient and adequate processes, procedures, policies, and frameworks to ensure that the agency complies with legislative or regulatory matters impacting TIA. The Internal Audit planning process identifies audit areas in a manner that ensures compliance with legislative requirements and supports a value-added audit process. Non-compliance with applicable regulations and statutory requirements are identified, and guidance is provided for implementation plans to address and resolve these matters of non-compliance.

21. FRAUD AND CORRUPTION

The provisions of Section 38(1)(a)(i) of the PFMA stipulates that the Accounting Authority is responsible for ensuring that an organisation has and maintains an effective, efficient, and transparent system of financial, risk management, and internal controls. For this purpose, TIA has implemented a Fraud and Corruption Prevention Policy.

Fraud means the unlawful and intentional making of a misrepresentation which causes actual prejudice or which is potentially prejudicial to another, and includes offences in respect of corrupt activities as defined in the Prevention and Combating of Corrupt Activities Act 12 of 2004, and cybercrime as defined in the Electronic Communications and Transactions Act 25 of 2002.

Corruption is any conduct or behaviour where a person accepts, agrees to, or offers any gratification for himself/herself or for another person where the purpose is to act dishonestly or illegally. Such behaviour also includes the misuse of material or information, abuse of a position of authority, or a breach of trust or violation of duty.

21.1 PROCEDURE FOR DISCLOSURE

In terms of the amended act an employer is required to implement internal procedures for receiving and dealing with information about improprieties and shall do so as follows:

- Any disclosure shall first be raised with the employee's line manager, verbally or in writing.
- Should the employee feel uncomfortable, or if the line manager is party to the disclosed facts, the disclosure may then be raised with:
    - The Executive: Corporate Services;
    - Any other Executive or Manager;
    - The Company Secretary;
    - The CEO; or
    - The Head: Internal Audit.
- Should the above channels have been exhausted internally and the employee is of the opinion that the disclosure could not be trusted in the hands of the above employees for whatever reason, s/he may approach the Chairman of A&RC, or make use of TIA's independent service provider for whistle-blowing, whose hotline number is communicated to all staff.
- Should an employee be uncomfortable approaching TIA staff or the independent service provider for whistle-blowing s/he can call the National Anti-Corruption hotline.

Once a disclosure has been made, Management shall be obliged to:

- Acknowledge receipt of the disclosure in writing;
- Within a period of 21 days after receiving the protected disclosure, decide whether to investigate the matter or refer the disclosure to another person or body, if the disclosure could be investigated or dealt with more appropriately by that other person or body; and
- Inform the employee making a disclosure as to what steps had been taken once the disclosure has been made.

TIA shall ensure that any employee who makes a disclosure shall not be penalised or suffer any occupational detriment for doing so. Employees making a disclosure are not required to disclose their names.

22. MINIMISING CONFLICT OF INTEREST

Annually, and on an ad-hoc basis, through active solicitation, members are required to disclose potential conflicts of interest. During the period under review, disclosures received from members were closely scrutinised by the Company Secretary and the A&RC Chairman. No conflicts or potential conflicts of interests were noted. Where required, members were excused from matters which have given rise to conflicts of interests. Members are regularly encouraged to disclose potential conflicts at every meeting.

23. CODE OF CONDUCT

To support good governance, TIA adopted a code of ethics and values as part of its policies and procedures. The code is adhered to in TIA's dealings with all stakeholders and organisations, internally, externally, nationally, and globally. The Board operates and conducts itself through three standing subcommittees: The Audit and Risk Committee, the Investment and Finance Committee, and the Human Resources and Remuneration Committee. The Board's devolution of responsibilities, therefore, falls on these three subcommittees, which meet independently and report regularly to the full Board through their respective chairpersons.

24. HEALTH, SAFETY AND ENVIRONMENTAL ISSUES

TIA is committed to prioritising the safety of employees and visitors by ensuring safe and secure working environments. TIA ensures compliance to occupational health and safety governance obligations by maintaining offices and providing the necessary equipment. The internal occupational health and safety measures implemented are aimed at protecting employees and visitors. Regular inspections are conducted in the workplace to identify and minimise hazards that could potentially affect the safety of employees and visitors or expose them to health risks. Health and safety representatives have also been trained to respond to office environment emergencies.

Emergency evacuation exercises were conducted to ensure that all employees are familiar with the emergency procedures and to test TIA's state of preparedness in case of emergencies. The fire equipment, backup generator, and uninterrupted power supply systems have been regularly tested throughout the year to avoid operation disruptions and ensure business continuity.

TIA implemented additional health and safety protocols in response to the COVID-19 pandemic. Measures included complying with the National lockdown requirements and requiring that staff members work from home during the lockdown, issuing personal protective equipment (masks) and hand sanitisers to staff members, and installing hand sanitising stations in TIA offices to protect TIA's staff members and our clients. Staff members have mostly continued to work remotely during the year to minimise the chance of staff members and their families contracting and spreading the coronavirus.

25. BROAD-BASED BLACK ECONOMIC EMPOWERMENT

TIA continues with the commitment to supporting the country's transformational agenda and the policy objectives of B-BBEE. This is entrenched through contributions in various areas including skills, enterprise and supplier development, as well as preferential procurement. TIA does not only focus on its own B-BBEE contribution, but also ensures that the principles of B-BBEE are entrenched within the businesses of its funded projects through continuous monitoring of project transformational plans. Further, enhanced targeted investment strategies will be implemented in 2021/22 to facilitate transformation and inclusiveness within the NSI.

26. COMPANY SECRETARY

The Company Secretary provides the Board with professional and independent guidance on corporate governance and its legal duties. In addition to coordinating the functioning of the Board and its Committees, the Company Secretary acts as a central source of information and advice to the Board on matters of ethics, adherence to good corporate governance principles, compliance with procedures, and applicable statutes and regulations.

In accordance with Principle 10 of the King IV Report on Corporate Governance for South Africa 2016 (King IV™ 2016), the company secretary reports functionally to the Board, and administratively to the CEO, as the designated member of the executive management for this purpose. The Company Secretary is not a Board member, and has unfettered access to the Board, but maintains an arms-length relationship with the Board and its members. The appointment of the Company Secretary, Mr Louw, including his employment contract and remuneration, was approved by the Board.

The Company Secretary has certified that, to the best of his knowledge and belief, TIA has lodged all such returns as are required in terms of the Companies Act 71 of 2008, and that such returns are true, correct, and up to date. In addition, he has certified that TIA has lodged with the Minister of Higher Education, Science and Innovation the financial statements in respect of the preceding financial year.

27. BOARD EVALUATION

A Board evaluation, facilitated by an independent external consultant, was conducted during the year under review. The evaluation was done in respect of the performance of the Board, as well as the A&RC, IFC, and HR&REMCO.

The evaluation covered five main governance areas, namely Board composition, Board culture, Board roles and responsibilities, Board committees, and Board role-players. The overall result of the evaluation is that the Board is performing at a "good" level, according to the views of the Board members. The detailed analysis and commentary in respect of the five governance areas include the following:

- The Board has a good grasp of the fundamental principles of good governance and there is some room for growth to optimal levels of best practice.
- The Board is understaffed which impacts on its ability to perform optimally.
- Whilst the three existing Board committees are performing efficiently, a shortage of manpower has a negative impact on the Board's ability to realise its full performance potential. As a result, the Board Technical Committee is currently not able to perform its function efficiently.
- The Board should consider implementing a multi-pronged stakeholder management approach as part of its work plan.

The Company Secretary was rated higher than the overall TIA average score during the Board evaluation process, and was rated as "excellent" in the quality of administrative tasks which sit at the core of the secretarial function.

28. SOCIAL RESPONSIBILITY

Due to the COVID-19 pandemic and associated restriction of movement, TIA was unfortunately not able to hold its annual TIA Cares Charity Event.

29. AUDIT AND RISK COMMITTEE REPORT

We are pleased to present our report for the financial year ended 31 March 2021.

29.1 AUDIT AND RISK COMMITTEE STATEMENT

The A&RC is appointed in terms of section 94(2) of the Companies Act (2008) and section 51 of the PFMA, read with principle 8 of King IV™ 2016. The committee has performed its duties and carried out its responsibilities in accordance with its annually reviewed charter, and has executed specific duties delegated to it by the Board. Among other things, the charter empowers the committee with the following responsibilities:

- Examine and review the AFS and report on the final results.
- Appoint and evaluate the qualification, appropriateness, eligibility, and independence of the external auditor.
- Approve the internal audit plan, internal audit charter, and fees of the external auditor.
- Evaluate the scope and effectiveness of the internal audit function to ensure that effective internal controls have been identified and are in place.
- Ensure TIA complies with legal and financial regulatory requirements.
- Evaluate the adequacy and efficiency of the internal control systems, accounting practices, information systems, and auditing processes applied in the management of TIA.
- Discharge its duties relating to the safeguarding of assets, the implementation of adequate IT systems, effective control processes, and the preparation of accurate financial reporting and statements in compliance with all applicable legal requirements and accounting standards.
- Monitor financial and all other risks, ensuring that mitigating action plans are in place.

29.2 AUDIT COMMITTEE RESPONSIBILITY

The Audit Committee reports that it has complied with its responsibilities arising from section 51 (1)(a)(ii) of the PFMA and Treasury Regulation 27.1. The Audit Committee also reports that it has adopted appropriate formal terms of reference as its Audit Committee Charter, has regulated its affairs in compliance with this charter and has discharged all its responsibilities as contained therein, except that we have not reviewed changes in accounting policies and practices.

29.3 THE EFFECTIVENESS OF INTERNAL CONTROLS

Internal Audit is responsible for the evaluation of the effectiveness of TIA's internal controls, including recommending improvement of the same. Therefore, Internal Audit must determine whether the internal controls designed and applied by management are adequate and functions as intended.

Our review of the findings of the Internal Audit work, which was based on the risk assessments conducted in the public entity, revealed certain weaknesses and areas of improvement, which were then raised with the public entity.

Internal Audit provided the following assurance to TIA management and the Board during the year under review.

- Assets are adequately and appropriately safeguarded.
- Funds disbursed by TIA are managed economically, effectively, and efficiently.
- Applicable laws, regulations, and directives are complied with.
- Resources are acquired economically, utilised efficiently, and are adequately protected.
- Significant financial, managerial, and operating information is accurate, reliable, and timeously available.
- Internal controls and systems (including IT systems) and corporate governance practices are efficient and effective.
- Acts, regulations, policies, procedures, and contracts are complied with.
- Financial and operating information is effective.
- Recommendations for improvement of the efficiency and effectiveness of operations were provided

Whilst several areas of improvement were identified, there is reasonable assurance that the most significant risks at TIA are at acceptable levels. It is our overall view that the control environment has improved marginally since the previous financial year, based on a number of critical factors.

All the outcomes from specific investigations undertaken by Internal Audit were adequately resolved during the year under review.

29.4 IN-YEAR MANAGEMENT AND MONTHLY/ QUARTERLY REPORTING

In 2020/21, TIA reported quarterly to its executive authority as per the requirements of section 5.3.1 of the Treasury Regulations, read together with sections 27(4) and 40 of the PFMA. In the period under review, the A&RC ensured compliance with section 5.3.1 for the establishment of such procedures. In consideration of the reports during the year, the committee guided management in reviewing targets and assessing the adequacy of quarterly performance reports against the targets.

The public entity has reported monthly and quarterly to National Treasury, as is required by the PFMA.

29.5 EVALUATION OF FINANCIAL STATEMENTS

A&RC reviewed the AFS and agreed that the statement presented fairly, in all material respects, the consolidated financial position

of TIA. The committee concluded that it was satisfied that the statements complied with GRAP.

29.6 EXTERNAL AUDITOR

The external auditors, Rakoma & Associates Inc., remain on record with oversight by the office of the Auditor-General of South Africa. A&RC was satisfied that the external auditors have complied with sections 90(2)(b) and 94(8) of the Companies Act (2008), as amended, and confirmed that there are no conflicts of interest as determined by the criteria prescribed by the Independent Regulatory Board for Auditors. A&RC, in consultation with management, agreed to the terms contained in the engagement letter, audit plan and audit fees for the financial year ended 31 March 2021. In consideration of the external audit plan, the committee was satisfied that it is comprehensive and adequately interrogates the risk areas identified. The external auditors remain independent and no non-audit services were provided. In further consideration of their services and engagement with the external auditors, A&RC was satisfied that:

- The quality and effectiveness of their services were appropriate;
- In-camera sessions excluding management were held when required; and
- A level of assurance was provided to confirm that Rakoma & Associates Inc. maintained its integrity as a firm through open and transparent processes, and accordingly posed no risk to TIA during the execution of its duties.

No reportable irregularities were identified by the external auditors.

29.7 AUDITOR'S REPORT

We have reviewed the entity's implementation plan for audit issues raised in the prior year and we are satisfied that the matters have been adequately resolved.

The Audit Committee concurs and accepts the conclusions of the Auditor-General on the AFS and is of the opinion that the audited AFS be accepted and read together with the report of the Auditor-General.

29.8 GOING CONCERN

Management provided assurance that TIA is a going concern. Through its annual funding allocation received from its executive authority, income from royalties and interest received, there appeared to be no indicators to suggest that TIA will not continue as a going concern for the next 12 months.

29.9 FRAUD PREVENTION

A fraud prevention policy and procedure is in place, along with an anonymous ethics line, to manage potential concerns raised. During the period under review, no complaints or concerns about potential fraud were raised.

A&RC assists the Board in discharging its duties regarding the identification, responsiveness, and mitigation strategies in relation to fraud prevention. In this regard, A&RC has ensured that fraud prevention policies and procedures are in place, along with an anonymous ethics line to manage matters relating to fraud and A&RC regularly evaluates the effectiveness of these processes.

29.10 RISK MANAGEMENT

Risk management remains central to TIA's business. Key strategic risks were identified and deliberated on by management and the Board. Risks were evaluated in terms of impact and likelihood. Appropriate actions and action plans have been considered and implemented, where required, to mitigate risks. Management is aware of the need to improve risk management in terms of the following:

- Embedding risk management within the organisational processes.
- Risk tolerance and appetite review and consideration.

Management regularly reviews risk-related internal control processes and will continue to do so through the recently re-established Risk Management Committee. Actions are delegated to staff with the encouragement to embed risk management in the execution of their daily tasks.

29.11 INFORMATION TECHNOLOGY GOVERNANCE

A&RC is responsible for monitoring IT governance. The approved IT policies that are in place and the procedures that have been implemented safeguard TIA's IT systems and information, and draw on the agency's disaster recovery plans when necessary. There were no material weaknesses found in TIA's IT environment during the period under review.

29.12 GOVERNANCE ON QUALITY

The Board was pleased to learn of management having secured the recertification of TIA's ISO 9001:2015 standard following a surveillance audit in the fourth quarter of 2020/21. This standard is used to demonstrate the agency's ability to consistently provide products and services that meet customer and regulatory requirements.

Thabiso Ramasike
Audit and Risk Committee Chairperson

PART D

Human Resource Management

30. INTRODUCTION

TIA's Human Resources unit resides within the Corporate Services Division. This unit is mainly responsible for implementing and maintaining the full human resources value chain offering (Figure 36), adding value to TIA by ensuring that each sub-programme is adequately resourced and capacitated to deliver on the strategy.

Human Resources focuses on recruitment and selection, as well as reward and recognition in line with approved budgets. It drives talent management, performance management, succession planning, and promotes staff wellness.

The TIA Board filled most of the executive positions during the year under review. The position of CEO is on hold, pending a review of TIA.

Management identified the need to create self-awareness in order to enhance collaboration amongst team members. Personality assessments were conducted, using the Meyers-Briggs Type Indicator to inform a better understanding of team dynamics within the organisation. This is a personality assessment tool that is applied globally to identify personality preferences, and to discern how these enable decision-making, approach to the outside world, accumulation and assimilation of information, and what energises individuals. Following these assessments, executive mentoring and coaching commenced.

Figure 36: TIA's human resources value chain offering

31. HUMAN RESOURCES OVERSIGHT STATISTICS

31.1 PERSONNEL COST BY PROGRAMME

During August 2020, the Board approved a revised organisational structure, geared towards the implementation of the 2020-2025 Strategic Plan. The core divisions constitute the Bio-economy, Commercialisation, and Innovation Enabling divisions. All the support functions are reported under Administration.

As a result of the current economic conditions, measures were implemented to reduce operational expenditure as well as personnel expenditure. The total number of employees remunerated increased from 155 as at 31 March 2020, to 163 as at 31 March 2021. This resulted in an increase in the personnel expenditure as a percentage of total expenditure from 17,6% to 17,8%. The average personnel cost per employee reduced from approximately R703,000 to R620,000 over the last financial year. Personnel costs by division are shown in Table 27.

Table 27: Personnel costs by division for 2020/21

Division	Total expenditure for the entity (R'000)	Personnel expenditure (R'000)	Personnel expenditure as a % of total expenditure	Number of employees	Average personnel cost per employee (R'000)
Administration	97,992	49,584	50.6%	78	635.7
Bio-Economy	213,722	16,640	7.8%	23	723.5
Innovation Enabling	44,311	15,520	35.0%	41	378.5
Commercialised Innovations	95,855	16,870	17.6%	21	803.3
Other*	116,793	2,439	2.1%	N/A	N/A
TOTAL	**568,673**	**101,053**	**17.8%****	**163**	**620.0****

* Other costs include Board remuneration, workman's compensation and other provisions
** This is the average for TIA, not the sum of the above averages
Note: The data includes interns paid through TIA's payroll system

31.2 PERSONNEL COST BY SALARY BAND

The notable movements in the average cost per employee per salary band occurred in the top management band (48% reduction), as well as the semi-skilled band (62% reduction) as per Table 28. Three new executives were appointed during the financial year, after the contracts for the Interim CEO and the CFO came to an end. It should also be noted that the remuneration for these employees is not reflected for a full financial year but aligns to the period of employment. Eighteen interns were included in the semi-skilled band, which increased the number of employees from four to 22 in this band, thereby reducing the average cost per employee.

Table 28: Personnel cost by salary band for 2020/21

Level	Personnel expenditure (R'000)	% of personnel expenditure to total personnel cost	Number of employees	Average personnel cost per employee (R'000)
Top management	8,989	8.9%	7	1,284.1
Senior management	23,400	23.2%	21	1,114.3
Professional qualified	47,529	47.0%	65	731.2
Skilled	16,348	16.2%	43	380.2
Semi-skilled	1,763	1.7%	22	80.1
Unskilled	585	0.6%	5	117.0
Other*	2,439	2.4%	N/A	N/A
TOTAL	**101,053**	**100%**	**163**	**620.0****

* Other costs include Board remuneration, workman's compensation and other provisions
** This is the average for TIA, not the sum of the above averages
Note: The data includes interns paid through TIA's payroll system

31.3 PERFORMANCE REWARDS

Aligned to the Remuneration and Rewards Policy, performance-based incentives are paid only to employees who met certain performance criteria. The incentive is determined based on the performance of the employee and translates into a percentage of the employees' total cost to company.

Accordingly, bonuses were paid to staff members who performed well in 2019/20 as per Table 29. This was done after consultation with National Treasury and the Board to retain high performing staff. Provision for performance bonuses had been made in the 2019/20 Financial Statements, which were paid out on 31 March 2021.

Table 29: Performance rewards for 2020/21

Level	Performance rewards (R'000)	Personnel expenditure (R'000)	% of performance rewards to total personnel cost
Top management	467	8,989	5.2%
Senior management	1,514	23,400	6.5%
Professional qualified	2,487	47,529	5.2%
Skilled	803	16,348	4.9%
Semi-skilled	80	1,763	4.5%
Unskilled	62	585	10.6%
Other*	207	2,439	8.5%
TOTAL	**5,620**	**101,053**	**5.6%****

* Other costs include Board remuneration, workman's compensation and other provisions
** This is the average for TIA, not the sum of the above averages
Note: The data includes interns paid through TIA's payroll system

31.4 TRAINING COSTS

As a result of the COVID19 pandemic, training interventions were conducted mostly online. This resulted in a reduction in training costs as reflected in Table 30. TIA also supported 13 employees with studies towards formal qualifications.

Table 30: Training costs for 2020/21

Programme	Personnel expenditure (R'000)	Training expenditure (R'000)	Training expenditure as a % of personnel cost	Number of employees trained	Average training cost per employee (R'000)
Administration	49,584	402	0.8%	56	7.2
Bio-economy	16,640	48	0.3%	9	5.3
Innovation Enabling	15,520	87	0.6%	3	29.0
Commercialisation	16,870	91	0.5%	9	10.1
Other*	2,439	N/A	N/A	N/A	N/A
TOTAL	**101,053**	**628**	**0.6%**	**77**	**8.2****

* Other costs include Board remuneration, workman's compensation and other provisions
** This is the average for TIA, not the sum of the above averages
Note: This table excludes interns

31.5 EMPLOYMENT AND VACANCIES

As at 31 March 2021, the vacancy rate amounted to 22.5% as shown in Table 31. Staff were appointed in acting capacity, and lateral movements or secondments were utilised to capacitate key areas to ensure delivery.

Table 31: Employment and vacancies by programme for 2020/21

Programme	2019/20 Number of employees	2020/21 Approved posts	2020/21 Number of employees	2020/21 Vacancies	% of vacancies
Administration	66	78	67	11	14.1%
Bio-economy	36	50	33	17	34.0%
Innovation Enabling	31	35	27	8	22.9%
Commercialisation	19	24	18	6	25.0%
TOTAL	**152**	**187**	**145**	**42**	**22.5%***

*This is the average for TIA, not the sum of the above averages
Note: This table excludes interns

Two positions on the Top Management level were vacant as at 31 March 2021. The position of CEO is on hold, pending a review of TIA. Recruitment for the position of Executive: Innovation Enabling will commence early in 2021/22. Employment and vacancies by salary band are shown in Table 32.

Table 32: Employment and vacancies by salary band for 2020/21

Level	2019/20 Number of employees	2020/21 Approved posts	2020/21 Number of employees	2020/21 Vacancies	% of vacancies
Top management	3	7	5	2	28.6%
Senior management	21	26	20	6	23.1%
Professional qualified	70	89	64	25	28.1%
Skilled	48	54	46	8	14.8%
Semi-skilled	4	5	4	1	20.0%
Unskilled	6	6	6	0	0%
TOTAL	**152**	**187**	**145**	**42**	**22.5%**

*This is the average for TIA, not the sum of the above averages
Note: This table excludes interns

31.6 EMPLOYMENT CHANGES

Management focussed on recruitment to capacitate key strategic positions in the period under review, while other vacant positions were placed on hold because of budget limitations. These positions will be reconsidered after finalisation of the TIA review.

The vacant positions of Executive: Bio-economy, Executive: Commercialisation and Chief Financial Officer were filled in the period under review.

TIA's staff turnover rate for the period under review was 10.8%, with further employment changes by salary band shown in Table 33. Figure 37 shows that most staff resignations are at the senior management (31%) and professionally qualified/mid-management (50%) occupational levels.

Table 33: Employment changes by salary band for 2020/21

Level	Employment at beginning of reporting period	Appointments	Terminations	Employment at end of reporting period
Top management	3	3	2	4
Senior management	21	3	5	19
Professional qualified	70	5	9	66
Skilled	48	1	2	47
Semi-skilled	4	0	1	3
Unskilled	6	0	0	6
TOTAL	**152**	**12**	**19**	**145**

Note: This table excludes interns

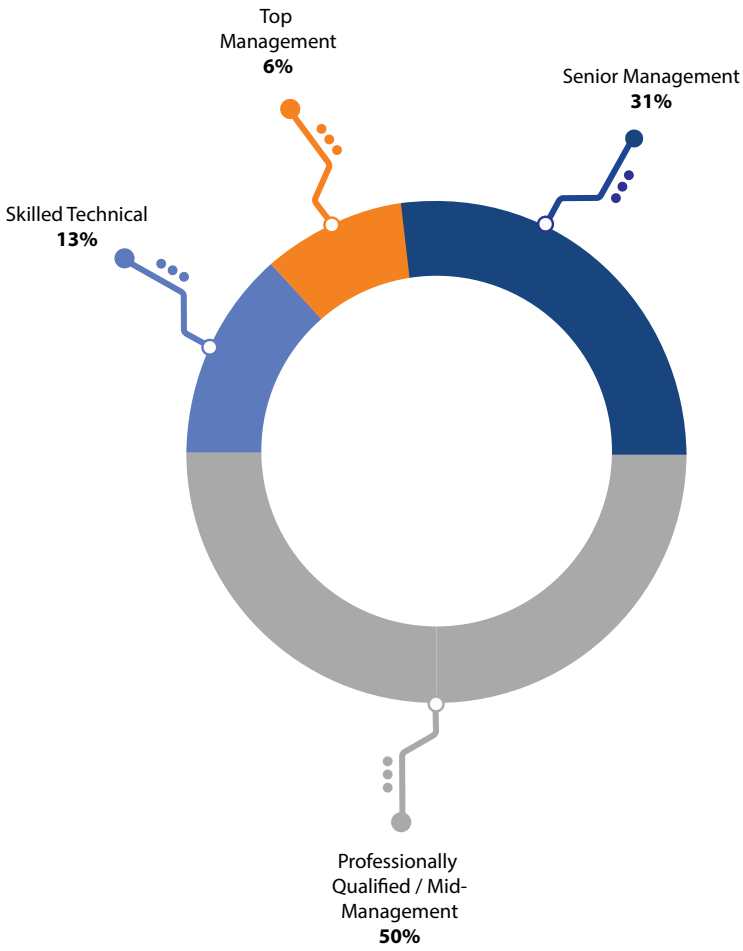


Figure 37: Resignations per occupational level

31.7 REASONS FOR STAFF LEAVING

Unfortunately, high performing staff (especially at senior management level) left TIA in pursuit of other career opportunities. Several also emigrated from South Africa. The reasons for staff leaving TIA are depicted in Table 34, and the reasons for staff resignations in Table 35.

Table 34: Reasons for staff leaving in 2020/21

Reason	Number	% of total number of staff leaving
Death	0	0%
Resignation	13	68.4%
Dismissal	0	0%
Retirement	0	0%
Ill health	0	0%
Expiry of contract	6	31.6%
Other	0	0%
Total	**19**	**100.0%**

Note: This table excludes interns

Table 35: Reasons for staff resignations in 2020/21

Reason	Number	% of total number of staff leaving
Further studies	1	7.7%
Emigration	2	15.4%
Other career opportunities	5	38.5%
Travel distance	2	15.4%
Reasons not disclosed	3	23.1%
Total	**13**	**100.1%***

* Does not add to 100.0% due to rounding.
Note: This table excludes interns

31.8 LABOUR RELATIONS: MISCONDUCT AND DISCIPLINARY ACTION

Table 36: Misconduct and disciplinary action in 2020/21

Nature of disciplinary action	Number
Verbal warning	0
Written warning	2
Final written warning	0
Dismissal	0

Note: This table excludes interns

31.9 EQUITY TARGET, EMPLOYMENT EQUITY STATUS AND TRANSFORMATION

TIA is committed to transformation, and the recruitment of women, youth, and people with disabilities is foundational to this national priority. To align with the economic active population, recruitment practises in 2020/21 focused on the recruitment of African males and Coloured males.

TIA's employment equity profile as at 31 March 2021 is shown in Figure 38. The graphic depicts the actual number of employees (according to demographic category) currently employed by TIA compared with the ideal based on the economically active population. The proportion of African males increased from 22.4% as at 31 March 2020, to 25.0% as at 31 March 2021, but the proportion of Coloured males decreased from 2.6% to 2.1% over the same period. The proportion of staff from designated groups increased from 86.2% last year to 88.2% this year.

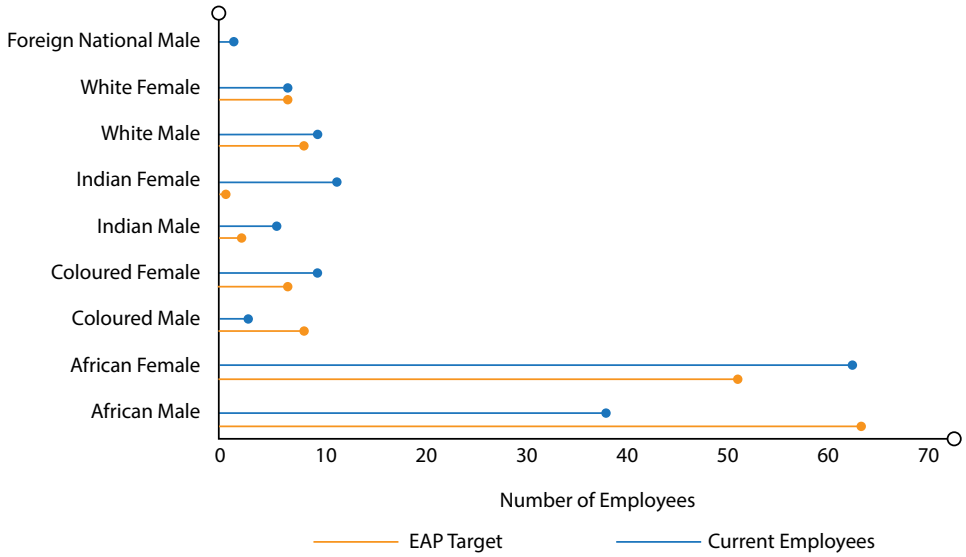
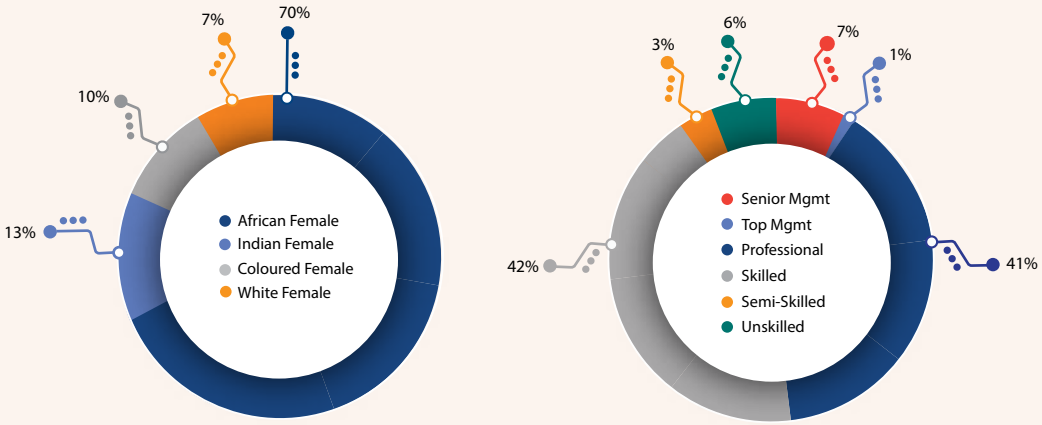
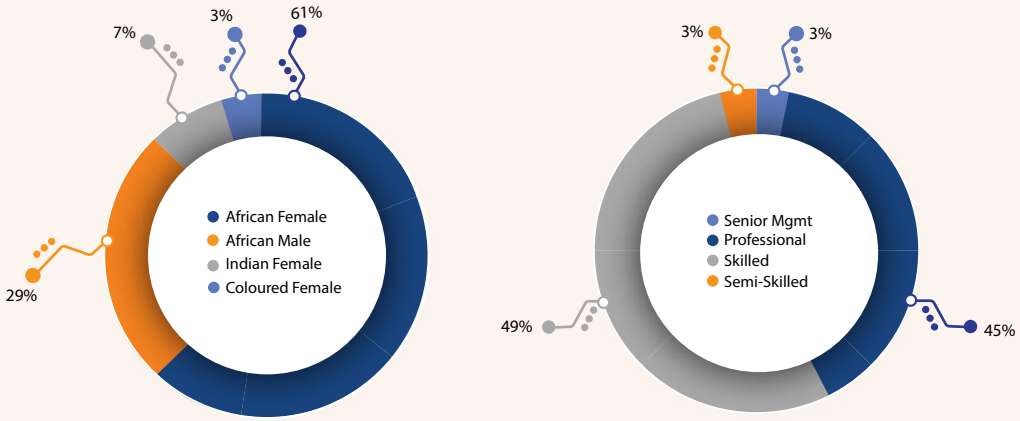


Figure 38: TIA's employment equity profile (measured against the economic active population) as at 31 March 2021

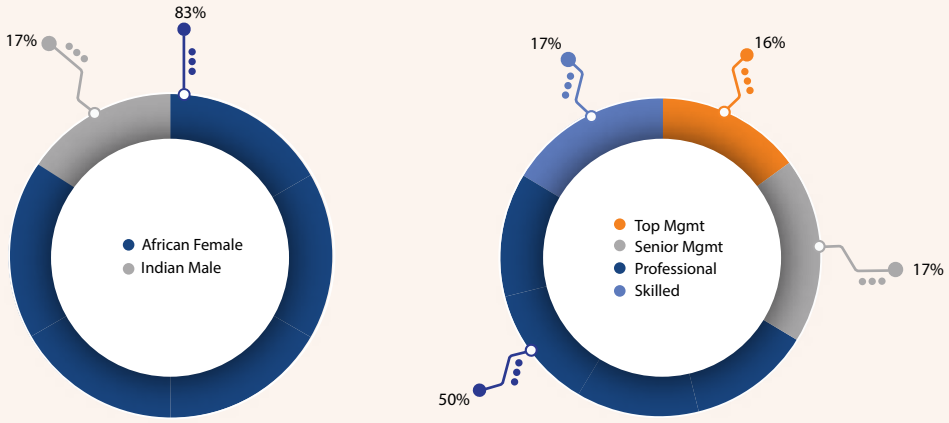
As at 31 March 2021, 61.8% of TIA's staff were female employees, 21.5% are classified as youth (between the age of 20 and 35), and 4.2% were employees with disabilities (against a target of 3%). TIA also created learnership opportunities for 10 interns, all between the age of 20 and 25. The employment equity demographics and occupational levels in each of these categories are presented in Figure 39, Table 37, Table 38, and Table 39.



Demographics (Left) and occupational levels (right) within the 61.8% women employment segment



Demographics (Left) and occupational levels (right) within the 21.5% youth employment segment



Demographics (Left) and occupational levels (right) within the 4.2% people with disabilities employment segment

Figure 39: Employment equity demographics and occupational levels of women, youth, and people with disabilities within the respective employment segment

Table 37: Female employees

Level	African		Coloured		Indian		White	
	Current	Target	Current	Target	Current	Target	Current	Target
Top management	0	2	0	0	0	0	1	1
Senior management	4	5	0	1	1	1	1	1
Professional qualified	21	23	3	3	9	9	4	4
Skilled	30	30	5	6	2	3	0	0
Semi-skilled	2	2	1	1	0	0	0	0
Unskilled	5	5	0	0	0	0	0	0
TOTAL	**62**	**67**	**9**	**11**	**12**	**13**	**6**	**6**

Note: This table excludes interns

Table 38: Male employees

Level	African		Coloured		Indian		White	
	Current	Target	Current	Target	Current	Target	Current	Target
Top management	3	3	0	0	1	1	0	0
Senior management	7	9	1	2	2	3	3	3
Professional qualified	17	28	2	10	2	6	6	6
Skilled	9	13	0	1	0	1	0	0
Semi-skilled	1	1	0	0	0	0	0	0
Unskilled	1	1	0	0	0	0	0	0
TOTAL	**38**	**55**	**3**	**13**	**5**	**11**	**9**	**9**

Note: This table excludes interns

Table 39: People with disabilities

Level	Female		Male	
	Current	Target	Current	Target
Top management	0	0	1	1
Senior management	1	1	0	0
Professional qualified	3	4	0	1
Skilled	1	1	0	0
Semi-skilled	0	0	0	0
Unskilled	0	0	0	0
TOTAL	**5**	**6**	**1**	**2**

Note: This table excludes interns

PART E

Financial Information

32. BOARD'S RESPONSIBILITIES AND APPROVAL

The Board is required by the Public Finance Management Act (Act 1 of 1999), to maintain adequate accounting records and is responsible for the content and integrity of the annual financial statements and related financial information included in this report. It is the responsibility of the Board to ensure that the annual financial statements fairly present the state of affairs of the entity as at the end of the financial year and the results of its operations and cash flows for the period then ended. The external auditors are engaged to express an independent opinion on the annual financial statements and were given unrestricted access to all financial records and related data.

The annual financial statements have been prepared in accordance with the Standards of Generally Recognised Accounting Practice (GRAP) including any interpretations, guidelines and directives issued by the Accounting Standards Board.

The annual financial statements are based upon appropriate accounting policies consistently applied and supported by reasonable and prudent judgements and estimates.

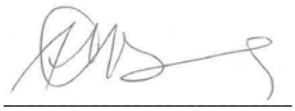
The Board acknowledge that they are ultimately responsible for the system of internal financial control established by the economic entity and place considerable importance on maintaining a strong control environment. To enable the Board to meet these responsibilities, the Board sets standards for internal control aimed at reducing the risk of error in a cost effective manner. The standards include the proper delegation of responsibilities within a clearly defined framework, effective accounting procedures and adequate segregation of duties to ensure an acceptable level of risk. These controls are monitored throughout the economic entity and all employees are required to maintain the highest ethical standards in ensuring the economic entity's business is conducted in a manner that in all reasonable circumstances is above reproach. The focus of risk management in the economic entity is on identifying, assessing, managing and monitoring all known forms of risk across the economic entity. While operating risk cannot be fully eliminated, the economic entity endeavours to minimise it by ensuring that appropriate infrastructure, controls, systems and ethical behaviour are applied and managed within predetermined procedures and constraints.

The Board is of the opinion, based on the information and explanations given by management, that the system of internal control provides reasonable assurance that the financial records may be relied on for the preparation of the annual financial statements. However, any system of internal financial control can provide only reasonable, and not absolute, assurance against material misstatement.

The Board has reviewed the economic entity's cash flow forecast for the year to 31 March 2021 and, in light of this review and the current financial position, they are satisfied that the economic entity has access to adequate resources to continue in operational existence for the foreseeable future.

The external auditors are responsible for independently reviewing and reporting on the economic entity's annual financial statements. The annual financial statements have been examined by the economic entity's external auditors and their report is presented on pages 117 to 121.

The annual financial statements set out on pages 122 to 157, which have been prepared on the going concern basis, were approved by the Board on 30 June 2021 and were signed on its behalf by:



Butana Mboniswa
Interim Chairperson of the Board

33. REPORT OF THE EXTERNAL AUDITOR

REPORT ON THE AUDIT OF THE CONSOLIDATED AND SEPARATE FINANCIAL STATEMENTS

OPINION

1. We have audited the consolidated and separate financial statements of the Technology Innovation Agency Group set out on pages 122 to 157, which comprise the consolidated and separate statement of financial position as at 31 March 2021, the consolidated and separate statement of financial performance, statement of changes in net assets, cash flow statement and statement of comparison of budget and actual amounts for the year then ended, as well as notes to the consolidated and separate financial statements, including a summary of significant accounting policies.

2. In our opinion, the consolidated and separate financial statements present fairly, in all material respects, the financial position of the Technology Innovation Agency Group as at 31 March 2021, and their financial performance and cash flows for the year then ended in accordance with South African Standards of Generally Recognised Accounting Practices (GRAP) and the requirements of the Public Finance Management Act of South Africa 1999(Act No.1 of 1999) PFMA.

CONTEXT FOR THE OPINION

3. We conducted our audit in accordance with the International Standards on Auditing (ISAs). Our responsibilities under those standards are further described in the auditor's responsibilities for the audit of the consolidated and separate financial statements section of our report.

4. We are independent of the public entity in accordance with Independent Regulatory Board for Auditors' Code of Professional Conduct for Auditors (IRBA Code) and other independence requirements applicable to performing audits of financial statements in South Africa. We have fulfilled our other ethical responsibilities in accordance with the IRBA Code and in accordance with other ethical requirements applicable to performing audits in South Africa. The IRBA Code is consistent with the corresponding sections of the International Ethics Standards Board for Accountants' International Code of Ethics for Professional Accountants (Including International Independence Standards).

5. We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our opinion.

EMPHASIS OF MATTER

6. We draw attention to the matter below. Our opinion is not modified in respect of this matter.

RESTATEMENT OF CORRESPONDING FIGURES

As disclosed in note 34 to the financial statements, the corresponding figures for 31 March 2020 were restated as a result of an error in the financial statements of the public entity at, and for the year ended, 31 March 2021.

RESPONSIBILITIES OF THE ACCOUNTING AUTHORITY FOR THE FINANCIAL STATEMENTS

7. The Board of directors, which constitutes the accounting authority, is responsible for the preparation and fair presentation of the consolidated and separate financial statements in accordance with GRAP and the requirements of the PFMA, and for such internal control as the accounting authority determines is necessary to enable the preparation of consolidated and separate financial statements that are free from material misstatement, whether due to fraud or error.

8. In preparing the consolidated and separate financial statements, the accounting authority is responsible for assessing the public entity's ability to continue as a going concern, disclosing, as applicable, matters relating to going concern and using the going concern basis of accounting unless the accounting authority either intends to liquidate the public entity or to cease operations, or has no realistic alternative but to do so.

AUDITOR'S RESPONSIBILITIES FOR THE AUDIT OF THE CONSOLIDATED AND SEPARATE FINANCIAL STATEMENTS

9. Our objectives are to obtain reasonable assurance about whether the consolidated and separate financial statements as a whole are free from material misstatement, whether due to fraud or error, and to issue an auditor's report that includes our opinion. Reasonable assurance is a high level of assurance but is not a guarantee that an audit conducted in accordance

with the ISAs will always detect a material misstatement when it exists. Misstatements can arise from fraud or error and are considered material if, individually or in aggregate, they could reasonably be expected to influence the economic decisions of users taken on the basis of these consolidated and separate financial statements.

10. A further description of our responsibilities for the audit of the consolidated and separate financial statements is included in the annexure to this auditor's report.

INTRODUCTION AND SCOPE

11. In accordance with the Public Audit Act 25 of 2004 (PAA) and the general notice issued in terms thereof, we have a responsibility to report on the usefulness and reliability of the reported performance information against predetermined objectives for selected outcomes presented in the annual performance report. We performed procedures to identify material findings but not to gather evidence to express assurance.

12. We evaluated the usefulness and reliability of the reported performance information in accordance with the criteria developed from the performance management and reporting framework, as defined in the general notice, for the following selected outcome presented in the public entity's annual performance report for the year ended 31 March 2021.

[Programmes/ objectives]	Pages in the annual performance report
Outcome 1– Commercialised Innovation	31-32

13. We performed procedures to determine whether the reported performance information was properly presented and whether performance was consistent with the approved performance planning documents. We performed further procedures to determine whether the indicators and related targets were measurable and relevant, and assessed the reliability of the reported performance information to determine whether it was valid, accurate and complete.

14. We did not identify any material findings on the usefulness and reliability of the reported performance information for this outcome:

- Outcome 1-Commercialised Innovation

OTHER MATTER

15. We draw attention to the matter below.

Achievement of planned targets

16. Refer to the annual performance report on pages 24-27, 30-32, 41-48 and 70-72 for information on the achievement of planned targets for the year and management's explanations provided for the under/ over achievement of targets.

REPORT ON THE AUDIT OF COMPLIANCE WITH LEGISLATION

INTRODUCTION AND SCOPE

17. In accordance with the PAA and the general notice issued in terms thereof, we have a responsibility to report material findings on the public entity's compliance with specific matters in key legislation. We performed procedures to identify findings but not to gather evidence to express assurance.

18. We did not identify any material findings on compliance with the specific matters in key legislation set out in the general notice issued in terms of the PAA.

OTHER INFORMATION

19. The accounting authority is responsible for the other information. The other information comprises the information included in the annual report, which includes Part A: General Information, Part B: Performance Information, Part C: Governance and Part D: Human Resource Management. The other information does not include the consolidated and separate financial statements, the auditor's report and those selected outcomes presented in the annual performance report that have been specifically reported in this auditor's report.

20. Our opinion on the financial statements and our findings on the reported performance information and compliance with legislation do not cover the other information and we do not express an audit opinion or any form of assurance conclusion on it.

21. In connection with our audit, our responsibility is to read the other information and, in doing so, consider whether the other information is materially inconsistent with the consolidated and separate financial statements and the selected outcomes presented in the annual performance report, or our knowledge obtained in the audit, or otherwise appears to be materially misstated.

INTERNAL CONTROL DEFICIENCIES

22. We considered internal control relevant to our audit of the consolidated and separate financial statements, reported performance information and compliance with applicable legislation; however, our objective was not to express any form of assurance on it. We did not identify any significant deficiencies in internal control.

OTHER REPORTS

23. We draw attention to the following engagements conducted by various parties which had, or could have, an impact on the matters reported in the public entity's financial statements, reported performance information, compliance with applicable legislation and other related matters. These reports did not form part of our opinion on the financial statements or our findings on the reported performance information or compliance with legislation.

AUDIT-RELATED SERVICES AND SPECIAL AUDITS

24. We will perform procedures to review the Treasury Pack to ensure conversion adjustments are captured correctly for the consolidation purposes by National Treasury.

AUDITOR TENURE

25. In terms of the IRBA rule published in Government gazette number 39475 dated 4 December 2015, we report that Rakoma and Associates Incorporated has been the auditor of Technology Innovation Agency for 3 years.

Rakoma and Associates Inc.

Rakoma and Associates Incorporated
Per: Eugene Lufhugu
Partner
Registered Auditor

30 June 2021

Ground Floor Building B
Monte Circle Office Park
178 Montecasino Boulevard
Fourways
Johannesburg
2191

RAKOMA & ASSOCIATES INC.

AUDITOR'S RESPONSIBILITY FOR THE AUDIT

1. As part of an audit in accordance with the ISAs, we exercise professional judgement and maintain professional scepticism throughout our audit of the [consolidated and separate] financial statements, and the procedures performed on the reported performance information for selected [programmes/objectives] and on the public entity's compliance with respect to the selected subject matters.

FINANCIAL STATEMENTS

2. In addition to our responsibility for the audit of the [consolidated and separate] financial statements as described in this auditor's report, we also:

- identify and assess the risks of material misstatement of the consolidated and separate financial statements whether due to fraud or error, design and perform audit procedures responsive to those risks, and obtain audit evidence that is sufficient and appropriate to provide a basis for our opinion. The risk of not detecting a material misstatement resulting from fraud is higher than for one resulting from error, as fraud may involve collusion, forgery, intentional omissions, misrepresentations, or the override of internal control;
- obtain an understanding of internal control relevant to the audit in order to design audit procedures that are appropriate in the circumstances, but not for the purpose of expressing an opinion on the effectiveness of the public entity's internal control;
- evaluate the appropriateness of accounting policies used and the reasonableness of accounting estimates and related disclosures made by the board of directors, which constitutes the accounting authority;
- conclude on the appropriateness of the accounting authority's use of the going concern basis of accounting in the preparation of the financial statements. We also conclude, based on the audit evidence obtained, whether a material uncertainty exists relating to events or conditions that may cast significant doubt on the ability of the Technology Innovation Agency and its subsidiaries to continue as a going concern. If we conclude that a material uncertainty exists, we are required to draw attention in our auditor's report to the related disclosures in the financial statements about the material uncertainty or, if such disclosures are inadequate, to modify our opinion on the financial statements. Our conclusions are based on the information available to us at the date of this auditor's report. However, future events or conditions may cause a public entity to cease operating as a going concern;
- evaluate the overall presentation, structure and content of the financial statements, including the disclosures, and determine whether the financial statements represent the underlying transactions and events in a manner that achieves fair presentation; and
- obtain sufficient appropriate audit evidence regarding the financial information of the entities or business activities within the group to express an opinion on the consolidated financial statements. We are responsible for the direction, supervision and performance of the group audit. We remain solely responsible for our audit opinion.

COMMUNICATION WITH THOSE CHARGED WITH GOVERNANCE.

3. We communicate with the accounting authority regarding, among other matters, the planned scope and timing of the audit and significant audit findings, including any significant deficiencies in internal control that we identify during our audit.

4. We also provide the accounting authority with a statement that we have complied with relevant ethical requirements regarding independence, and to communicate with them all relationships and other matters that may reasonably be thought to have a bearing on our independence and, where applicable, actions taken to eliminate threats or safeguards applied.

From the matters communicated to those charged with governance, we determine those matters that were of most significance in the audit of the consolidated and separate financial statements of the current period and are therefore key audit matters. We describe these matters in this auditor's report unless law or regulation precludes public disclosure about the matter or when, in extremely rare circumstances, we determine that a matter should not be communicated in this auditor's report because the adverse consequences of doing so would reasonably be expected to outweigh the public interest of such communication.

34. ANNUAL FINANCIAL STATEMENTS
STATEMENT OF FINANCIAL POSITION
AS AT 31 MARCH 2021

	Note(s)	(R thousands)			
		Economic entity		Controlling entity	
		March 2021	March 2020 Restated	March 2021	March 2020 Restated
Assets					
Current Assets					
Loans and receivables	7	9,195	5,754	9,195	5,754
Trade and other receivables	9	1,035	880	1,035	880
Pre-payments	10	3,503	3,947	3,503	3,947
Cash and cash equivalents	11	241,970	147,540	241,970	144,949
		255,703	**158,121**	**255,703**	**155,530**
Non-Current Assets					
Property and equipment	3	6,750	10,118	6,750	10,118
Intangible assets	4	1,799	3,028	1,799	3,028
Investments in controlled entities	5	–	–	2,189	2,189
Investments in associates	6	296	555	–	–
Loans and receivables	7	25,410	34,692	25,410	34,692
Other financial assets	8	3,000	3,000	3,000	3,000
		37,255	**51,393**	**39,148**	**53,027**
Total Assets		**292,958**	**209,514**	**294,851**	**208,557**
Liabilities					
Current Liabilities					
Committed conditional grants	13	126,669	–	126,669	–
Finance lease obligation	12	174	325	174	325
Operating lease liability		430	570	430	570
Trade and other payables	14	65,013	53,919	67,199	53,514
		192,286	**54,814**	**194,472**	**54,409**
Non-Current Liabilities					
Finance lease obligation	12	–	173	–	173
Committed conditional grants	13	20,533	88,356	20,533	88,356
		20,533	**88,529**	**20,533**	**88,529**
Total Liabilities		**212,819**	**143,343**	**215,005**	**142,938**
Net Assets		**80,139**	**66,171**	**79,846**	**65,619**

STATEMENT OF FINANCIAL PERFORMANCE
FOR THE YEAR ENDED 31 MARCH 2021

		(R thousands)			
		Economic entity		Controlling entity	
	Note(s)	March 2021	March 2020	March 2021	March 2020
Revenue					
Revenue	15	569,715	587,028	569,715	587,028
Other income	16	5,483	4,206	5,483	6,395
Interest received	17	7,443	12,525	7,443	12,262
Total revenue		**582,641**	**603,759**	**582,641**	**605,685**
Expenditure					
Employee related costs	18	(101,053)	(108,998)	(101,053)	(108,998)
Project funding expenditure	19	(419,247)	(450,989)	(419,247)	(450,989)
Depreciation and amortisation		(4,516)	(6,187)	(4,516)	(6,187)
Lease rentals on operating lease		(10,924)	(10,810)	(10,924)	(10,810)
Impairment	20	(8,847)	(1,465)	(8,847)	(1,465)
Deficit from equity accounted investments	6	(259)	(530)	–	–
Other operating expenses	21	(23,827)	(40,756)	(23,827)	(40,754)
Total expenditure		**(568,673)**	**(619,735)**	**(568,414)**	**(619,203)**
Surplus/(deficit) for the year		**13,968**	**(15,976)**	**14,227**	**(13,518)**
Attributable to:					
Owners of the controlling entity		13,968	(16,052)	14,227	(13,518)
Non-controlling interest		–	76	–	–
		13,968	**(15,976)**	**14,227**	**(13,518)**

STATEMENT OF CHANGES IN NET ASSETS
FOR THE YEAR ENDED 31 MARCH 2021

	(R thousands)			
	Accumulated surplus	Total attributable to owners of the economic entity/ controlling entity	Non–controlling interest	Total net assets
Economic entity				
Balance at 01 April 2019	**97,598**	**97,598**	**(76)**	**97,522**
Payment of surpluses to National Treasury	(15,372)	(15,372)	–	(15,372)
Deficit for the year	(16,052)	(16,052)	76	(15,976)
Balance at 01 April 2020	**66,171**	**66,171**	**–**	**66,171**
Changes in net assets: Surplus for the year	13,968	13,968	–	13,968
Balance at 31 March 2021	**80,139**	**80,139**	**–**	**80,139**
Controlling entity				
Balance at 01 April 2019	**94,509**	**94,509**	**–**	**94,509**
Payment of surpluses to National Treasury	(15,372)	(15,372)	–	(15,372)
Deficit for the year	(13,518)	(13,518)	–	(13,518)
Balance at 01 April 2020	**65,619**	**65,619**	**–**	**65,619**
Surplus for the year	14,227	14,227	–	14,227
Balance at 31 March 2021	**79,846**	**79,846**	**–**	**79,846**

CASH FLOW STATEMENT
FOR THE YEAR ENDED 31 MARCH 2021

	Note(s)	(R thousands)			
		Economic entity		Controlling entity	
		March 2021	March 2020	March 2021	March 2020
Cash flows from operating activities					
Receipts					
Grants		569,715	587,028	569,715	587,028
Interest income		6,451	10,769	6,451	10,506
Other receipts		1,411	4,047	1,411	3,517
		577,577	**601,844**	**577,577**	**601,051**
Payments					
Employee related costs		(101,053)	(108,998)	(101,053)	(108,998)
Project funding expenditure		(408,153)	(450,989)	(408,153)	(450,989)
Other payments		(32, 394)	(57,975)	(29,803)	(57,442)
		(541,600)	(617,962)	(539,009)	(617,429)
Net cash flows from operating activities	23	**35,977**	**(16,118)**	**38,568**	**(16,378)**
Cash flows from investing activities					
Purchase of property and equipment	3	(1,319)	(1,879)	(1,319)	(1,879)
Purchase of intangible assets	4	(192)	(685)	(192)	(685)
Repayment of loans from economic entities		1,118	5,116	1,118	5,116
Net cash flows from investing activities		**(393)**	**2,552**	**(393)**	**2,552**
Cash flows from financing activities					
Repayment of surplusses		–	(15,372)	–	(15,372)
Conditional grants received		219,746	154,298	219,746	154,298
Conditional grants paid		(160,900)	(147,062)	(160,900)	(147,062)
Net cash flows from financing activities		**58,846**	**(8,136)**	**58,846**	**(8,136)**
Net increase/(decrease) in cash and cash equivalents		**94,430**	**(21,702)**	**97,021**	**(21,962)**
Cash and cash equivalents at the beginning of the year		147,540	169,242	144,949	166,911
Cash and cash equivalents at the end of the year	11	**241,970**	**147,540**	**241,970**	**144,949**

STATEMENT OF COMPARISON OF BUDGET AND ACTUAL AMOUNTS
FOR THE YEAR ENDED 31 MARCH 2021

	(R thousands)					
Budget on Cash Basis	Approved budget	Adjustments	Final Budget	Actual amounts on comparable basis	Difference between final budget and actual	Reference
Controlling entity						
Statement of financial performance						
Revenue						
DST allocation	410,272	–	**410,272**	408,825	**(1,447)**	Note 33
Other income	142,000	–	**142,000**	166,373	**24,373**	Note 33
Interest received	9,900	–	**9,900**	7,443	**(2,457)**	Note 33
Total revenue from exchange transactions	**562,172**	**–**	**562,172**	**582,641**	**20,469**	
Expenditure						
Employee related costs	(109,338)	–	**(109,338)**	(101,053)	**8,285**	Note 33
Project related funding	(396,614)	–	**(396,614)**	(419,247)	**(22,633)**	Note 33
Other operating expenditure	(56,220)	–	**(56,220)**	(48,114)	**8,106**	Note 33
Total expenditure	**(562,172)**	**–**	**(562,172)**	**(568,414)**	**(6,242)**	
Surplus before taxation	**–**	**–**	**–**	**14,227**	**14,227**	
Actual Amount on Comparable Basis as Presented in the Budget and Actual Comparative Statement	**–**		**–**	**14,227**	**14,227**	

ACCOUNTING POLICIES
AS AT 31 MARCH 2021

1. PRESENTATION OF ANNUAL FINANCIAL STATEMENTS

The annual financial statements (AFS) have been prepared in accordance with the Standards of Generally Recognised Accounting Practice (GRAP), issued by the Accounting Standards Board in accordance with Section 91(1) of the Public Finance Management Act (Act 1 of 1999).

These AFS have been prepared on an accrual basis of accounting and are in accordance with historical cost convention as the basis of measurement, unless specified otherwise. They are presented in South African Rand. Amounts are rounded off to the nearest thousand.

These accounting policies are consistent with the previous period.

1.1 CONSOLIDATION

BASIS OF CONSOLIDATION

Consolidated AFS are the AFS of the economic entity presented as those of a single entity.

The consolidated AFS incorporate the AFS of the controlling entity and all controlled entities which are controlled by the controlling entity.

Consolidated AFS are prepared using uniform accounting policies for like transactions and other events in similar circumstances.

Control exists when the controlling entity has the power to govern the financial and operating policies of another entity so as to obtain benefits from its activities.

The revenue and expenses of a controlled entity are included in the consolidated AFS from the transfer date or acquisition date as defined in the Standards of GRAP on Transfer of functions between entities under common control or Transfer of functions between entities not under common control. The revenue and expenses of the controlled entity are based on the values of the assets and liabilities recognised in the controlling entity's AFS at the acquisition date.

The AFS of the controlling entity and its controlled entities used in the preparation of the consolidated AFS are prepared as of the same date.

When the end of the reporting date of the controlling entity is different from that of a controlled entity, the controlled entity prepares, for consolidation purposes, additional AFS as of the same date as the AFS of the controlling entity unless it is impracticable to do so. When the AFS of a controlled entity used in the preparation of consolidated AFS are prepared as of a date different from that of the controlling entity, adjustments are made for the effects of significant transactions or events that occur between that date and the date of the controlling entity's AFS. In any case, the difference between the end of the reporting date of the controlled entity and that of the controlling entity is no more than three months. The length of the reporting periods and any difference between the ends of the reporting dates is the same from period to period.

Adjustments are made when necessary to the AFS of the controlled entities to bring their accounting policies in line with those of the controlling entity.

All intra-entity transactions, balances, revenues and expenses are eliminated in full on consolidation.

Non-controlling interest in the net assets of the economic entity is identified and recognised separately from the controlling entity's interest therein, and are recognised within net assets.

Changes in a controlling entity's ownership interest in a controlled entity that do not result in a loss of control are accounted for as transactions that affect net assets.

INVESTMENT IN ASSOCIATES

An associate is an entity, over which the investor has significant influence and that is neither a controlled entity nor an interest in a joint venture. Significant influence is the power to participate in the financial and operating policy decisions of an activity but is not control or joint control over those policies.

An investment in associate is accounted for using the equity method. Under the equity method, investments in associates are carried in the consolidated statement of financial position at cost adjusted for post-acquisition changes in the economic entity's share of net assets of the associate, less any impairment losses.

The economic entity's share of the surplus or deficit of the investee is recognised in surplus or deficit. The most recent available AFS of the associate are used by the economic entity in applying the equity method. When the reporting dates of the economic entity and the associate are different, the associate prepares, for the use of the economic entity, AFS as of the same date as the AFS of the economic entity unless it is impractical to do so.

When the AFS of an associate used in applying the equity method are prepared as of a different date from that of the economic entity, adjustments are made for the effects of significant transactions or events that occur between that

ACCOUNTING POLICIES
AS AT 31 MARCH 2021 (CONTINUED)

date and the date of the economic entity's AFS. In any case, the difference between the end of the reporting dates of the associate and that of the economic entity is no more than three months. The length of the reporting dates and any difference between the ends of the reporting dates is the same from period to period.

The economic entity's AFS are prepared using uniform accounting policies for like transactions and events in similar circumstances.

Deficits in an associate in excess of the economic entity's interest in that associate are recognised only to the extent that the economic entity has incurred a legal or constructive obligation to make payments on behalf of the associate. If the associate subsequently reports surpluses, the economic entity resumes recognising its share of those surpluses only after its share of the surpluses equals the share of deficits not recognised.

The controlling entity discontinues the use of the equity method from the date that it ceases to have significant influence over an associate and account for the investment in accordance with the Standards of GRAP on Financial instruments from that date, unless the associate becomes a controlled entity or a joint venture, in which case it is accounted for as such. The carrying amount of the investment at the date that it ceases to be an associate is regarded as the fair value on initial recognition as a financial asset in accordance with the Standards of GRAP on Financial instruments.

1.2 SIGNIFICANT JUDGEMENTS AND SOURCES OF ESTIMATION UNCERTAINTY

In preparing the AFS, management is required to make estimates and assumptions that affect the amounts represented in the AFS and related disclosures. Use of available information and the application of judgement is inherent in the formation of estimates. Actual results in the future could differ from these estimates which may be material to the AFS. Significant judgements include:

TRADE RECEIVABLE & LOAN AND RECEIVABLES

The economic entity assesses its loans and receivables for impairment at the end of each reporting period. In determining whether an impairment loss should be recorded in surplus or deficit, the entity makes judgements as to whether there is observable data indicating a measurable decrease in the estimated future cash flows from a financial asset.

The impairment for loans and receivables is calculated on an individual basis, based on historical losses, financial position of the entity, repayment terms and the commercial viability of the business.

The impairment for loans and receivables is calculated on client by client basis based on client specific economic, operational and financial conditions that are present at the reporting date which correlate with defaults on the amounts owing by the client.

COMMITTED CONDITIONAL GRANTS

The economic entity assesses the split of amounts payable in the next twelve months at each reporting date. In determining the amount payable, consideration is taken of the expected disbursements for each programme. Such assessment requires judgement to be applied. Where such estimation cannot be reliably determined, such amounts are disclosed as non-current.

IMPAIRMENT TESTING

The recoverable amounts of individual assets have been determined based on the higher of value-in-use calculations and fair values less costs to sell. These calculations require the use of estimates and assumptions. It is reasonably possible that the assumptions used may change which may then impact our estimations and may then require a material adjustment to the carrying value of tangible assets.

The economic entity reviews and tests the carrying value of assets when events or changes in circumstances suggest that the carrying amount may not be recoverable. If there are indications that impairment may have occurred, estimates are prepared of expected future cash flows for each asset. Expected future cash flows used to determine the value in use of other assets which are inherently uncertain and could materially change over time.

ALLOWANCE FOR DOUBTFUL DEBTS

On debtors an impairment loss is recognised in surplus and deficit when there is objective evidence that it is impaired. The impairment is measured as the difference between the debtors carrying amount and the present value of estimated future cash flows discounted at the effective interest rate, computed at initial recognition.

1.3 PROPERTY AND EQUIPMENT

Property and equipment are tangible non-current assets that are held for use in the production or supply of goods or services, rental to others, or for administrative purposes, and are expected to be used during more than one period.

The cost of an item of property and equipment is recognised as an asset when:

- it is probable that future economic benefits or service potential associated with the item will flow to the economic entity; and
- the cost of the item can be measured reliably.

The cost of an item of property and equipment is the purchase price and other costs attributable to bring the asset to the location and condition necessary for it to be capable of operating in the manner intended by management. Trade discounts and rebates are deducted in arriving at the cost.

Where an asset is acquired through a non-exchange transaction, its cost is its fair value as at date of acquisition.

Where an item of property and equipment is acquired in exchange for a non-monetary asset or monetary assets, or a combination of monetary and non-monetary assets, the asset acquired is initially measured at fair value (the cost). If the acquired item's fair value was not determinable, it's deemed cost is the carrying amount of the asset(s) given up.

When significant components of an item of property and equipment have different useful lives, they are accounted for as separate items (major components) of property and equipment.

Costs include costs incurred initially to acquire or construct an item of property and equipment and costs incurred subsequently to add to, replace part of, or service it. If a replacement cost is recognised in the carrying amount of an item of property and equipment, the carrying amount of the replaced part is derecognised.

Recognition of costs in the carrying amount of an item of property and equipment ceases when the item is in the location and condition necessary for it to be capable of operating in the manner intended by management.

Items such as spare parts, standby equipment and servicing equipment are recognised when they meet the definition of property and equipment.

Property and equipment are depreciated on the straight-line basis over their expected useful lives to their estimated residual value.

Property and equipment is carried at cost less accumulated depreciation and any impairment losses. The depreciable amount of an asset is allocated on a systematic basis over its useful life.

Each part of an item of property and equipment with a cost that is significant in relation to the total cost of the item is depreciated separately.

The depreciation method used reflects the pattern in which the asset's future economic benefits or service potential are expected to be consumed by the economic entity. The depreciation method applied to an asset is reviewed at least at each reporting date and, if there has been a significant change in the expected pattern of consumption of the future economic benefits or service potential embodied in the asset, the method is changed to reflect the changed pattern. Such a change is accounted for as a change in an accounting estimate.

The economic entity assesses at each reporting date whether there is any indication that the economic entity expectations about the residual value and the useful life of an asset have changed since the preceding reporting date. If any such indication exists, the economic entity revises the expected useful life and/or residual value accordingly. The change is accounted for as a change in an accounting estimate.

The depreciation charge for each period is recognised in surplus or deficit.

Items of property and equipment are derecognised when the asset is disposed of or when there are no further economic benefits or service potential expected from the use of the asset.

The gain or loss arising from the derecognition of an item of property and equipment is included in surplus or deficit when the item is derecognised. The gain or loss arising from the derecognition of an item of property and equipment is determined as the difference between the net disposal proceeds, if any, and the carrying amount of the item.

1.4 INTANGIBLE ASSETS

An asset is identifiable if it either:

- is separable, i.e. is capable of being separated or divided from an entity and sold, transferred, licensed, rented or exchanged, either individually or together with a related contract, identifiable assets or liability, regardless of whether the entity intends to do so; or
- arises from binding arrangements (including rights from contracts), regardless of whether those rights are transferable or separable from the economic entity or from other rights and obligations.

ACCOUNTING POLICIES
AS AT 31 MARCH 2021 (CONTINUED)

A binding arrangement describes an arrangement that confers similar rights and obligations on the parties to it as if it were in the form of a contract.

An intangible asset is recognised when:
- it is probable that the expected future economic benefits or service potential that are attributable to the asset will flow to the economic entity; and
- the cost or fair value of the asset can be measured reliably.

The economic entity assesses the probability of expected future economic benefits or service potential using reasonable and supportable assumptions that represent management's best estimate of the set of economic conditions that will exist over the useful life of the asset.

Where an intangible asset is acquired through a non-exchange transaction, its initial cost at the date of acquisition is measured at its fair value as at that date.

Intangible assets are carried at cost less any accumulated amortisation and any impairment losses.

An intangible asset is regarded as having an indefinite useful life when, based on all relevant factors, there is no foreseeable limit to the period over which the asset is expected to generate net cash inflows or service potential. Amortisation is not provided for these intangible assets, but they are tested for impairment annually and whenever there is an indication that the asset may be impaired. For all other intangible assets amortisation is provided on a straight-line basis over their useful life.

The amortisation period and the amortisation method for intangible assets are reviewed at each reporting date.

Amortisation is provided to write down the intangible assets, on a straight-line basis, to their residual values as follows:

Item	Depreciation method	Average useful life
Computer software	Straight line	2 – 3 years
Website	Straight line	5 years

1.5 INVESTMENTS IN CONTROLLED ENTITIES

ECONOMIC ENTITY ANNUAL FINANCIAL STATEMENTS

Investments in controlled entities are consolidated in the economic entity's AFS. Refer to the accounting policy on Consolidations (Note 1.1).

CONTROLLING ENTITY AFS

In the entity's separate AFS, investments in controlled entities are carried at cost. The entity applies the same accounting for each category of investment.

Investments in controlled entities that are accounted for in accordance with the accounting policy on Financial instruments in the consolidated AFS, are accounted for in the same way in the controlling entity's separate AFS.

1.6 INVESTMENTS IN ASSOCIATES

ECONOMIC ENTITY ANNUAL FINANCIAL STATEMENTS

An investment in an associate is accounted for using the equity method. Under the equity method, the investment is initially recognised at cost and the carrying amount is increased or decreased to recognise the economic entity's share of the surpluses or deficit of the investee after acquisition date. The use of the equity method is discontinued from the date the economic entity ceases to have significant influence over an associate.

Any impairment losses are deducted from the carrying amount of the investment in associate.

Surpluses and deficit resulting from transactions with associates are recognised only to the extent of unrelated investors' interests in the associate.

The most recent available AFS of the associate are used by the investor in applying the equity method. When the end of the reporting period of the investor is different from that of the associate, the associate prepares, for the use of the investor, AFS as of the same date as the AFS of the investor unless it is impracticable to do so.

The recognition of the economic entity's share of losses is discontinued once the economic entity's share of losses of an associate equals or exceeds its interest in the associate.

CONTROLLING ENTITY AFS

An investment in an associate is carried at cost less accumulated impairement. The entity applies the same accounting for each category of investment.

1.7 FINANCIAL INSTRUMENTS

A financial instrument is any contract that gives rise to a financial asset of one entity and a financial liability or a residual interest of another entity.

The amortised cost of a financial asset or financial liability is the amount at which the financial asset or financial liability is measured at initial recognition minus principal repayments, plus or minus the cumulative amortisation using the effective interest method of any difference between that initial amount and the maturity amount, and minus any reduction (directly or through the use of an allowance account) for impairment or uncollectibility.

Credit risk is the risk that one party to a financial instrument will cause a financial loss for the other party by failing to discharge an obligation.

Currency risk is the risk that the fair value or future cash flows of a financial instrument will fluctuate because of changes in foreign exchange rates.

Derecognition is the removal of a previously recognised financial asset or financial liability from an entity's statement of financial position.

Fair value is the amount for which an asset could be exchanged, or a liability settled, between knowledgeable willing parties in an arm's length transaction.

A financial asset is:

- cash;
- a residual interest of another entity; or
- a contractual right to:
  - receive cash or another financial asset from another entity; or
  - exchange financial assets or financial liabilities with another entity under conditions that are potentially favourable to the entity.

A financial liability is any liability that is a contractual obligation to:

- deliver cash or another financial asset to another entity; or
- exchange financial assets or financial liabilities under conditions that are potentially unfavourable to the entity.

Interest rate risk is the risk that the fair value or future cash flows of a financial instrument will fluctuate because of changes in market interest rates.

Liquidity risk is the risk encountered by an entity in the event of difficulty in meeting obligations associated with financial liabilities that are settled by delivering cash or another financial asset.

Loans payable are financial liabilities, other than short-term payables on normal credit terms.

A financial asset is past due when a counterparty has failed to make a payment when contractually due.

Transaction costs are incremental costs that are directly attributable to the acquisition, issue or disposal of a financial asset or financial liability. An incremental cost is one that would not have been incurred if the entity had not acquired, issued or disposed of the financial instrument.

Financial instruments at amortised cost are non-derivative financial assets or non-derivative financial liabilities that have fixed or determinable payments, excluding those instruments that:

- the entity designates at fair value at initial recognition; or
- are held for trading.

Financial instruments at cost are investments in residual interests that do not have a quoted market price in an active market, and whose fair value cannot be reliably measured.

CLASSIFICATION

The entity has the following types of financial assets (classes and category) as reflected on the face of the statement of financial position or in the notes thereto:

Class	Category
Investment in controlled entities	Financial asset measured at cost
Investment in associates	Financial asset measured at cost
Other financial assets	Financial asset measured at cost
Cash and cash equivalents	Financial asset measured at amortised cost
Loans and receivables	Financial asset measured at amortised cost

The entity has the following types of financial liabilities (classes and category) as reflected on the face of the statement of financial position or in the notes thereto:

Class	Category
Trade and other payables	Financial liability measured at amortised cost
Finance lease obligation	Financial liability measured at amortised cost

ACCOUNTING POLICIES
AS AT 31 MARCH 2021 (CONTINUED)

1.8 LEASES

A lease is classified as a finance lease if it transfers substantially all the risks and rewards incidental to ownership. A lease is classified as an operating lease if it does not transfer substantially all the risks and rewards incidental to ownership.

When a lease includes both land and buildings elements, the entity assesses the classification of each element separately.

FINANCE LEASES – LESSEE

Finance leases are recognised as assets and liabilities in the statement of financial position at amounts equal to the fair value of the leased property or, if lower, the present value of the minimum lease payments. The corresponding liability to the lessor is included in the statement of financial position as a finance lease obligation.

The discount rate used in calculating the present value of the minimum lease payments is the interest rate implicit in the lease.

Minimum lease payments are apportioned between the finance charge and reduction of the outstanding liability. The finance charge is allocated to each period during the lease term so as to produce a constant periodic rate of on the remaining balance of the liability.

Any contingent rents are expensed in the period in which they are incurred.

OPERATING LEASES – LESSEE

Operating lease payments are recognised as an expense on a straight-line basis over the lease term. The difference between the amounts recognised as an expense and the contractual payments are recognised as an operating lease asset or liability.

1.9 IMPAIRMENT OF CASH-GENERATING ASSETS

Cash-generating assets are assets used with the objective of generating a commercial return. Commercial return means that positive cash flows are expected to be significantly higher than the cost of the asset.

Impairment is a loss in the future economic benefits or service potential of an asset, over and above the systematic recognition of the loss of the asset's future economic benefits or service potential through depreciation (amortisation).

Carrying amount is the amount at which an asset is recognised in the statement of financial position after deducting any accumulated depreciation and accumulated impairment losses thereon.

A cash-generating unit is the smallest identifiable group of assets used with the objective of generating a commercial return that generates cash inflows from continuing use that are largely independent of the cash inflows from other assets or groups of assets.

Costs of disposal are incremental costs directly attributable to the disposal of an asset, excluding finance costs and income tax expense.

Depreciation (armortisation) is the systematic allocation of the depreciable amount of an asset over its useful life.

Fair value less costs to sell is the amount obtainable from the sale of an asset in an arm's length transaction between knowledgeable, willing parties, less the costs of disposal.

Recoverable amount of an asset or a cash-generating unit is the higher its fair value less costs to sell and its value in use.

Useful life is either:
- the period of time over which an asset is expected to be used by the economic entity; or
- the number of production or similar units expected to be obtained from the asset by the economic entity.

VALUE IN USE

Value in use of a cash-generating asset is the present value of the estimated future cash flows expected to be derived from the continuing use of an asset and from its disposal at the end of its useful life.

When estimating the value in use of an asset, the economic entity estimates the future cash inflows and outflows to be derived from continuing use of the asset and from its ultimate disposal and the economic entity applies the appropriate discount rate to those future cash flows.

1.10 EMPLOYEE BENEFITS

SHORT-TERM EMPLOYEE BENEFITS

The cost of short-term employee benefits, (those payable within 12 months after the service is rendered, such as paid vacation leave and sick leave, bonuses, and non-monetary benefits such as medical care), are recognised in the period in which the service is rendered and are not discounted.

The expected cost of compensated absences is recognised as an expense as the employees render services that increase

their entitlement or, in the case of non-accumulating absences, when the absence occurs.

The expected cost of surplus sharing and bonus payments is recognised as an expense when there is a legal or constructive obligation to make such payments as a result of past performance.

DEFINED CONTRIBUTION PLANS

Payments to defined contribution retirement benefit plans are charged as an expense as they fall due.

Payments made to industry-managed (or state plans) retirement benefit schemes are dealt with as defined contribution plans where the entity's obligation under the schemes is equivalent to those arising in a defined contribution retirement benefit plan.

1.11 CONTINGENCIES

Contingent assets and contingent liabilities are not recognised. Contingencies are disclosed in note 25.

1.12 REVENUE FROM EXCHANGE TRANSACTIONS

Revenue is the gross inflow of economic benefits or service potential during the reporting period when those inflows result in an increase in net assets, other than increases relating to contributions from owners.

An exchange transaction is one in which one entity receives assets or services, or has liabilities extinguished, and directly gives approximately equal value (primarily in the form of goods, services or use of assets) to the other party in exchange.

Fair value is the amount for which an asset could be exchanged, or a liability settled, between knowledgeable, willing parties in an arm's length transaction.

MEASUREMENT

Revenue is measured at the fair value of the consideration received or receivable, net of trade discounts and volume rebates.

INTEREST AND ROYALTIES

Revenue arising from the use by others of entity assets yielding interest, royalties and dividends or similar distributions is recognised when:

- It is probable that the economic benefits or service potential associated with the transaction will flow to the entity; and
- The amount of the revenue can be measured reliably.

Interest is recognised using the effective interest rate method for financial instruments. Interest levied on transactions arising from exchange or non-exchange transactions is classified based on the nature of the underlying transaction.

Interest will not accure on loans and receivables where there is an indication that payment will be deferred in the short term. Royalties are recognised as they are earned in accordance with the substance of the relevant agreements.

1.13 REVENUE FROM NON-EXCHANGE TRANSACTIONS

Revenue comprises gross inflows of economic benefits or service potential received and receivable by an entity, which represents an increase in net assets, other than increases relating to contributions from owners.

Control of an asset arises when the entity can use or otherwise benefit from the asset in pursuit of its objectives and can exclude or otherwise regulate the access of others to that benefit.

Exchange transactions are transactions in which one entity receives assets or services, or has liabilities extinguished, and directly gives approximately equal value (primarily in the form of cash, goods, services, or use of assets) to another entity in exchange.

Non-exchange transactions are transactions that are not exchange transactions. In a non-exchange transaction, an entity either receives value from another entity without directly giving approximately equal value in exchange, or gives value to another entity without directly receiving approximately equal value in exchange.

RECOGNITION

An inflow of resources from a non-exchange transaction recognised as an asset is recognised as revenue, except to the extent that a liability is also recognised in respect of the same inflow.

As the entity satisfies a present obligation recognised as a liability in respect of an inflow of resources from a non-exchange transaction recognised as an asset, it reduces the carrying amount of the liability recognised and recognises an amount of revenue equal to that reduction.

MEASUREMENT

Revenue from a non-exchange transaction is measured at the amount of the increase in net assets recognised by the entity.

ACCOUNTING POLICIES
AS AT 31 MARCH 2021 (CONTINUED)

When, as a result of a non-exchange transaction, the entity recognises an asset, it also recognises revenue equivalent to the amount of the asset measured at its fair value as at the date of acquisition, unless it is also required to recognise a liability. Where a liability is required to be recognised it will be measured as the best estimate of the amount required to settle the obligation at the reporting date, and the amount of the increase in net assets, if any, recognised as revenue. When a liability is subsequently reduced, because the taxable event occurs or a condition is satisfied, the amount of the reduction in the liability is recognised as revenue.

1.14 INVESTMENT INCOME

Investment income is recognised on a time-proportion basis using the effective interest method.

1.15 COMPARATIVE FIGURES

Where necessary, comparative figures have been reclassified to conform to changes in presentation in the current year.

1.16 FRUITLESS AND WASTEFUL EXPENDITURE

Fruitless expenditure means expenditure which was made in vain and would have been avoided had reasonable care been exercised.

All expenditure relating to fruitless and wasteful expenditure is recognised as an expense in the statement of financial performance in the year that the expenditure was incurred. The expenditure is classified in accordance with the nature of the expense, and where recovered, it is subsequently accounted for as revenue in the statement of financial performance.

1.17 IRREGULAR EXPENDITURE

Irregular expenditure as defined in section 1 of the PFMA is expenditure other than unauthorised expenditure, incurred in contravention of or that is not in accordance with a requirement of any applicable legislation, including -

(a) this Act;
(b) the State Tender Board Act, 1968 (Act No. 86 of 1968), or any regulations made in terms of the Act; or
(c) any provincial legislation providing for procurement procedures in that provincial government.

1.18 SEGMENT INFORMATION

A segment is an activity of an entity:

- that generates economic benefits or service potential (including economic benefits or service potential relating to transactions between activities of the same entity);
- whose results are regularly reviewed by management to make decisions about resources to be allocated to that activity and in assessing its performance; and
- for which separate financial information is available.

Reportable segments are the actual segments which are reported on in the segment report. They are the segments identified above or alternatively an aggregation of two or more of those segments where the aggregation criteria are met.

MEASUREMENT

The amount of each segment item reported is the measure reported to management for the purposes of making decisions about allocating resources to the segment and assessing its performance. Adjustments and eliminations made in preparing the entity's financial statements and allocations of revenues and expenses are included in determining reported segment surplus or deficit only if they are included in the measure of the segment's surplus or deficit that is used by management. Similarly, only those assets and liabilities that are included in the measures of the segment's assets and segment's liabilities that are used by management are reported for that segment. If amounts are allocated to reported segment surplus or deficit, assets or liabilities, those amounts are allocated on a reasonable basis.

1.19 BUDGET INFORMATION

An economic entity is typically subject to budgetary limits in the form of appropriations or budget authorisations, which is given effect through authorising legislation, appropriation or similar.

General purpose financial reporting by economic entity shall provide information on whether resources were obtained and used in accordance with the legally adopted budget.

The approved budget is prepared on an accrual basis and presented by economic classification linked to performance outcome objectives.

The approved budget covers the fiscal period from 01/04/2020 to 31/03/2021.

The AFS and the budget are on the same basis of accounting therefore a comparison with the budgeted amounts for the reporting period have been included in the Statement of comparison of budget and actual amounts.

The Statement of comparative and actual information has been included in the AFS as the recommended disclosure when the AFS and the budget are on the same basis of accounting as determined by National Treasury.

1.20 RELATED PARTIES

A related party is a person or an entity with the ability to control or jointly control the other party, or exercise significant influence over the other party, or vice versa, or an entity that is subject to common control, or joint control.

Control is the power to govern the financial and operating policies of an entity so as to obtain benefits from its activities.

A related party transaction is a transfer of resources, services or obligations between the reporting entity and a related party, regardless of whether a price is charged.

Significant influence is the power to participate in the financial and operating policy decisions of an entity, but is not control over those policies.

Management are those persons responsible for planning, directing and controlling the activities of the economic entity, including those charged with the governance of the economic entity in accordance with legislation, in instances where they are required to perform such functions.

Close members of the family of a person are those family members who may be expected to influence, or be influenced by that person in their dealings with the economic entity.

The economic entity is exempt from disclosure requirements in relation to related party transactions if that transaction occurs within normal supplier and/or client/recipient relationships on terms and conditions no more or less favourable than those which it is reasonable to expect the economic entity to have adopted if dealing with that individual entity or person in the same circumstances and terms and conditions are within the normal operating parameters established by that reporting entity's legal mandate.

Where the economic entity is exempt from the disclosures in accordance with the above, the economic entity discloses narrative information about the nature of the transactions and the related outstanding balances, to enable users of the entity's financial statements to understand the effect of related party transactions on its AFS.

1.21 EVENTS AFTER REPORTING DATE

Events after reporting date are those events, both favourable and unfavourable, that occur between the reporting date and the date when the financial statements are authorised for issue. Two types of events can be identified:

- those that provide evidence of conditions that existed at the reporting date (adjusting events after the reporting date); and
- those that are indicative of conditions that arose after the reporting date (non-adjusting events after the reporting date).

The economic entity will adjust the amount recognised in the financial statements to reflect adjusting events after the reporting date once the event occurred.

The economic entity will disclose the nature of the event and an estimate of its financial effect or a statement that such estimate cannot be made in respect of all material non-adjusting events, where non-disclosure could influence the economic decisions of users taken on the basis of the financial statements.

1.22 PRIOR PERIOD ERROR

Where necessary, prior period errors have been corrected to conform to changes in presentation in both the current and previous year.

NOTES TO THE ANNUAL FINANCIAL STATEMENTS
AS AT 31 MARCH 2021

2. NEW STANDARDS AND INTERPRETATIONS

2.1 STANDARDS AND INTERPRETATIONS EFFECTIVE AND ADOPTED IN THE CURRENT YEAR

No new standards were adopted in the year under review.

	(R thousands)					
	March 2021			March 2020		
	Cost	Accumulated depreciation and impairment	Carrying value	Cost	Accumulated depreciation and impairment	Carrying value
3. PROPERTY AND EQUIPMENT						
ECONOMIC ENTITY						
Furniture and office equipment	28,795	(23,622)	5,173	30,819	(23,361)	7,458
Motor vehicles	371	(329)	42	371	(288)	83
Leasehold improvements	1,798	(1,798)	–	7,058	(7,011)	47
Laboratory equipment	11,191	(9,656)	1,535	11,218	(8,688)	2,530
Total	**42,155**	**(35,405)**	**6,750**	**49,466**	**(39,348)**	**10,118**
CONTROLLING ENTITY						
Furniture and office equipment	28,795	(23,622)	5,173	30,819	(23,361)	7,458
Motor vehicles	371	(329)	42	371	(288)	83
Leasehold improvements	1,798	(1,798)	–	7,058	(7,011)	47
Laboratory equipment	11,191	(9,656)	1,535	11,218	(8,688)	2,530
Total	**42,155**	**(35,405)**	**6,750**	**49,466**	**(39,348)**	**10,118**

NOTES TO THE ANNUAL FINANCIAL STATEMENTS
FOR THE YEAR ENDED 31 MARCH 2021

	(R thousands)				
	Opening balance	Additions	Disposals	Depreciation	Total
3. PROPERTY AND EQUIPMENT CONTINUED					
RECONCILIATION OF PROPERTY AND EQUIPMENT – ECONOMIC ENTITY – MARCH 2021					
Furniture and office equipment	7,458	1,250	(385)	(3,150)	5,173
Motor vehicles	83	–	–	(41)	42
Leasehold improvements	47	27	–	(74)	–
Laboratory equipment	2,530	42	(6)	(1,031)	1,535
	10,118	**1,319**	**(391)**	**(4,296)**	**6,750**
RECONCILIATION OF PROPERTY AND EQUIPMENT – ECONOMIC ENTITY – MARCH 2020					
Furniture and office equipment	11,380	1,536	(249)	(5,209)	7,458
Motor vehicles	144	–	–	(61)	83
Leasehold improvements	268	69	–	(290)	47
Laboratory equipment	3,383	274	–	(1,127)	2,530
	15,175	**1,879**	**(249)**	**(6,687)**	**10,118**
RECONCILIATION OF PROPERTY AND EQUIPMENT – CONTROLLING ENTITY – MARCH 2021					
Furniture and office equipment	7,458	1,250	(385)	(3,150)	5,173
Motor vehicles	83	–	–	(41)	42
Leasehold improvements	47	27	–	(74)	–
Laboratory equipment	2,530	42	(6)	(1,031)	1,535
	10,118	**1,319**	**(391)**	**(4,296)**	**6,750**
RECONCILIATION OF PROPERTY AND EQUIPMENT – CONTROLLING ENTITY – MARCH 2020					
Furniture and office equipment	11,380	1,536	(249)	(5,209)	7,458
Motor vehicles	144	–	–	(61)	83
Leasehold improvements	268	69	–	(290)	47
Laboratory equipment	3,383	274	–	(1,127)	2,530
	15,175	**1,879**	**(249)**	**(6,687)**	**10,118**

PLEDGED AS SECURITY

None of the assets above have been pledged as security or have restrictions on title.

DEPRECIATION RATES

Depreciation related to technology platform programmes is included in project expenditure.

The depreciation methods and average useful lives of property and equipment have been assessed as follows:

Item	Depreciation method	Average useful life
Leasehold improvements	Straight-line	Shorter of the period of the lease agreement or the useful life
Furniture and office equipment	Straight-line	2 – 13 years
Motor vehicles	Straight-line	2 – 12 years
Laboratory equipment	Straight-line	5 – 10 years

NOTES TO THE ANNUAL FINANCIAL STATEMENTS
FOR THE YEAR ENDED 31 MARCH 2021

	March 2021			March 2020		
	Cost	Accumulated amortisation and impairment	Carrying value	Cost	Accumulated amortisation and impairment	Carrying value
4. INTANGIBLE ASSETS						
ECONOMIC ENTITY						
Computer software	9,477	(8,027)	1,450	11,182	(8,154)	3,028
Website	873	(524)	349	–	–	–
Total	**10,350**	**(8,551)**	**1,799**	**11,182**	**(8,154)**	**3,028**
CONTROLLING ENTITY						
Computer software	9,477	(8,027)	1,450	11,182	(8,154)	3,028
Website	873	(524)	349	–	–	–
Total	**10,350**	**(8,551)**	**1,799**	**11,182**	**(8,154)**	**3,028**

	Opening balance	Additions	Transfers	Amortisation	Total
RECONCILIATION OF INTANGIBLE ASSETS – ECONOMIC ENTITY – MARCH 2021					
Computer software	3,028	192	(873)	(897)	1,450
Website	–	–	873	(524)	349
	3,028	**192**	**–**	**(1,421)**	**1,799**

	Opening balance	Additions	Amortisation	Total
RECONCILIATION OF INTANGIBLE ASSETS – ECONOMIC ENTITY – MARCH 2020				
Computer software	3,434	686	(1,092)	3,028

	Opening balance	Additions	Transfers	Amortisation	Total
RECONCILIATION OF INTANGIBLE ASSETS – CONTROLLING ENTITY – MARCH 2021					
Computer software	3,028	192	(873)	(897)	1,450
Website	–	–	873	(524)	349
	3,028	**192**	**–**	**(1,421)**	**1,799**

	Opening balance	Additions	Amortisation	Total
RECONCILIATION OF INTANGIBLE ASSETS – CONTROLLING ENTITY – MARCH 2020				
Computer software	3,434	686	(1,092)	3,028

RESTRICTED TITLE

None of the above intangible assets have restrictions in title or have been pledged as security.

NOTES TO THE ANNUAL FINANCIAL STATEMENTS
FOR THE YEAR ENDED 31 MARCH 2021

Name of company	Reporting period end	% holding March 2021	% holding March 2020	Carrying amount March 2021	Carrying amount March 2020
5. INVESTMENTS IN CONTROLLED ENTITIES					
Investments in the process of deregistration/liquidation					
Capelands Nurseries (Pty) Ltd*	31 Mar	–%	100.00%	–	–
iThemba Pharmaceutical (Pty) Ltd	31 Dec	50.10%	50.10%	–	–
Natural Carotenoids South African (Pty) Ltd	31 Jul	98.80%	98.80%	–	–
Bio2Biz (Pty) Ltd	31 Dec	100.00%	100.00%	2,189	2,189
				2,189	**2,189**

The carrying amounts of controlled entities are shown net of impairment losses.

*The investment was deregistered during the current financial year.

CONTROLLED ENTITY'S REPORTING DATE IS DIFFERENT FROM THAT OF THE CONTROLLING ENTITY

Some of the controlled entities, have reporting dates that differ from the controlling entity. If the reporting date is within a three month period of the reporting period of the controlling entity, the AFS for that period were used in consolidating the results of the entity. The management accounts for the entities were reviewed in order to ensure that no significant changes took place between the reporting date and 31 March 2021.

Where the reporting dates differ with more than three months, a review of the financial affairs of the entity is performed up to the reporting date of the controlling entity and this is used for consolidation purposes.

Name of entity	Reporting period end	% holding March 2021	% holding March 2020	Carrying amount March 2021	Carrying amount March 2020
6. INVESTMENTS IN ASSOCIATES					
Active investments					
Lifeassay (Pty) Ltd	28 Feb	26.00%	26.00%	296	555
Ribotech (Pty) Ltd	31 Aug	35.00%	35.00%	–	–
Tenacent SA (Pty) Ltd	28 Feb	20.00%	20.00%	–	–
Investments in process of deregistration/liquidation					
Niocad (Pty) Ltd	28 Feb	22.00%	22.00%	–	–
Nkomazi Chemicals (Pty) Ltd*	30 Jun	–%	35.70%	–	–
Commercial Aquaculture (Pty) Ltd*	28 Feb	–%	34.00%	–	–
Edgi Tech (Pty) Ltd	28 Feb	26.00%	26.00%	–	–
Silverlake Trading (Pty) Ltd	28 Feb	28.00%	28.00%	–	–
Eyeborn (Pty) Ltd	31 Mar	25.00%	25.00%	–	–
Femtech (Pty) Ltd	28 Feb	69.00%	69.00%	–	–
Mycoroot (Pty) Ltd*	28 Feb	–%	25.00%	–	–
				296	**555**

* These investments were deregistered during the current financial year.

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FOR THE YEAR ENDED 31 MARCH 2021

6. INVESTMENTS IN ASSOCIATES CONTINUED

The carrying amounts of associates are shown net of impairment losses.

Although the controlling entity holds more than 50% of the voting powers in some of the entities, the investment is not considered a controlled entity because the controlling entity does not have control over the entity due to voting rights/appointment powers of Directors. These investments are therefore classified as investments in associates.

	(R thousands)			
	Economic entity		Controlling entity	
	March 2021	March 2020	March 2021	March 2020
Movements in carrying value				
Opening balance	555	1,085	–	–
Share of deficit	(259)	(530)	–	–
Closing balance	**296**	**555**	**–**	**–**

PRINCIPAL ACTIVITIES

Legal name	Principal activity
LifeAssay Diagnostics (Pty) Ltd	Manufacture of vitro diagnostics test kits
Ribotech (Pty) Ltd	Manufacturing of rHOG CSF. Product is used in cancer treatment
Tenacent (Pty) Ltd	Development and sales of technical devices for the control of containers

All the above entities are incorporated in South Africa.

SUMMARY OF CONTROLLED ENTITY'S INTEREST IN ASSOCIATE

Total assets	1,380	23,164
Total liabilities	(58,362)	(156,793)
Revenue	4,296	22,002
Deficit for the year	(1,938)	(12,709)

ASSOCIATES WITH DIFFERENT REPORTING DATES

Some of the associates have reporting dates that differ from the controlling entity. If the reporting date is within a three month period of the reporting period of the controlling entity, the AFS for that period were used in consolidating the results of the entity. The management accounts for the entities were reviewed in order to ensure that no significant changes took place between the reporting date and the year end. The entity has utilised latest financial available information for the purposes of disclosure.

UNRECOGNISED SHARE OF LOSSES OF ASSOCIATES

The economic entity has discontinued recognising its share of the deficit of associate companies, as the investment is held at R nil and the economic entity has no obligation for any deficit of the associate. The total unrecognised deficit for the current period is R1,822,547 (2020: R1,786,856). The accumulated unrecognised deficit to date amount to R56,313,881 (2020: R46,659,073).

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	(R thousands)			
	Economic entity		Controlling entity	
	March 2021	March 2020	March 2021	March 2020
7. LOANS AND RECEIVABLES				
OTHER ENTITIES				
Agriprotein (Pty) Ltd*	7,894	12,961	7,894	12,961
The loan has fixed monthly repayment terms and interest accrues at prime				
Synexa (Pty) Ltd	3,411	4,185	3,411	4,185
This loan has fixed quarterly repayment terms over a period of 6 years and accrues interest at prime				
The Biologicals and Vaccines Institute of Southern Africa (Pty) Ltd	23,300	23,300	23,300	23,300
The shareholder loan has no fixed date of repayment and currently bears no interest payment				
	34,605	**40,446**	**34,605**	**40,446**
Non-current assets	25,410	34,692	25,410	34,692
Current assets	9,195	5,754	9,195	5,754
	34,605	**40,446**	**34,605**	**40,446**

COMPARATIVE FIGURES

Prior year comparatives have been restated to reflect a reclassification of a shareholder loan to loan and receivables. This has no impact to the total amount of non-current assets as disclosed in the Statement of Financial Position. Refer to note 34 for further details.

LOANS TO ECONOMIC ENTITIES IMPAIRED

* This investment was impaired during the current financial year due to the company being placed under business rescue.

As at 31 March 2021, loans to economic entities of R146,856,788 (2020: R146,856,788) were impaired and provided for. The movement from the prior year to current year includes current year impairment. The amount of prior year impaired loans and receivables to economic entities has been restated as a result of the reclassification of a shareholder loan to Biovac.

The creation and release of provision for impaired receivables has been included in operating expenses in the statement of financial performance. Amounts charged to the allowance account are generally written off when the recovery of such amounts are improbable.

The economic entity does not hold collateral as security.

RECONCILIATION OF PROVISION FOR IMPAIRMENT ON LOANS AND RECEIVABLES

Provision for impairment	5,715	–	5,715	–
Closing Balance	**5,715**	**–**	**5,715**	**–**

NOTES TO THE ANNUAL FINANCIAL STATEMENTS
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	(R thousands)			
	Economic entity		Controlling entity	
	March 2021	March 2020	March 2021	March 2020

8. OTHER FINANCIAL ASSETS

The Biologicals and Vaccines Institute of Southern Africa (Pty) Ltd 12.5% shareholding	3,000	3,000	3,000	3,000

COMPARATIVE FIGURES

During the current year, prior year comparatives have been restated to reclassify a shareholder loan (totaling R23,300,000 net of impairment) to loans and receivables (financial asset at amortised cost) per GRAP 104. Refer to notes 7 and 34 for further details.

9. TRADE AND OTHER RECEIVABLES

Trade debtors	2,366	415	2,366	415
Deposits	270	329	270	329
Other receivables	2,593	136	2,593	136
Provision for bad debt	(4,194)	–	(4,194)	–
	1,035	**880**	**1,035**	**880**

Included in other receivables is an amount of R564,000 in respect of a labour matter which was deposited in a trust account of the respective attorney. Refer to note 29 for further details.

FAIR VALUE OF TRADE AND OTHER RECEIVABLES

The entity is of the opinion that the carrying value approximates the fair value of trade and other receivables at period end, due to the short term nature of these balances.

TRADE AND OTHER RECEIVABLES PAST DUE BUT NOT IMPAIRED

Trade and other receivables which are less than three months past due are not considered to be impaired. At 31 March 2021, R – (2020: R –) were past due but not impaired.

TRADE AND OTHER RECEIVABLES IMPAIRED

As at 31 March 2021, trade and other receivables of R4,194,000 (2020: R1,062,489) were impaired and provided for.

The ageing of these loans is as follows:

3 to 6 months	3,132	–	3,132	–
Over 6 months	1,062	1,062	1,062	1,062

NOTES TO THE ANNUAL FINANCIAL STATEMENTS
FOR THE YEAR ENDED 31 MARCH 2021

9. TRADE AND OTHER RECEIVABLES CONTINUED

RECONCILIATION OF PROVISION FOR IMPAIRMENT OF TRADE AND OTHER RECEIVABLES

	(R thousands)			
	Economic entity		Controlling entity	
	March 2021	March 2020	March 2021	March 2020
Opening balance	1,062	1,062	1,062	1,062
Provision for impairment	3,132	–	3,132	–
	4,194	**1,062**	**4,194**	**1,062**

The creation and release of provision for impaired receivables have been included in operating expenses in deficit. Amounts charged to the allowance account are generally written off when there is no expectation of recovering additional cash.

No collateral is held as security.

10. PREPAYMENTS

Prepayments are due to rentals for the Western Cape, Durban and Pretoria offices as well as Bio-Safety, Bio-Processing, Platforms and software licences which are paid in advance.

11. CASH AND CASH EQUIVALENTS

Cash and cash equivalents consist of:

Cash on hand	–	10	–	10
Bank balances	241,970	147,530	241,970	144,939
	241,970	**147,540**	**241,970**	**144,949**

The entity is of the opinion that the carrying value approximates the fair value of cash and cash equivalents at period end, due to the short term nature of these balances.

The entity has moved to a paycard system during the year and therefore no physical cash is held on hand.

NOTES TO THE ANNUAL FINANCIAL STATEMENTS
FOR THE YEAR ENDED 31 MARCH 2021

	(R thousands)			
	Economic entity		Controlling entity	
	March 2021	March 2020	March 2021	March 2020

12. FINANCE LEASE OBLIGATION

Minimum lease payments due				
– within one year	174	325	174	325
– in second to fifth year inclusive	–	173	–	173
Present value of minimum lease payments	**174**	**498**	**174**	**498**
Present value of minimum lease payments due				
– within one year	174	325	174	325
– in second to fifth year inclusive	–	173	–	173
	174	**498**	**174**	**498**
Non-current liabilities	–	173	–	173
Current liabilities	174	325	174	325
	174	**498**	**174**	**498**

It is economic entity policy to lease certain office equipment under finance leases.

The average lease term is three years and the average effective borrowing rate is -% (2020: -%). Interest rates are fixed at the contract date. All leases have fixed repayments.

13. COMMITTED CONDITIONAL GRANTS

COMMITTED CONDITIONAL GRANTS AND RECEIPTS COMPRISES OF:				
Africa Programme	6,200	6,761	6,200	6,761
Agriculture Bio-Economy Partnership Programme	13,598	8,353	13,598	8,353
Fibrelux technology diffusion initiative	36	35	36	35
Forest Molecular Genomics	–	133	–	133
ICT flagship programme	221	213	221	213
Innovation Bridge	–	4	–	4
Innovation for Inclusive Development	32,813	42,405	32,813	42,405
Joint technology innovation programme	1,341	1,291	1,341	1,291
Limpopo Agri Food Technology Station	128	123	128	123
Nuclear medicine	77	2,140	77	2,140
Sabdi (Biodesign initiative programme)	12,577	13,566	12,577	13,566
Innovation fund	55,711	–	55,711	–
Seed Fund Programme	60	58	60	58
Strategic Industrial Bio-Innovation Programme	14,545	871	14,545	871
Sugarcane research projects	1,150	1,402	1,150	1,402
Technology Station Programme	8,745	11,001	8,745	11,001
	147,202	**88,356**	**147,202**	**88,356**

NOTES TO THE ANNUAL FINANCIAL STATEMENTS
FOR THE YEAR ENDED 31 MARCH 2021

	(R thousands)			
	Economic entity		Controlling entity	
	March 2021	March 2020	March 2021	March 2020

13. COMMITTED CONDITIONAL GRANTS (CONTINUED)

MOVEMENT DURING THE YEAR

Balance at the beginning of the year	88,356	81,120	88,356	81,120
Additions during the year	219,746	154,298	219,746	154,298
Income recognition during the year	(160,900)	(147,062)	(160,900)	(147,062)
	147,202	**88,356**	**147,202**	**88,356**
Non-current liabilities	20,533	88,356	20,533	88,356
Current liabilities	126,669	–	126,669	–
	147,202	**88,356**	**147,202**	**88,356**

Committed conditional grants represent specific contracts with primarily the Department of Science and Innovation (DSI). Funds payable under the contract have been disclosed between amounts expected to outflow based on programme requirements.

Committed conditional grants have been split between current and non-current portions based on expected outflows from programmes.

14. TRADE AND OTHER PAYABLES

Trade payables	2,725	8,082	2,725	7,677
Employee related accruals	12,128	10,776	12,128	10,776
Other payables	50,160	35,061	52,346	35,061
	65,013	**53,919**	**67,199**	**53,514**

Included in other payables is funds received from the DSI through the Innovation Fund for specifically selected projects.

Included within Other payables is an amount of R36,813,697 in respect of the liquidation of Clean Energy Investments (Pty) Ltd (a specific programme managed on behalf of the DSI). These funds are expected to be repaid to the DSI in the 2021/22 financial year.

NOTES TO THE ANNUAL FINANCIAL STATEMENTS
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	(R thousands)			
	Economic entity		Controlling entity	
	March 2021	March 2020	March 2021	March 2020
15. REVENUE FROM NON-EXCHANGE TRANSACTIONS				
DST allocation received during the year	408,825	440,929	408,825	440,929
Committed conditional grant funding recognised for:	–	–	–	–
Africa Programme	818	7,452	818	7,452
Agriculture Bio-Economy Partnerships Programme	16,923	23,914	16,923	23,914
Bioprocessing	1,899	–	1,899	–
Forest Molecular Genomics	–	3,000	–	3,000
ICT flagship programme	–	3,000	–	3,000
Innovation Bridge	–	228	–	228
Innovation For Inclusive Development	22,048	22,104	22,048	22,104
Innovation Fund	25,237	–	25,237	–
Sabdi (Biodesign Initiative Programme)	1,494	9,188	1,494	9,188
Seed Fund programme	–	14,868	–	14,868
Strategic Industrial Bio-Innovation Programme	10,753	9,460	10,753	9,460
Technology Innovation Cluster Programme	3,108	–	3,108	–
Technology Station Programme	78,610	52,885	78,610	52,885
	569,715	**587,028**	**569,715**	**587,028**
16. OTHER INCOME				
Royalties received	5,368	1,641	5,368	1,641
Sundry receipts	115	160	115	160
EWSETA funding received	–	2,405	–	2,405
Income from investment	–	–	–	2,189
	5,483	**4,206**	**5,483**	**6,395**
17. INTEREST REVENUE				
Investment revenue				
Interest earned – Loans and receivables	992	1,756	992	1,756
Interest earned – Bank	6,451	10,769	6,451	10,506
	7,443	**12,525**	**7,443**	**12,262**
18. EMPLOYEE RELATED COSTS				
Remuneration	94,316	101,599	94,316	101,599
Defined contribution plans	6,737	7,399	6,737	7,399
	101,053	**108,998**	**101,053**	**108,998**

NOTES TO THE ANNUAL FINANCIAL STATEMENTS
FOR THE YEAR ENDED 31 MARCH 2021

	(R thousands)			
	Economic entity		Controlling entity	
	March 2021	March 2020	March 2021	March 2020
19. PROJECT FUNDING EXPENDITURE				
Project grants – third party	419,247	450,989	419,247	450,989
Project funding is made up of the following:				
Africa Programme	818	7,425	818	7,425
Global Cleantech Innovation Programme	2,623	2,378	2,623	2,378
Innovation for Inclusive Development	20,698	22,104	20,698	22,104
Innovation Skills Development Programme	4,036	4,041	4,036	4,041
Seed Fund Programme	8,769	32,688	8,769	32,688
Technology Development	170,888	155,833	170,888	155,833
Technology Innovation Cluster Programme	21,446	31,930	21,446	31,930
Technology Platform Programme	69,433	83,560	69,433	83,560
Technology Station Programme	114,354	96,501	114,354	96,501
Thought Leadership & BioConvention	5,407	13,183	5,407	13,183
Youth Technology Innovation Programme	775	1,346	775	1,346
	419,247	**450,989**	**419,247**	**450,989**
20. IMPAIRMENT				
Impairment of financial assets at amortised cost	5,715	1,465	5,715	1,465
Provision for bad debts	3,132	–	3,132	–
	8,847	**1,465**	**8,847**	**1,465**
21. OTHER OPERATING EXPENSES				
Other operating expenses include expenditure such as:				
Auditors remuneration	985	1,248	985	1,248
Cleaning	498	525	498	525
Consulting and professional fees	5,102	7,904	5,102	7,904
Electricity	1,583	1,729	1,583	1,729
IT expenses	7,037	6,167	7,037	6,167
Insurance	693	500	693	500
Marketing	94	2,271	94	2,271
Placement fees	1,433	803	1,433	803
Printing and stationery	184	671	184	671
Repairs and maintenance	464	262	464	262
Security	1,000	1,264	1,000	1,264
Sponsorships	71	873	71	873
Staff welfare	849	398	849	398
Subscription and certification costs	1,047	1,893	1,047	1,893
Telephone and fax	785	822	785	822
Training	33	4,050	33	4,050
Travel	650	8,151	650	8,151

NOTES TO THE ANNUAL FINANCIAL STATEMENTS
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22. TAXATION

The economic and controlling entity is exempt from income tax in terms of the provisions of section 10(1)(cA)(i) of the Income Tax Act.

	(R thousands)			
	Economic entity		Controlling entity	
	March 2021	March 2020	March 2021	March 2020

23. CASH GENERATED FROM (USED IN) OPERATIONS

Surplus (deficit)	13,968	(15,976)	14,227	(13,518)
Adjustments for:				
Depreciation and amortisation	5,717	7,779	5,717	7,779
Deficit/(surplus) from equity accounted investments	259	530	–	–
Income from investment in subsidiary	–	–	–	(2,189)
Debt impairment	8,847	1,465	8,847	1,465
Interest on loan accounts	(992)	(1,756)	(992)	(1,756)
Assets written off	391	249	391	249
Changes in working capital:				
Trade and other receivables	(3,287)	1,011	(3,287)	1,011
Prepayments	444	(1,700)	444	(1,700)
Trade and other payables	10,630	(7,720)	13,221	(7,719)
	35,977	**(16,118)**	**38,568**	**(16,378)**

24. COMMITMENTS

Operating leases – as lessee (expense)

Minimum lease payments due				
- within one year	4,398	8,750	4,398	8,750
- in second to fifth year inclusive	1,394	3,353	1,394	3,353
	5,792	**12,103**	**5,792**	**12,103**

Operating lease payments represent rentals payable by the economic entity for certain of its offices. Leases are negotiated for an average term of five years and rentals are fixed for an average of three years. No contingent rent is payable.

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25. CONTINGENCIES

CONTINGENT LIABILITIES

Funding agreements:
These agreements will be funded using surplus cash and funds to be allocated in the financial periods in which these agreements become payable.

	(R thousands)			
	Economic entity		Controlling entity	
	March 2021	March 2020	March 2021	March 2020
Funding agreements	177,501	61,383	177,501	61,383

Legal proceedings:
There are several legal proceedings that are currently ongoing, these legal proceedings relate to prior or existing investments made by the Technology Innovation Agency, either for refunds of grants, repayment of loans or incorrect disclosure on the value of shares sold.

The estimated costs are as follows:

Legal costs	3,760	2,640	3,760	2,640

CONTINGENT ASSETS

This matter relates to a sale of shares transaction whereby the Controlling entity disposed of its 49% shareholding in Kapa Biosystems (Pty) Ltd to Kapa Biosystems Inc. It later transpired that the purchase price for the shares was significantly undervalued and that TIA was in fact entitled to an additional amount. The arbitration in this matter is presently ongoing. The amount owing to the Controlling entity is uncertain at this time.

26. RELATED PARTIES

Relationships	
Members	Refer to members' report note 27
Controlled entities	Refer to note 5
Associates	Refer to note 6
National department	Department of Science and Innovation
National government business enterprise	Council for Scientific and Industrial Research
National public entities	Agricultural Research Council Medical Research Council of South Africa The South African Nuclear Energy Corporation Mintek

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	(R thousands)	
	Controlling entity	
	March 2021	March 2020
26. RELATED PARTIES (CONTINUED)		
RELATED PARTY BALANCES		
Trade and Other Payables – Owing (to) by related parties		
Department of Science and Innovation	(36,813)	–
Commitments with related parties		
Department of Science and Innovation	–	(34,552)
Committed Conditional Grants		
Department of Science and Innovation	(147,202)	(88,356)
RELATED PARTY TRANSACTIONS		
Allocations received by TIA		
Department of Science and Innovation	(569,715)	(588,796)
Surplus funds returned by TIA		
National Treasury	–	15,372
Transactions with TIA		
Agricultural Research Council	1,565	1,498
Council for Scientific and Industrial Research	26,403	27,056
Medical Research Council for South Africa	9,412	4,800
Mintek	–	55
The South African Nucleur Energy Corporation	1,625	2,000

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	(R thousands)			
	Emoluments	Annual bonus	Allowances*	Total
27. MEMBERS EMOLUMENTS				
EXECUTIVE MEMBERS				
March 2021				
P. Krappie (Acting CEO)	1,759	259	474	2,492
I. Abdoola – CFO	623	–	–	623
K. Lourens (Acting CFO)	503	–	70	573
F. Levy-Hassen (Interim CEO)	868	–	–	868
W. Van der Merwe – CFO	790	–	5	795
P. Dekker	1,651	208	–	1,859
S. Pillay (Acting)	321	–	36	357
B.M. Mphahlele	1,388	–	–	1,388
Dr V.N. Phehane	1,233	–	–	1,233
M. Molatudi (Acting)	535	–	77	612
E. Mokhethi (Acting)	279	–	37	316
T.Y. Nquma-Moyo (Acting)	902	127	120	1,149
	10,852	**594**	**819**	**12,265**

* Allowances including the following: Cell phone, car, acting and travel and subsistence.

Performance bonuses paid during the period relate to the 2019/20 financial year

March 2020

P. Krappie	1,180	264	32	1,476
F. Levy-Hassen (Interim CEO)	2,818	–	11	2,829
B. Manilal – CEO	3,377	727	–	4,104
W. Van der Merwe – CFO	2,411	288	23	2,722
P. Dekker	1,668	–	–	1,668
V. Skosana (Acting)	287	–	41	328
M. Molatudi (Acting)	1,139	–	172	1,311
J. Hechter	257	141	61	459
S. Pillay (Acting)	278	–	39	317
Dr A. Ramsuran (Acting)	690	124	199	1,013
E. Mokhethi (Acting)	786	–	102	888
M. Lekoto	844	–	83	927
	15,735	**1,544**	**763**	**18,042**

* The annual bonus amount includes the bonus for 2 financial years.

NOTES TO THE ANNUAL FINANCIAL STATEMENTS
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	(R thousands)	
	Members' fees	Total

27. MEMBERS EMOLUMENTS (CONTINUED)

BOARD MEMBERS

March 2021		
B.A. Mboniswa	230	230
Dr S.J. Lennon	226	226
Dr M. Madikizela	193	193
J.S.P. Matsebula	152	152
Dr P.L. Mlengana	96	96
T.G. Ramasike	230	230
	1,127	**1,127**

The members did not receive any allowances during the current financial year.

	(R thousands)		
	Members' fees	Allowances	Total
March 2020			
B.A. Mboniswa	97	4	101
Dr J. Coates (resigned 28/02/2019)	–	2	2
Dr S.J. Lennon	341	3	344
F. Levy-Hassen (resigned 12/06/2019)	31	–	31
Dr M. Madikizela	162	12	174
J.S.P. Matsebula	157	20	177
Dr P.L. Mlengana	77	–	77
T.G. Ramasike	214	14	228
Dr J. Van de Loosdrecht	61	–	61
	1,140	**55**	**1,195**

NOTES TO THE ANNUAL FINANCIAL STATEMENTS
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28. RISK MANAGEMENT

FINANCIAL RISK MANAGEMENT

The economic entity's activities expose it to a variety of financial risks: market risk (including currency risk, fair value interest rate risk, cash flow interest rate risk and price risk), credit risk and liquidity risk.

LIQUIDITY RISK

The economic entity's risk to liquidity is a result of the Economic entity

	(R thousands)			
	Less than 1 year	Between 1 and 2 years	Between 2 and 5 years	Over 5 years
At 31 March 2021				
Trade and other payables	65,013	–	–	–
Finance lease liability	174	–	–	–
At 31 March 2020				
Trade and other payables	53,919	–	–	–
Finance lease liability	325	173	–	–

CONTROLLING ENTITY

At 31 March 2021				
Trade and other payables	67,199	–	–	–
Finance lease liability	174	–	–	–
At 31 March 2020				
Trade and other payables	53,514	–	–	–
Finance lease liability	325	173	–	–

CREDIT RISK

Credit risk consists mainly of cash deposits, cash equivalents and trade debtors. The entity only deposits cash with major banks with high quality credit standing and limits exposure to any one counter-party.

Loans and receivables, investment in controlled entities, investment in associates and other investments consist mainly of funding granted to start up companies. The exposure to credit risk is managed through ongoing review of the operating results and financial position of the investee companies. Should the entity have doubt over the recoverability of the loan of the value of the investment, the loan/investment is impaired and further funding is carefully considered.

NOTES TO THE ANNUAL FINANCIAL STATEMENTS
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	(R thousands)			
	Economic entity – March 2021	Economic entity March 2020	Controlling entity – March 2021	Controlling entity – March 2020

28. RISK MANAGEMENT (CONTINUED)

Financial assets exposed to credit risk at year end were as follows:

Financial instrument				
Cash and cash equivalents	241,970	147,540	241,970	144,949
Trade and other receivables	5,229	880	5,229	880
Loans and receivables	54,578	54,704	54,578	54,704

The entity has little doubt over the recoverability of trade and other receivables not considered to be impaired at year end.

The entity has reviewed the financial position of each of the entities where they have not impaired the loan disbursed or investment made to the investee company based on the management is of the opinion that at the period end the amount is recoverable.

MARKET RISK

Interest rate risk

Changes in interest rates will affect the revenue from exchange transaction revenue stream as the return on investment of surplus funds is linked to the prime rate.

Cash flow interest rate risk

	Current interest rate	Due in less than a year	Due in one to two years	Due in two to three years	Due in three to four years	Due after five years
Financial instrument						
Cash reserves at CPD (SARB)	3.75%	231,656	–	–	–	–
Cash reserves at Standard Bank	9.50 %	10,296	–	–	–	–
Other cash reserves	- %	18	–	–	–	–

Foreign exchange risk

The economic entity does not hedge foreign exchange fluctuations.

The economic entity reviews its foreign currency exposure, including commitments on an ongoing basis.

29. EVENTS AFTER THE REPORTING DATE

There is one labour matter that has subsequently been concluded after year end of which the CCMA ruling was against TIA. This amount will be expensed in the 2021/22 financial year. The funds are held in a trust account of the attorney for an amount of R564,000. Refer to note 9 for further details.

NOTES TO THE ANNUAL FINANCIAL STATEMENTS
FOR THE YEAR ENDED 31 MARCH 2021

	(R thousands)			
	Economic entity		Controlling entity	
	March 2021	March 2020	March 2021	March 2020

30. FRUITLESS AND WASTEFUL EXPENDITURE

Opening balance as previously reported	80	80	–	–
Opening balance as restated	**80**	**80**	**–**	**–**
Add: Expenditure identified - current	5	–	–	–
Closing balance	**85**	**80**	**–**	**–**

Economic Entity: Current year – The nature of the expense (R5,486) that could be avoided are interest and penalties in taxes for one controlled entity that is currently under de-registration. An amount of R685 will be recovered from the previous shareholder.

Prior year – The nature of the expenses that could have been avoided are interest and penalties on PAYE for two controlled entities which were subsequently deregistered.

31. IRREGULAR EXPENDITURE

Opening balance as previously reported	10,752	7,923	2,829	–
Opening balance as restated	**10,752**	**7,923**	**2,829**	**–**
Add: Irregular Expenditure - current	868	2,829	868	2,829
Closing balance	**11,620**	**10,752**	**3,697**	**2,829**

NARRATIVE

Economic entity: 13 controlled entities were inherited when the trusts (Biopad, Lifelab, Plantbio, Tshumisano, Innovation Fund, Cape Biotech Trust) were combined to form TIA. The entities were not set up to comply with the detail requirements of Treasury Regulation 16A6.1. The controlling entity is continuing to exit these entities and of the original 13 only 5 are remaining.

Controlling entity: Irregular expenditure has been highlighted, which relates to the manner in which the ex-interim CEO Fuzlin Levy-Hassen was appointed and the remuneration paid to her for services rendered in this capacity during the reporting period. Ms Levy-Hassen's contract came to an end on 12 June 2020 and no further irregular expenditure was incurred. The request for condonation is currently in progress.

32. SEGMENT INFORMATION

GENERAL INFORMATION

IDENTIFICATION OF SEGMENTS

The economic entity is organised and reports to management on the basis of four major functional areas and administration: Bio-economy, Sector funding, Strategic Engagements and Corporate Relations and Administration. The segments were organised around the type of service delivered and the target market within the National System of Innovation. Management uses these same segments for determining strategic objectives. Segments were aggregated for reporting purposes. The segments have changed from the prior financial year as the current mechanism of reporting is more accurate and aligned to the new 5 year strategic plan.

Information reported about these segments is used by management as a basis for evaluating the segments' performances and for making decisions about the allocation of resources. The disclosure of information about these segments is also considered appropriate for external reporting purposes.

NOTES TO THE ANNUAL FINANCIAL STATEMENTS
FOR THE YEAR ENDED 31 MARCH 2021

	(R thousands)					
	Bio-economy	Commer-cialisation	Innovation Enabling Programmes	Stations Programmes	Technology and strategic engagements	Total
32. SEGMENT INFORMATION (CONTINUED)						
SEGMENT SURPLUS OR DEFICIT						
CONTROLLING ENTITY - MARCH 2021						
Revenue						
Revenue from non-exchange transactions	197,046	78,902	28,070	114,354	151,343	569,715
Interest received	992	–	–	–	6,451	7,443
Other Income	115	5,368	–	–	–	5,483
Total segment revenue	**198,153**	**84,270**	**28,070**	**114,354**	**157,794**	**582,641**
Entity's revenue						**582,641**
Expenditure						
Employee related costs	16,640	16,870	15,520	2,439	49,584	101,053
Project funding expenditure	197,046	78,902	28,070	114,354	875	419,247
Other operating expenditure	36	83	721	–	47,533	48,373
Total segment expenditure	**213,722**	**95,855**	**44,311**	**116,793**	**97,992**	**568,673**
Total segmental surplus/(deficit)						**13,968**

NOTES TO THE ANNUAL FINANCIAL STATEMENTS
FOR THE YEAR ENDED 31 MARCH 2021

	Bio-economy	Commer-cialisation	Innovation Enabling	Administration and strategic engagements	Total
			(R thousands)		

32. SEGMENT INFORMATION (CONTINUED)

CONTROLLING ENTITY – MARCH 2020

Revenue					
Revenue	229,269	57,499	154,050	146,210	587,028
Interest received	1,756	–	–	10,506	12,262
Other income	456	1,346	2,178	2,415	6,395
Total segment revenue	**231,481**	**58,845**	**156,228**	**159,131**	**605,685**
Entity's revenue					**605,685**
Expenditure					
Employee related costs	14,983	15,139	15,914	62,962	108,998
Other expenses	1,364	1,058	3,876	52,918	59,216
Project funding expenditure	192,668	84,396	173,925	–	450,989
Total segment expenditure	**209,015**	**100,593**	**193,715**	**115,880**	**619,203**
Total segmental surplus/(deficit)					**(13,518)**

33. BUDGET DIFFERENCES

MATERIAL DIFFERENCES BETWEEN BUDGET AND ACTUAL AMOUNTS

DSI allocation – As a result of the impact of the COVID-19 pandemic, national budget constraints were cascaded down to public entities through reduced Medium-Term Expenditure Framework allocation. In line with Vote 35, a reduction of R1,447m was effected to the Entities overall MTEF allocation.

Other income – Increases were attributable to additional funds managed through specific programmes of the DSI. During the 2020/21 financial year, TIA was allocated funding to manage on behalf of the Innovation Fund.

Interest earned: A reduction in interest revenue was attributable to reductions in repo rate by the South African Reserve Bank.

Project related funding: Increases were attributable to additional funds managed through specific programmes of the DSI. During the 2020/21 financial year, TIA was allocated funding to manage on behalf of the Innovation Fund.

Employee related costs: Employee costs were lower than budget due to lower actual head count than anticipated during the period, due to a higher than budgeted vacancy ratio. Further, no increases to cost of living salary adjustments was effected and this resulted in positive variances.

Other operating expenditure: The Agency experienced a general reduction in operating expenditure as a result of COVID-19 lock down levels. Operational savings recognised through the year were re-allocated to project expenditure which added value to the overall efficiency ratio and investment expenditure.

34. PRIOR PERIOD ERROR

During the current year, prior year comparatives have been restated to reclassify a shareholder loan (totaling R23,300,000 net of impairment) to loans and receivables (financial asset at amortised cost) per GRAP 104. Refer to notes 7 and 8 for further details.

This reclassification has no impact to the total amount of non-current assets as disclosed in the Statement of Financial Position. There was further no impact to the Statement of Financial Position or Statement of Changes in Net Assets.

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