CSIR SHAREHOLDER'S COMPACT

Cycle commencing **1 April 2020**

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

CSIR
our future through science

Contents

Acronyms

AEM	Anion Exchange Membrane
AI	Artificial Intelligence
AISI	Aerospace Industry Support Initiative
ALC	African Laser Centre
AMD	Acid Mine Drainage
ARC	Agricultural Research Council
ARDP	Accelerated Researcher Development Programme
B-BBEE	Broad-Based Black Economic Empowerment
BDO	Butanediol
BIDC	Biomanufacturing Industry Development Centre
BIDF	Biorefinery Industry Development Facility
CAGR	Compound Annual Growth Rate
CeNAM	Centre for Nanostructures and Advanced Materials
CEO	Chief Executive Officer
CHPC	Centre for High Performance Computing
CNF	Cellulose Nanofibres
CPDO	Campus Master Planning Development Office
CRM	Customer Relations Management
CSIR	Council for Scientific and Industrial Research
DARD	Department of Agriculture and Rural Development
DIFR	Disabling Injury Frequency Rate
DoD	Department of Defence
DoH	Department of Health
DSI	Department of Science and Innovation
DTIC	Department of Trade, Industry and Competition
ECD	Enterprise Creation for Development
EE	Employment Equity
ER	Employee Relations
ERAs	Emerging Research Areas
ERM	Enterprise Risk Management
EVP	Employee Value Proposition
GDP	Gross Domestic Product
GERD	Gross Expenditure on Research and Development
GIS	Geographic Information System
GMP	Good Manufacturing Practice
HCD	Human Capital Development
HEIs	Higher Education Institutions
HFR	High Flow Reactor
HSRC	Human Sciences Research Council
IAS	Internal Audit Service
ICT	Information and Communication Technology
IDC	Industrial Development Corporation
IIPF	Industry Innovation Partnerships Programme
IoT	Internet of Things
IP	Intellectual Property
IPAP	Industrial Policy Action Plan
IPOSS	Integrated Port Operations Support System
IT	Information Technology
KAM	Key Account Management
KPIs	Key Performance Indicators
LMO	Lithium Magnesium Oxide
LMNO	Lithium Manganese Oxide

Acronyms

MEA	Membrane Electrode Assembly
MHSC	Mine Health and Safety Council
MICT	Media, Information and Communication Technologies
MTSF	Medium-term Strategic Framework
MTEF	Medium-term Expenditure Framework
MW	Megawatt
NCPC	National Cleaner Production Centre
NDP	National Development Plan
NEPAD	New Partnership for Africa's Development
NFTN	National Foundry Technology Network
NFV	Network Function Virtualisation
NGEI	NextGen Enterprises and Institutions
NHI	National Health Insurance
NIDF	Nanomaterials Industrial Development Facility
NLC	National Laser Centre
NMDF	Nanomicro Device Manufacturing Facility
NMISA	National Metrology Institute of South Africa
NSI	National System of Innovation
OEMs	Original Equipment Manufacturers
PBS	Polybutylene Succinate
PFMA	Public Finance Management Act, 1999 (Act 1 of 1999)
PGM	Platinum Group Metal
PLM	Product Lifecycle Management
PoC	Point-of-Care
PPE	Plant, Property and Equipment
PPF	Photonics Prototyping Facility
PV	Photovoltaic
RPP	Rental Pool Programme
R&D	Research and Development
RD&I	Research, Development and Innovation
RIA	Research Impact Areas
RTOs	Research Technology Organisations
ROI	Return on Investment
SAAF	South African Air Force
SAHPRA	South Africa Health Products Regulatory Authority
SANBio	Southern Africa Network for Biosciences
SADC	Southern African Development Community
SALGA	South African Local Government Association
SAMERDI	South African Mining Extraction Research, Development and Innovation
SANAS	South African National Accreditation System
SANDF	South African National Defence Force
SANReN	South African National Research Network
SAPS	South African Police Service
SCF	Super Critical Fluid
SDG	Sustainable Development Goals
SET	Science, Engineering and Technology
SETAs	Sector Education Training Authorities
SIB	Sodium Ion Battery
SIPs	Strategic Infrastructure Programmes
SMMEs	Small, Medium and Micro Enterprises
SOCs	State-owned Corporations
SOEs	State-owned Enterprises
STI	Science, Technology and Innovation
TD	Technology Demonstrator
THRIP	Technology and Human Resource for Industry Programme
TIA	Technology Innovation Agency
TRL	Technology Readiness Level
VRE	Variable Renewable Energy
WASA	Wind Atlas for South Africa

01 Overview of Shareholder's Compact

The Shareholder's Compact is a performance agreement between the Council for Scientific and Industrial Research (CSIR) and the Minister of Higher Education, Science and Technology. It consists of the text of the Compact itself (Chapter 2) and a series of supporting annexures covering the following aspects:

- Strategic planning documents:
  - Strategic Plan (Annexure A); and
  - Annual Performance Plan: 2020/21 (Annexure B).

- Documents setting out the governance structures and risk management strategies of the CSIR:
  - Governance Structure (Annexure C);
  - Risk Management Strategy (Plan) (Annexure D);
  - Fraud Prevention Plan (Annexure E); and
  - Materiality/Significance Framework (Annexure F).

- Documents setting out the CSIR Financial Plan and CSIR's compliance with the applicable financial legislation
  - Financial Plan (Annexure G)

02 Shareholder's Compact Agreement

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

FOR THE CYCLE COMMENCING 1 APRIL 2020

MADE AND ENTERED INTO BY AND BETWEEN:

THE MINISTER OF HIGHER EDUCATION, SCIENCE AND TECHNOLOGY

Dr. Blade Nzimande, in his capacity as Executive Authority being the responsible Cabinet member
(hereinafter referred to as "the Executive Authority")

and

THE CSIR BOARD

herein represented by Prof. Thokozani Majozi, the Chairperson of the Board
(hereinafter referred to as "the Accounting Authority")

(The Parties are hereinafter collectively referred to as "the Parties")

WHEREAS:

The Parties wish to conclude a Shareholder's Compact in order to underscore a constructive working relationship between them, clarify mutual expectations that are to be satisfied, articulate the CSIR's role in support of the effective functioning of the NSI and establish a framework of good corporate governance;

Treasury Regulation 29.2, issued under the PFMA, further requires the Accounting Authority of a Schedule 3B public entity to conclude a Shareholder's Compact with its Executive Authority annually; and

The CSIR Board is the organisation's Accounting Authority and the Minister of Higher Education, Science and Technology its Executive Authority as the Cabinet member responsible for the CSIR; the Parties have negotiated and reached an agreement on the contents of the Shareholder's Compact and wish to record the same in writing.

NOW THEREFORE THE PARTIES HEREBY AGREE AS FOLLOWS:

1. GLOSSARY OF TERMS

In this Shareholder's Compact, the following words and/or phrases shall have the following meanings:

1.1 **Accounting Authority** means the CSIR Board as established in terms of section 7 of the Scientific Research Council Act, 1988 (Act 46 of 1988);

1.2 The **Corporate Plan**, as embodied in Annexures A to G to this Shareholder's Compact, with

- Annexure A being the CSIR Strategic Plan;
- Annexure B being the CSIR Annual Plan for the 2020/21 financial year;
- Annexure C being the CSIR Governance Structure;
- Annexure D being the CSIR Risk Management Strategy (Plan);
- Annexure E being the CSIR Fraud Prevention Plan (FPP);
- Annexure F being the Materiality Framework; and
- Annexure G being the Financial Plan (including the Budget and Cash flow for 2020/21; the Group's three-year Financial Plan and the three-year borrowing plan).

1.3 **Annual Budget** means the CSIR's annual budget as embodied in Annexures A, B and G;

1.4 **Balanced Scorecard Framework** means the Executive Authority's framework for evaluating the performance of SET institutes described in the DSI's publication entitled "Reviewing the science, engineering, technology and innovation (SETI) scorecards", dated May 2003;

1.5 **Basic Conditions of Employment Act** means Act 75 of 1997;

1.6 **B-BBEE Codes** means the Broad-Based Black Economic Empowerment Codes as published in the Government Gazette from time to time;

1.7 **Employment Equity (EE) Act** means Act 55 of 1988;

1.8 **Effective Date** means the effective date of this Shareholder's Compact, which shall be 1 April 2020;

1.9 **Executive Authority** means the Minister of Higher Education, Science and Technology;

1.10 **Key Performance Indicators (KPIs)** means the performance measures described in the Corporate Plan, against which the performance of the CSIR shall be evaluated;

1.11 **Labour Relations Act** means Act 66 of 1995;

1.12 **Materiality Framework** means the materiality framework as envisaged by clauses 6.3 and 13.1.5. below and as recorded in Annexure F;

1.13 **Parties** means the Executive Authority and the Accounting Authority, respectively;

1.14 **PFMA** means Act 1 of 1999;

1.15 **Shareholder's Compact** means this document and all annexures thereto;

1.16 **Scientific Research Council Act** means the CSIR's enabling legislation, namely Act 46 of 1988;

1.17 **Skills Development Act** means Act 97 of 1998;

1.18 **Treasury Regulations** means any prescripts or legislative requirements or practice notes issued by the National Treasury for implementation by government departments, trading entities, constitutional institutions and public entities, issued in line with the PFMA.

2. THE SHAREHOLDER'S COMPACT

2.1 This Shareholder's Compact represents the agreement between the Executive Authority of the CSIR, being the Minister of Higher Education, Science and Technology, and the Accounting Authority of the CSIR, being the CSIR Board, herein represented by the Chairperson of the Board. It is a reflection of the expectations of each of the Parties, expressed in terms of outcomes and outputs that need to be achieved during the financial year starting on 1 April 2020.

2.2 This Shareholder's Compact shall operate from the Effective Date and will be reviewed by the Parties at the end of the financial year ending on 31 March 2021.

3. LEGAL REQUIREMENT AND PRIMARY RELATIONSHIP BETWEEN THE SIGNATORIES

3.1 Chapter 29 of the Treasury Regulations imposes the following legal requirements on the Accounting Authority of a Schedule 3B public entity, such as the CSIR, and its Executive Authority, in terms of the conclusion of a Shareholder's Compact:

"29.2 Shareholder's Compact

29.2.1 The accounting authority for a public entity listed in Schedule 2, 3B or 3D must, in consultation with its executive authority, annually conclude a Shareholder's Compact.

29.2.2 The Shareholder's Compact must document the mandated key performance measures and indicators to be attained by the public entity as agreed between the Accounting Authority and the Executive Authority."

4. FRAMEWORK FOR SHAREHOLDER'S COMPACT

4.1 In terms of section 3 of its enabling legislation, namely the Scientific Research Council Act, the mandate of the CSIR is as follows:

"The objects of the CSIR are, through directed and particularly multidisciplinary research and technological innovation, to foster, in the national interest, and in fields which in its opinion should receive preference, industrial and scientific development, either by itself or in co-operation with principals from the private or public sectors and thereby to contribute to the improvement of the quality of life of the people of the Republic; and to perform any other functions that may be assigned to the CSIR by or under this Act."

4.2 The Shareholder's Compact

The CSIR's strategic objectives (SOs) are outlined in the Corporate Plan, which incorporates the CSIR Strategic Plan and the CSIR Annual Plan for the 2020/21 planning cycle; the CSIR's Risk Management Strategy; the CSIR's FPP; the Materiality Framework; the Budget and Cash flow for 2020/21; the Group's three-year financial plan and the organisation's three-year borrowing plan. The Accounting Authority undertakes to oversee the implementation of the said elements of the Corporate Plan.

5. INTERNAL TRANSFORMATION

In Annexure A, the Corporate Plan of the CSIR deals with matters relating to transformation, among others. In giving effect to the Corporate Plan, the Accounting Authority will ensure that the CSIR is in full compliance with all applicable legislation, such as, but not limited to, the EE Act, the Skills Development Act, the Labour Relations Act, the Basic Conditions of Employment Act, the B-BBEE Codes and the like.

6. THE ROLE AND POWERS OF THE ACCOUNTING AUTHORITY

6.1 The role and powers of the Accounting Authority are set out in sections 7(1), 11, 12 and 19 of the Scientific Research Council Act read with section 3 of the Science and Technology Laws Amendment Act, 2014 (Act 7 of 2014).

6.2 In terms of section 56 of the PFMA, the Accounting Authority has delegated, in writing, certain of the powers entrusted or delegated to it to officials in the CSIR. To this end, the Accounting Authority has also adopted an approval framework, which governs the authorisation process in the CSIR. It deals with the development of strategic and operational plans, and budgets, appointment of staff, approval of salaries and acquisition and disposal of assets, among others. It also defines authority levels in relation to organisational positions.

6.3 The Materiality Framework for reporting losses through criminal conduct and irregular, fruitless and wasteful expenditure, as well as for significant transactions as envisaged by sections 55 (2) and 54 (2) of the PFMA, is in place and is included as Annexure F attached hereto.

7. UNDERTAKINGS BY THE ACCOUNTING AUTHORITY OF THE PUBLIC ENTITY

7.1 The Accounting Authority undertakes to act in accordance with the approved Corporate Plan attached hereto.

7.2 In the event that it is envisaged that the Accounting Authority will not be able to fully execute the plans as embodied in Annexure A, it will promptly, and in writing, inform the Executive Authority accordingly to seek its advice prior to making decisions or taking action.

7.3 The Accounting Authority confirms that it will comply with the provisions of sections 50 and 51 of the PFMA, as more fully dealt with in Annexures D, E and F attached hereto, as well as with the reporting requirements as embodied in the PFMA and the relevant Treasury Regulations.

7.4 The Accounting Authority undertakes to ensure that the CSIR complies with its statutory mandate as encapsulated in section 3 of the Scientific Research Council Act.

8. UNDERTAKINGS BY THE EXECUTIVE AUTHORITY AS THE SHAREHOLDER

8.1 The Executive Authority undertakes to allow the Accounting Authority to manage the business of the CSIR as has been approved in the Corporate Plan through ensuring the following:

8.1.1 Issuing of instructions and requests for information with sufficient prior notice and response times, with due cognisance that this will not be applicable in instances where the information is required by Parliament and must be provided urgently;

8.1.2 Not reneging on written guarantees and undertakings given;

8.1.3 Providing the organisation with strategic direction and control; and

8.1.4 Complying with the relevant provisions of the PFMA, as well as the Treasury Regulations insofar as the same relates to it in terms of the relationship between the Parties.

9. GOVERNANCE

9.1 The Accounting Authority recognises that systems of good corporate governance should be in place and reviewed continuously to ensure that they are sound and consistent with world-class standards at all times, and that they are and remain relevant to the business of the CSIR. Apart from complying with the provisions of the Scientific Research Council Act, the Science and Technology Laws Amendment Act, the PFMA, as well as the Treasury Regulations issued thereunder, and all other applicable legislation, the Accounting Authority shall also ensure compliance with the relevant provisions of the King IV Code on Corporate Governance (2016), and the Protocol on Good Corporate Governance in the Public Sector (2002) issued by the Department of Public Enterprises.

9.2 The Accounting Authority will strive to ensure that the CSIR upholds and sets in place review mechanisms and protocols to ensure that reports and publications, including public comments made by the employees of the CSIR, are based on sound scientific analysis, and do not bring the institution into disrepute.

10. KEY PERFORMANCE INDICATORS (KPIs) LINKED TO THE BALANCED SCORECARD FRAMEWORK

The KPIs have been summarised according to the categories of the Balanced Scorecard Framework of the DSI and reflect the SOs of the CSIR. The categories and their associated SOs are:

SO1 Conduct research, development and innovation of transformative technologies and accelerate their diffusion.

This strategic objective seeks to ensure that the CSIR undertakes cutting edge research and development in areas that will bring transformative change in the South African economy and society.

SO2 Improve the competitiveness of high-impact industries to support South Africa's re-industrialisation by collaboratively developing, localising and implementing technology.

This strategic objective seeks to improve the competitiveness of South Africa's high-impact industries through research, development, technology localisation and industrialisation in a collaborative manner with partners, thereby contributing to the re-industrialisation of the country.

SO3 Drive socioeconomic transformation through RD&I that supports the development of a capable state.

This strategic objective emphasises the CSIR's role in supporting the development of a capable state and enabling government to drive the socioeconomic transformation of South Africa through research, development and innovation.

SO4 Build and transform human capital and infrastructure.

This strategic objective seeks to build and transform the required human capital, and invest in infrastructure to drive industrialisation and the advancement of society.

SO5 Diversify income, maintain financial sustainability and good governance.

This strategic objective seeks to improve the CSIR's financial sustainability by diversifying revenue sources and optimising the business model to achieve competitiveness supported by good (efficient and sound) governance.

The strategic objectives are explained in greater detail in Annexures A and B.

Our KPIs provide an understanding of performance in terms of inputs, outputs, efficiencies, and to some extent provide lead indicators of the outcomes and impact that are required for the CSIR to fulfill its mandate. The KPIs provide a basket of measures that reflect various aspects of organisational performance.

SO1: Conduct research, development and innovation of transformative technologies and accelerate their diffusion.

- **KPI 1 - Publication equivalents:** *Research publications are a measure of the CSIR's research quality, capabilities and outputs. The impact of the quantity and quality of peer-reviewed research publications is a contribution to the scientific knowledge base.*
- **KPI 2 - New priority patent applications filed:** *Priority patent filings serve as a pipeline indicator of patent families. It is the first patent application filed for a particular invention.*
- **KPI 3 - New patents granted:** *Patents provide a lead indicator of impact through commercialisation. The patents granted in multiple countries reflect the potential market size for and value of the technology.*
- **KPI 4 - New technology demonstrators:** *These measure an intermediate output of research and*

development activities with the potential to be developed further into technology packages that can be transferred to various markets for socioeconomic impact.

- **KPI 5 - Number of technology licence agreements signed:** *Technology licences are an indicator of the uptake of CSIR Intellectual Property in the market by private and/or public sectors.*

SO2: Improve the competitiveness of high-impact industries to support South Africa's re-industrialisation by collaboratively developing, localising and implementing technology.

- **KPI 6 - Number of localised technologies:** *This measure aims to accelerate re-industrialisation and prevent the need to 'reinvent the wheel'. This also means development of local products that can be used and perfected in the South African context and environment, which can then also be exported to other countries.*
- **KPI 7 - Number of joint technology development agreements being implemented for industry:** *This indicator measures contribution to re-industrialisation through joint R&D activities with partners from industry.*
- **KPI 8 - Number of SMMEs supported:** *This indicator measures contribution to socioeconomic development and industrialisation.*

SO3: Drive socioeconomic transformation through RD&I that supports the development of a capable state

- **KPI 9 - Number of reports directly contributing to national policy formulation and development:** *This indicator measures assistance to government with evidence-based, as well as science, engineering and technology informed policy development and decision-making.*
- **KPI 10 - Number of standards delivered or contributed to in support of the state:** *This indicator measures the contribution provided by the CSIR to development of national standards and regulation and thereby enabling standardised practice across economic and social sectors (e.g. interoperability standards, accessibility standards, products or infrastructure standards).*
- **KPI 11 - Number of projects implemented to increase capability of the state:** *This indicator measures the number of projects CSIR implements on behalf of the state which contribute to improved efficiency and effectiveness within and between government departments and entities, thereby leading to improved service delivery (across public or private sector).*

SO4: Build and transform human capital and infrastructure

- **KPI 12 - Total SET staff:** *This measure enumerates the number of CSIR staff qualified in the fields*

of science, engineering and technology (SET) is an indicator of the CSIR's capacity and capability to deliver on RD&I projects.

- **KPI 13 - Percentage of SET staff who are black:** *This measure indicates the degree of demographic transformation within the RD&I capacity of the CSIR. This KPI specifically measures the number of black South African SET staff, and is aligned to Employment Equity and B-BEEE objectives of the CSIR. Foreign nationals are not included in this measure.*

- **KPI 14 - Percentage of SET staff who are female:** *This measure indicates the degree of demographic transformation within the RD&I capacity of the organisation. This KPI specifically measures the number of female South African SET staff, aligned to Employment Equity and B-BEEE objectives of the CSIR. Foreign nationals are not included in this measure.*

- **KPI 15 - Percentage of SET staff with a Doctoral qualification:** *The doctoral qualification measure indicates the quality of the profile of CSIR's SET capacity and capability which also assures achievement and quality of KPIs 1 – 11.*

- **KPI 16 - Total Chief Researchers:** *The number of Chief Researchers measure, the most senior researcher level within the CSIR, i.e. a researcher of international repute, and are a critical component of the science leadership cohort within the SET base. Chief Researchers include SET staff classified as Chief Researchers, Chief Engineers, Chief Project Managers or Chief Knowledge Applicators.*

- **KPI 17 - Percentage of Chief Researchers who are black:** *This measures indicates the level of demographic transformation within the Chief Researcher level. The KPI specifically measures the number of black South Africans. Foreign nationals are not included in this measure.*

- **KPI 18 - Percentage of Chief Researchers who are female:** *This measure indicates the extent of gender transformation within the Chief Researcher level.*

- **KPI 19 - Total Principal Researchers:** *Principal researchers constitute researchers of national repute within the CSIR, and are a critical component of the science leadership cohort within the SET base. Principal Researchers include SET staff classified as Principal Researchers, Principal Engineers, Principal Knowledge Applicators, Principal Project Managers or Research Group Leaders.*

- **KPI 20 - Percentage of Principal Researchers who are black:** *This measure indicates the level of demographic transformation within the Principal Researcher level. The KPI specifically measures the number of black South Africans. Foreign nationals are not included in this measure.*

- **KPI 21 - Percentage of Principal Researchers who are female:** *This measure indicates the level of gender transformation within the Principal Researcher level.*

- **KPI 22 - Number of exchange programmes with industry:** *This measure indicates the number of formal staff exchange programmes between the CSIR and industry partners. The purpose is to share domain level knowledge or system and process information on an immersed basis.*

- **KPI 23 - PPE investment (Rm) Investment in Property, Plant and Equipment:** *The CSIR needs to develop and maintain world-class facilities and equipment to provide the quality of RD&I that is expected of it. This indicator provides a measure of the CSIR's investment in research, ICT and general infrastructure.*

SO5: Diversify income, maintain financial sustainability and good governance

- **KPI 24 - Total income (Rm):** *Total income reflects the ability of the CSIR to ensure financial sustainability. Growth in total income indicates growth in the outcomes and impact achieved by the CSIR.*

- **KPI 25 - Net profit (Rm):** *Net profit is a key indicator of financial sustainability and the ability of the organisation to manage its expenses according to the affordability determined by income levels.*

- **KPI 26 - SA public sector income (% Total income):** *SA public sector income reflects the degree of public sector income in the CSIR. A relative reduction in SA public sector income in conjunction with growth in total operating income is a key indicator of income diversification and impact in industry.*

- **KPI 27 - SA private sector income (% Total income):** *SA private sector income reflects the degree of private investment in the CSIR. Growth in SA private sector income is a key indicator of income diversification as well as strategic alignment to; and growth in the outcomes and impact achieved by the CSIR within the South African private sector.*

- **KPI 28 - International contract income (% Total Income):** *International contract income reflects the global relevance of the CSIR. Growth in international income is a key indicator of income diversification, as well as the relevance and impact of the CSIR within the global economy.*

- **KPI 29 - B-BBEE rating:** *The CSIR B-BBEE policy seeks to support socioeconomic transformation of society, within and outside the CSIR, by changing the demographic profile of meaningful and productive participation in the country's economic activity.*

- **KPI 30 – Recordable Incident Rate:** *RIR indicates the effectiveness of health and safety management system within the organisation in a year.*

- **KPI 31 – Audit Opinion:** The CSIR will aim to present all the affairs of its financial statements fairly in *all material aspects. This opinion embodies the assumptions that the CSIR will observe*

compliance with generally accepted accounting principles and all statutory requirements. Such a view implies that any changes in the regulatory requirements and accounting policies, their application and effects, will be adequately determined and disclosed.

The target values for the set of KPIs are given in Table 1.

11. REPORTING

11.1 The Accounting Authority will report on the achievement of its KPIs quarterly, based on PFMA requirements.

11.2 A detailed KPI report approved by the Accounting Authority will be submitted to the Executive Authority annually on or before 31 July of each year, in respect of the immediately preceding financial year. The format of such reporting will be based on the CSIR's KPIs linked to the categories of the Balanced Scorecard Framework.

11.3 The Accounting Authority will meet all the external audit requirements, the results of which will be made available to the Executive Authority, the external auditor of the CSIR, being the Auditor-General, who is responsible for independently auditing and reporting on the financial statements of the CSIR.

12. EXTRAORDINARY REPORTING

The Accounting Authority will, at its discretion, report to the Executive Authority on matters of strategic importance and/or operational issues that fall outside the agreed framework of this Shareholder's Compact and the PFMA, as agreed to from time to time during its Board meetings.

13. SUPPORTING DOCUMENTATION

13.1 Supporting documentation to this Shareholder's Compact is to be found in the following supporting documents attached hereto:

13.1.1 CSIR Strategic Plan as embodied in Annexure A attached hereto;

13.1.2 CSIR Annual Plan for the 2019/20 as embodied in Annexure B attached hereto;

13.1.3 Risk Management Strategy (Plan) as embodied in Annexure D attached hereto;

13.1.4 FPP, as embodied in Annexure E attached hereto;

13.1.5 Materiality Framework, as embodied in Annexure F attached hereto; and

13.1.6 Financial Plan as embodied in Annexure G attached hereto.

INDICATOR	ACTUAL 2017/18	ACTUAL 2018/19	TARGET 2019/20	PROJECTED 2019/20	TARGET 2020/21
SO 1: Conduct research, development and innovation of transformative technologies and accelerate their diffusion					
KPI 01: Publication equivalents	545,5	536	420	420	390
KPI 02: New priority patent applications filed	-	-	5	6	5
KPI 03: New patents granted	13	22	13	18	15
KPI 04: New technology demonstrators	60	50	66	39	57
KPI 05: Number of technology licence agreements signed	-	-	24	16	26
SO2: Improve the competitiveness of high-impact industries to support South Africa's re-industrialisation by collaboratively developing, localising and implementing technology					
KPI 06: Number of localised technologies	-	-	12	9	13
KPI 07: Number of joint technology development agreements being implemented for industry	-	-	39	22	31
KPI 08: Number of SMMEs supported	-	-	92	153	118
SO3: Drive socioeconomic transformation through RD&I that supports the development of a capable state					
KPI 09: Number of reports contributing to national policy development	-	-	24	15	19
KPI 10: Number of standards delivered or contributed in support of the state	-	-	16	8	11
KPI 11: Number of projects implemented to increase the capability of the state	-	-	54	45	35
SO 4: Build and transform human capital and infrastructure					
KPI 12: Total SET staff	1 850	1 608	1 619	1321	1410
KPI 13: Percentage of SET staff who are black	61,57%	62,08%	62%	63%	62%
KPI 14: Percentage of SET staff who are female	36,43%	35,95%	36%	37%	37%
KPI 15: Percentage of SET staff with PhDs	18,32%	19,47%	22,0%	21%	22%
KPI 16: Total chief researchers	21	14	15	12	15
KPI 17: Percentage of chief researchers who are black	9,52%	7,14%	20%	8%	13%
KPI 18: Percentage of chief researchers who are female	19,05%	14,29%	13%	15%	20%
KPI 19: Total principal researchers	202	190	209	165	184
KPI 20: Percentage of principal researchers who are black	26,24%	27,37%	28%	37%	37%
KPI 21: Percentage of principal researchers who are female	18,81%	16,84%	18%	19%	20%
KPI 22: Number of exchange programmes with industry	-	-	8	8	13
KPI 23: PPE Investment (Rm)*	72	74	95	95	105
SO 5: Diversify income and maintain financial sustainability and good governance					
KPI 24: Total Income (Rm)	2 506	2 555	2 859	2694	2991
KPI 25: Net Profit (Rm)	-14	7,7	9	-10	0
KPI 26: SA Public sector income (% Total Income)	-	-	55%	55%	55%
KPI 27: SA Private sector income (% Total Income)	-	-	8%	7%	10%
KPI 28: International contract income (% Total Income)	-	-	8%	7%	6%
KPI 29: B-BBEE Rating*	3	3	3	4	3
KPI 30: RIR*	-	-	2	2	2,0
KPI 31: Audit opinion	-	-	Unqualified audit opinion	Unqualified audit opinion	Unqualified audit opinion

14. PENALTIES AND REWARDS

14.1 The Accounting Authority, in terms of the provisions of section 12 of the Scientific Research Council Act, shall determine the remuneration payable to employees of the CSIR, and, in addition, shall approve the payment of allowances, subsidies and benefits, including performance bonuses.

15. GOVERNING LAW AND DISPUTE RESOLUTION

15.1 This Shareholder's Compact shall be governed by and construed in accordance with the laws of the Republic of South Africa.

15.2 In the event of any dispute arising from this Shareholder's Compact, the Parties shall make every effort to settle such dispute amicably. Should the dispute, despite such mediation, remain unresolved for a further period of 30 days after being so referred, either Party may declare such dispute a formal intergovernmental dispute by notifying the other Party of such declaration in writing. In which event, the Parties will follow the procedure as outlined in section 42 of the Intergovernmental Relations Framework Act, 2005 (Act 13 of 2005). Should the dispute remain unresolved for a period of 30 days, the said dispute or difference shall be adjudicated upon by a competent third Party agreed upon by the Parties, unless otherwise agreed between the Parties by means of arbitration, mediation or other agreement.

15.3 Should the Parties be unable to agree upon a competent third Party as contemplated in clause 15.3, the dispute will be adjudicated by a competent court with jurisdiction to hear the matter.

16. NOTICES

16.1 The Parties choose as their domicilium addresses for purposes of this Shareholder's Compact the following physical addresses:

16.1.1 The Accounting Authority: c/o the Office of the CEO

CSIR, Building 3, CSIR Campus, Meiring Naudé Road, BRUMMERIA, Pretoria, 0184

16.1.2 The Executive Authority: I, Building 53, CSIR Campus, Meiring Naude Road, BRUMMERIA, Pretoria, 0184

16.2 Each Party shall be entitled, from time to time, by written notice to the other, to vary its domicilium to any other address within the Republic of South Africa, which is not a post office box or poste restante.

16.3 Any notice given by one Party to the other ("the addressee") which:

16.3.1 is delivered by hand during the normal business hours of the addressee at the addressee's domicilium for the time being shall be presumed, until the contrary is proved, to have been received by the addressee at the time of delivery;

16.3.2 is posted by pre-paid registered post from an address within the Republic of South Africa to the addressee at the addressee's domicilium for the time being shall be presumed, until the contrary is proved, to have been received by the addressee on the 4th (fourth) day after the date of posting;

16.3.3 is transmitted by telefax or e-mail shall be deemed (in the absence of proof to the contrary) to have been received within one hour of transmission where it is transmitted during normal business hours of the receiving instrument, and within 2 (two) hours of the commencement of the following business day where it is transmitted outside those business hours.

17. WHOLE AGREEMENT

17.1 This document, together with the annexures thereto, constitutes the whole of the agreement between the Parties. No instructions, agreements, representations or warranties between the Parties, other than those set out herein, are binding on the Parties.

17.2 All undertakings and annexures to this Shareholder's Compact are declared active on the effective date.

18. VARIATIONS

No variation or modification of any provision of this Shareholder's Compact or consent to deviate therefrom or waiver in terms thereof shall be valid, unless such variation or modification or waiver has been reduced to writing and has been signed by both Parties, and such variation, modification, consent or waiver shall be valid only for a specific case and only for the purpose for which and extent to which it was made or given.

19. AMENDMENTS TO THE SHAREHOLDER'S COMPACT

19.1 Should either Party wish to make any amendment or alteration to the Shareholder's Compact, that Party shall prepare a change order and present it to the other Party, which shall specify the following:

19.1.1 The date of the change order;

19.1.2 The description of the proposed amendment or alteration;

19.1.3 Previous unspecified ad hoc work to be undertaken, if applicable;

19.1.4 The reason for making the proposed amendment or alteration;

19.1.5 When the Party requires the change to be implemented;

19.1.6 The resources available; and

19.1.7 The continued balance of the Parties' obligations under this Shareholder's Compact;

19.2 The other Party shall be given an opportunity to consider such change order and make a decision on whether it is prepared to accept such change or not; and

19.3 No change order shall be of any force and effect until it is signed by duly authorised representatives of each of the Parties.

20. UNDERTAKING BY THE CHAIRPERSON OF THE CSIR BOARD

The Chairperson of the CSIR Board undertakes to represent the Accounting Authority in the carrying out of the terms of this Shareholder's Compact and in cascading the spirit of the agreement through the ranks of the CSIR.

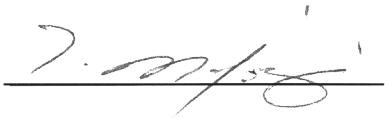
21. UNDERTAKING BY THE MINISTER OF HIGHER EDUCATION, SCIENCE AND TECHNOLOGY

The Minister of Higher Education, Science and Technology, Dr Blade Nzimande, approves of this approach and looks forward to the successful implementation of the undertakings embodied in this Shareholder's Compact and its annexures. The Minister accepts that, although the detail of this Shareholder's Compact may change due to variations and changes in the market and in society, the spirit thereof will remain unchanged.

THE CSIR SHAREHOLDER'S COMPACT

Agreed to and signed in Pretoria on 24.02.2020

Prof. Thokozani Majozi



On behalf of the Accounting Authority

Agreed to and signed in PRETORIA on 28/02/2020

Dr Blade Nzimande

The Executive Authority

A Strategic Plan

A.1 Strategic Context

The CSIR mandate is to foster industrial and scientific development through directed multidisciplinary research and technological innovation to improve the quality of life of South Africans. The interpretation of this mandate has seen the CSIR revamp its strategy to strengthen its industrial development efforts in a drive to balance the focus of the organisation's efforts between directed research through scientific excellence, and effective and meaningful translation of that research and development into solutions that address the triple challenge of poverty, inequality and unemployment.

In the past year, the CSIR has started to implement its new strategy, which positions the organisation to amplify the industrial research activities of the organisation (the 'I' in CSIR). To this end, the CSIR has implemented its new operating model, the architecture of which is to drive the technology-oriented sector focus of the CSIR strategy. The 2020/ 21 financial year will thus mark the first full year of implementation of the new organisational strategy, and will be marked by significant strategic re-alignment of the organisation. Over the medium term, up to 2025, the CSIR will seek to leverage its strong SET capability to address challenges and take advantage of opportunities in the sectors that are aligned with the CSIR strategic focus. Such sectors were selected on their potential to significantly contribute to the South African economy if suitably supported through innovation. Through this, we aim to contribute to re-industrialisation in South Africa by actively developing or facilitating the uptake of new technologies, including, but not limited to, technologies and paradigms articulated through the fourth industrial revolution (4IR), that will improve the competitiveness and productivity of strategic local economic sectors. Equally, we aim to contribute to the state to better address socioeconomic development through technologically enhanced service delivery activities. Through these efforts, the CSIR will endeavor to maintain the right balance between scientific and industrial development in its innovation portfolio.

Prevailing and emerging external and internal environmental factors influence the strategic direction of the CSIR. Our research programmes address national priorities as articulated by the President in the State of the Nation addresses, and are aligned with various national strategies and frameworks such as the NDP, the MTSF, 2019 to 2024, the departmental policies, not least those of the DSI. Looking ahead, the CSIR Strategy seeks to give meaning to the DTIC's Industrial Policy Action Plan (2018/19 to 2020/21) and the DSI's White Paper on Science, Technology and Innovation (2019), in particular. In addition to existing strategies, plans, policies and frameworks, the CSIR also intends to respond and contribute to the implementation of national priorities of the sixth democratic government that are under development. These include the NDP five-year Implementation Plan, the DTIC's "Re-imagining Industrialisation Strategy for South Africa" and its Sector Master Plans, and the DSI's Decadal Plan 2020.

Equally, we plan to develop capabilities to respond to national and international private sector requirements across a broad range of industries. South Africa finds itself faced with numerous challenges hampering economic growth, a situation exacerbated by a tight fiscus in the face of numerous competing developmental alternatives. Internationally, South Africa seeks to participate in global high-value economic activity, while competing with low-cost production in the more efficient economies.

A.1.1 EXTERNAL CONTEXT

A.1.1.1 GLOBAL MEGATRENDS

Several global megatrends have an impact on the economic and social wellbeing of many people across the globe. These include:

- Rapid urbanisation, with more than half the world's population living in urban areas;
- Climate change and resource scarcity, as a result of the world becoming more populous, urbanised and prosperous, with a commensurate increase in demand for energy, food and water;
- Shifts in global economic power, with emerging economies that were growing rapidly now in recession, as a result of declining commodity prices;
- Demographic and social change, notably by 2030 the world's population is projected to rise by more than one billion, and people will live longer;
- Major technological breakthroughs driven by the digital revolution, which has no boundaries or borders, and which is changing behaviour and expectations of consumers as much as it is disrupting the tools used to deliver new services and experiences.

Globally, there has been a steady decline in growth, manufacturing, job creation, living standards and commodity exchange leading to an overall economic slowdown. Global manufacturing output growth has been decelerating since 2018, and this trend continued in the third quarter of 2019. Global manufacturing output growth fell to 1.2% in the third quarter following a modest growth of 1.5% and 2.2% growth rate in the second and first quarters of 2019, respectively (UNIDO World Manufacturing Report, Statistics for Quarter III, 2019). The tariffs and trade tensions between the world's most dominant economies, including the United States, China and Europe, have contributed significantly to the decline. The slowdown affected many economies across the globe; major industrial economies such as Germany, Japan and the United States experienced a decline in manufacturing production, as did India, Mexico and Turkey. Africa's manufacturing output registered a lower but positive year-over-year growth rate of 0.6%, compared to higher growth rates of 1.3% and 1.1% in the second and first quarters of 2019 respectively, and compared to an overall 2.1% in the previous year. African countries showed diverse growth patterns, with Egypt's, Nigeria's and Senegal's manufacturing output rising by 2.2%, 1.0% and 0.7% respectively, whereas South Africa's output decreased by 1.8% (UNIDO World Manufacturing Report, Statistics for Quarter III, 2019). One year ago, this country group registered a growth rate of 2.1% but this has been progressively declining over the last year.

Global Megatrends[1] will inevitably have an impact on South Africa's economy, businesses, careers and lives.

A.1.1 EXTERNAL CONTEXT (continued)

The CSIR has taken cognisance of these rapidly changing drivers and has reshaped the organisational structure and its offerings to align the organisation with the evolving world. Outlined below are 11 global megatrends that will evolve by 2030:

Population, Aging and Rise of the Middle Class: The global population is expected to reach 8.5 billion by 2030; a 16% increase from 2015 figures. The elderly will be the most escalating demographic, as a result of improved health care. Life expectancy in China was 40 years in 1950 and is projected to be 80 years by 2050. The middle class is swelling from 1.8 billion in 2009 to an estimated 4.9 billion in 2030. This income group will have the greatest purchasing power and companies will align their products and services to accommodate the middle class.

Urbanisation: Sixty-seven per cent of the world's population will be urbanised by 2030. Megacities will require more buildings with better management technologies. Big data and AI will be required to make buildings more efficient. The cost of living will increase. More food will have to be transported from rural farms to the cities, unless there is a move towards urban agriculture.

Increasing Connectivity and Decreasing Privacy: Our world will become more transparent and less private. With increased connectivity, copious amounts of information gathered on people and products, companies will expand exponentially. Pressure will increase to share this information, analyse it and utilise it to make informed decisions.

Shortage of Resources: There is growing demand for major commodities like metals, water and energy. We need to re-evaluate recycling and remanufactured materials. Water has become a stressed resource and we need to consider advanced water technologies and desalination of seawater. As far as energy is concerned, we need to consider renewable energy forms like wind energy or solar energy and fracking.

Climate Change: This is an unfolding global crisis. The consequences of drastic changes in our weather patterns and climate are dire. During summer, the Arctic snow will melt and cause sea levels to rise and there will be catastrophic flooding in coastal areas. The Intergovernmental Panel on Climate Change suggested measures to reduce carbon emissions to keep global warming to 1.5°C. Due to lack of commitment of global governments to implement behavioural changes, it is unlikely that this target will be reached. It is envisaged that many animal species will decline or become extinct and the earth will lose valuable ecosystems, like coral reefs. Agricultural regions will relocate due to droughts and floods. Crop production and food security will be affected in unprecedented ways.

A.1.1 EXTERNAL CONTEXT (continued)

Clean, Zero-carbon Technologies: Renewable energy is preferred to obtaining energy from fossil-fuel-based technologies because the cost of clean technologies is decreasing. Electric vehicles will become the mode of transport with batteries becoming more cost effective and legislation prohibiting fossil fuel engines. It is estimated that by 2030, nearly 100% of all teenagers will drive electric vehicles.

Internet of Things: AI and machine learning will reach new levels by 2030 as the world approaches technological singularity. AI will assist in planning our lives, making us more efficient. Machines will have the processing capabilities and intelligence of human beings, e.g. using robotics, speech recognition and natural language processing. The emergence of AI will also eradicate many low-skilled and high-skilled careers.

Global Policy and Diffusion of Power: There is a desperate need for global policy to tackle challenges affecting the entire world. Governments and institutions have to be in unison to aggressively fight climate change, address diminishing resources, halt trade wars and raging tariffs and eradicate poverty and inequality. The Paris Agreement was a move in the right direction, but some countries, including the USA, retreated from this global cooperation. It is difficult to predict these political trends. It is possible that global challenges will continue to be addressed by country or region or that businesses may play major roles. Historically, Europe and North America were the economic powerhouses of the world, but this is changing. By 2030, developing countries in Asia will have surpassed the western world. The global economy will be linked to how well the developing countries fare.

Political Unrest and Mass Migration: Political instability is rife in countries across the world, e.g. Brazil, Britain (with Brexit looming) the Democratic Republic of Congo, Hong Kong, Somalia, South Sudan, Syria, Venezuela and Yemen. Citizens in autocratic countries like Algeria, Sudan and Turkey are rebelling. Populists have been voted into power in countries like Brazil and the USA. Hundreds of thousands of refugees are fleeing their war-torn countries and escaping poverty to seek a better life in the European Union.

Generation Z: Generation Z succeed the millennials and together they will comprise the majority of the workforce in 2030. Generation Z is the most adaptive, IT literate and digital savvy generation in history. It is eager to experiment with new technologies and its lifestyle and behavioural patterns will dictate products. Its priorities and values must be taken into consideration.

The fourth industrial revolution (4IR) is affecting competitiveness significantly. For instance, the digitisation of manufacturing is characterised by technology convergence, affecting the way data is organised, analysed and shared. It includes integration into the manufacturing of cloud computing, big data analysis, the Internet of Things (IoT), apps, mobile computing and so on. Also included are manufacturing trends where technology is impacting the way we sense and interact with the physical world, for example, through advances in robotics, cyber physical systems, integrative production technologies, model-based production, embedded software and sensors, 3D printing and additive manufacturing, and the industrial Internet. Opportunities abound for organisations like the CSIR, which can assist the country in harnessing this wave to address customer demands and new industry pressures.

A.1.1 EXTERNAL CONTEXT (continued)

A.1.1.2 THE AFRICAN PERSPECTIVE

The G20 Initiative on Industrialisation in Africa and Least Developed Countries makes several critical observations on Africa's industrialisation that are worth noting. In particular, they highlight that expanding manufacturing production and exports, and increasing their sophistication, can drive industrialisation and create much-needed jobs. Like South Africa, several regions and countries have seen their share of manufacturing in GDP decline, and earlier in their development path than was previously the case. However, the initiative notes that even if premature deindustrialisation is happening in Africa, there is still scope for increases in both the share and volume of manufacturing (G20, Japan 2019, Initiative on Industrialisation in Africa and Least Developed Countries). Clearly, innovation has a role to play here, and the CSIR's new strategy positions it to contribute to manufacturing-led industrialisation of South Africa and the continent.

The World Bank estimates that Africa's working-age population will increase by nearly 70% by 2035. Without industrialisation to create jobs, it will be difficult to achieve sustainable development and South Africa may see an influx of migrants from different African countries. East Asian countries had rapid industrialisation, led by the manufacturing sector, but for Africa manufacturing to promote economic growth has been challenging for many countries.

Africa has a growing infrastructure and skills gap that reduce the continent's ability to participate in global value chains. Between 1992 and 2012, developing countries doubled their manufacturing output to more than a third of global production [UNU-WIDER, 2016], with some countries gaining a world market share in both simple and complex manufacturing products. In 2010, Africa's global manufacturing share fell from 3% in 1970 to less than 2%, with some economies experiencing premature de-industrialisation. Subsequently, the share of manufacturing in GDP for Africa has been declining since the 1970s.

As Africa strives to industrialise, the need to improve key elements of the investment climate, which include infrastructure and skills, is paramount. Strategies and action plans have been put in place at continental and regional levels to improve infrastructure in energy, transport, ICT and water; areas that the CSIR has technical capabilities to support the continent in.

Moreover, health and the wellbeing of the African population are some of the key strategic focus areas of the continent. In this regard, several health and nutrition strategies are in place, including at regional level, i.e. the Food and Nutrition Security Strategy 2015-2025, among others. The CSIR is in a good position to respond to the needs of the region in health and nutrition through its strategic partners, like AUDA NEPAD, and as a host of the NEPAD Southern Africa Network for Biosciences.

It is forecast that sub-Saharan Africa (SSA) will record increasingly higher growth rates, buoyed by a gradually improving demand for commodities and their respective prices. The International Monetary Fund estimates the

A.1.1 EXTERNAL CONTEXT (continued)

GDP growth for SSA at 2.5% for 2019 up from 1.4% in 2017. However, political challenges and subdued capital inflows could undermine the region's prospects.

Regional integration is vital to South Africa's economic development plans and its economy benefits greatly from regional trade, but could do even better. The African Continental Free Trade Agreement is a trade agreement that was signed in Kigali, Rwanda, on 21 March 2018, and is in force between 27 African Union (AU) member states. As of July 2019, 54 states have signed the agreement. Ratification by 22 countries was required for the AfCFTA to enter into force and the African Continental Free Trade Area to become effective. The agreement will function as an umbrella under which protocols and annexes will be added. This will likely have a significant effect on intra-African trade going forward, and thus affect the prospects for South Africa.

South Africa's commitment to promoting growth and development on the continent is also recognition that it would be creating opportunities for itself, while supporting the region's developmental initiatives. The AU recognises the importance of STI, and has the Science, Technology and Innovation Strategy for Africa (STISA-2024) in place, which African heads of state adopted in 2014, as an integral part of the AU Agenda 2063. STISA responds to the demand for STI to play a role in critical sectors, such as agriculture, energy, environment, health, infrastructure, mining, security and water.

Closer to home, but still aligned to STISA-2024, the SADC Industrialisation Strategy and Roadmap, launched in 2015, is even more relevant in this regional context. It is rooted in three key anchors of 'industrialisation, namely as a champion of economic and technological transformation; competitiveness as an active process to move from comparative advantage to competitive advantage; and regional integration and geography as the context for industrial development and economic prosperity' (SADC Industrialisation Strategy and Roadmap 2015 – 2063).

Recently, SADC held its fifth SADC Industrialisation Week in Dar es Salaam, Tanzania, where various resolutions that affect regional trade were taken. The CSIR is collaborating with the NEPAD Business Forum on identifying those resolutions that can be jointly implemented in cooperation with the two Parties.

It is against this background that the CSIR is also reviewing its role on the continent and putting forward a responsive Africa strategy. This will build on the Africa Strategy developed in 2017 and partially implemented in the past 2 years. The goal of this strategy is to:

"Establish CSIR as the hub of a vibrant African network of innovation centres providing capabilities to solve Africa's developmental challenges"

In response to this goal, we have developed a number of partnerships and networks over the past 3 years, including strong ties to the SADC secretariat, providing input to the SADC Industrialisation Strategy, and to the AU, where we have made inputs to the programmes aligned to STISA-2024. CSIR developed, hosted and or strengthened regional and continental initiatives such as the Southern African Network for Biosciences (SANBio), the African

A.1.1 EXTERNAL CONTEXT (continued)

Road and Transport Research Forum (ARTReF), the African Earth Model System, the African Laser Centre and High Performance Computing (including support for the Square Kilometer Array). Over the next medium-term period CSIR will build on these initiatives as well as develop new regional networks and programmes:

- African Climate Modeling Centre – is to establish an African climate modeling and climate science centre at CSIR.
- The eHealth interoperability programme – is to support healthcare delivery in Africa through seamless interoperability of eHealth system.
- Environmental asset management – is to roll out integrated technologies and situational awareness to protect natural assets.
- Biomanufacturing initiative – is to establish technology incubation centres in the SADC region linked to the Biomanufacturing Industry Development Centre at the CSIR.

A.1.1.3 THE SOUTH AFRICAN PERSPECTIVE

A recent review of the government's performance since the dawn of democracy was undertaken (25-year review, DPME) to evaluate our success in delivering on the promise of a better life for all South Africans and implementing the priorities set out in the NDP 2030. The review focused on nation-building, social cohesion and identity; gender and building a non-sexist South Africa; social wage; developing human resources (HR) and HC; better quality health for all; economic transformation; spatial planning and human settlements; land reform and rural development; infrastructure; climate change and environment; democratising the state and society; justice, crime prevention and building safer communities; and building a better Africa and the world (Towards a 25 –year Review, 1994 -2019). During the 25-year period, South Africa invested significantly into STIs and consequently, STIs have played a discernable role in the implementation of the national goals.

Broadly, the review found that government had improved access significantly to essential services and provided social protection. However, it had not been successful in improving the quality and efficiency of service delivery, building a truly capable and coherent state, realising the developmental objectives and reducing inequalities in both per capita income and expenditure, improving the HC base of the economy and in modernising its public service artillery.

South Africa has made significant progress, but its economic transition from a system of exclusion under segregation remains incomplete. In the period 1994 to 2018, poverty has declined significantly, but the extent of inequality remains extremely high. (World Bank in its Systematic Country Diagnosis Report of April 2018). The World Bank further states that, in its view, insufficient skills form the key constraints to reducing poverty and inequality in South Africa. Our high unemployment rate remains a key challenge and the country's economy struggles to create sufficient employment opportunities. The unemployment rate increased by 1.4 percentage points from 27.6% in the first quarter of 2019 to 29% in the second quarter of the year. Among the youth, the unemployment figures increased from 55.2% to 56.4% during the same period.

A.1.1 EXTERNAL CONTEXT (continued)

Global growth projections for 2019 are in the region of 3.7% and will be in the region of 3.6% in 2020. In comparison, South Africa is expected to grow between 1-1.7% between 2019 and 2021. For South Africa to realise growth in excess of 3%, it needs to address the structural faults in its economy. These structural faults can be summarised as follows:

- The structure of the South African economy remains insufficiently diversified.
- Inefficient public monopolies imposing high-cost structure for network infrastructure, such as electricity and transport.
- Disappointing export performance and exports that are concentrated in minerals and metals products.
- Highly concentrated industrial structures, limited competition and high barriers to entry.
- Weak and volatile growth in labour-intensive sectors, such as construction, manufacturing and agriculture.
- Skills development not sufficiently linked to the economy's needs and developing capabilities.

The DTIC is currently developing a new "Re-imagining Industrialisation Strategy for South Africa". The new approach is a focus on five growth engines:

- Industrialisation through master plans and social compacts for priority sectors;
- Investment and infrastructure through leveraging private investment to expand infrastructure;
- Innovation through the digital economy, 4IR and developing and diffusing new technologies;
- Integration by complete access to the Africa Free Trade Area to grow investment and exports (and attend to the technology balance of payments); and
- Inclusion realised through the revitalisation of township economies, boosting SMMEs, creating jobs, as well as youth, black and women empowerment.

The five engines must be directed towards seven priority sectors and enabled through spatial interventions of special economic zones, industrial parks, smart youth centres, incubation hubs, and township and village enterprises.

The development of sectoral masterplans, as part of revitalising industrialisation, should embed a strong research and development component intended to improve the competitiveness and sustainability of the sector under discussion. Some sectors will emerge in the future driven by innovation. Such an approach is termed innovation-led industrialisation. Investments in sectoral research and development would also serve as positive contributions towards GERD and advance progress towards the national target of 1.1% (expenditure on R&D as a percentage of GDP) by 2024 that has been set in the 2019-2024 MTSF.

South Africa has experienced premature de-industrialisation over the past decade. This position is exasperated by the fact that South Africa struggles in the key factors required to reinvigorate the industrial sector from a global perspective (83rd in labour market efficiency; 112nd in higher education and training; 124th in technological readiness; 135th in innovation). Therefore, it is clear that addressing these key enablers is essential to reversing

A.1.1 EXTERNAL CONTEXT (continued)

the de-industrialisation that South Africa is experiencing and in this, particularly with respect to innovation and technology readiness and partially in training, the CSIR intends to play a significant role.

Addressing de-industrialisation should also focus on the enabling environment, including elements of infrastructure (logistics, services, ICT), natural resources (including the balance between industrial activity and sustainable resource use), labour (both the supply of scarce, skilled labour and the retention of existing labour) and a conducive policy environment (trade, regulatory, etc.). The CSIR considers all these aspects as crucial in stimulating the country's re-industrialisation.

Science and technology is critical to the future of South Africa. Government recognises that generating knowledge and understanding through science enables us to find solutions to today's economic, social and environmental challenges, as well achieving sustainable development. The scientific and technological revolutions underpin economic advances, improvements in health systems, education and infrastructure and, hence, contribute to the quality of life of the people.

As part of the National Macro-reorganisation of Government, the sixth democratic government has reinforced the significance of STI by creating a Ministry of Higher Education, Science and Technology and has also reviewed the mandate of the former Department of Science and Technology (DST) to the now DSI. The changes in the political leadership for science and technology will enhance already existing collaborations with the higher education sector in RD&I, and training of students. The CSIR is also working closely with various SETAs, such as merSETA and MICT. The scope to expand and deepen the collaborations with HEIs and the SETAs is an area that the CSIR will continue to pursue in order to achieve its SOs and contribute to national goals. The DSI innovation mandate, in turn, will enhance the realisation of the CSIR strategic intent (i.e. growth, sustainability, impact and relevance) and will enable the achievement of the NDP objectives (which the CSIR strategy contributes to), such as:

- The exploitation of new sources of economic growth;
- The improvement of the competitiveness of existing industries and firms;
- The development of SMMEs;
- Grassroots innovation;
- Service delivery support;
- The improvement of government decision-making; and
- The innovation for environmental sustainability.

The key role of science and technology is also evident in the need to keep improving science policies. For instance, the White Paper on Science and Technology of 1996 has since been updated with the White Paper on Science, Technology and Innovation of 2019, which intends to improve collaboration between the DSI, all its entities, HEIs and the private sector. Further, the new White Paper will also require government departments that have substantial

A.1.1 EXTERNAL CONTEXT (continued)

STI components to spend a certain percentage of their budgets on raising science awareness.

The state and nature of funding for R&D remains a concern for the NSI, and particularly for the CSIR. GERD remains well below the targets set by the then DST, of 1.5%. Our response through this strategy is to target increased private sector and international funding. However, public sector funding remains a key component of our income and National Treasury regulations make it increasingly difficult for public entities to contract directly with government and SOEs. The CSIR is required to compete in open tenders (from public institutions) for research and development activities, which, as a public entity mandated to perform this type of work, should not be the case. In the 2018/19 financial year alone, this practice led to R800 million in lost revenue opportunities.

What is encouraging is the fact that industrial policies continue to place science and technology at the centre of industrial development, with a clear statement that certain sectors, such as mining, can only be transformed through technological innovations and strong partnership between government and the private sector.

These policy changes definitely present a good opportunity for the CSIR, which has recently adopted a new strategy that places emphasis on collaborative research and diffusion of transformative technologies for higher impact.

A.1.1.4 NATIONAL PRIORITIES

This planning cycle (2020/21) is taking place against the backdrop of such key national challenges as highlighted by the President in his State of the Nation address (2019):

- The economy has been stuck in a low-growth trajectory over the last few years;
- Structural unemployment at 29.1% in quarter 1 of 2019 against the NDP target of 6% by 2030;
- High inequality (Gini co-efficient of 0.68) against the NDP target of 0.6% by 2030;
- Persistent poverty, with the population living below the lower bound poverty line increased from 36.4% in 2011 (18.7 million people) to 40% in 2015 (21.9 million people) against the NDP target of zero proportion of households with a monthly income level of R419 (in 2009) by 2030;
- Spatial inequality and injustice has not been addressed; and
- Decline in quality and efficiency of social service delivery.

Therefore, the design and implementation of the CSIR's strategic plan is guided by the above imperatives requiring solutions, as well as a range of policy documents, chief among which is the NDP, which sets out the long-term developmental framework for the nation. This long-term vision is then supported by the MTSF, 2019 -2024, the recently adopted White Paper on Science, Technology and Innovation (2019), Industrial Policy Action Plan, 2018/19 to 2020/21 to name a few relevant policy instruments. As part of the sixth democratic government, focus priorities are being articulated in other relevant instruments being developed. These include the NDP 5-year Implementation Plan, the DTIC's "Re-imagining Industrialisation Strategy for South Africa" and its Sector Master Plans, and the DSI's Decadal Plan 2020.

A.1.1 EXTERNAL CONTEXT (continued)

Investments into STI have the potential to grow the economy through new firms and increased competitiveness of existing firms; increased exports and reduced imports; as well as new opportunities for emerging black and female entrepreneurs. An updated policy will see these recognised as drivers of competitiveness and economic growth, integrated across government departments and appropriately funded.

The NDP – Vision 2030

The NDP offers a long-term perspective on South Africa's development by clearly articulating a desired destination and identifying the role that different sectors of society need to play in reaching that goal. As a long-term strategic plan, it serves four broad objectives:

- Provides a set of overarching goals that we need to achieve by 2030;
- Builds consensus on the key obstacles to achieving these goals, and what needs to be done to overcome those obstacles;
- Provides a shared long-term strategic framework within which more detailed planning can take place; and
- Creates a basis for making choices about how best to use limited resources.

The CSIR's R&D programme speaks to seven of the focus areas identified in the NDP:

I. **Economy and employment.** The CSIR initiates programmes directly aligned with supporting key national economic sectors. New strategic clusters for the chemicals, mining, agriculture and manufacturing sectors will focus specifically on this goal.

II. **Building a capable state.** Our interventions in this area focus on service delivery and its associated issues. We have defined strategic clusters, namely CSIR Smart Mobility, Smart Places and NextGen Enterprises and Institutions to support government in this area.

III. **Economic and social infrastructure.** We conduct research to inform policymaking and technology development for water, transport, coastal and ICT infrastructure, as well as improved building design and improved building materials.

IV. **Transition to a low-carbon economy.** The CSIR is working on improving the measurement and management of our natural resources, improving our ability to understand the long-term effects of climate change and hence assist government with the formulation of mitigation and adaptation strategies.

V. **Transforming human settlements.** The CSIR is supporting metropolitan areas and municipalities in a number of areas, including spatial planning, the management of infrastructure and the transition to greener and smarter economies. Our Smart Places strategic cluster, in particular, will address elements of long-term planning and technology integration for smarter, more efficient communities.

VI. **Improving health.** Under a new dedicated strategic cluster, CSIR NextGen Health, the CSIR's work in support of health, ranges from technical support to the NHI initiative, the development of interconnected and inter-operable

A.1.1 EXTERNAL CONTEXT (continued)

point-of-care devices and the development of new methods to understand, manage and diagnose disease at the cellular and molecular level.

VII. **Building safer communities.** CSIR interventions in this area focus on supporting the acquisition and integration of technology by our security forces, national police and the security sector. CSIR Defence and Security will predominantly focus on this goal.

NDP Five-year Implementation Plan

During this sixth democratic government, in implementing the NDP, government is developing two sets of instruments, namely the NDP Five-year Implementation Plan and the MTSF as a monitoring framework. The NDP Five-year Implementation Plan is under development and, through it, government will collaborate with the private sector, labour and civil society to contribute to the achievement of the set priorities. The CSIR will accordingly align its strategy, programmes and interventions to the NDP Five-year Implementation Plan.

Mid-term Strategic Framework (MTSF), 2019 to 2024

The MTSF 2019 - 2024, aims to address the challenges of unemployment, inequality and poverty through three pillars :

I. Driving a strong and inclusive economy.

II. Building and strengthening the capabilities of South Africans.

III. Achieving a more capable state.

The new MTSF is being designed around seven priorities. The DSI has indicated that the NSI will focus predominantly on priorities 2 and 3 (economic transformation, job creation, education, skills and health), with some focus on priority 1 (Building a capable state). The new CSIR Strategy is fully aligned to these aims and, as these priority areas align closely to the National Development Plan, the CSIR will contribute to all priority areas:

Priority 1: A capable, ethical and developmental state – As per the NDP focus, the CSIR has defined the Smart Mobility, Smart Places and NextGen Enterprises and Institutions clusters to support government in this area.

Priority 2: Economic transformation and job creation – CSIR renewed focus on the future of production is aimed at stimulating economic development of key sectors in the South African economy. The Mining, Manufacturing, Defence & Security, Chemicals and Agriculture Clusters will focus on achieving this priority area.

Priority 3: Education, skills and health – The CSIR has a number of programmes aimed at skills development in a changing workplace. For example, it is implementing the Data Science for Impact and Decision Enablement (DSIDE) programme, which is funded by the DSI. The programme is aimed at building capacity in data science by recruiting students to participate in learn-by-doing problem solving to meet real-world needs. Further, the CSIR is in collaboration with merSETA on the Learning Factory as a platform to develop the skills of the future

A.1.1 EXTERNAL CONTEXT (continued)

(in particular for industry 4.0). We also host a number of interns and support multiple internal and external studentships and bursars. Through the NextGen Health and Chemicals clusters, the CSIR is well-positioned to contribute through its competences and innovation initiatives in pharmaceutical process innovations, health information systems, medical devices and diagnostics, and precision medicine.

Priority 4: Consolidating the social wage through reliable and quality basic services – The CSIR's support to government in this regard is through achieving its strategic objective, namely "drive socioeconomic transformation through RD&I that supports the development of a capable state." According to National Treasury, social wage comprises education, health services, social development, public transport, housing and local amenities. The CSIR contributes through its competences and innovations in CSIR NextGen Health, Smart Places, and Smart Mobility to a variety of the components of the social wage.

Priority 5: Spatial integration, human settlements and local government – The Natural Resources, Enabling Infrastructure, Public and Professional Services Division of the CSIR will address elements of long-term planning and technology integration for smarter, more efficient communities and improved service delivery.

Priority 6: Social cohesion and safe communities – Through the Defence and Security strategic cluster, the CSIR will develop and implement technology interventions aimed at improved digital and physical security.

Priority 7: A better Africa and world – The CSIR engages throughout the SADC region and supports the AU and NEPAD in the implementation of various industrialisation, science and technology strategies. The CSIR also collaborates internationally on issues of climate change and technology governance.

White Paper for Science, Technology and Innovation (2019)

A key policy document is the new White Paper for Science, Technology and Innovation. It is to be the basis used to convince government and society that STI should be elevated and prioritised as a key mechanism for development, economic growth and poverty alleviation in South Africa, the region and the continent. It calls for greater collaboration, increased private sector involvement, increased capacity across the innovation value chain and increased resourcing. Through its new strategy, the CSIR aims to support these aspirations through greater collaboration, particularly with private sector; increased research capacity (particularly research translation infrastructure and capacity); and increased resourcing through actively targeting private sector and foreign investment funding.

The new White Paper places greater emphasis on the enabling environment in and around the NSI, particularly in the context of increased involvement of private sector and civil society, support of SMMEs, financial incentives, policy guidance, with respect to procurement and private sector investment in RD&I. In this respect, the CSIR has a number of programmes that target SMMEs (Enterprise Creation for Development, Industry Innovation Programme) and will continue to support government in evidence-led policy development (e.g. energy regulation, industrial policy, 4IR policy, ICTs and telecommunication standards).

A.1.1 EXTERNAL CONTEXT (continued)

A further aspect that the CSIR believes is necessary (and in which it believes it can play a significant role in) is the strengthening of the country's regulatory and standardisation environment (e.g. in collaboration with SABS, SARPHA, and in agricultural products) in light of improving efficiencies and preparing for responsible adoption of (new) local and international technologies.

The DSI has developed six outcomes and three cross-cutting themes to assess impact across all the six outcome focus areas. The cross-cutting themes are partnerships, internationalisation and transformation. The CSIR will contribute to the achievement of the DSI outcomes as follows:

Table A.1: CSIR Key Performance Indicators: 2020/21

DSI Outcomes	CSIR Strategic Objectives	Relevant programmes/ initiatives
A transformed, inclusive, responsive and coherent NSI		Strategic agreements with TIA, IDC, Sasol, Transnet, Eskom, DBSA, NUMSA Investment, and BGM Pharma amongst others, as well as agreements with National Government and various Universities
Knowledge utilisation for economic development (a) in revitalising existing industries, (b) stimulating R&D led industrial development	Improve the competitiveness of high-impact industries to support South Africa's re-industrialisation by collaboratively developing, localising and implementing technology.	Synapse strategy, focusing on mining, manufacturing and chemicals sector as well as emerging technologies in Fourth Industrial Revolution
Human capabilities and skills for the economy and for development.	Build and leverage human capital and infrastructure	CSIR Bursary program, Young Researchers Development Fund, Professional Development, Accelerated Researcher Program, YES program.
Increased knowledge generation and innovation output	Conduct research, development and innovation of transformative technologies and accelerate their diffusion.	All CSIR RD&I programmes
Knowledge utilisation for inclusive development	Conduct research, development and innovation of transformative technologies and accelerate their diffusion.	Industry Innovation Program, Red and Green Book initiatives, Impact Catalyst

A.1.1 EXTERNAL CONTEXT (continued)

DSI Outcomes	CSIR Strategic Objectives	Relevant programmes/ initiatives
Innovation in support of a capable and developmental state	Drive socioeconomic transformation through RD&I that supports the development of a capable state	Smart Transport Network Programme, Digital enablement of public institutions for eGovernment, Policy testing, evaluation and support.

Decadal Plan for STI

The CSIR will also respond to the emerging priority areas identified in development of the new Decadal Plan. Due to its mandate and multidisciplinarity, it is not surprising that the CSIR is already active in these areas (Figure A.1). However, we will support the DSI by placing more emphasis on these areas with other actors in the NSI.

Finally, the CSIR will support the DSI and the NSI in the critical area of skills development. We will continue to assist the higher education system with postgraduate training and, in this aspect, we will strive to provide much needed supervisory capacity for postgraduate studies. The CSIR is also in a good position to play a key role in preparing young graduates for transitioning into the world of the practice of scientific and technological careers by providing them with the necessary experience.

Figure A.1: Emerging STI priority areas and the relevant areas that the CSIR is already actively pursuing

A.1.1 EXTERNAL CONTEXT (continued)

Other government Initiatives that the CSIR is contributing to:

DTIC "Re-imagining Industrialisation Strategy for South Africa" and Sector Master Plans

The DTIC is currently developing the "Re-imagining Industrialisation Strategy for South Africa" and its Sector Master Plans. The Sector Master Plans focus on auto and components; textile, leather and footwear; poultry; sugar; steel and metal fabrication; mining and beneficiation; tourism; chemicals; green economy – renewable energy; green economy – gas; ICT and software production; aerospace and defense; health economy; agriculture and processing plus cannabis and hemp; furniture sector and creative sectors. CSIR Advanced Agriculture and Food, Chemicals, Defence and Security, Mining, Manufacturing, NextGen Health, NextGen Enterprises and Institutions, and Smart Places (including the Energy Research Centre) are already aligned to and will contribute to the implementation of some of the Sector Master Plans. The CSIR is already part of the teams developing the Sector Master Plans and is in collaboration with the DSI on this initiative.

Integrated Resource Plan (IRP) 2019

The IRP 2019 is premised on the NDP, which envisaged that South Africa will have an energy sector that provides reliable and efficient energy service at competitive rates; that is socially equitable through expanded access to energy at affordable tariffs; and that is environmentally sustainable through reduced emissions and pollution. Another key driver for South Africa to adopt an IRP is the Paris Agreement on Climate Change and, which South Africa has ratified. According to the IRP 2019, the energy sector in South Africa contributes close to 80% towards the country's total greenhouse gas emissions of which 50% are from electricity generation and liquid fuel production alone. Several interventions, such as investment in renewable energy, energy efficiency and public transport are expected to reduce emissions.

The IRP is defined as an "electricity infrastructure development plan based on least-cost electricity supply and demand balance, taking into account security of supply and the environment (minimise negative emissions and water usage)" (IRP 2019). The CSIR provided comments on the Draft IRP 2016 and Draft IRP 2018. As part of this, the CSIR also engaged bilaterally with the Department of Mineral Resources and Energy, as the key custodian of the IRP, along with other industry stakeholders (including Eskom, the National Energy Regulator of South Africa, SALGA, Energy Intensive Users Group of Southern Africa and the public). The CSIR, through the research, development and innovation activities of its Energy Research Centre and other competences, will actively contribute to the achievement of the IRP 2019 objectives.

A.1.1 EXTERNAL CONTEXT (continued)

A.1.1.5 CSIR REVIEW OF THE STRATEGIC PERIOD 2015 -2019

The CSIR has performed well over the past 5 year MTSF period (2015 – 2019), meeting or exceeding 71% of the KPI targets agreed upon with the Department of Science and Innovation, with a further 13% of targets partially achieved (defined as within 10% of acceptable performance limits) (see table A.2). Over this period the CSIR has consistently performed well in the areas of scientific outputs (100% achievement) with less than expected performance in human capital, Finance and Governance (particularly B-BBEEE Level and Safety) over the past 2 years. Measures have been put in place to address these issues to meet target over the next period.

Table A.2: CSIR performance against KPIs over the 2015-2019 MTSF period

MTSF Period	CSIR Financial Year	KPIs	Achieved		Partially Achieved		Not Achieved	
			Number	%	Number	%	Number	%
2014	2014/15	18	18	100%	0	0%	0	0%
2015	2015/16	18	16	89%	0	0%	2	11%
2016	2016/17	18	15	83%	2	11%	1	6%
2017	2017/18	28	16	57%	7	25%	5	18%
2018	2018/19	28	13	46%	5	18%	10	36%
Total for MTSF Period		**110**	**78**	**71%**	**14**	**13%**	**18**	**16%**

The CSIR has continued to make impact in various sectors of society and address MTSF priorities as evidenced by multiple research impact examples in our Annual Reports (www.csir.co.za). The past 5-year period has seen a number of high impact programmes and projects, some examples being:

- The Safety and Security Flagship, which had significant impact on the fight against rhino poaching (Protecting and enhancing our environmental assets);
- The Health Flagship, which saw the development of revolutionary point-of-care diagnostics to address maternal and fetal health in rural areas. We have also successfully implemented the Health Patient Registry System across all 9 provinces to enable the implementation of the National Health Insurance and better health outcomes (A long and healthy life for all South Africans);
- Development of integrated ocean monitoring systems (OCIMS) in support of Oceans Phakisa (An efficient, competitive and responsive economic infrastructure network);
- The establishment of the Mandela Mining Precinct in response to the Mining Phakisa (Enhancing natural resources, inclusive growth);

A.1.1 EXTERNAL CONTEXT (continued)

- The CSIR's impacts on inclusive economic development through establishing programs such as the Biomanufacturing Industry Development Centre and the Nanotechnology Industry Development Facility, which support small and emerging business (predominantly black owned) to enter high technology markets;
- Sustainable Human Settlements – The creation and roll out of the "Green Book" and "Red Book" for development of sustainable human settlements and adaptation to climate change; and
- The CSIR's continued contribution to the priority "A skilled and capable workforce" through various internship programmes, the DSIDE programme and more recently the Graduate in Training programme.

The past 5 years has also seen a strategic transition for the CSIR, aiming to compliment the scientific base with capabilities to support industrial development in South Africa. This transistion has seen the introduction of new performance indicators. The organisation is still determining the best targets, approaches and capabilities to best attain these targets.

A review of the CSIR was performed in 2018, where the panel noted that "It was encouraging to see the leadership and staff's dedication to ensuring that the organisation takes its rightful place in South Africa as a national asset, offering innovative and relevant solutions to address the country's triple challenges by stimulating the economy through new industry development, contributing to equal opportunities for socioeconomic development, and creating jobs". The Panel congratulated the CSIR on its work in the R&D arena, in particular the excellent human capital development (HCD) programmes that are now bearing fruit and where projects are well received by especially the public sector. The organisation has many challenges to meet, some of which require a response from the NSI with the leadership of the DSI, and government as a whole noting the strategic role of the CSIR.

A.1.2 INTERNAL CONTEXT

A.1.2.1 CSIR MANDATE

The CSIR was established on 5 October 1945 by an Act of Parliament. The Act under which the CSIR now operates, the Scientific Research Council stipulates the following mandate:

> The objects of the CSIR are, through directed and particularly multidisciplinary research and technological innovation, to foster, in the national interest and in fields which in its opinion should receive preference, industrial and scientific development, either by itself or in co-operation with principals from the private or public sectors, and thereby to contribute to the improvement of the quality of life of the people of the Republic, and to perform any other functions that may be assigned to the CSIR by or under this Act.
>
> *Extract from Scientific Research Council Act 46 of 1988*

Figure A.2: The CSIR Mandate

Specifically, section 4 of the mandate dictates that the CSIR supports better utilisation of the resources of the Republic. This is done through the improvement of the productive capacity of its population, improvement of technical processes and methods to improve industrial production, the promotion and expansion of existing, as well as the establishment of new industries, standardisation in industry and commerce and training of the national work force.

The CSIR utilises the framework depicted in Figure A.2 to manage its business and fulfill this mandate. This framework also forms the basis of our KPIs to monitor and manage organisational performance.

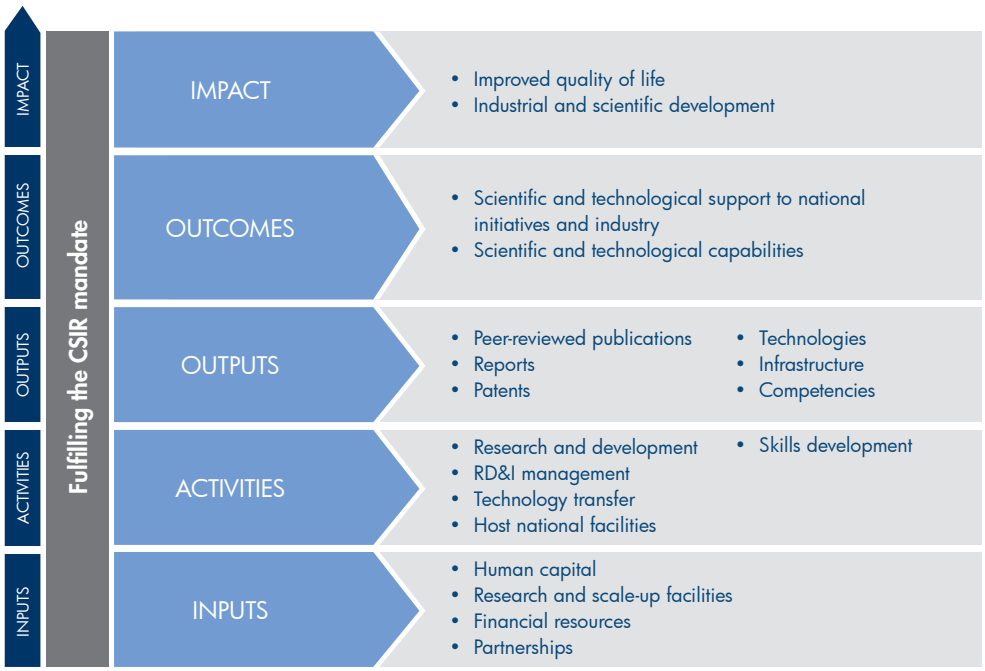


Figure A.2: CSIR Framework for fulfilling its mandate.

A.1.2 INTERNAL CONTEXT (continued)

A.1.2.2 VISION, MISSION AND VALUES

While the mandate, with its timeless attributes, remains the launch pad for any CSIR activity, trends in our operating environment, internal and external engagements, as well as contemporary best practice, highlighted the need for a bridge between the mandate and the CSIR Strategy and brought about the organisation's vision and mission statements.

OUR VISION

We are accelerators of socioeconomic prosperity in South Africa through leading innovation.

OUR MISSION

Collaboratively innovating and localising technologies, while providing knowledge solutions for the inclusive and sustainable advancement of industry and society.

OUR VALUES

We **EXCEL** in R&D and industrial innovation solutions that address South Africa's challenges. Quality and efficient thinking, systems and processes enable the necessary agility to change course should our stakeholders or environment require it. We are unashamedly passionate about the impact we make and pursue excellence in every facet of CSIR life.

We care about **PEOPLE** – our impact through innovation aims to improve lives. We respect each other's diversity, and uphold the dignity of every person, regardless of culture or belief system. Our systems and processes enable continuous personal development and we encourage one another to seize opportunities. We treat our stakeholders the way we like to be treated.

We value **INTEGRITY** – in ourselves and in others. We are honest and fair in how we work and how we engage the world around us. We respect the trust that our colleagues and our stakeholders place in us and commit to ethical decision-making, delivery and governance.

We are keen to learn from one another and **COLLABORATE** across the organisation and with external partners to ensure that our work has the best chance to innovate a better future for South Africans. We actively share our knowledge and expertise by design, formally and informally, so that we can realise large-scale impact.

A.1.2 INTERNAL CONTEXT (continued)

STRATEGIC INTENT

The strategic intent of the new strategy can be summarised as growth, sustainability, impact and relevance. These pillars bring alignment between responding to our mandate and addressing internal organisational imperatives.

The CSIR will use its capabilities, such as skilled HR, infrastructure and IP, to support the growth of the South African enterprises and assist in growing the South African economy, contributing to the alleviation of poverty, and addressing unemployment and inequality. The CSIR also intends to grow as an organisation, strengthening its human capital base, infrastructure and other competencies required to remain a world-class organiation, while strengthening its financial position.

Our intentions on sustainability refer to the CSIR developing technologies that improve the competitive advantage of South African enterprises, ensuring that they remain sustainable, and the creation of new viable industries and industry players. It also speaks to the financial sustainability and good governance of the organisation in a resource-constrained environment.

The CSIR will strive to make greater impact on economy and society through the commercialisation of technologies and innovations for industrial and socioeconomic development, as well as technology and knowledge transfer that enable a capable state.

The last pillar, which is relevance, relates to the appreciation of private sector decision-makers and public sector policymakers for the relevance of innovation in industrialisation, while also ensuring that the organisation is relevant and able to deliver on its mandate of improving the quality of life of the people of South Africa today.

A.1.2 INTERNAL CONTEXT (continued)

STRATEGIC OBJECTIVES

The strategy of the organisation hangs on its clearly defined SOs, which are derived from the prevailing strategic drivers in our operating environment. The CSIR's SOs provide the framework on which our plan is designed, and these are reflected in Figure A.3 below.

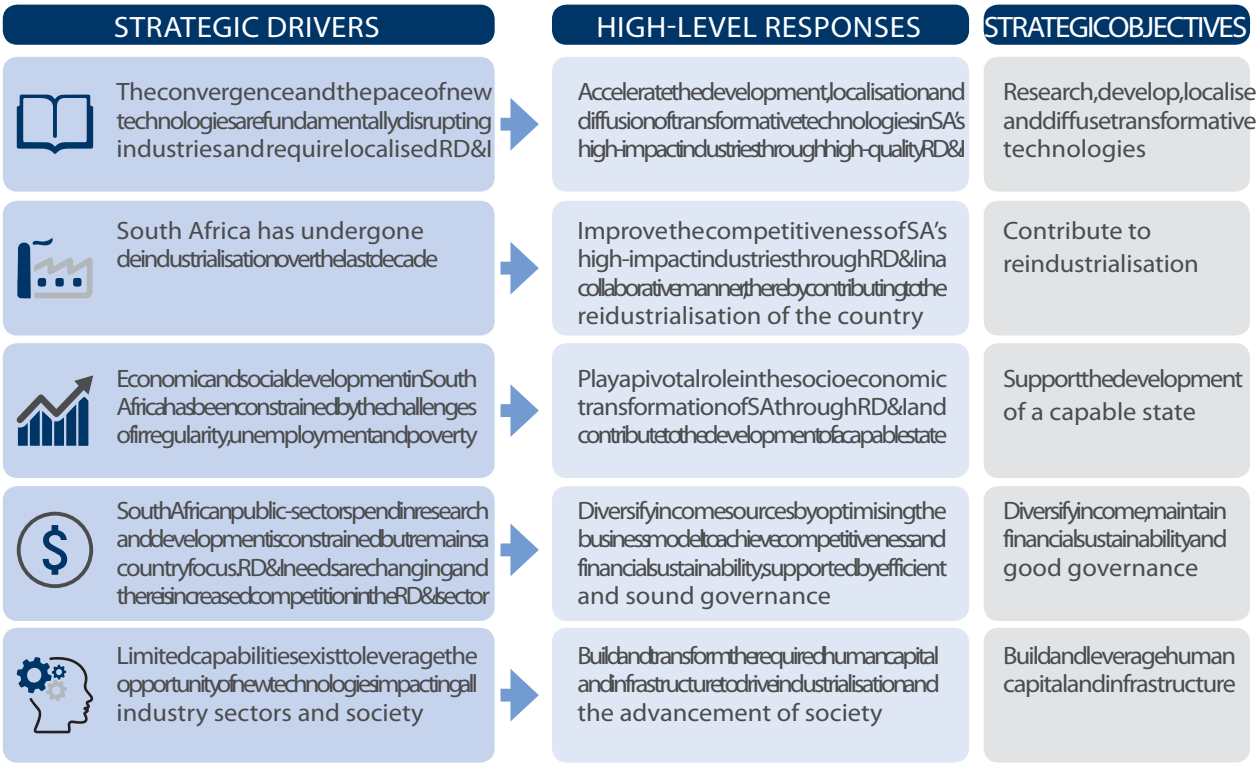


Figure A.3: Strategic drivers that shaped the CSIR's SOs

A.2 The CSIR Strategy

The CSIR Strategy is responsive to global and local socioeconomic and technological megatrends, South Africa's challenges and opportunities, as well as various national priorities. The strategy defines technology sector clusters, which are reflected and defined in a new, revamped operating model that is fit for purpose and underpins the CSIR Strategy. The operating model is also informed by the intent of the organisation to balance scientific and industrial development by amplifying industrial development in select high-impact economic sectors through research development and innovation. The overview of the strategic clusters, intent and focus is described below.

A.2.1 OVERVIEW OF STRATEGIC CLUSTERS

In selecting the sectors of the South African economy to focus on, the CSIR Strategy considers South Africa's readiness for the future, given that the world is currently undergoing a seismic change as it transitions to the era of the 4IR. In light of South Africa's prevailing challenges of slow economic growth and a tight fiscus, the CSIR needs to prioritise its finite R&D resources, and focus them on priority sectors that are most likely to move the needle in stimulating growth of the economy. The CSIR Strategy thus defines priority industries as those industries that:

- Present the greatest potential for socioeconomic impact according to a robust set of economic and social criteria that are both forward looking and reflective of the current status; and
- To varying extents, dependent on R&D, are amenable to stimulation through innovation, and thus offer opportunities for the CSIR to pursue.

Due to the critical nature of education, health, and defence and security, these industries are, by default, considered priorities for South Africa. Figure A.4 summarises the industries that constitute the CSIR's prioritised industries.

In addition to narrowing down the choice of sectors that the CSIR will focus on, the strategy also makes a deliberate choice of a suite of technologies that will form an integral part of the CSIR capabilities. The CSIR reviewed the 4IR technologies that are likely to have the greatest transformative and disruptive effect and improve sectoral performance, and these are highlighted in Figure A.4.

Figure A.4:
The CSIR's prioritised industries

A.2.1 OVERVIEW OF STRATEGIC CLUSTERS (continued)

Figure A.5: Transformative 4IR technologies

The relevant 4IR technologies that are potentially disruptive to the high-impact sectors will thus be an integral part of the capabilities that the CSIR is actively developing. The CSIR will seek to implement all technologies that will aid in achieving our objectives, thus relevant non-4IR technologies will also be key components to the CSIR capabilities. This approach ultimately led to the selection of technology sector clusters that are an integral part of the CSIR Strategy. The CSIR deemed that an isolated industry and technology view may be limiting as technologies and industries continuously converge and evolve. To amplify the impact from these technology industry convergences, the CSIR Strategy, buttressed by detailed industry competitive analyses, defined technology sector clusters that group clear synergies across technologies and industries. These nine synergetic clusters form the basis of the CSIR Strategy (Table A.3, and described in more detail below).

A.2.1 OVERVIEW OF STRATEGIC CLUSTERS (continued)

Table A.3: CSIR Strategy prioritised industry clusters and foci

Chemicals	Apply disruptive and innovative (bio)-chemical conversion technology to create a dynamic African chemical industry with access to forward-looking and modern digitised production processes.
Manufacturing	Strengthen the middle tiers of the value chain (fabrication and assembly), and develop strategic capabilities to address high-value industries, facilitating supply chain integration technological advances, through Industry 4.0 technologies.
Mining	Modernise mines via mechanisation and automation and, ultimately, fully autonomous operations, is the envisaged path that will bring change to processes, technologies, skillsets, and social and environmental impacts associated with current and future mining practices.
Advanced Agriculture and Food	Harness the opportunities afforded by transformative technologies to develop the agricultural industry and associated processing activities and, in turn, use these opportunities as a catalyst for rural development and inclusive growth.
NextGen Health	Continuous personalised health care and timely, personalised interventions through connected intelligent medical devices, AI algorithms to predict risk factors and the creation of new preventive clinical paths (synthetic biology interventions, telemedicine).
Smart Mobility	Connected and robotised logistics and infrastructure to maximise the efficiency and productivity associated with transport and logistics; this is especially important for a resource-extraction country that is spatially divided.
Defence and Security	Enable integrated national defence and security solutions in South Africa by being pre-emptive and adaptive through hardened intelligence defence and security offerings, linking into global supply chain markets.
NextGen Enterprises and Institutions	Enable the digital transition of South Africa's enterprises and institutions that support effective service delivery, improve transparency and accountability, and cultivate a connected platform that supports industrial and societal advancement; ultimately, improving the ease and effectiveness of doing business.
Smart Places	Smarter resources, infrastructure and service developments directed towards enabling competitive manufacturing environments and sustainable economic growth, through integrated and holistic planning and trade-off modelling.

The following section defines a brief overview of the cluster strategies, focusing on a brief sector assessment, the CSIR focus, capabilities to be established and the centres hosted in each cluster. The CSIR adopts in many instances a platform approach to capability development, a platform is defined as a suite of related and complementary capabilities that is positioned to generate a range of products and services.

A.2.1 OVERVIEW OF STRATEGIC CLUSTERS (continued)

A.2.1.1 CSIR FUTURE PRODUCTION: CHEMICALS

Sector assessment

The Chemicals cluster strategy is responsive to the needs of the chemical industry and the opportunity to grow new focus areas in this sector. The chemicals sector creates 3.5% of South Africa's GDP and is important for job creation and economic growth. It also counts for 25% of all imports into RSA. The main sectors are liquid fuels, plastic products and pharmaceuticals. The pharmaceutical sector can assist with reducing drug shortages and broaden access and affordability for people. The global active pharmaceutical ingredient (API) market is estimated to reach $245 billion by 2024, at a CAGR of 6.1% during the forecast period. Africa is one of the world's fasted growing economies, with the pharmaceuticals industry market value predicted to reach $40-60 billion by 2020, in response to the disproportionate disease burden on the continent. The South African sector is the largest pharmaceuticals market in SSA, with 2016 pharmaceutical sales at R47 billion (1.1% GDP). Pharmaceutical exports are almost non-existent and, as a result, there is a huge trade imbalance and foreign exchange burden for the sector.

Chemical manufacture is a mature market and any changes to the industry are incremental in nature. The sector is coming under pressure though from a need for "Green" manufacturing processes, less reliance on fossil feed stocks and increasing regulatory pressures. The industry will therefore need disruptive innovation to realise significant change.

CSIR Focus

The strategic objective of CSIR Future Production: Chemical is to develop a sustainable, vibrant and competitive South African Chemical Industry, driving growth through green chemicals, pharmaceuticals and new material advancements for the African economy.

Globally, there are emerging trends focussing on bio-chemical conversions, the use of biomass as feedstock, advanced conversion processes with reduced environmental impact, continuous flow manufacturing of APIs and advanced materials.

The current South African private R&D funding in the chemicals industry is around R800 million and we intend to capture a larger portion of this funding. Internal R&D funding at chemical industry level has decreased and industry intends to collaborate more, which is an ideal scenario for the CSIR. Relevant South African active industrial partners could be AECI, Interwaste, Foskor, Omnia, Sasol, Sappi, Pfizer and Illovo, while globally there are numeorus industrial role-players that could be engaged.

Relevant Capabilities

The capability base for the CSIR Future Production: Chemicals cluster is generally well-established, with a strong suite of programmes, infrastructure and a client base that includes a growing component of private sector players. The cluster focuses on three strategic capability platforms, namely (bio)-chemical conversions, pharmaceutical innovation technology and advanced materials. These will be underpinned by established bioprocessing, biomanufacturing,

A.2.1 OVERVIEW OF STRATEGIC CLUSTERS (continued)

as well as a biorefinery research group. In this area, there is scope to develop high-value chemicals and materials through combined bio- and chemical conversions of biomass and petrochemical feedstocks to generate high-value chemical products and material substrates. In the long term, we will explore ways to convert low-value compounds (methanol) and greenhouse gases (methane, carbon monoxide, CO_2), which are available at low cost, into higher value substrates and materials through novel biological processes. There is also scope for the development of novel and high-value materials from waste to drive the implementation of a circular economy. Computation, data analytics and digital technologies in synthetic biology (computational enzyme and microorganism design) will be adopted to develop unique capabilities in support of modern product development.

The cluster is establishing new emerging areas in advanced nanomaterials (particular focus is on 2D materials), bioconversions and synthetic biology for industrial applications, which are areas of strategic investment for South Africa's long-term competitiveness. The investment in building these new capabilities will still be required in the short to mid term. The cluster also has significant scope for growth and strategic collaboration with industry players, notably Sasol, whose relationship has been developed during 2019/20. The 4IR technologies that include biotechnology, specifically synthetic biology, nanotechnology and process modelling to drive industrial processes, will be core to the advancement of this cluster

Centre(s) hosted

The cluster hosts a research centre, the CeNAM with a strong focus on polymers and composites, which has collaborations and provides support across the organisation. The CeNAM aims to focus on the continual maturation of its technology platforms to deepen industry engagement across its research areas. Polymer work will also be expanded to address different aspects of the plastics, packaging and cosmetics value chains, in line with societal needs. Furthermore, advanced carbon materials will be investigated as a possible future focus area.

The Sensor Group is moving towards an application within the food industry to prevent food spoilage and wastage, not only for end-users but also within the value chain. This is an essential application of their work in the synthesis, characterisation, and development of nanoparticles for sensing.

Across the cluster, the BIDC and the BIDF will continue to pursue its support of SMMEs, in terms of technological and process development in the biomanufacturing and biorefinery sectors, respectively, with the intent of developing these particular sectors and enabling job creation. At the same time, an efficient operation model, particularly in terms of the utilisation of new industry-facing facilities, will be pursued.

A.2.1 OVERVIEW OF STRATEGIC CLUSTERS (continued)

A.2.1.2 CSIR FUTURE PRODUCTION: MANUFACTURING

Sector assessment

The manufacturing sector as driven by the metals, metal products, machinery and equipment sector and contributes significantly to the economy, providing:

- 2.5% of GDP;
- ~99 000 jobs;
- 18% of all exports; and
- 15% of all imports.

The disruptive changes that the manufacturing sector and society are going through require a strategic response that is a clear break from the past. Business-as-usual will not enable the CSIR, including the CSIR Future Production: Manufacturing, to reach its strategic ambitions and will not help prepare South Africa's manufacturing sector for the opportunities presented by the 4IR.

CSIR Focus

The CSIR Future Production: Manufacturing focuses on strengthening the middle tiers of the value chain (namely, fabrication and assembly), and developing strategic capabilities to address high-value industries, facilitating supply chain integration technological advances, through Industry 4.0 technologies. Thus, the cluster will assist the relevant industries with engineering and manufacturing solutions that are embedded at the core of innovative products. Particular focus will be placed on metals, ceramics, multifunctional materials, bio-based and bio-inspired materials. The expected impact on societal challenges related to energy, mobility and transport, environment and climate, information and communication, and health, has a very high potential. Examples are TiAl inter-metallics, additive manufacturing, ceramic membranes and powder processing (metallic and ceramic).

Relevant Capabilities

The cluster is building world-class capabilities for the engineering and production industries, which involves localising and developing transformative and/or efficient ways of manufacturing existing or new products. These capabilities include the use of new and advanced materials and new technologies for products and the manufacturing thereof. New capabilities that will be built include a combination of product, process and business model innovation over the full lifecycle of a product – PLM – aimed at digitalisation (digital thread and digital twin).

These capabilities typically underpin strategic value chains, are knowledge and capital-intensive, often requiring high R&D intensity, have high capital expenditure, result in highly-skilled employment, enable process, product and service innovation throughout the economy, and are multidisciplinary and trans-sectorial. They also cut across many technology areas with a trend towards convergence, technology integration and the potential to induce structural change. They require analysis and advising on multiple dependencies and interests in ecosystems that bring trade-

A.2.1 OVERVIEW OF STRATEGIC CLUSTERS (continued)

offs, development choices and risk management into the foreground, contribute to reducing environmental risk and social inequalities, understand the state of natural resources, including constraints and/or opportunities associated with particular development pathways.

The strategic underpinning capabilities that are being strengthened to support this intent include the seven of the 4IR technology areas, namely 3D printing, advanced materials, advanced robotics, AI, biotechnology, human enhancement technologies and IoT, that are expected to have the greatest transformative impact on the engineering and production industries.

South Africa must follow the worldwide trend of major industrial transformation known more broadly as the 4IR. The adoption and deployment of 4IR best practice linked to digitalisation of product design, manufacturing and general enterprise management within South Africa has the potential to improve the competiveness of manufacturing firms significantly, including small and medium enterprises (SMEs), across many sectors.

Centre(s) hosted

The CSIR's Future Production: Manufacturing cluster hosts the Photonics Centre, which includes the former National Laser Centre, which aims to develop and apply novel laser applications across a variety of sectors. The Centre is involved in early stage research (development of novel laser systems and applications) through to late-stage research (additive manufacturing, prototyping) and developing service-based solutions (laser-based refurbishment and engineering). The Centre is further described in section A.3.1.2.2.

The cluster will collaborate strongly with its partners and stakeholders from a position of strength derived from its unique position to add value to and innovate in numerous industries (including metals, medical, transport, aerospace, infrastructure and textiles (fibre)). These are dependent on improved materials and manufacturing techniques and require specific product solutions and insights to ensure the impact of new materials and materials beneficiation by providing science-based evidence.

A.2.1.3 CSIR FUTURE PRODUCTION: MINING

Sector assessment

The mining industry contributes over 18%, directly and indirectly, to the GDP of South Africa. Mining has been the cornerstone of the economy for more than a century. The high multiplier effects for mining employment (upstream and downstream) suggest that mining will continue to play a critical role in the economy. However, this continuation is highly dependent on the South African mining industry's ability to sustain itself into the future – especially the labour-intensive gold and PGM industries.

In addition to the price depression in the gold and PGM sectors, the issues of aging infrastructure, deepening of mines and longer travel times to underground working areas have influenced the profitability and sustainability of the sectors. Consequently, with increasing distance from the shaft, actual face time has decreased, thereby

A.2.1 OVERVIEW OF STRATEGIC CLUSTERS (continued)

accounting for the reduction in production and contributing to escalating costs, and also posing additional threats to health and safety standards.

CSIR Focus

CSIR Future Production: Mining addresses the challenges and opportunities of mining and quarrying, non-metal mining, manufacturing and chemicals sectors. The cluster focuses on leveraging the strong history of mining in South Africa through the modernisation of mines via mechanisation and automation and, ultimately, fully autonomous operations, as the envisaged path to improve safety, bring change to processes, technologies, skillsets, and social and environmental impacts associated with current mining practices.

Relevant capabilities

The CSIR, through its multi-, inter- and transdisciplinary capabilities and offerings, is ideally suited to provide technological solutions as needed for the revitalisation of mining R&D in South Africa. Industry 4.0 technologies are evolving at a far more rapid pace than previous revolutions. In the mining space, it integrates relevant technologies, such as robotics, IoT, cloud computing, AI and additive manufacturing. Given that mineral resources are required for so many new 4IR technologies, such as smartphones, electronics, green technologies, etc., it is clear that mining is a key driver of the 4IR and the revolution cannot happen without the mineral resources produced by the mines.

The cluster plans to consolidate its capacity into two solid areas of competence by combining geophysics, geology and rock engineering into a capability called geotechnical engineering and to expand the mining engineering capability to include mineral economics, and to grow both of these into a critical mass of skilled engineers and scientists. This capability development will enable the team to provide insight into the systemic structure of the mine, give guidance on the best way to engage mines and be able to evaluate effective mitigation strategies critically.

Initiatives hosted

The overall strategy of the The CSIR's Future Production: Mining cluster is aligned with the Phakisa outcomes via the SAMERDI initiative; and will address the challenges in occupational health and safety facing the mining sector as a partner to the MHSC. Such challenges include thematic areas to address occupational health and safety, covering, but not limited to, mine engineering, lab testing, rope testing, occupational diseases, airborne pollutants, fires and explosions, machinery and transport, rock bursts, rock falls and silicones.

A.2.1.4 CSIR ADVANCED AGRICULTURE AND FOOD

Sector assessment

In 2016, the sector contributed R80.9 billion (22%) of the GDP and employed 288 587 South Africans and contributed 17.5 billion trade balance (Statistics SA 2017). Agro-processing has made a significant contribution to GDP over the past 10 years. The South African government identified Agro-processing - together with its upstream sector (agriculture), as a critical driver of inclusive growth in the South African economy, with very significant

A.2.1 OVERVIEW OF STRATEGIC CLUSTERS (continued)

potential to create jobs. The commitment to agro-processing has been repeatedly articulated in the NDP; successive iterations of the IPAP; the Agricultural Policy Action Plan; Operation Phakisa for Agriculture, Land Reform and Rural Development (2016); and the Presidential Nine-Point Plan (Revitalisation of the Agriculture and Agro-processing Value Chains). Particularly, the development of the cannabis value chain is receiving heightened attention among various role players in South Africa. Food safety is an issue of growing importance due to several worldwide trends that contribute to increasing safety risks in food systems, increased movement of agricultural and food products across borders; changes in food processing and handling practices; and the re-emergence/emergence of diseases, pathogens due to climate change effects.

Engagements with key stakeholder have led to validated priority areas of focus. Currently the cluster remains reliant on government stakeholders for funding due to agriculture being a national priority sector. However, this has exposed the cluster to financial risks and thus diversification of its partners and income stream is critical for the sustainability of the cluster. Key public sector stakeholders for implementing these programs are DTIC, DoH, DSI, DARD (North West Province), ARC, NMISA and SANAS. The industry associations such as GRAINSA, the MAIZE Trust have indicated strong interest and commitment to support the CSIR programs. Targeted private sector partners include Tiger Brands, Pioneer Foods and various SMMEs.

CSIR Focus

The CSIR aims to harness the opportunities afforded by transformative technologies to develop the agricultural industry and associated processing activities and, in turn, use these opportunities as a catalyst for rural development and inclusive growth. The cluster will use advanced approaches to complement the efforts of other NSI layers, such as the ARC, to support primary production, and will also seek to reinforce the current growth in the agro-processing sector by supporting existing and new entrants to the industry. A special focus in this area will be on redistributing the benefits of value addition closer to the farmers, and stimulating rural economic growth.

Relevant capabilities

The cluster will develop advanced capabilities to drive primary production, advanced processing and food safety. For precision agriculture, we will employ earth observation technologies and collaborate with stakeholders like the ARC in providing farmers with technological services that enhance productivity using algorithms and geospatial data sources relevant to the African context. Besides the human capital requirement to expand the team, investment is required for equipment and infrastructure (e.g. drones).

In agro-processing, the CSIR will strengthen its capabilities in advanced processing and chemical analytics for specialty oils (e.g. cannabis and marula) and alternative proteins. This will be achieved through the development and localisation of high-efficiency and high-quality extraction technologies for cannabis oil, as well as developing innovative cannabinoid-based products. This work will be underpinned by advanced formulation and analytics, and leveraging capabilities in the CSIR's Future Production: Chemicals cluster. A second and closely related area is in the

A.2.1 OVERVIEW OF STRATEGIC CLUSTERS (continued)

advanced extraction and processing of high-value plant-based oils to support the local beneficiation of these oils, in keeping with national priorities as set out in IPAP 2018/19 -2020/21.

In food safety, the CSIR proposes a number of interventions along the value chain, which will leverage on the various capabilities across the CSIR, such as nanosensors, nanocomposites and polymers, smart packaging technologies, biometrics, Mobile APP systems, Smart Mobility and Logistics, medical devices and multiplexing, to address some of these challenges.

Centre(s) hosted

The are no particular centres hosted in this cluster, but it benefits significantly from the capabilities in the CSIR Future Production: Chemicals, notably the agro-processing capabilities in the BIDC, and the materials and sensor capabilities in the CeNAM.

The agricultural productivity and food safety challenges experienced in South Africa extend beyond the borders to the rest of Africa. However, South Africa remains better equipped to deal with some of these challenges than other African countries. Therefore, it is of critical importance that the CSIR leverages its hosting of the NEPAD SANBio to extend its offering to other African countries. Both the ECD Research Impact Area and SANBio have extensive experience working with stakeholders beyond the South Africa borders in assisting with establishing incubators, implementing innovative business models and supporting the public sector in establishing business support structures.

A.2.1.5 CSIR NEXTGEN HEALTH

Sector assessment

The health sector is a critical sector in the country, where significant challenges exist in areas such as supply of medicines, health service delivery and the growing triple burden of diseases on the South African population. The SA health care spending represents an average of 9.5% of the national GDP, in line with Organisation for Economic Co-operation and Development (OECD) countries, yet presents among the poorest health outcomes. This highlights the need for a concerted effort to address gaps in the sector. The SDGs, especially SDG 3 on "ensure healthy lives and promote healthy lives at all ages", present very clear global objectives that countries need to attain within a defined period.

From a technology trends perspective, digitisation in medicine is integral to efficient service delivery support, but also to health data mining, which results in more effective solutions and better health outcomes. Synthetic biology and precision medicine are at the cutting edge of advanced and more personalised health care solutions. The global synthetic biology market was valued at a $22.47 billion in 2018, and is expected to reach $145.62 billion by 2024, with an anticipated CAGR of 34.91% during the forecast period.

A.2.1 OVERVIEW OF STRATEGIC CLUSTERS (continued)

CSIR Focus

The CSIR aims to support the state in achieving its key priorities in health. The CSIR's NextGen Health cluster focuses on the improvement of access to health care services and products, incorporates synthetic biology and state-of-the-art diagnostic and treatment technology, with advances in AI to provide integrated health solutions. It thus aims to ensure that appropriate treatments are delivered at an appropriate time, cost and place for the patient. Areas that the CSIR has prioritised in attaining these objectives include health systems and digitisation, localisation of medical devices and diagnostics product innovation and lastly the development of precision medicine tools to support efforts of improving health care outcomes.

In health systems and digitisation, the CSIR focuses on developing locally relevant digital platforms and tools that contribute to improved health outcomes, as well as implements systems to support the implementation of the NHI. The ability of the CSIR to localise and adapt digital platforms to the local content is a key value proposition that it offers to the state in this area. This will continue to be the priority for the CSIR in the next years as the NHI is being rolled out. The area of health systems and digitisation is a key growth area. The CSIR team will focus on bringing board private sector partners on board, in addition to the public sector work it conducts to bring diversification.

An emerging area that regulators such as South African Health Products Regulatory Authority are putting immerse focus on, is the area of pharmacovigilance, with the goal being to increase their South African capacity in identifying drugs that present with unreported adverse side effects. Currently, there is limited technical capacity in South Africa to test drugs for these effects. The CSIR has developed and continues to develop tools to detect such adverse side effect in the area of precision medicine. Thus, the cluster will focus on deepening its current capability and focus on commercialising these tools.

Relevant capabilities

Early detection of diseases at the PoC is a priority of both the human health and veterinary health private and public health stakeholders. The CSIR's long-standing capability in developing PoC screening devices and interfacing these with digital platforms remains a key offering that makes the CSIR the go-to institution in this area. The cluster will build on the success of such programmes, as well as the PLM and the 3D printing capabilities to strengthen its emerging programmes. Furthermore, the NMDF will be the anchor device prototyping facility through which the cluster will demonstrate its emerging programmes. This offering will also be availed to external clients. Significant CSIR investment, as well as partner funding will be required over the next three years to implement this platform fully.

While these systems, i.e. digital platform, PoC diagnostic tools and precision medicine tools will indeed support the South African health service offering, a critical area that continues to affect the sector is drug shortages and heavy reliance on imported drugs. To this effect, the pharmaceutical technology innovation platform will focus on using modern manufacturing technology, initially through technology on-shoring and, in the long term, through technology interventions in process, manufacture and product innovation applying for the production of small molecule APIs. It is expected that the platform will enable the provision of low-cost drugs in South Africa and across Africa.

A.2.1 OVERVIEW OF STRATEGIC CLUSTERS (continued)

Centre(s) hosted

The cluster hosts the CSIR Synthetic Biology ERA, which focuses on the pioneering areas of bioengineering, biomimetics and biophysics and which are contributing to significant outcomes in this field. The governments of various nations have provided support for research on synthetic biology, because of its wide applications. The extensive use of various technologies for different genetic disorders and terminal illnesses is expected to be one of the primary drivers for the growth of the market, especially for the genome-engineering segment. Synthetic biology is used in several applications, such as medicine, biofuels, biochemical, and other bio-based substitutes. The increasing widespread application of synthetic biology is expected to be a primary factor contributing to the market's expansion. Thus, this area will have a strong international focus for the CSIR as the market is limited in South Africa.

While diagnostics are rapidly improving, limited access to technologies that allow for the informed prediction of how individuals will respond to specific treatment strategies along with a poor understanding of the unique biological and environmental factors underlying disease, represent significant barriers to improved health outcomes in low- to middle-income countries, including South Africa. In fact, South Africa has recently been ranked as the lowest scoring country in the world on the Indigo Wellbeing Index, where 10 key measures, including diabetes risk, blood pressure, obesity and life expectancy, are tracked. Knowledge of contributory factors like genetic predisposition, types of concurrent infections, and gut microbial health have been recognised to contribute significantly to the success of a patient's response to drug treatments. As such, screens with increased specificity are being developed at a rapid rate internationally and form a crucial part of the modern health response strategy, allowing for appropriate drugs to be administered in a manner that is tailored to specific populations and individual patients. A significant component of the CSIR's work in precision medicine is implemented in the Synthetic Biology Centre, although the work overall is depended on capabilities in other parts of the cluster.

A.2.1.6 CSIR SMART MOBILITY

Sector assessment

Mobility of persons and goods is changing rapidly, and its future trajectory is non-deterministic. However, we know that mobility will increase as more people and goods move across towns and across the globe. For example, by 2030, annual passenger traffic will exceed 80 trillion passenger-kilometres – a 50% increase compared to 2015; global freight volumes will grow by 70% compared to 2015; and an additional 1.2 billion cars will be on the road – double today's total. Sustainable transport and mobility are fundamental to progress in realising the promise of the 2030 Agenda for Sustainable Development. In achieving the 17 SDGs, mobility should have four key objectives:

- *Equitable* – it accounts for distributional considerations and places a minimum value on everyone's travel needs, providing all, including the vulnerable, women, young, old, and disabled, in both urban and rural areas, with at least some basic level of access through transport services and leaving "no one behind".

A.2.1 OVERVIEW OF STRATEGIC CLUSTERS (continued)

- *Efficient* – it seeks to ensure that transport demand is met effectively and, and at the least possible cost through the optimisation of resources – energy, technology, space, institutions, and regulations, in order to generate an efficient transport system or network.
- *Safe* – it aims to improve the safety of mobility across all modes of transport by avoiding fatalities, injuries and crashes from transport mishaps. There are internationally agreed global targets for road and air transport safety.
- *Climate responsive* – aims to address climate change through mitigation and adaptation, and to reduce both air and noise pollution

CSIR Focus

CSIR Smart Mobility addresses the challenges and opportunities of the transport and logistics, transport equipment, infrastructure, public services and transport dependent industries. The cluster seeks to improve overall economic competitiveness and sustainable growth of high-impact industries through directed investment in the SET of transport logistics infrastructure, systems and operations with the intention to improve the ease of doing business and enable other sectors from the perspective of logistics and transport. The strategic intent is to work with the transport, wholesale and retail sectors (the logistics sector) to enable South Africa to be a global leader in the provision of safe, reliable, effective, efficient and fully integrated transport and infrastructure solutions in support of logistics to enable the sustainable growth of the country's strategic industries. An efficient logistics sector contributes significantly to a reduced cost of doing business in the country and improves the competitiveness of products and operations across all industries.

The deregulated nature of the sector has resulted in destructive competition at a micro-logistics level, manifested through practices such as poor maintenance of vehicles, poor labour practices and the overloading of vehicles. Subdued capital investment to expand the capacity and quality of rail infrastructure has increasingly resulted in the shift of goods from rail to road, consequently leading to road network bottlenecks near ports, and increased frequency and severity of road crashes. Low levels of efficiencies in ports, customs and within the supply chain practices of individual firms translate to poor macro-logistics performance. In fact, South Africa's Logistics Performance Index, published by the World Bank, has increasingly worsened relative to major trading partners. High levels of unproductive vehicle kilometres, in the form of empty return trips, contribute to increased greenhouse gas emissions. Often, this happens because of little collaboration between micro-logistics actors and lack of appropriate communication infrastructure to facilitate such collaboration.

To improve logistics competitiveness across South Africa's strategic industries, improvements are required across the value chain (inbound, operations and outbound logistics) to constantly monitor and reduce logistics costs. This will require deliberate interventions in the form of improved data management in the logistics sector to match the forms of supply to demand and reduce inventory costs, reduce delivery lead times and increase asset productivity. Improved data management in the form of increasing data availability in real time, interoperability of data platforms across different actors in the value chain, and appropriate packaging of data and data analytics for end users will

A.2.1 OVERVIEW OF STRATEGIC CLUSTERS (continued)

be value transformative to the sector's performance. The development of macro-logistics network models to help manage network bottlenecks to improve network reliability and demonstrate the ability of various technology and management tools to improve safety of operations to influence the adoption of appropriate macro-level policies will be essential.

Relevant capabilities

The cluster employs civil engineers, coastal engineers, mechanical engineers, and various other built environment expertise that are largely scarce in South Africa and across the world. The skills trajectory in these disciplines is ever changing and cross-cutting across disciplines as new areas of specialisation are being developed, making it imperative that current and future employees have specialised skills relevant for industry development within the various disciplines.

A.2.1.7 CSIR DEFENCE AND SECURITY

Sector assessment

The defence sector employs over 70 000 people. It is a net exporter (62% of output is exported), despite its relatively small contribution to GDP (R15 billion). The South African Defence Industry (SADI) exported to 66 countries in 2019. The defence sector invests R1.7 billion annually in own technology development/R&D, as well as provides meaningful skilled employment opportunities to an estimated 15 000 engineers, technicians and artisans. These highly skilled engineers, technicians and artisans are contributing to key national projects in space, transportation, rail safety, mining, construction, power generation and telecommunications. A conservative estimate of the defence sector having a multiplier factor of one to four in terms of direct additional job opportunities thus means that the sector supports a further 60 000 skilled jobs in the economy.

The South African population face escalating crime rates. With a staggering 349% increase in business robberies over the past 11 years, these crime rates also affect the economy adversely. The cost of violence in South Africa is 22.3% of GDP. The SAPS's lack of capacity is a serious challenge. South Africa's police officer to citizen ratio is currently 1 to 383. This is almost double the international standard of 1 to 220. The safety and security industry employs more than 758 740 people (>4500 000 in the private sector). The global cybersecurity market is predicted to have grown at 10.7% between 2017 and 2023 (20,41% predicted for Africa). Cybersecurity risk and its adverse impacts have increased drastically, both globally and in South Africa, over the past decade. South Africa is considered to be one of the countries that is worst affected by cyberattacks, costing the economy an estimated R5 billion a year (Fripp, 2014).

CSIR Focus

CSIR Defence and Security focuses on these two sectors and intends to build resilient defence and security capabilities for South Africa to ensure secure borders and enable the safety of all inhabitants, while fostering a secure platform

A.2.1 OVERVIEW OF STRATEGIC CLUSTERS (continued)

for business to conduct industrial/economic activities. The sector is a major contributor to expanding and deepening the national skills base and furthering national industrialisation policies, generating foreign currency earnings from equipment exports with related services, and creating employment, as well as other national benefits. Therefore, it is clear that the South African defence and security sector is key to the strategic security of the republic's sovereignty and ensuring the safety of its inhabitants. The sector also plays a strategic role in contributing to economic prosperity. The cluster is looking to leverage on its strong technology demonstrator pipeline to ensure that there is an increase in the number of technologies being commercialised with the defence industry.

Thus, the envisaged outcome is to enable integrated national defence and security solutions in South Africa by being pre-emptive and adaptive through hardened intelligence defence and security offerings, linking into global supply chain markets.

Relevant capabilities

The CSIR's Defence and Security cluster has a broad spectrum of key capabilities and technologies primarily applicable to the defence and security sector in, but not limited to, aeronautics, ballistics, command and control, cybersecurity, cyberwarfare, detonics, electronic warfare, explosives, identity authentication, network and data security, optronics, radar and tactical vehicle mobility, among others. The associated tools, processes, facilities and skills are applied and directed in a number of ways; but can be classified broadly under the following impact pathways:

- Making the defence and security industry more competitive.
- Enabling the SANDF and other security agencies for the security and safety of South Africa.
- Providing a base of established capabilities and engineering capacity to other strategic state institutions and industries for non-defence, non-security-related applications.

A.2.1.8 CSIR NEXTGEN ENTERPRISES AND INSTITUTIONS

Sector assessment

South Africa is ranked 82nd out of 130 in the ease of doing business index (WBG, 2018). This is supported by findings in the Global IT Report. It states that in the Use of ICT for Economic and Social Impact, the country did well in the business category by obtaining a ranking of 30 out of 130, while the country did not do so well in the government category, where we obtained a score in the lower hundreds of the 130 countries assessed (World Economic Forum, 2016). Below are the areas that contributed to the low score:

- Absence of policy coordination/alignment mechanisms by/in government departments and state institutions;
- Fragmentation in systems and inability to access or integrate data;
- Poor connectivity and high costs, as a result of underdeveloped or underutilised ICT infrastructure, considering that the digital divide is still a significant challenge;

A.2.1 OVERVIEW OF STRATEGIC CLUSTERS (continued)

- Privacy and security as key prohibitors for digitising public institutions;
- Paper-based processes and systems; and
- Current financing, which is limiting the magnitude and scope of institutional digitalising and integration.

CSIR Focus

CSIR NextGen Enterprises and Institutions addresses the challenges and opportunities of public institutions and private service enterprises, state-owned entities, municipal services, notary services, insurance banking, etc. It will enable the transition of South Africa's public institutions into a digitalised era that will support effective (public and private) service delivery, improve government transparency and accountability, and cultivate a connected platform that supports service provision, and industrial and societal advancement.

The CSIR will focus predominantly on building digital tools and systems, efficient data generation and acquisition, as well as data processing and analytics, in line with emerging trends to transition from traditional paper-based services to fully digital services, ranging from information provision through digitally enhanced and supported offerings to full conclusion of a public service.

Relevant capabilities

The crosscutting capabilities within this cluster position it to respond to high-level problems across a whole spectrum of disciplines and application areas. Coordinated cross-disciplinary responses of this type assist in ensuring that the CSIR provides an optimal response to SET problems emanating from national challenges. The CSIR's NextGen Enterprises and Institutions cluster is positioned to respond to national challenges through the following modes of capability deployment:

- Deployment of domain-specific capabilities. Addressing relevant SET problems that lie within a particular application domain (i.e. a domain-specific area such as Telecommunication). In such cases, the cluster's response to challenges is informed by the perceived demand in the impact space, as well as national policy documents and plans.
- Deployment of enabling capabilities. The cluster responds to national challenges by deploying enabling capabilities to strengthen RD&I initiatives that address national priorities. CSIR NextGen Enterprises and Institutions contains crosscutting capabilities in mathematical modelling, data science, IoT, human technologies, AI, distributed ledger technologies, and related areas of computational science. These capabilities are complimentary to domain-specific capabilities that address SET problems in a wide range of application areas, such as coastal systems, aeronautics, and decision support.

Centre(s) hosted

CSIR Emerging Digital Technologies Research Centre

The Emerging Digital Technologies Research Centre's objective is the research and development of the emerging technologies underpinned by 4IR digital technology blocks, which aims to enable digital disruption in local

A.2.1 OVERVIEW OF STRATEGIC CLUSTERS (continued)

enterprises to keep South African organisations relevant and competitive. The areas that the Centre will incubate will include AI, augmented reality, advanced IoT, as well as distributed ledger technologies, among others.

A.2.1.9 CSIR SMART PLACES

Sector assessment

Well-functioning infrastructure and an efficient built environment are crucial to socioeconomic development and poverty alleviation. Creating smart places is important, as it allows industries to have wider economic impact and reach. While infrastructure alone will not lead directly to best-in-class manufacturing, a serious lack of infrastructure or a steadily decaying infrastructure will affect a nation's manufacturing competitiveness negatively and create serious obstacles for the supply chain networks of manufacturers (WEF 2018). Addressing this challenge will help ensure sustainable growth in the future.

Climate change and resource use trade-offs also have an impact on industrial activity in South Africa. From this perspective, the two priorities are creating sustainable economic opportunities derived from the natural resource endowment of South Africa and reducing the risk of costly and misinformed decisions on natural resource and environment related issues.

CSIR Focus

CSIR Smart Places addresses the challenges and opportunities of public institutions, transportation and logistics, utilities, ICT, business and financial services, education and health sectors. It aims to effect smarter resource use, infrastructure and service developments directed towards enabling competitive manufacturing environments and sustainable economic growth. The implementation of advanced technologies will improve the ease and effectiveness of doing business through lowering the cost of transport and communications; improving availability and reducing the cost of water and electricity, while fixing roads and infrastructure, are minimum requirements.

Smart interventions support prudent resource use through trade-off modelling, ensure connectivity between resources and enabling industries that have a large economic impact and reach (e.g. health, education, transport, ICT, electricity, etc.), and ensure productivity and growth across multiple industries. Without enablers, the economy will have segmented players operating independently and not leveraging each other's strengths.

Smart interventions will include smart maintenance, which is an imperative for sustaining public service offerings and will strengthen quality, performance and interactivity through ICT and innovation. The CSIR's response will cover the full value chain, and is predicated upon harnessing the opportunities afforded by transformative technologies to develop smarter resource use, infrastructure, and service developments directed towards enabling competitive industrial environments and sustainable economic growth. Current relevant programmes related to smart infrastructure include smart spatial planning (earth observation and IT), intelligent systems, as well as advanced materials and processes. Relevant municipal programmes include SET solutions for infrastructure delivery, as well as capacity and capability-driven local economic development.

A.2.1 OVERVIEW OF STRATEGIC CLUSTERS (continued)

Relevant capabilities

The CSIR's Smart Places cluster builds on capabilities developed over a number of years in climate change modelling and mitigation, earth observation technologies, spatial planning, natural resource sciences, hydrological modelling and infrastructure engineering. The cluster will further harness (and develop) capabilities in emerging digital technologies together with CSIR NextGen Enterprises and Institutions.

Centre(s) hosted

CSIR Energy Research Centre: The CSIR Energy Research Centre provides the scientific expertise and research infrastructure necessary to address South Africa's growing energy needs and the associated industrialisation opportunities for new products and services. The Centre provides thought leadership, innovation and capacity building to address the two main energy imperatives of energy efficiency and cleaner energy. The Centre's growth and impact plan responds directly to the challenges identified in NDP by providing unbiased decision support to solve the long-term, sustainable energy needs of South Africa, while concurrently addressing issues such as CO2 emissions, water use, uncertainty, localisation and regional development.

The CSIR Water Resource Management Research Centre: The CSIR Water Resource Management Research Centre has four key integrated and cross-cutting RD&I objectives:

- to improve water resources resilience to ensure the availability of good quality water against the backdrop of climate change impact, future land use and the incidence of extreme droughts;
- to improve water management systems through contribution towards policy review and the development of tools and techniques that will reduce the cost of water delivery and promote equitable water use;
- technological developments for access to alternative water resources; and
- to develop and optimise smart and robust water and wastewater infrastructure with concomitant improved operation and maintenance.

Smart Places Hosted Programmes (NCPC and NFTN): Although the NCPC-SA and NFTN do not conduct RD&I, they play a significant role in localising transformative technologies and accelerate their diffusion into the South African economy. This is demonstrated by the implemention of the Resource Efficient and Cleaner Production technology and techniques to assist industry to transform from conventional economy to a green, low-carbon and sustainable economy. The hosted programmes drive industrial development through providing technology and enabling support to the private sector to improve industrial competitiveness. This is done through the exploitation of research outputs and other innovation activities executed in selected industries in the manufacturing and services sectors prioritised in alignment with government policies such as the IPAP, the NDP and the New Growth Path. This is achieved through the design, establishment and management of strategic initiatives/programmes, by facilitating technology transfer and localisation, and by building and facilitating national capability and capacity.

A.2.2 BUSINESS AND OPERATIONAL MODELS

The roll out of the new organisational strategy involves the implementation of the new business and operating models.

Centre for the Fourth Industrial Revolution, South Africa: The CSIR, at the request of the Department of Science and Innovation will be hosting the South African (World Economic Forum) Affiliate Centre for the Fourth Industrial Revolution (C4IR-SA). The Centre will allow the CSIR to play a central role in implementation of the 4IR country strategy (under development through the Presidential Commission), particularly as the Centre activities focus on the policy and regulatory environment necessary for implementation of technologies. The Centre will also provide a means for interaction with relevant public and private sector stakeholders, both locally and internationally. The WEF C4IR affiliate centres are intended to be public-private partnerships, facilitated by government but with strong buy in from relevant private and public sector partners. It will also allow for fast tracking national development in this space through access to learning (best practice) in other regions globally (through the C4IR network), who are grappling with many of the same issues around the adoption of new and advancing technologies for public good and national growth.

A.2.2.1 BUSINESS MODEL

The renewed CSIR business model aims to improve the suite of CSIR offerings and thus broaden the scope for impact. In line with the CSIR's strategic direction to amplify the 'I' in CSIR, the key purpose of renewing the CSIR's business model is to increase income and relevance to the private sector.

The renewed CSIR business model will enable the organisation to enhance its way of doing business through the following key components:

Table A.4: Key components of the CSIR Business Model

COMPONENT	DEFINITIONS
Customer Value Proposition	Relevance and effectiveness of the CSIR's products, services, brand and experiences as perceived by its customers.
Income Sources	Stability and diversity across the CSIR's income sources, as well as the level of profitability driven by these income sources.
Cost Structures	Sustainability of the underlying cost base, as well as the effectiveness of controls in place to maintain this.
Customer Segments	Diversity and stability of customer segmentation by type and income.
Customer Relationships	Development and management of customer relationships, including the effectiveness of these activities.
Partnerships	Development and management of partnerships, including the effectiveness of these
Channels	CSIR approaches to communication and marketing that impact the visibility of the CSIR brand, bring our offerings to market.

A.2.2 BUSINESS AND OPERATIONAL MODELS (continued)

As part of the roll out of its new strategy, the CSIR had its business model assessed, along the seven components. Overall, the assessment showed that there are substantial and partial gaps to achieve best practice in the areas that were assessed. The key findings of business model assessment are outlined in Table A.5 below:

Table A.5: Findings of the CSIR Business Model assessment

COMPONENT	ASSESSMENT AREAS	FINDINGS
Customer Value Proposition	Relevance to customers; Awareness by customers; and Satisfaction of customers.	The private sector does not fully understand what the CSIR value proposition is.
Income Sources	Stability of income sources; Diversity of income sources; and Profitability.	Total income declined by a CAGR of 8% between FY16 and FY18, despite increases in international and private sector income.
Cost Structures	Sustainability of cost base; and Effectiveness of cost controls.	The cost base of the organisation was growing rapidly as result of an increase in manpower.
Customer Segments	Diversity of customer segments; and Stability of customer segments.	Over dependence on the public sector as a source of income and lack of diversity across customers and customer types.
Customer Relationships	Development of customer relationships; Management of customer relationships; and Effectiveness of customer relationships.	Roles and responsibilities are partially defined, with partially effective coordination across the organisation.
Partnerships	Partnership development; Partnership management; and Effectiveness of partnerships.	While partnerships are aimed at the right groups, limited coordination across the CSIR stunted the ability to prioritise, manage, and develop them.
Channels	Marketing strategy; Marketing structures; and Marketing activities.	Brand and offerings not visible to critical stakeholders.

A.2.2 BUSINESS AND OPERATIONAL MODELS (continued)

During 2020/21, the CSIR will be optimising the key components of its business model, in order to realise the key purpose outlined. The components of our business model are described below and are positioned to achieve the SOs of our new strategy:

Customer value proposition

Key elements of the CSIR value proposition include research development and innovation capabilities; industry-facing pilot infrastructure; its track record in, for example, technology development, commercialisation of technologies, enterprise creation for development, new business models for the public and private sectors and scaling up of products and processes; research and development infrastructure; and a highly skilled multidisciplinary human capital base.

The CSIR creates value for customers through its knowledge-based services that include new knowledge generation; technology development; innovations; decision-support solutions; evidence-based contribution to policy, regulations and standards development; product and technology validation; enterprise creation and support. Further, the organisation has capabilities to design, develop, manufacture and assemble and maintain products that impact industry and society. The CSIR offers commercial services that include specialised services, standards and compliance assurance. It also hosts national initiatives, such as the NCPC and the Technology Localisation Implementation Unit, as well as strategic infrastructure, such as wind tunnels, the CHPC and SANReN.

In line with the intent of our new strategy, the CSIR value proposition to industry includes:

- Technology licensing and start-up creation;
- Access to infrastructure, skills and technology incubation;
- Innovation in support if industries in decline;
- Improvement of industry competitiveness;
- New industry creation;
- Technology localisation and supplier development; and
- Community-based industry creation.

Our efforts in 2020/21 will continue to ensure that we deliver a consolidated, strengthened offering that is relevant to the competitiveness of the South African economy.

A.2.2 BUSINESS AND OPERATIONAL MODELS (continued)

Our investment priorities will see to a strategic investment shift in our research, development and innovation portfolio, with greater focus on the later stages of TRLs (Table A.6)

Table A.6: Planned strategic investment shift in the CSIR RD&I portfolio

RDI TYPE ACTIVITIES	TYPE A	TYPE B	TYPE C
Equivalent Technology Readiness Level (TRL)	TRL 1 TRL 2 TRL 3	TRL 4 TRL 5 TRL 6	TRL 7 TRL 8 TRL 9
Pre-Project Synapse Investment profile of the CSIR RD&I portfolio	35%	40%	25%
Planned Strategic Investment of the CSIR RD&I portfolio	20%	40%	40%

The greater investment in Type B and Type C will enhance technology development, commercialisation and technology transfer that will support re-industrialisation and socioeconomic development.

For the medium term, we will also further deepen our value proposition to our customers and partners through collaborative initiatives, such as the establishment of shared innovation centres, and strategic secondments of our expertise to industry, while generally improving the physical proximity of our activities to industry.

Income Sources and Customer Segments

The CSIR derives its income from contract R&D from the public sector, private sector and international customers; the Parliamentary Grant (PG); and royalties and licensing income. An analysis of its total annual income for the past 5 years showed a CAGR of -0.33%. Clearly, this component of our business model requires greater effort to ensure income stability, sufficient diversity of income sources and profitability.

The largest portion of the CSIR's income is contract R&D from the public sector, followed by the PG. It is the intention of the CSIR, as part of its new strategy, to diversify its income sources by particularly increasing income from the private sector, international customers, as well as royalties and licensing. In recent years, the CSIR's share of income from the private sector has been increasing. However, the CSIR's private sector income remains lower than benchmarks. It is the CSIR's aspiration to increase its share of private sector R&D income from 7% to 33% by 2023. During 2020/21, the CSIR will continue to increase its focus on industry and the private sector by aligning its offerings to their needs and will also enhance collaborations and co-investment opportunities with this sector of the economy. Facilitated by the new approach in PG investment, the CSIR will continue in 2020/21 to drive the commercialisation of the pipeline technologies, in order increase earnings from royalties and licensing. The CSIR's income from royalties and licensing is very low compared to the benchmark average of 5% of total income.

A.2.2 BUSINESS AND OPERATIONAL MODELS (continued)

International income sources, especially opportunities in the African continent, will be pursued rigorously. Our objectives in the African continent are to align to our government's goal of supporting the region's development initiatives, while also pursuing and creating opportunities that advance our new strategy.

Our new operating model has established Business Development and Commercialisation (BD&C) functions in divisions, which will, in collaboration with RD&I experts, ensure that:

- there is improved relevance and competitiveness of the CSIR RD&I offerings;
- there is improved collaboration, particularly with the private sector;
- our income grows and is diversified;
- commercialisation and technology transfer is rigorously driven;
- customers are satisfied; and
- there is repeat business.

During 2020/21 this BD&C capability will be strengthened and deepened to ensure that the CSIR grows in terms of income and building stronger relationships with customers.

Cost structures

As part of the implementation of the new CSIR Strategy and Operational Model, in the 2018/19 to 2019/20 financial years, the CSIR started with the optimisation of the SET base of the organisation. The process involved a review of pockets of inefficiencies in the then Operating Units, as well as the streamlining of capabilities that had become inefficient. During 2019/20, the SET base was successfully placed in the new operating model in divisions and clusters, and is now stable. The aim now and into 2020/21 is to strengthen and grow the SET capabilities, in line with the required competences of our new strategy.

In 2019/20, the process of optmising the support functions of the CSIR, in order to build a support function that is "fit-for-purpose", started. The process followed included a benchmark with best practice, alignment of the support functions to the SOs, and addressing the challenges highlighted in the review of the internal operating environment. During 2020/21, the support functions are expected to be fully aligned to our new operating model and stable. Greater efficiencies will be pursued in each of the support functions by implementing improvements in each of the support functions, in line with stages of excellence including Basic, Aspirational, Emerging, Consolidating and Transformative as defined through the exercise

Business process optimisation is also an area of focus as a way of further improveming efficiencies. In the 2019/20 to 2020/21 financial years, there will be focus on an organisation-wide business process mapping. Once mapping has been completed, there will be prioritisation of "game-changing" business processes for implementation. The business process implementation will also be complemented by the implementation of a new ICT strategy that will allow the CSIR to develop into a modern, integrated, secure and digitally enabled organisation.

A.2.2 BUSINESS AND OPERATIONAL MODELS (continued)

Customer relationships

As the CSIR pursues the goal of growing its revenue, improving profitability, diversity income through, among others, enhanced customer attraction, satisfaction and retention, it is going to be imperative to enhance its customer relationship strategy and approach. As already stated, the organisation has now implemented the requisite organisational structure, namely, the BD&C function, as the lead interface with customers in divisions. During 2019/20, key leadership in all three divisions was appointed to this structure. In 2020/21, there will be key focus on professionalising customer relationship management, by adopting an integrated strategy, approach, and practices in respect of customer relationship management. Further, the initiative on the development of a CRM system, which commenced in 2019/20, will be fully implemented by 2020/21. The CRM will ensure that there is an integrated customer view, customer interfaces are reported on regularly, the history of the customers is captured to inform strategy and approach, the organisation stays connected to the customer, and, overall, the process of CRM is streamlined.

The CSIR will also develop a KAM Framework, which will guide key account management practice in the CSIR and in divisions, and so that the CSIR is able to maximise mutual value and achieve mutually beneficial goals with the most important customers identified.

Partnerships

As part of its new operating model, the CSIR has established a Strategic Partnerships function at the central level to identify, develop and manage partnerships. This function ensures that the CSIR effectively collaborates – as suggested in its mandate, mission, values and SOs – with parties in the public sector, private sector and internationally, in order to advance the purpose of its new strategy. The CSIR has segmented its partners to include, the private sector, government, SOEs, finance and development institutions, HEI, research and technology organisations or science councils and international institutions. Through partnerships, the CSIR, develops relationships, evolves areas of mutual interest, leverages and pool skills, competences and capability towards the achievement of common goals. Overall, partnerships are formalised through agreements that state collaboration principles and the objectives of the parties and thus provide the basis for their effective management. Effectively managed partnerships are aimed at leading to joint projects, co-investments, finance leverage, outputs and outcomes such a joint publications, joint IP, technologies/innovations, as well as skills development. In addition, partnerships can also evolve into commercial partnerships.

In 2019/20, the CSIR, collaborating at all levels of the organisation, initiated and maintained several partnerships that included government, including provincial governments, SOEs, finance and development institutions, venture capitalists, HEIs, the private sector and international governments and institutions. Several agreements with new partners will be formalised by end of 2019/20 and will be fully executed by 2020/21. During 2020/21, a Strategic Partnerships Framework and related policies will be developed and implemented. New partnerships, particularly those focusing on the private sector will also be initiated and developed in 2020/21.

A.2.2 BUSINESS AND OPERATIONAL MODELS (continued)

Channels

The CSIR has provided for a Marketing function as part of the BD&C functions in divisions. During 2019/20, the CSIR undertook a re-branding exercise and developed a Strategic Communications Strategy that will see be fully implemented in 2020/21. The new brand and Strategic Communication Strategy will re-position and enhance the CSIR's visibility in the market in 2020/21. Enhanced marketing collateral, reflective of our new strategy, will provide opportunities to re-introduce the CSIR's offerings in existing and new markets.

The Marketing function will ensure that there are marketing strategies, pitched at the appropriate level, and which communicate and deliver offerings that have value for customers, clients and partners. Various marketing platforms, such as exhibitions, conferences, open days, digital marketing platforms and advertising will be utilised and expanded on, to ensure greater visibility and uptake of our offerings in the market place.

A.2.2.2 OPERATING MODEL

The primary purpose of the Operating Model is to enable the execution of the organisation's strategy through the identified core business offerings. Additionally, the Operating Model's design aims to address areas of improvement in the organisation. To best enable the new strategy and address key challenges, organisational design best practices applied by other RTOs and service-offering firms were considered. A detailed assessment of the organisation's value proposition identified the following strengths and weaknesses:

KEY STRENGTHS	Clearly distinguishes core & support functions	• The organisation has sufficient clarity around the distinction between core and support functions
	Allows for clearly defined accountability at operational level	• All accountability is fully contained within the Operating Units. Each Operating Unit is responsible for the monitoring and reporting of performance, including P&L and operational performance
	Has Business Development capabilities focused on SOEs	• Existing capabilities and resources to develop a limited number of strategic customer relationships, mostly focused on state owned entities
AREAS FOR IMPROVEMENT	Does not adequately support customer relationship development to drive CSIR's industrial objective	• R&D activities are not industry oriented preventing the strengthening of existing and potential industry relationships. BD responsibilities lie within the OU, are not well defined and often lack capability. • Does not support coordinated private sector interaction
	Does not adequately support commercialisation of core R&D offerings in industry & the private sector	• Does not enable the commercialisation of R&D Initiatives. Inappropriate commercial skillset within the OUs & typically focused on public sector
	Promotes siloed, independent OUs disabling cross-functional collaboration & efficiency	• Does not allow for inter-unit collaboration encouraging a siloed way of working with limited integration and coordination • No permanent structure to enable collaboration. Currently ad hoc R&D programmes support some degree of collaboration
	Allows for duplication of functions across OUs creating inefficiencies	• Features duplication of functions across multiple units, not effectively utilising people & financial resources e.g. Laser centre & DPSS • CSIR's supporting functions are currently not organised optimally
	Does not support the agility, flexibility and adaptability required of an RTO	• Rigid with complex governance structures and approvals, hindering the organisation's ability to respond to evolving customer needs. No direct line of reporting between leadership and core business activities.

Figure A.6: Assessment of current strengths and weaknesses in the CSIR value proposition

A.2.2 BUSINESS AND OPERATIONAL MODELS (continued)

To retain the key strengths and address the organisation's weaknesses, the following design principles were considered:

- **Enable the strategy, mission and vision:** Translate the CSIR's renewed strategic directions into directed multidisciplinary research and technological innovation with a stronger industry focus.
- **Promote customer-centricity and market focus:** Support coordinated relationship-building with the private and public sectors to enable greater understanding of their needs and drive commercial relevance.
- **Enable collaboration:** Enable collaboration across multiple departments, reduce the silo mentality and drive integrated solutions that fulfil customer needs.
- **Promote efficiency and agility:** Improve business performance through more effective use of resources, enabling a less bureaucratic organisation and promoting responsiveness to customer needs.
- **Elevate core business representation:** Have sufficient representation from core business functions at a senior leadership level, enabling empowered accountability and driving collaboration.
- **Endorse implementation and leadership buy-in:** Support a manageable transition from the as-is to the to-be model and support the successful, sustainable execution of the renewed strategy.
- **Structural changes:** Optimise the Operating Model and include, among others, the establishment of research, development and industry advisory panel to ensure that the CSIR's work remains relevant and responsive to industry and national needs.

From a technology and sector focus point of view, the realigned CSIR Operating Model and structure focuses on three technology/sector divisions. The divisions are market-facing units – the 'structural home' of clusters, centres, impact areas and research groups that share complementary competences to promote collaboration and drive efficiency, and that share synergies in process, products and solutions.

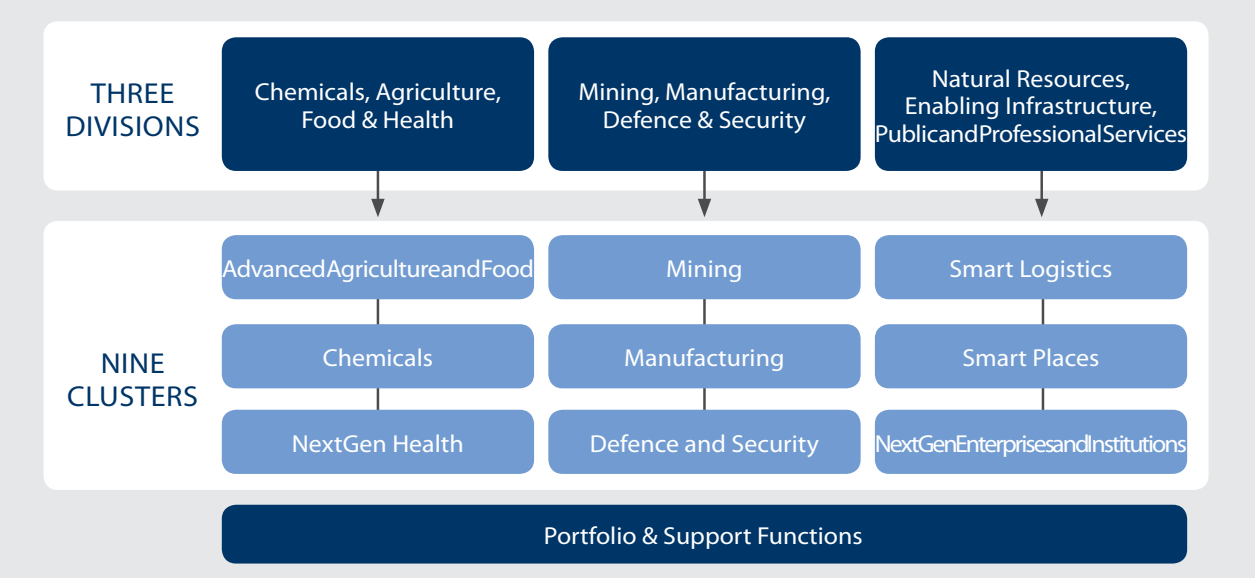


Figure A.7: CSIR divisions and clusters overview

A.2.2 BUSINESS AND OPERATIONAL MODELS (continued)

The divisions enable inter- and intra-divisional collaboration as appropriate, and have a broad, external overview of the industries targeted for impact to ensure CSIR responses remain relevant. These span several industries and involve collaboration with a host of public and private sector stakeholders, funding partners, industry associations, higher education institutions and other innovation partners.

Each division is composed of three strategic clusters. Each cluster comprises Impact Areas and Research Centres.

The Impact Areas are an outcome and an impact oriented organisation of competencies as required for desired impact in the anchoring and related clusters. They span the RD&I value chain, and they are designed to facilitate research, development and translation.

Research Centres in the CSIR are areas where research and technology in specific areas is consolidated and further developed into deep world-class capabilities to support multiple areas of application across the organisation. Centres are housed in clusters where the relevant competences are most established, but capabilities are deployed across all areas where they are required in the CSIR and the NSI. They may also include areas where research and technology in specific areas is consolidated and further developed into deep world-class capability to support multiple areas of application across the organisation. The capabilities could transition to other elements once matured.

At divisional level, a Business Development and Commercialisation (BD&C) function has been created which requires a diversity of skills to work together as a team, managing intellectual property, collecting business intelligence, balancing business development and commercialisation demands as appropriate. This BD&C function will comprise of a BD&C Executive manager, and managers specialising in marketing, business development and commercialisation. Activities across the CSIR in this area will be facilitated through a joint BD&C and Strategic Partnerships Forum. This is a Community of Practice for practitioners in business development, strategic partnerships, IP management, technology transfer and commercialisation. It will serve as the first point of contact for all organisation-wide opportunities in business development, strategic partnerships, IP management, technology transfer and commercialisation.

The **operations** of the CSIR are overseen at three levels. The BEI Executive Portfolio carries the responsibility of integrating organisational operations, which is facilitate by an Operations Committee (OPCO), among other platforms. This committee also works collaboratively to facilitate implementations of the organisation's obligations as agreed in the CSIR Shareholder's Compact and ensures efficient and effective operations in the organisation. At the divisional level, the divisional Operations Manager integrates the operations of a particular division. Operations managers are also deployed in the clusters, depending on the size and complexity of the business. The Operations Managers are responsible for co-ordination of divisional and cluster Strategy development processes that cascade from division into clusters, Impact Areas and Centres. They facilitate the execution of divisional and cluster Operational plans and monitor progress on implementation at division, cluster, Impact Area and Centre levels.

A.2.2 BUSINESS AND OPERATIONAL MODELS (continued)

In each of the divisions, there will be a support team comprising of embedded divisional financial and human resources managers to attend to the related requirements of each division. Resources will typically be deployed at divisional level and shared across clusters to ensure that the line support is optimised. Services such as Safety, Health, Environment and Quality (SHEQ), Legal Services, Facilities Management and Enterprise Risk Management services will be provided centrally on the basis of service level agreements.

The Operating Model is depicted in Figure A.8 below.

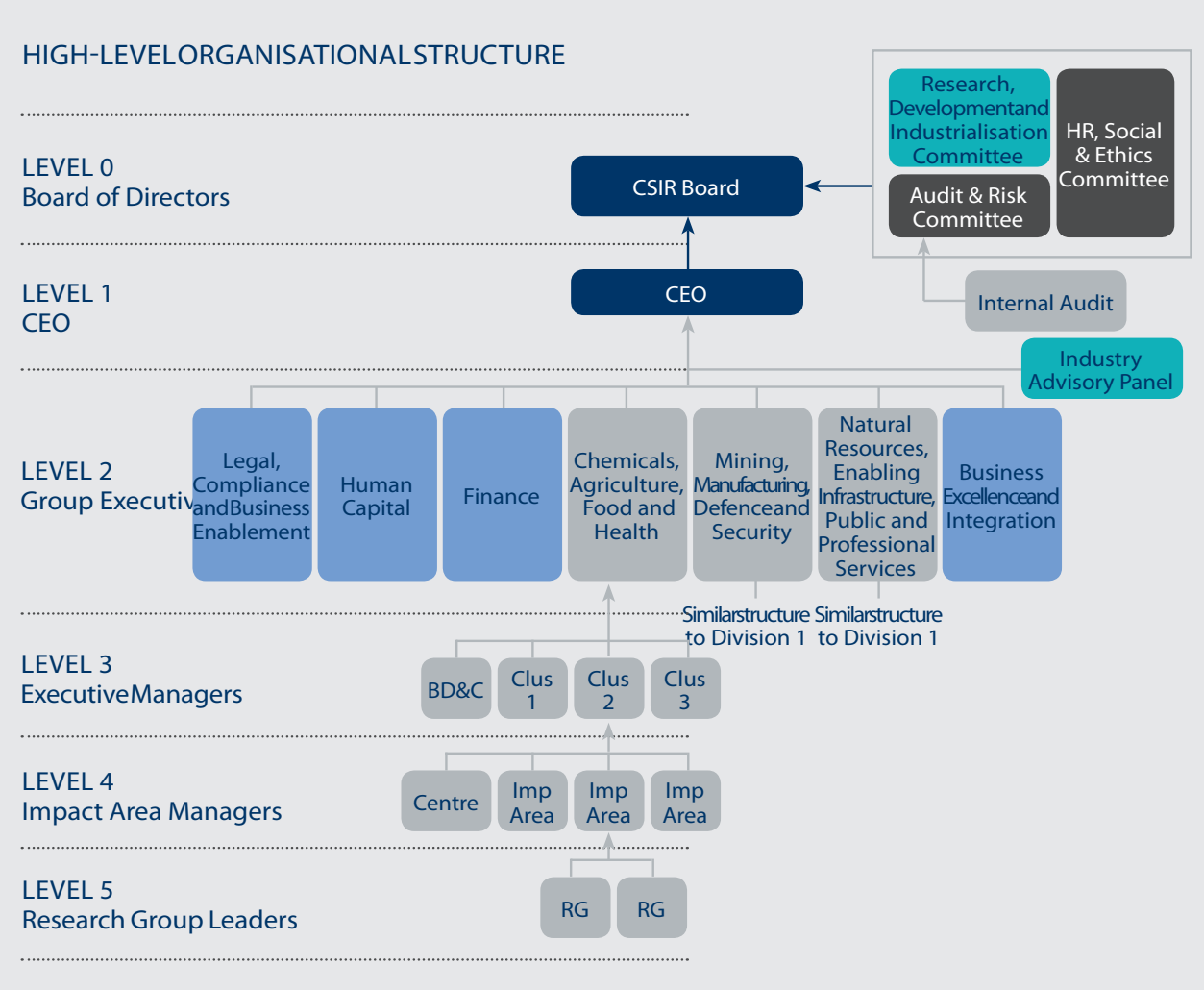


Figure A.8: CSIR Operating model

A.3 Strategic Objectives

SO1: Conduct research, development and innovation of transformative technologies and accelerate their diffusion.

SO2: Improve the competitiveness of high-impact industries to support South Africa's re-industrialisation by collaboratively developing, localising and implementing technology.

SO3: Drive socioeconomic transformation through RD&I that supports the development of a capable state.

SO4: Build and transform human capital and infrastructure.

SO5: Diversify income, and maintain financial sustainability and good governance.

A.3.1 SO1: CONDUCT RESEARCH, DEVELOPMENT AND INNOVATION OF TRANSFORMATIVE TECHNOLOGIES AND ACCELERATE THEIR DIFFUSION

The convergence and pace of new technologies are fundamentally disrupting industries and require synchronised RD&I efforts, in order to achieve maximum benefits. Thus, this strategic objective entails conducting research, development and innovation, as well localising transformative technologies and accelerating their diffusion into South Africa's high-impact industries. This strategic objective is achieved through various programmes as described below.

A.3.1.1 STRATEGIC PROGRAMMES

Under the **mining (development and) operations programme**, the CSIR will focus on the development of processes ensuring efficiency so that mines can maximise the recovery of the mineral wealth in a safe and sustainable manner. It will focus on the longevity of current mines (LoCM), mechanised drill and blast, non-explosive rock breaking and advanced orebody knowledge (AOK) and real-time information management systems. The CSIR will build on current programmes on geophysics and rock engineering, mining engineering, sensor development, and robotics and automation.

In the **post-mining landscapes** programme, the CSIR will aim to facilitate effective closures and the rehabilitation of mining sites to minimise environmental impact. The CSIR also agreed to establish the **Impact Catalyst initiative** backbone at the CSIR. This is a socioeconomic development initiative in partnership with Anglo American, Exxaro and Word Vision, with a focus on mining communities in the different provinces. The initiative will be piloted in Limpopo, in conjunction with the Premiers Office (aligned with SO3).

Precision agriculture that integrates advanced digital spatial technologies, such as earth observation (EO, satellite, aircraft, drone), GPS, field sensors, spatial modelling, to map soil fertility and plant growth variability is widely seen as a solution to the farmers' key production challenges. This information is integral to decision-support systems to optimise the use of inputs, enhance yield and product quality and, at the same time, reduce farming impact on

A.3.1 SO1: CONDUCT RESEARCH, DEVELOPMENT AND INNOVATION OF TRANSFORMATIVE TECHNOLOGIES AND ACCELERATE THEIR DIFFUSION (continued)

the environment. The platform will look to employ EO technologies and collaborate with stakeholders like the ARC in providing farmers with technological services that enhance productivity using algorithms and geospatial data sources relevant to the African context. Besides the human capital requirement to expand the team, investment is required for equipment and infrastructure (e.g. drones).

The **agro-processing platform** will apply innovative technologies to create a dynamic African agro-processing industry with access to forward-looking emerging agro-processing technologies. The CSIR's interventions include:

- The application of the CSIR's processing capabilities in the cannabis industry, where the CSIR's focus is on developing high-quality oil extraction technologies and product formulation;
- Technology scouting for localisation; integration of existing agroprocessing activities with modern bioprocessing and biorefinery technologies, as well as modern digital technologies; and
- Valorising South Africa's indigenous biodiversity in a manner that promotes inclusive development, particularly in rural communities.

Advanced Functional Materials (AFM): The AFM group will conduct cutting-edge, high-quality research development and innovation in the (drug) delivery systems, and functional polymers. Additionally, **Advanced Polymer Composites** continue to conduct RD&I on three technology focus areas, such as polymer nanocomposites, bioplastics and biocomposites, and polymer blends and alloys to address market needs for higher performance, smart/intelligent, light materials and sustainable resource utilisation.

The **advanced manufacturing platform** will bring together all the 4IR technologies related to manufacturing industries for best practice sharing and benchmarking across industry sectors/clusters. Interventions include the implementation of a learning factory equipped with smart machines (smart manufacturing). The primary focus is on assisting the South African industry to understand the impact of the end-to-end digitalisation of manufacturing processes and advanced manufacturing techniques, such as additive manufacturing, using advanced materials as part of the future of production. This includes the implementation of PLM processes and software (digital thread and digital twin). The platform will also enable direct industry interaction with the possibility of manufacturing small quantities of products, addressing the development of advanced sensors for 4IR applications, targeting localisation initiatives in support of the electrotechnical sector. In the mode of strategic partner to Armscor and the SA Navy, it will address the SANDF need for localised wet-end sonar solutions. A key element of the advanced manufacturing platform will be the learning factory for human capital development (aligned to SO4). A planned intervention will be the establishment of a manufacturing industry development centre to assist SMMEs and manufacturing start-ups.

The **medical devices and diagnostics platform** will support the establishment of a thriving local medical devices and diagnostic industry and position South Africa as a key exporter of these technologies. Early detection for many communicable and non-communicable diseases is a major priority in the diagnostics and screening sectors. For many diseases, such as cancers, cardiovascular diseases and other infectious diseases, early diagnosis could lead

A.3.1 SO1:CONDUCTRESEARCH,DEVELOPMENTANDINNOVATIONOFTRANSFORMATIVE TECHNOLOGIES AND ACCELERATE THEIR DIFFUSION (continued)

to treatment and advice on lifestyle changes and early diseases management that offer the potential to improve the quality of life. The CSIR will focus predominantly on synergistic molecular and integrated diagnostics that are designed to meet the ASSURED1 needs of the developing world, mobile health care coordination and new payment systems. Interventions in this area include:

- The implementation of PLM and advanced development of multiplex PoC diagnostics for human and veterinary applications.
- Facilitating and accelerating the commercialisation of medical devices and diagnostics through the provision of advanced materials for both human and animal health applications, product testing infrastructure, incubation, in-house medical device development and support to entrepreneurs for medical device development according to ISO 13485 regulations.
- Making a concerted effort to apply digitisation tools that will support that private sector primarily as the need for data management systems that organise and integrate test results and make them available to physicians and medical records personnel are required by the private sector. These engagements have already been initiated with hospital groups and medical device companies in partnership with CSIR Future Production: Manufacturing.

The **precision medicine platform** develops innovative technology platforms and African-specific testing to reduce development time, save investment costs and lower barriers to market entry. It will focus on precision medicine, companion diagnostics and stem cell technology to discover protein-biomarker treatments, predict adverse drug reactions, develop novel models of disease and investigate nanotechnology for targeted drug delivery and precision treatments. The platform will leverage on the digitisation platform in CSIR NextGen Enterprises and Institutions to establish a strategic initiative of digital precision medicine with the aim being to support the growing area of pharmacovigilance to increase South Africa's capacity to identify drugs that have unreported adverse side effects.

The **pharmaceutical technology innovation platform** aims to differentiate the South African pharmaceutical industry to offer an internationally competitive production advantage through the inclusion of cutting-edge integrated continuous flow chemical and biopharmaceutical production. By linking emerging and disruptive production technologies, the remote control of production processes and the application of big data analytics, simulation and machine learning, the CSIR will be able to transcend traditional batch manufacturing to offer remote-controlled self-optimising continuous pharmaceutical production. The additional inclusion of green strategies for process automation, waste reduction and energy efficiency will revolutionise the pharmaceutical sector in the long term, facilitating increased local API production from the current 2.3% to 5% and increasing exports of APIs into the SADC region to realise economies of scale.

Food safety aims to position itself as the go-to authority of food safety technologies, while playing a key role is supporting a capable state by bringing coherence to how current institutions work in this space. Specifically, the group will develop unique food safety testing technologies that find utility in food fraud, rapid surveillance testing

A.3.1 SO1:CONDUCTRESEARCH,DEVELOPMENTANDINNOVATIONOFTRANSFORMATIVE TECHNOLOGIES AND ACCELERATE THEIR DIFFUSION (continued)

on site for pathogens, employ nanotechnology in developing smart packaging and labelling of products, early spoilage detection sensors and traceability systems of foods from farm gate to plate.

The **robotics, machine learning and future production systems platform** is an emerging initiative that will use the advanced manufacturing platform as a basis for the development of capabilities for the future of production across all industry sectors. The key will be understanding the impact of 4IR technologies, such as AI robotics, in the production environment, which includes the mining, medical devices and transport sectors, for example. This includes research and development of smart machines for manufacturing and production.

This initiative will leverage the existing CSIR capabilities in robotics, advanced machine design, mechatronics and machine learning to focus on the following future themes:

- Human-centred automation – use of robotics, AI and machine learning to automate and digitise processes; and
- Human enhancement technologies – use of wearables, augmented reality and robotics to enhance human capabilities.

This intervention will further focus on the establishment of a machine learning platform for future production, which will be used to accelerate the development of expert and decision-support systems for manufacturers, and will be linked to the PLM software focusing on plant simulations, in order to optimise the current production systems.

A.3.1.2 RING-FENCED DSI INITIATIVES

A.3.1.2.1 Implementing the national ICT Roadmap

The ring-fenced PG is used across a number of focus areas and ICT RD&I interventions in the CSIR. The investment is aligned with the ICT RD&I Roadmap and is utilised to ensure the CSIR's contribution to RD&I that brings the country closer to the goals of the ICT RD&I Roadmap. The capabilities responsible for the delivery of these activities have been realigned in the new strategy for greater efficiency. Programmes supported through ICT Roadmap include (section A3.3.1):

- The CSIR cybersecurity capability;
- Projects in *eGovernment, eHealth* and *Oceans and Coasts Monitoring*;
- Digitilisation of industry; and
- ICT sector growth and transformation.

The Office of Digital Advantage, established to oversee the implementation of the ICT Roadmap, has redefined its strategic objectives for the remainder of the ICT Roadmap period (up to 2023). Primarily, they will focus on guiding the allocation of funds to ensure alignment and delivery on the ICT Roadmap, but will also increasingly look at the inclusion of and recommending investment in emerging areas such as the 4IR and the national AI Strategy. (See Section B3.3.1 for specific objectives).

A.3.1 SO1: SO1 CONDUCT RESEARCH, DEVELOPMENT AND INNOVATION OF TRANSFORMATIVE TECHNOLOGIES AND ACCELERATE THEIR DIFFUSION (continued)

A.3.1.2.2 Photonics Centre

Under the new CSIR Strategy and operational structure, the NLC will be called the Photonics Centre, hosted within CSIR Future Production: Manufacturing. The aim of the Photonics Centre is to develop and more specifically apply novel laser applications for improved competitiveness across a number of sectors. Its SOs include:

- **Additive manufacturing** – develop and transfer novel technologies to advance the competitiveness of the South African manufacturing industry through efficient final part production and superior manufacturing system performance.
- **Laser surface engineering –** develop and transfer manufacturing processes to reduce operational costs and improve efficiencies for the manufacturing, transport and power-generation industries through the improvement of material properties of structural or functional equipment, or the material processing of raw material or production components in industrial processes.
- **Enterprise creation and development –** the PPF provides the necessary infrastructure, skills and expertise for the prototyping and product development of photonics technologies, which will lead to competitive offerings being available for transfer to established industry and new or emerging SMMEs.
- The **Rental Pool and ALC programmes** are principally directed programmes that seek to train a corps of top laser researchers with postgraduate qualifications as key drivers. These programmes directly support South Africa's international research and innovation competitiveness, while responding to the country's social and economic challenges. It does this by providing cutting-edge laser equipment and diagnostics to HEIs, supporting the operational and maintenance aspect of the equipment, as well as providing mobility support for South African researchers to collaborate with counterparts from the African continent.
- Construction of **laser-based rapid PoC diagnostics** for HIV/TB, as well as substandard drug screening devices.

A.3.2 SO2: IMPROVE THE COMPETITIVENESS OF HIGH-IMPACT INDUSTRIES TO SUPPORT SOUTH AFRICA'S RE-INDUSTRIALISATION BY COLLABORATIVELY DEVELOPING, LOCALISING AND IMPLEMENTING TECHNOLOGY

South Africa has undergone de-industrialisation over the last decade. This strategic objective seeks to improve the competitiveness of South Africa's high-impact industries through conducting RD&I with partners, in a collaborative manner, thereby contributing to the re-industrialisation of the country. The CSIR has identified various RD&I programmes where collaboration with industry partners will be the driver for achieving the desired impact:

A.3.2 SO2: IMPROVE THE COMPETITIVENESS OF HIGH-IMPACT INDUSTRIES TO SUPPORT SOUTH AFRICA'S RE-INDUSTRIALISATION BY COLLABORATIVELY DEVELOPING, LOCALISING AND IMPLEMENTING TECHNOLOGY (continued)

A.3.2.1 STRATEGIC PROGRAMMES

The **biochemical conversions** platform applies disruptive and innovative (bio)chemical conversion technology to create a dynamic African chemical industry with access to forward-looking and modern digitised and greener production processes. Environmental concerns are driving a global shift towards the use of sustainable and renewable resources for the manufacture of chemicals and fuel. Use of these feedstocks and the implementation of environmentally friendly (bio)chemical processes provides the opportunity to decouple industrial growth from environmental degradation through more sustainable production methods – reduced water and energy consumption, reduced emission of greenhouse gases and reduced generation of toxic waste are all benefits offered by the adoption of these technologies. In addition to these global trends, in South Africa we also find industries such as the sugar and paper and pulp industries under tremendous pressure to survive, because of declining local and international markets for the limited range of products that they currently produce. Thus, there is scope in this area to develop high-value chemicals and materials through combined bio- and chemical conversions of biomass to generate high-value chemical products and material substrates. There is also scope for the development of novel and high-value materials from waste to drive the implementation of a circular economy. Computation, data analytics and digital technologies in synthetic biology (computational enzyme and microorganism design) will be adopted to develop unique capabilities in support of modern product development.

The **biopharmaceuticals platform** focuses on the development and production of biological reagents, antibodies and peptides with improved specificity and activity compared to existing chemical products and the development of novel bioprocesses to allow the production of these bio-based solutions according to GMP guidelines. The aim is to develop manufacturing process for biopharmaceuticals to enhance the competitiveness of local industries. Biological substances have become increasingly important in the manufacture of pharmaceuticals and the modern delivery of disease therapy and prevention. These biologics (or biopharmaceuticals) are revolutionising health care and, today, they comprise about 50% of the best-selling medicines globally.

The **advanced materials and engineering platform** focuses on raw material beneficiation, especially titanium, aluminium, steel and platinum group metals; import replacement of specialty metals and alloys, advanced polymers, plastics and next-generation composites and fibres; the testing and qualification capability for new materials; and nurturing end-to-end value chains working collaboratively with the end users. It innovates across the materials value chain, exploiting Industry 4.0 technologies, as well as develop novel advanced materials to provide the local industry with a globally competitive edge. For this platform, the CSIR develops metal alloys and composites; formulates advanced polymers, as well as next-generation composites, fibres and alloys. Existing interventions that are being leveraged include the Titanium Centre of Competence and the South African Aluminium Industry Roadmap work done with respect to lightweight and titanium alloys, polymers, nanocomposite thermoplastics; and nano-, natural fibre-, and metal-matrix composites.

A.3.2 SO2: IMPROVE THE COMPETITIVENESS OF HIGH-IMPACT INDUSTRIES TO SUPPORT SOUTH AFRICA'S RE-INDUSTRIALISATION BY COLLABORATIVELY DEVELOPING, LOCALISING AND IMPLEMENTING TECHNOLOGY (continued)

The **defence platform** will commercialise technologies to ensure industry competitiveness and develop integrated security solutions. Joint product systems development with SADI will be central to the business strategy, in order to increase industry competitiveness. Further developments focus on integrated, large-scale intelligence, surveillance and reconnaissance platforms; technology solutions that are interoperable, prioritising collaborative designing, advanced manufacturing, and defence industry supply chain developments; and complete OEM solutions focusing on the middle tier for the short to medium term. This effort builds on the current SANDF operations and other strategic capabilities, including weapons integration, propulsion systems and aerodynamic testing.

Smart Logistics Management was identified through the Synapse Strategy for its growth potential in support of industrial development. The intention is for this area to be industry facing, and become South Africa's reference institution for the explicit econometric modelling of the relationship between logistics performance and the different sectors of the economy, including agriculture, manufacturing, mining, trade and finance. The area will advise on appropriate technology adoption and adaptation strategies for the logistics value chain.

A.3.3 SO3: DRIVE SOCIOECONOMIC TRANSFORMATION THROUGH RD&I THAT SUPPORTS THE DEVELOPMENT OF A CAPABLE STATE

Economic and social development in South Africa has been constrained by the challenges of inequality, unemployment and poverty. The CSIR aims to play a pivotal role in the socioeconomic transformation of South Africa through RD&I and contribute to supporting the development of a capable state and enabling government to drive the socioeconomic transformation of South Africa through RD&I.

A.3.3.1 STRATEGIC PROGRAMMES

The **health information systems and digitisation platform** applies interoperable health information systems for continuity of care and patient-centric health care delivery, supporting the implementation of the NHI. The CSIR's strategic intervention includes a health normative standards framework and shared national ICT infrastructure, with additional focus on data mining using digital and cognitive technologies to produce insights and trends for health system planning. The CSIR's strategic intervention, led by CSIR NextGen Enterprises and Institutions will ensure:

- An appropriate and up-to-date standards framework for eHealth systems;
- Provision of technical guidance for the implementation of standards;
- The establishment of national certification of standards' compliance;
- The establishment of national shared ICT infrastructure for health data exchange; and
- Appropriate tools to support the implementation of the NHI.

A.3.3 SO3: DRIVE SOCIOECONOMIC TRANSFORMATION THROUGH RD&I THAT SUPPORTS THE DEVELOPMENT OF A CAPABLE STATE (continued)

The intervention will allow the development of a capable state by enabling efficient health care system and formulation of policies that guide health care provision and in the current context, the NHI.

Complementing this initiative in supporting a capable state in health, is CSIR NextGen Health's medical devices and diagnostics platform detailed under S01, which also contributes to the provision of primary level health care screening solutions, something that is a key element of the national DoH strategy going forward.

Under the new CSIR Strategy, we aim to develop or strengthen a number of digital technologies platforms, which support the digitisation and digital enhancement of public services. These include the **digital systems platform**, **data platform** and the **analytics platform**. Through these platforms, we aim to:

- Develop standards, policies, technique generation, strategies and frameworks through applied data science and mathematical modelling for government to better deliver services and create avenues for public service innovation.
- Analyse information for planning, resourcing, tracking, monitoring, and evaluating broader and complex programmes or initiatives at an integrated level to enable planning and monitoring for both government and industry.
- Develop advanced models, methodologies and techniques for applications in areas such as the deployment of wireless networks, advisory role of spectrum issues, water and energy supply and demand forecasting, law enforcement, national mobile network coverage, etc.
- Support government departments in their respective modernisation programmes, including the implementation of the technologies for the digitalisation of parts of their services.
- Provide operational support in areas that do not have facilities or computing infrastructure for fail-over during downtime; support projects such as HANIS (Home Affairs), DoH and the Water Research Commission. Fail-over service for South African Weather Services, assisting SITA in areas where HPC skills are required.

The CSIR **cybersecurity capability** provides cutting-edge research and development to address information and cybersecurity threats and vulnerabilities across diverse domains in South Africa. This include, among others, sovereign technology innovations that enhance systems and applications security, data security, network security, mobile security, digital forensics, cybercrime analysis, next-generation identity authentication approaches and systems and cyberphysical critical infrastructure. These capabilities are built in collaboration with government, private sector, institutions of higher learning and international partners for advancement of national security imperatives in the cyber space.

A.3.3 SO3: DRIVE SOCIOECONOMIC TRANSFORMATION THROUGH RD&I THAT SUPPORTS THE DEVELOPMENT OF A CAPABLE STATE (continued)

The **civil security platform** offers command and control capabilities for crowd management; sensor systems for homes, businesses and critical infrastructure that will enable authorities to identify and react quicker to criminal activities; integrated security solutions for infrastructure security; and security solutions for the cash-in-transit industry. An integrated security solutions platform will link various security agencies and Justice, Crime Prevention and Security cluster departments, so that they can collaborate and share information on security-related incidences. These interventions are built on the numerous security cluster capabilities and decision-support tools.

The Smart Transport Network programme will be inclusive of Logistics Supply Chain Engineering, Network Nerve Design and Systems, Digital Transport Networks and Smart (Intelligent) ports (including rail freight) and Smart Roads. The focus will be on the interconnectedness of the individual components through a systems functional approach in order to optimise the national transport system (both passenger and freight transport). The concept of digitisation is to be used to integrate apparent separate issues into a high-level value add offering.

Interventions from **CSIR Smart Places** support prudent resource use through trade-off modelling, ensuring connectivity between resources, enabling industries that have a large economic impact and reach (e.g. health, education, transport, ICT, electricity), and ensuring productivity and growth across multiple industries. The areas of focus include the following:

- The resource programme will include resource efficiency and cleaner production for sustainable industrialisation and trade-off modelling services to industry and policymakers and driving concepts of the circular economy, as well as relevant programmes for decision support, notably climate change and adaptation and urban decision support.
- The (hard and soft) infrastructure programme include capacitating all spheres of government to fix and improve all aspects relating to 'smart places'; enabling smarter connected resources and infrastructures and revolutionising the way of doing business and delivering services through, for example, new business models eco-industrialisation and flatter organisational structures. Current relevant programmes related to smart infrastructure include smart spatial (earth observation and IT systems), as well as advanced materials and processes. Relevant municipal programmes include SET solutions for infrastructure delivery, as well as capacity and capability-driven local economic development within the revitalisation of industrial parks.
- The services/utilities programme will create benefit from quality and cost optimisation, real- time support, and innovation to effect a cleaner sustainable environment and automation, including smart grid solutions and systems and renewable energy technologies. The relevant current programmes include water systems, renewable energy, energy system design and operation; and energy technologies.

A.3.3 SO3: DRIVE SOCIOECONOMIC TRANSFORMATION THROUGH RD&I THAT SUPPORTS THE DEVELOPMENT OF A CAPABLE STATE (continued)

A.3.3.2 RING-FENCED DSI INITIATIVES

South African World Economic Forum (WEF) Affiliate Centre for the Fourth Industrial Revolution (C4IR-SA)

In 2020/21, the CSIR will be hosting the C4IR-SA. The CSIR was nominated to host the Centre, after the DSI agreed, on behalf of government and with the support from the Presidency, to establish the C4IR-SA.

In 2019/2020, the then Minster of Science and Technology, signed a country level agreement with the WEF on the establishment of the C4IR-SA. In turn, CSIR, as the hosting institution, signed the Affiliate Collaboration and Licensing Agreements with the WEF. The establishment phase of the Centre commenced in 2019/20 and has entailed: appointing a core team to administer and manage the Centre on a day to day basis, establishing governance structures, securing partnerships, and developing a programme of action.

Hosting the C4IR-SA will position the CSIR to play a supporting role in the implementation of the 4IR country strategy, which is under development through the Presidential Commission on 4IR.

The Centre activities will focus on supporting government and industry on developing and piloting the policies, standards and other regulatory instruments necessary for the implementation of the 4IR technologies prioritised by key stakeholders. The Centre will also be a platform for interaction with relevant public and private sector stakeholders on its initiatives, both locally and internationally. The WEF Affiliate 4IR Centre globally are intended to be public-private partnerships, facilitated by government, but with strong buy-in from relevant private and public sector partners. The C4IR-SA will fast track national development and implementation of enabling 4IR technologies through, among other, access to methodologies, best practice and learning in other regions, globally, that are grappling with many of the same issues around the adoption of new and advancing 4IR technologies for public good and national growth.

In 2020/21, programmes of the C4IR-SA will roll out as per agreed business plan of the Centre.

A.3.4 SO4: BUILD AND TRANSFORM HUMAN CAPITAL AND INFRASTRUCTURE

There are limited capabilities to leverage the opportunity of new technologies impacting all industry sectors and society. This strategic objective seeks to build and transform the required human capital and infrastructure to drive industrialisation and the advancement of society. It emphasises the need for targeted capability development to leverage emerging technologies and capabilities.

A.3.4 SO4: BUILD AND TRANSFORM HUMAN CAPITAL AND INFRASTRUCTURE (continued)

A.3.4.1 BUILD AND TRANSFORM HUMAN CAPITAL STRATEGIC OBJECTIVE

Human capital is one of the key drivers used to assess a country's preparedness to capitalise on emerging technologies and transform industries. By building and strengthening capacity, capabilities and the future readiness of its people, along strengthening other drivers, South Africa can easily be catapulted into a one of the leading countries in terms of its 4IR readiness level, as well as the readiness level of other key emerging technologies.

Externally, the NDP goes into detail about how to drive HCD to positively influence national economic development and it makes several specific recommendations, including:

- Growing the pool of researchers (SET) to improve South Africa's competitiveness and increase innovation and new product development.
- Increasing South Africa's pool of doctoral graduates in SET and mathematics, this will also contribute to increasing the supervisory capacity of the national system of innovation.
- Capacity building through international partnerships and through collaboration between universities and research councils.
- Transforming the demographic composition of researchers by supporting young, female and black researchers.

The HR Development Strategy for South Africa (HRD□SA) 2010 – 2030 also makes key commitments towards the development of key innovation skills. Of importance, is the sixth commitment made in the strategy towards the improvement of the technological and innovation capability and outcomes within the public and private sectors to enhance the country's competitiveness in the global economy and meet its human development priorities.

The HCD and Management Portfolio has adopted four strategic pillars to achieve the CSIR SO4. The four strategic pillars aims to align human capital strategy and operational planning with the CSIR's new strategy, vision, mission and values and create synergy with human capital functions and the strategic leadership role to achieve and implement cultural change initiatives. Looking ahead to 2020/21 and beyond, the four CSIR human capital Strategic pillars that drive the HC delivery excellence to the business are as follows:

Building a diverse talent ecosystem and a sustainable future supply: This recognises the critical role that human capital has in meeting the immediate talent demands of the business post restructuring and responding to Synapse strategic demands in addressing the longer-term talent requirements and sources of supply. This encompasses building and retaining our own talent, as well as implementing the CSIR Talent Sourcing Strategy through LinkedIn to source disciplines now and in the future and better enable the movement of skilled resources across the three divisions. Further embedding diversity and inclusiveness into the 'way we do business' in CSIR will continue to be a key contributor.

A.3.4 SO4: BUILD AND TRANSFORM HUMAN CAPITAL AND INFRASTRUCTURE (continued)

Strengthening Leadership and Deepening Professionalism: This reinforces the commitment to leadership development and deepening professional (SET and non-SET) capability. Leadership capability will be strengthened through the enhancement and rollout of core leadership programmes, a commitment to the development of leaders and high potential staff and succession planning. In addition, the drive to increase behavioural and technical competencies will be delivered through leveraging CILLA Academy supplemented by business, commercial and function specific skills/capability development and increasing the profile of technical professionals.

Improving Individual and Organisational Performance: The emphasis will be on simplifying the organisation to better integrate capability on a CSIR-wide basis and focusing on making the new structures work. This includes support to business critical Synapse strategy.

Increased Efficiency and the Effectiveness of HR Systems and Processes: This is key to the standardisation and simplification of HR processes supported as necessary by IT solutions in response to the 4IR and further implementation of the HC Operating model.

HC is a crucial enabler in the achievement of organisational strategic goals through the attraction, deployment, development, retention and transfer of talent. HC is supporting the wider business in creating the right environment for people to be engaged and productive.

By delivering the strategy, HC will:

- Ensure change management towards a seamless adoption of the new strategy;
- Ensure that the organisation has the appropriate skill sets and capacity to deliver on its new strategy;
- Improve productivity by having people with the right skills to fill roles when needed and have skilled resources available to meet customer demands, as well as the realisation of the organisational strategy;
- Improve performance through an engaged workforce;
- Build our brand and reputation as an employer;
- Improve retention by retaining key knowledge and skills through fewer people leaving voluntarily or reducing the need for redundancies;
- Reduce the time for managers dealing with issues such as discipline and grievances through better quality people management, exemplary leadership and pre-empting and resolving issues before they escalate;
- Reduce overall employment cost through lower reliance on recruitment agencies;
- Reduce recruitment advertising costs through better effective planning for roles and recruitment tools/resources,
- Realise high ROI on training/investment in people; and
- Address the lack of transformation through dedicated and targeted support programmes linked to mentorship and appropriate incentives.

A.3.4 SO4: BUILD AND TRANSFORM HUMAN CAPITAL AND INFRASTRUCTURE (continued)

A.3.4.2 STRATEGIC INFRASTRUCTURE PROGRAMMES

A.3.4.2.1 Overview of Infrastructure renewal and development objectives

To achieve the CSIR's new vision, research and general infrastructure renewal and development are key in scientific discovery and producing solutions for industry and society. Our scientific infrastructure includes laboratories, testing facilities, scientific instruments and equipment, and pilot plants needed for research and technological innovation. Our research and development infrastructure is housed on our campuses in Cape Town, Durban, Johannesburg, Pretoria and Stellenbosch.

In the past, the CSIR has invested significantly in equipment and facilities that support scientific development and it is expected that this trend will continue as new areas of research also continue to evolve with time. The CSIR has, with support from government, embarked on the development of five research and development facilities that provide capability for industrial innovation initiatives, such as prototyping, upscaling, pilot manufacturing and testing, that allow research to be translated into market-ready products. These facilities include the PPF, BIDC, BIDF, NIDF and the Nanomicro Device Manufacturing Facility (NMDMF).

The consequences of the strategic repositioning of the CSIR are that the size and shape of the CSIR will evolve over time. In order for the CSIR to implement its strategy effectively, it requires modern and appropriate facilities and research infrastructure, and an appropriate, safe and secure environment within which to do its work. Therefore, infrastructure renewal and development is one of the organisation's SOs to ensure business continuity and support the research programmes and growth.

As a science council, the CSIR's facilities and infrastructure and its location directly impact the work conducted and the organisation's accessibility to the wider research community. There is a continuous need for the provision of facilities that best serve the needs of the wider research community and enable the achievement of world-class research work, in line with the CSIR Strategy.

In addition to ongoing investments in research equipment and general CSIR facilities, and in order to support the new CSIR Strategy and industry development needs, the CSIR has embarked on significant long-term strategic interventions in support of infrastructure renewal and development – namely, the Campus Master Plan (CMP).

A.3.4.2.2 CSIR strategic long term infrastructure planning framework – The CMP

Given the reduced level of resources available, sharp prioritisation of capital investment is paramount. This requires difficult trade-offs between investment in new infrastructure and maintenance of existing facilities and infrastructure. The CSIR has developed a long-term planning framework - the CMP - to guide it in making thoughtful, well-informed choices about infrastructure development and renewal in the years ahead for delivering on its future R&D needs.

A.3.4 SO4: BUILD AND TRANSFORM HUMAN CAPITAL AND INFRASTRUCTURE (continued)

The framework is rooted in rigorous Capital Investment Planning, projects portfolio management and asset management approach, in order to prioritise capital investment in line with the organisational strategy. The CMP serves as a blueprint that will guide infrastructure development and Capital Investment Plan (CIP) in the next 10 to 20 years, in order to ensure that research infrastructure and the built environment are developed in an integrated manner. The framework provides the CSIR and broader stakeholder community with a planning framework within which the long-term development of infrastructure can be executed.

Objectives of the CMP are to:

- Facilitate a smooth transition from the current to the research campus of the future;
- Enable a knowledge economy and acknowledge the importance of knowledge clusters;
- Support open innovation where outside knowledge is absorbed and a meeting place for talents and best researchers is provided;
- Align campus renewal priorities with current and future RD&I needs and opportunities, and new research areas arising from the new strategy;
- Pursue an overall development approach that integrates campus planning objectives to continue creating and supporting an innovation ecosystem, while fostering fruitful collaborations between the CSIR and industry; and
- Support a high-tech campus and sustainability.

A phased Implementation Plan has been formulated to ensure the successful implementation of the CMP. The Implementation Plan includes a roadmap, which details the different catalytic phases and precincts to be targeted during different phases of implementation. The first phase of the plan, from 2017 to 2022 is focusing on the following strategic infrastructure projects (detailed under Strategic Infrastructure Projects):

- Energy Autonomous Campus (EAC);
- Gateway to Science and Innovation Centre;
- On-site Residential Accommodation;
- Shared Interdisciplinary Research Laboratory; and
- Pilot and Pre-manufacture Facilities.

A five-year CIP translates the CMP vision into the physical needs of the campus, enables the assessment of building conditions, and facilitates the projecting of space needs, based on programmatic requirements and available campus capacity. The five-year CIP details the capital projects recommended for implementation and funding in the short to medium term, and is the basis for the allocation of the annual capital budget and commitments in determining what will be executed in the next financial year.

A.3.4 SO4: BUILD AND TRANSFORM HUMAN CAPITAL AND INFRASTRUCTURE (continued)

The CIP projects are determined and managed as research and development projects, general infrastructure and ICT projects. The CIP research and development projects build increased research and development capability within the CSIR. General infrastructure projects enhance the buildings, systems and sites of the CSIR. The ICT projects maintain and build the CSIR's ICT systems and network.

The CSIR cannot sustain its capital programme on debt or internal funding alone and relies on significant state funding support and successful fundraising for capital projects. Our capital investment will be supported from financing sources such as:

- Limited internal funding to fund the highest prioritised deferred maintenance and facility renewal needs, focusing on those projects with the greatest life safety impact and on preserving and protecting our core buildings and infrastructure;
- Grant funding from the public and the private sectors;
- Public-private partnerships to leverage private sector investment; and
- Debt financing subject to limits imposed through the CSIR Borrowing Plan.

A.3.4.2.3 Strategic Infrastructure Programmes: Ongoing Translational Research Infrastructure

In addition to the planned and development projects under the CMP, the CSIR currently hosts translational infrastructure that contributes to our new strategy and SOs. These strategic facilities include:

The BIDC

The programme supports biomanufacturing opportunities by lowering barriers to market entry, lowering development cost, lowering regulatory hurdles and enabling shorter times to market. Products supported include cosmetics and cosmetic ingredients, nutraceuticals and various industrial biologics produced via microbial fermentation.

The BIDC aims to support the growth of a biomanufacturing sector in South Africa by:

- Building a critical mass of bioprocess and product development skills and infrastructure;
- Making the skills and infrastructure available and accessible to industry, and in particular SMMEs; and
- Creating sustainable jobs in the biomanufacturing sector.

The BIDC has successfully transferred 90 products to market for 31 SMMEs and two companies were established; and four licence agreements have been signed.

A.3.4 SO4: BUILD AND TRANSFORM HUMAN CAPITAL AND INFRASTRUCTURE (continued)

The NIDF

The programme was established to satisfy the following key objectives:

- Enhance industry competitiveness;
- Leverage R&D funding from the private sector; and
- Enhance job creation and to invest in strategic R&D programsme.

This is achieved by providing the South African industry, research institutions and the universities access to flexible facilities that can scale up nano-based innovations to industrial and commercial levels. There have been significant efforts to ensure tangible industry participation. There are strong engagements with industry partners involving the co-development of more than 20 products. A total of R16.1 million has been secured from the private sector, to date.

The BIDF

The objectives of the BIDF are to:

- Establish an R&D facility and infrastructure for testing, evaluating and/or developing biorefinery technologies at a pilot scale level at the CSIR;
- Develop technologies to improve industry competitiveness;
- Develop technologies to produce alternative/new products from underutilised biomass, including waste streams; and
- Address the shortage of science and engineering expertise needed to lead the development of the forest products biomass sector through postgraduate training.

The facility has secured R55 million over three years from the General Budget Support component of the EU-funded NDP support programme to assist SMMEs with the uptake of high-impact biorefinery technologies.

The PPF

The principal function of the PPF is to support the competitiveness of the existing South African photonics industry. Currently, South Africa has a miniscule market share of the lucrative global photonics industry. The contributing factors to this lack of impact are that many photonics-based technologies conceived at science councils and HEIs are not commercialised or prototyped. The aim of the PPF is to address these issues by providing the photonics community with the necessary skills and that will support prototype development and the characterisation of South African-based photonics technologies.

A.3.4 SO4: BUILD AND TRANSFORM HUMAN CAPITAL AND INFRASTRUCTURE (continued)

The NMDMF

Nanomicro manufacturing concerns the combination of nanomaterials, such as functional nanoparticles and polymer nanocomposites with micro-manufacturing technologies, such as fabrication of micro-chips, electronics, micro-channeling of fluids and light emitters, in processes such as printing, embossing and templating. The technology enables the mass production of new types of devices, such as flexible intelligent sensors, diagnostic devices and light emitting sheets. Some research groups are already active in this field in South Africa and the CSIR, but lack facilities to take their technologies to the next technology and manufacturing readiness level. The objective of the NMDMF is to harness and incubate nanoelectronic products that emanate from nanoscientific research, as well as from nano-R&D activities in South Africa and beyond. The facility is the newest in the programme. There has been significant focus on infrastructure development and refining the business and operating models of the facility.

Transport Safety Laboratory

Safe and efficient mobility is a basic right of all South Africans. However, transport safety is a core problem that the South African government battle with year-on-year. In order to promote safe and efficient mobility there is a need for an improved understanding of the factors (human, vehicle and environmental) that contribute to unsafe transport conditions. The Transport Safety Laboratory, a first in South Africa, will have the potential to collect transport data (historic as well as real-time) in support of an improved understanding of the elements that contribute to unsafe transport. Advances within the fields of engineering and computer sciences, the role of image processing and virtual environments for traffic simulations and modelling is not a new subject however in silos, none of the disciplines can successfully resolve transport safety problems. By synthesising efforts in a multidisciplinary manner, it becomes possible to extend experiments by incorporating simulated and real-world situations in support of an improved understanding of transport related risks.

A.3.4.3 RING-FENCED DSI RESEARCH INFRASTRUCTURE/FACILITIES INITIATIVES

A.3.4.3.1 The National Integrated Cyberinfrastructure System (NICIS)

NICIS is a national cyberinfrastructure system that enables, supports, enhances and contributes to the performance of the national science ecosystem as a whole.

NICIS promotes scientific and industrial development through the provision of a high-performance computing capability, high-speed network capacity (SANReN), a national data intensive research infrastructure Data Intensive Research Initiative of South Africa and a HCD pillar integrated horizontally into globally connected systems and hierarchically into a local system providing seamless access to the research and teaching community.

A.3.4 SO4: BUILD AND TRANSFORM HUMAN CAPITAL AND INFRASTRUCTURE (continued)

This integrated cyberinfrastructure enables national socioeconomic development through:

- New forms of scientific and industrial development;
- The solving of previously intractable computational challenges of national importance, by harnessing the Big Data[2] revolution;
- Enabling national and international science and education collaboration through highspeed networking; and
- Supporting South Africa's role and positioning in Grand Science endeavours, such as the Square Kilometre Array (SKA) initiative, large Hadron-Collider, Bio-Informatics, Climate Change and the 4IR.

The key SOs of NICIS are to:

- Sustain a world-class and relevant national integrated cyberinfrastructure system for science and technology;
- Enable and promote eScience in South Africa;
- Position South Africa to take part in, host and lead large-scale global research and science projects (e.g. SKA and CERN experiments);
- Provide thought leadership to South Africa's evolving cyberinfrastructure strategy and activities;
- Facilitate the uptake of advanced cyberinfrastructure;
- Foster the development of human capacity in cyberinfrastructure and its application; and
- Contribute to the transformation of this sector.

A.3.5 SO5: DIVERSIFY INCOME AND MAINTAIN FINANCIAL SUSTAINABILITY AND GOOD GOVERNANCE

South African public sector spend in research and development is constrained, but remains a country focus. RD&I needs are changing and there is increased competition in the RD&I sector. This strategic objective seeks to improve the CSIR's financial sustainability by diversifying revenue sources and optimising the business model to achieve competitiveness supported by good (efficient and sound) governance.

A.3.5.1. DIVERSIFICATION OF INCOME

The CSIR's new strategy is a growth strategy that amplifies the role of the CSIR in industrial development without taking away from the work currently done to support a capable state and public good science. Income diversification remains a key strategic objective and will reduce the financial risk associated with a significant reliance on public sector income. Income diversification is also expected to improve the CSIR's profitability as profit margins are currently between 1% and 2% on public sector income. As part of its reviewed business model, the CSIR has set a

2 Technological, conceptual and methodological capacity to manipulate massive amounts of data is becoming an important driver of techno-economic development, impacting a wide range of economic sectors, including manufacturing, biotechnology and pharmaceutics, and the financial services sector; this development has become known as the "Big Data" revolution.

A.3.5 SO5: DIVERSIFY INCOME AND MAINTAIN FINANCIAL SUSTAINABILITY AND GOOD GOVERNANCE (continued)

target of private sector R&D income to increase from 7% to 33% by 2023 and there will also be a concerted effort to pursue international opportunities especially in the African continent. Commercialisation and technology transfer will also be intensified as part of achieving impact, in line with our strategic intent, but also to grow our royalty and licensing income (refer also to A 2.2.1 on the business model).

A.3.5.2. FINANCIAL SUSTAINABILITY

The CSIR derives its income from contract R&D from public sector, private sector, and international customers; parliamentary grant; and royalties and licensing income. An analysis of its total annual income over the last 5 years showed a CAGR of -0.33%. Clearly, this component of our business model, requires greater effort to ensure income stability, sufficient diversity of income sources and profitability.

The largest portion of the CSIR's income is contract R&D from public sector, followed by the parliamentary grant. It is the intention of the CSIR as part of its new strategy to diversify its income sources by particularly increasing income from private sector, international customers as well as from royalties and licensing.

In recent years, CSIR's share of income from private sector has been increasing, however, the CSIR private sector income remains lower than benchmarks. It is the CSIR aspiration to increase its share of private sector R&D income from 7% to 33% by 2025. During 2020/21, the CSIR will continue to increase its focus on industry and private sector by aligning its offerings to their needs and will also enhance collaborations and co – investment opportunities with this sector of the economy.

Facilitated by the new approach in Parliamentary Grant investment, CSIR will continue in 2020/21 to drive commercialisation of the pipeline technologies in order increase earnings from royalties and licensing. CSIR's income from royalties and licensing is very low compared to benchmark average of 5% of total income.

International income sources especially opportunities in the African continent, will be pursued rigorously. Our objectives in the African continent are to align to our government's goal of supporting the regions development initiatives whilst we will also be pursuing and creating opportunities that advance our new strategy.

Our new operating model has established Business Development and Commercialisation (BD&C) functions in divisions that will, in collaboration with RD&I experts, ensure that:

- There is improved relevance and competitive of the CSIR RD&I offerings;
- There is improved collaboration particularly with private sector;
- Our income grows and is diversified;
- Commercialisation and technology transfer is rigorously driven;
- Customers are satisfied and that there is repeat business; and

A.3.5 SO5: DIVERSIFY INCOME AND MAINTAIN FINANCIAL SUSTAINABILITY AND GOOD GOVERNANCE (continued)

- During 2020/21, this BD&C capability will be strengthened and deepened to achieve the CSIR growth in income and stronger relationships with customers.

A.3.5.3. GOOD GOVERNANCE

At the CSIR, it is part of our mission to pursue the inclusive and sustainable advancement of industry and society. Living up to this pursuit goes far beyond leading innovation and providing unique solutions to address South Africa's challenges. The impact we seek through innovation seeks to improve lives, and, at the CSIR, this translates to the wider responsibility of operating as a responsible corporate citizen. Corporate Social Responsibility is part of our ethos and is entrenched in our value system, and we consider it our obligation to consider the interests of our customers, employees, the communities within which we operate, our shareholder and the environment carefully to ensure that we consider the social and environmental consequences of our business activities. We work with the highest integrity, a compliance culture and respect for human rights, while also improving the impact of our technology. In support of the CSIR's corporate citizenship strategy, critical emphasis will continue to be placed on the following initiatives:

- Enhanced implementation of the compliance function as part of our combined assurance model to more effectively manage risks associated with compliance, business ethics and fraud prevention;
- The enhancement of safety, health and environmental practices through integrated collaboration with all internal and external stakeholders to ensure zero harm;
- The active pursuit of strategies to improve the CSIR's carbon footprint against a trajectory of continuous improvement over time; and
- Contributions to B-BBEE based on the DTIC codes of good practice with specific focus on the critical role that the youth of South Africa has to play in shaping our economy.

Implementation of a compliance function

Elements of compliance were scattered in various operational and support areas without a defined strategy or value proposition. A centrally structured compliance function now forms part of the Legal and Compliance Function and it consolidates the resources associated with:

- Business ethics;
- Privacy law compliance;
- Company secretarial and governance services;
- Trade compliance; and
- B-BBEE.

This will allow compliance outcomes to take a central role and create an opportunity to promote and embed a

A.3.5 SO5: DIVERSIFY INCOME AND MAINTAIN FINANCIAL SUSTAINABILITY AND GOOD GOVERNANCE (continued)

compliance culture within the organisation.

Emphasis is being placed on access to resources that can define the regulatory environment with certainty and translate it into actionable policies, procedures and processes for the benefit of the organisation. The compliance function focuses on:

- Conducting regular assessments;
- Monitoring controls and policies;
- Reporting compliance shortcomings and remedial action to the regulators; and
- Strengthening the CSIR's ability to embed an effective combined assurance model through the apportionment of responsibilities based on the three lines of defence, where the first line typically comprises the business (operational management), the second line the control functions (ERM and the compliance function) and the third line assurance in the form of internal audit.

Maintenance and enhancement of (SHEQ) performance

The CSIR highlighted the need for urgent intervention, in order to improve the state of safety, health and environment on all CSIR campuses. The underlying issues identified include:

- Increased health and safety incidents;
- A changing health and safety risk profile;
- Health and safety practices and management system not institutionalised;
- Lack of appropriate and effective monitoring of performance; and
- Health and safety objectives not well articulated.

In 2018, the CSIR revisited the SHEQ's mandate, vision, mission and SOs. During 2019/20, we focused on understanding the capability requirements to establish a best in class SHEQ functionality that is well-integrated and enabling, and responsive to the risks we face in every level of the organisation. A fit-for-purpose operational model for the SHEQ function has been adopted and is being implemented during 2019/20. During 2020/21, the CSIR will continue to establish and integrate appropriate SHEQ practices into all operations.

The journey to demonstrate that the CSIR cares and commits to zero harm to the CSIR community and the areas in which it operates, is well underway, and will be further matured and developed in response to the SHEQ risk environment.

Strategic interventions focussed on behaviour-based safety and process safety management have been developed

A.3.5 SO5: DIVERSIFY INCOME AND MAINTAIN FINANCIAL SUSTAINABILITY AND GOOD GOVERNANCE (continued)

to reduce and/or manage SHEQ risks, and these are continuously being refined and matured in the pursuit of zero harm.

Measuring and reporting on the CSIR Carbon Emissions

In support of the CSIR's corporate citizenship strategy, the CSIR strives to become carbon neutral and ensure that emissions that are created in business operations are neutralised through the purchase of a carbon offset.

In 2018/19, the CSIR launched an initiative to measure its emissions, align its reporting practices with the National Greenhouse Gas Emission Reporting Regulations that came into effect on 3 April 2017, and ensure that CSIR provides stakeholders with relevant, up-to-date and accurate information on its emissions profile.

The CSIR believes that carbon effectiveness has the potential to offer untold value to the organisation. This was not only because reducing our impact on the environment is the morally correct thing to do, but also because carbon management makes excellent business sense and carbon foot printing can add significantly to the CSIR's bottom line over time and, in turn, enhance its ability to support the development of a capable state. To harness this value, the CSIR will lead by example and continuously seek to deliver innovative technologies in support of our own greenhouse gas emissions target, and those of our stakeholders, as part of our longstanding commitment to environmental stewardship, human rights and a culture of integrity and compliance.

B-BBEE Status

The CSIR continues to strive to recover to a Level 2 B-BBEE status. The organisation will continue to focus on the implementation of its transformation and EE plans, in line with its HCD strategy.

The CSIR will also launch the implementation of a YES programme in acknowledgement of the need to build economic pathways for the youth of South Africa. The CSIR's YES programme will focus on previously disadvantaged youth between the ages 18 and 35, by providing work experience for one year, giving young people a chance to demonstrate their abilities, establish their work ethic and prove their worth.

To complement the focus on transformation and the development of young South African talent, the CSIR will further seek to secure SETA accreditation for its training facilities and provide learnership opportunities that align the development needs of young South Africans with the skills needs of the national system of innovation.

A.3.5.4 RISK MANAGEMENT

A.3.5 SO5: DIVERSIFY INCOME AND MAINTAIN FINANCIAL SUSTAINABILITY AND GOOD GOVERNANCE (continued)

The CSIR's risk management plan is provided in Annexure D. The CSIR takes a broad view of risk management, and the risk management plan addresses risks in the areas of:

- **Research:** Shortage and retention of skilled staff in the market; falsifying and poor research output; increasing competition in the research space in producing disruptive technologies to meet the requirements of 4IR; obsolete research equipment.
- **Business:** Decrease in public sector funding and general local economic downturn and instability associated with low R&D investment appetite; contracting risks; exposure to global market and foreign exchange; regulatory constraints affecting collaborative partnerships in delivery on the CSIR mandate.
- **Operations:** Change management associated with revised strategic direction and operating model; reorganisation of operating areas no longer financially feasible; reorganisation of misaligned support structures; loss of institutional memory; business interruption due to power failures and aging infrastructure; lack of integrated and digitised business systems.
- **Fraud:** Financial misappropriation of assets and inappropriate contracting.
- **Environment, health and safety:** Compliance with relevant regulations; embedded culture that values environmental, health and safety responsibility and accountability.

A consolidated organisational risk register is managed on an ongoing basis to inform the Executive Committee and the Audit and Risk Committee (ARC) of the prevailing risks and how they are managed and mitigated to acceptance levels. Risks are revised through full quarterly reviews conducted in conjunction with the line risk owners.

The organisation's FPP presented in Annexure E is key to the mitigation of risk. In addition, the Materiality Framework (Annexure F) identifies significant risks that need to be addressed through appropriate controls. The major risks that may have significant bearing on the organisation and the execution of its plan, as well as key and high-level controls to mitigate these are monitored on an ongoing basis. In compliance with King IV, the CSIR Board of Directors will receive assurance regarding the effectiveness of the risk management plan based on a combined assurance model.

A.4 Strategic Communications and Partnerships

A.4.1 STRATEGIC COMMUNICATION

The CSIR's new strategy compels it to work more closely with stakeholders, including industry. Communication targeting multiple stakeholders, including the public sector, SOEs, the private sector, not-for-profit, international entities, as well as marketing CSIR capabilities will be enhanced in 2020/21. The CSIR will benefit from brand familiarity among key stakeholders. Achieving the brand recognition, will require the CSIR to 'be out there.' Ultimately, communication and brand promotion efforts should contribute to the CSIR acquiring a bigger share of public sector, SOEs, private sector, and international research and development contracts.

The CSIR will continue to align to key stakeholder interests in seeking technological, innovative and scientific solutions that will impact economic growth, industrialisation and social development in South Africa. To achieve these goals, integrated communication is of strategic importance. Messaging across all platforms should be consistent; alignment between internal and external audience should be seamless; and modern and traditional communication tools and strategies should be fused.

Strategic Communication aims to deliver a coherent and cohesive organisational message and positioning to the multifaceted stakeholders that the organisation serves or engages with.

In fulfilling this function, the strategic communication approach will be guided by national imperatives, such as the Science Engagement Strategy (2015), which seeks to:

- Popularise science, engineering, technology and innovation as attractive, relevant and accessible, in order to enhance scientific literacy and awaken interest in relevant careers;
- Develop a critical public that actively engages and participates in the national discourse of science and technology to the benefit of society;
- Promote science communication that will enhance science engagement in South Africa; and
- Profile South African science and science achievements domestically and internationally, demonstrating their contribution to national development and global science, thereby enhancing their public standing

The new CSIR Strategy, which is underpinned by the CSIR mandate, SOs, vision, mission and values, brings significant opportunities for reviewing how the organisation conducts its business and engages with stakeholders and partners. In 2019/ 20, a CSIR Strategic Communications Strategy was developed to harness these opportunities.

The CSIR is the largest multidisciplinary research institute in South Africa. This compels it to ensure that it does not only achieve its organisational objectives, but that it also showcases its achievements, capabilities and research through various communications platforms that demonstrate the value of investing in science, SETI. Contributing to public understanding of science as outlined in DSI's science engagement strategy is an imperative for the CSIR. The CSIR's capabilities and achievements show accountability on how public resources are utilised and how SETI have positive impact to both industry and society.

A.4.1 STRATEGIC COMMUNICATION (continued)

The year 2020 is a special one for the CSIR as the organisation will be celebrating 75 years of existence. This is a significant milestone that adds to the marketing value proposition conveying that the CSIR has been producing world-class and cutting-edge innovation for 75 years and is still going strong. Also in 2020, the CSIR will be hosting its seventh biennial conference to showcase its research projects.

The World Association of Industrial and Technological Research Organisation (WAITRO) has nominated the CSIR to host its 50th anniversary, which will be in conjunction with its 25 WAITRO General Assembly and 1st WAITRO Global Innovation Summit, during 2020. The CSIR Strategic Communication efforts will be at the forefront of these strategic activities, including introducing and promoting the CSIR's new logo and positioning statement.

A.4.1.1 STRATEGIC COMMUNICATION'S OBJECTIVES

Strategic communication is an important function of the CSIR, both internally and externally. The Strategic Communication Portfolio, together with Business Development and Commercialisation structures in CSIR divisions and clusters, will create campaigns that will lead to positive brand awareness aiming to connect with both internal and external stakeholders. These campaigns will also aim to address the needs of stakeholders and create opportunities for CSIR to grow. Key objectives for the strategic period include:

Raise the profile of the CSIR

In raising the profile of the brand, the overall goal is to increase CSIR brand recognition and foster a favourable organisational reputation. The objective is not to achieve an immediate response; instead a favourable climate is created that will ease the task of business developers when they access the market. Specifically, this means developing and implementing Integrated Marketing and Communication campaigns in support of the organisation's new strategic trajectory and to market CSIR capabilities.

Further, there will be effort to establish a strong media presence to drive positive perception about the organisation. This is a proactive undertaking encompassing the implementation of suitable media strategies and tactics to maximise the CSIR's content-richness for not-paid-for coverage.

Lastly, outreach activities to enhance the brand of the CSIR and promote public understanding of science, especially among the youth, will be part of the drive that contributes to raising the profile of the CSIR.

Create engagement opportunities between the CSIR and its stakeholders

The significant and influential role that stakeholders play in the success of an organisation can never be underestimated. Therefore, it is important for organisations to identify and correctly classify their stakeholders, in order to manage the stakeholder relationships effectively and to enhance the organisation's positive reputation.

In this area, the CSIR plans to host a number of open days targeting different stakeholders in the private and public sectors. The open days serve as marketing tools to showcase the CSIR's infrastructure, its people, skills, technologies, innovations and capabilities.

A.4.1 STRATEGIC COMMUNICATION (continued)

There are a number of activities planned under the CSIR@75 theme, including the CSIR Conference, launch of CSIR@75 coffee table book, CSIR Excellence Awards and participating at relevant trade fairs and exhibitions. The CSIR's body of work will also be specifically exhibited and profiled at WAITRO's 1st Global Innovation Summit, the Innovation Bridge and the Science Forum 2020.

Additional plans include identifying partnership, membership and sponsorship opportunities with suitable organisations to increase the participation of the CSIR in initiatives aimed at promoting business and increasing investment in South Africa

Build and strengthen the employee-brand relationship

The CSIR has gone through some changes internally with the introduction of a new strategy, new business model and new operating structure. Internal communication will continue to improve on communicating issues around the change management plan, to assist the organisation's (employees) smooth transition into a renewed CSIR.

There will be profiling of positive developments within the organisation, especially those linked to the new strategy, as a way of improving staff morale and instilling a sense of organisational pride.

There will also be communication and raising the awareness of the new brand (new logo and positioning statement) to staff through workshops, so that they fully understand the rationale behind the new look.

The internal communication programme will support the embedding of the CSIR mandate, vision, mission and values within the organisation by producing content and campaigns to assist employees in understanding how these factors fit into their day-to-day work.

A.4.2. STRATEGIC PARTNERSHIPS

The CSIR identifies, develops and manages its strategic partnerships as an integral part of its business model (refer also to A.2.21). The CSIR sees business value in having healthy strategic partnerships and stakeholder relations that enable the organisation to enhance and realise its vision of accelerating socioeconomic prosperity in South Africa through leading innovation.

The CSIR through strategic partnerships, aims to:

- Achieve the intentions of its mandate, which encourages collaboration with other parties in the public and private sectors;
- Achieve it mission, which seeks to **"collaboratively innovating and localising technologies while providing knowledge solutions for the inclusive and sustainable advancement of industry and society"**, as well as its strategic objectives;
- Leverage and pool capabilities and resources for mutual benefit of parties involved; and
- Build and maintain healthy relationships across sectors.

A.4.1 STRATEGIC COMMUNICATION (continued)

In 2019/20, the Strategic Partnership function of the CSIR, in collaboration with divisions and clusters, commenced with the renewed approach to strategic partnerships in line with the new CSIR Strategy. Relationships were initiated and renewed with private sector parties, public sector, higher education institutions, RTOs, not–for–profit organisations, venture capitalists, higher education entities, development finance institutions, state owned enterprises and international parties. Several of these relationships were formalised through Memoranda of Understanding/ Agreement (MoUs and MoAs).

Our Parliament liaison office has also been reinforced in 2019/20, and remains part of the new CSIR Operating Model. Parliament is the single biggest source of income for the CSIR and, as such, is a prioritised stakeholder. The strategic intent for development, management and maintenance of parliamentary relationships is to communicate the indirect return on investment (ROI) in the CSIR.

It is critical that the CSIR, together with the DSI, engages National Treasury to re-position CSIR in the context of the Public Finance Management Act (PFMA) and similar national legislation. The CSIR, through its mandate, was constituted to perform research for the Republic in the interest of public good, yet these current policies hinder the engagement and contacting process between public entities and the CSIR.

It is the intention of the CSIR that in 2020/21, a Strategic Partnerships Framework and supporting policies will be in place. The CSIR will also build and implement a representative portfolio of partnerships aligned to the CSIR RD&I focus areas and will cover all sectors especially the private sector portfolio.

During 2020/21, the CSIR will collaborate internally and with the DSI International Relations portfolio and the Department of International Relations and Cooperation (DIRCO), to develop and implement the CSIR International Cooperation Framework as well as the Africa Cooperation Framework. Through the development and implementation of these frameworks, the CSIR will thus be also aligning to the MTSF 2019 to 2024, in respect of priority seven i.e. a better Africa and the World in particular.

A.5 Monitoring and Evaluation

A.5.1 CSIR MEASUREMENT FRAMEWORK

Our measurement framework seeks to monitor our short-term progress towards meeting our SOs, as well as assessing whether the long-term substance of these aims is being achieved. The two components of our measurement framework are:

- A set of annual performance indicators across the five SOs (See A.6). These form part of our Annual Performance Plan and we will, on a quarterly basis, report on progress towards meeting these targets. In addition to setting targets for the upcoming financial year, we also set five-year targets for these indicators.
- A set of longer-term measures that focus more clearly on the outcomes and, potentially, the impacts of our efforts across the five strategic focus areas. The data required to support these measures may be collected on an irregular or ad hoc basic.

Impact planning, monitoring, evaluation and learning lead to a number of tangible deliverables, and these will be recorded in the annual plans. Deliverables include the tracking of R&D outcomes, the planning of interim outcome and longer-term impact assessments, delivery systems modelled and analysed for bottlenecks and leverage points, new solutions and transfer of knowledge (new offerings to be developed), and plans for improving divisions and clusters' capability to increase RD&I outcomes and impact.

In this financial year (2020/21), the CSIR will also implement a planning and impact framework to assess the impact of our activities more comprehensively. Some of the main processes across the CSIR in support of impact assessment include monitoring and evaluation planning, the evaluation of outcomes and impact, as well as reporting and communicating the results of monitoring and evaluation.

A.5.2 KPI TARGETS

Indicator	Target 2019/20	Forecast 2019/20	Target 2020/21	Target 2021/22	Target 2022/23	Target 2023/24	Target 2024/25
SO 1: Conduct research, development and innovation of transformative technologies and accelerate their diffusion							
KPI 1: Publication equivalents	420	420	390	414	444	463	494
KPI 2 New priority patent applications filed	5	6	5	5	6	6	6
KPI 3: New patents granted	13	18	15	15	16	18	19
KPI 4: New technology demonstrators	66	39	57	63	69	76	83
KPI 5: Number of technology licence agreements signed	24	16	26	29	31	35	38
SO2: Improve the competitiveness of high-impact industries to support South Africa's re-industrialisation through collaboratively developing, localising and implementing technology.							
KPI 6: Number of localised technologies	12	9	13	13	14	16	17
KPI 7: Number of joint technology agreements being implemented for industry	39	22	31	34	38	41	45
KPI 8: Number of SMMEs supported	92	153	118	130	143	157	173
SO3: Drive socioeconomic transformation through RD&I that supports the development of a capable state							
KPI 9: Number of reports contributing to national policy development	24	15	19	20	21	22	23
KPI 10: Number of standards delivered or contributed in support of the state	16	8	11	12	12	13	13
KPI 11: Number of projects implemented to increase the capability of the state	54	45	35	37	39	41	43
SO 4: Build and transform human capital and infrastructure							
KPI 12: Total SET staff	1 619	1321	1410	1481	1555	1632	1714
KPI 13: Percentage of SET staff who are black	61,50%	63%	62%	63%	63%	64%	64%
KPI 14: Percentage of SET staff who are female	35,70%	37%	37%	39%	41%	42%	42%
KPI 15: Percentage of SET staff with PhDs	18,60%	21%	22%	25%	26%	28%	30%
KPI 16: Total Chief Researchers	10	12	15	17	20	22	25
KPI 17: Percentage of chief researchers who are black	30%	8%	20%	24%	30%	32%	36%

A.5.2 KPI TARGETS

Indicator	Target 2019/20	Forecast 2019/20	Target 2020/21	Target 2021/22	Target 2022/23	Target 2023/24	Target 2024/25
SO 4: Build and transform human capital and infrastructure (cont.)							
KPI 18: Percentage of chief researchers who are female	20%	15%	20%	24%	25%	27%	32%
KPI 19: Total Principal Researchers	194	165	184	192	202	212	223
KPI 20: Percentage of principal researchers who are black	30,40%	37%	37%	38%	40%	43%	46%
KPI 21: Percentage of principal researchers who are female	16,50%	19%	20%	22%	23%	24%	26%
KPI 22: Number of exchange programmes with industry	8	8	13	15	17	20	23
KPI 23: PPE investment (Rm)*	95	95	105	118	132	148	165
SO 5: Diversify income and maintain financial sustainability and good governance							
KPI 24: Total income (Rm)	2859	2694	2991	3170	3365	3580	3817
KPI 25: Net profit (% Total Income)	0,4	-10	0	8,17	15,05	17,90	22,90
KPI 26: SA public sector income (% Total Income)	55%	55%	55%	55%	53%	46%	38%
KPI 27: SA private sector income (% Total Income)	8%	7%	10%	10%	11%	17%	24%
KPI 28: International contract income (% Total Income)	8%	7%	6%	7%	9%	10%	12%
KPI 29: B-BBEE rating*	3	4	3	2	2	2	2
KPI 30: RIR*	2	2	2,0	1,8	1,6	1,4	1,2
KPI 31: Audit opinion	Unqualified audit opinion	Unqualified audit opinion	Unqualified audit opinion	Unqualified audit opinion	Unqualified audit opinion	Unqualified audit opinion	Unqualified audit opinion

A.5.3 KPI DESCRIPTIONS

KPIs provide an understanding of performance in terms of inputs, outputs, efficiencies, and, to some extent, provide lead indicators of the outcomes and impact that are required for the CSIR to fulfill its mandate. The question of whether or not the CSIR is meeting its SOs related to achieving outcomes and impact cannot be resolved by KPI assessment alone, and requires a process of programme evaluation as described in the National Evaluation Policy Framework. The SOs provided in the CSIR Strategic Plan make specific statements on planned outcomes that will serve as the basis for future evaluation of performance in this regard.

The CSIR KPIs provide a basket of measures that reflect various aspects of the organisation's performance. The targets that are set reflect, in the context of limited resources, a strategic choice about the areas in which greatest impact can be achieved.

KPI 1: PUBLICATION EQUIVALENTS

Indicator Title	Publication Equivalents
Definition	Publication equivalents consist of peer-reviewed journal articles, peer-reviewed conference papers, peer-reviewed book chapters and books.
Purpose	Research publications are a measure of the CSIR's research quality, capabilities and outputs. The impact of the quantity and quality of peer-reviewed research publications is a contribution to the scientific knowledge base.
Performance assessment	The CSIR considers a performance above 95% of the target as acceptable. Performance in excess of the target is a positive result. Publication equivalents are part of a portfolio of scientific and technological outputs. The *CSIR guideline for the allocation of publication equivalents and accreditation of journals* is used as the guideline for evaluation.
Data source	Data is entered into the CSIR TOdB, which provides the information for reporting.
Data responsibility	CSIR Information Services.
Method of calculation	The number of publication equivalents assigned to each type of publication (value in parentheses) is peer-reviewed journal article (1); peer-reviewed conference proceedings (0.5); book chapter (1); book (minimum of 1 and maximum of 10, based on length of book); and editing a book (1). The publications are counted over the calendar year preceding the year in which the financial year ends.
Limitations	Authors submit publications for inclusion in TOdB via WorkFlow. There may be some under-reporting if individual authors do not submit their manuscripts for inclusion. However, there are also measures in place to automatically include publications whose authors are affiliated to the CSIR.
Type of indicator	Output.
Exclusions	Publications not submitted to the TOdB will not be allocated publication equivalents.

A.5.3 KPI DESCRIPTIONS (continued)

KPI 2: NEW PRIORITY PATENT APPLICATIONS FILED

Indicator Title	New Priority Patent Applications Filed
Definition	The first patent application filed for protection of a particular invention with the CSIR named as an applicant/assignee/co-applicant/co-assignee.
Purpose	Priority patent filings serve as a pipeline indicator of patent families.
Performance assessment	The CSIR considers a performance above 75% of the target as acceptable. Performance in excess of the target is a positive result.
Data source	KSS records containing evidentiary supporting documentation (from patent attorneys, patent offices and/or reliable patent databases) offices.
Data responsibility	BEI and divisions (BD&C).
Method of calculation	Number of qualifying records on KSS.
Data Limitations	Steps must be taken to avoid double counting of applications that have been previously filed, but withdrawn and refiled at a later date (despite obtaining a new priority number and priority date).
Type of indicator	Output.
Exclusions	• Any patent application that is not the first application filed in respect of a particular invention, including (without limitation) refilings/conversions/ nationalisations/continuations/divisional,etc. of a previously filed application. • Patent applications for which evidentiary supporting documentation is lacking. • Patent applications that do not name the CSIR as an applicant/assignee/ co-applicant/co-assignee.

A.5.3 KPI DESCRIPTIONS (continued)

KPI 3: NEW PATENTS GRANTED

Indicator Title	Publication Equivalents
Definition	Patents granted by an examining patent authority with the CSIR named as an applicant/assignee/co-applicant/co-assignee.
Purpose	Patents provide a lead indicator of impact through commercialisation. Patents granted in multiple countries reflect the potential market size for and expected value of the technology. Patent prosecution and maintenance are very costly. The decision of whether to patent, where to patent and in how many countries to file applications is driven by the requirements of a carefully considered commercialisation plan in each instance, including factors such as competition, market size and strength of the IP.
Performance assessment	The CSIR considers a performance above 80% of the target as acceptable. Performance in excess of the target is a positive result and patents granted in multiple countries may lead to a result substantially greater than the target.
Data source	KSS records containing evidentiary supporting documentation (from patent attorneys, patent offices and/or reliable patent databases).
Data responsibility	BEI and divisions (BD&C).
Method of calculation	• Number of qualifying records on KSS. • For patents from the same patent family granted in multiple territories, each patent granted by an examining authority is counted individually. • Where a patent is granted by a regional patent authority (e.g. EPO), only the EPO grant is counted, not the national validations in designated countries. • Divisional patents are counted. In cases where notification of a patent is only received after the results for the financial year have been completed, that patent will be included in the subsequent financial year's results. Only co-owned patents or patents in the name of the CSIR are counted.
Limitations	South Africa and certain other countries do not have examining patent offices. Therefore, patents filed in these countries are not counted for this KPI. The time taken for a patent to be granted after filing is unpredictable and can range from one to eight or even more years, depending on the efficiency of the patent authority concerned and the complexity of the examination process.
Type of indicator	Output.
Exclusions	• Patents granted by non-examining patent authorities. • Patents for which evidentiary supporting documentation is lacking. • Patents that do not name the CSIR as an applicant/assignee/co-applicant/co-assignee. • Patents that are national validations of a patent granted by a regional patent authority.

A.5.3 KPI DESCRIPTIONS (continued)

KPI 4: NEW TECHNOLOGY DEMONSTRATORS

Indicator Title	New Technology Demonstrators
Definition	A technology demonstrator is: • An intermediate output of an R&D project or an intermediate output derived from existing knowledge gained from research and/or practical experience; • An output at TRL 6 or higher, and, in the case of medical devices and pharmaceuticals, at TRL level 5 or higher; and • An output that performs and compares favourably to existing technologies/ products / processes.
Purpose	Measure an intermediate output of research and development activities with the potential to be developed further into technology packages that can be transferred to various markets for socioeconomic impacts.
Performance assessment	The CSIR considers a performance above 85% of the target as acceptable. Performance in excess of the target is a positive result. Technology demonstrators are part of a portfolio of scientific and technological outputs that are produced from the same capacity platform.
Data source	Technology demonstrators are submitted by divisions, clusters or centres for adjudication to the Technology Demonstrator Evaluation Panel. The panel uses the CSIR Technology Demonstrator Evaluation Framework as the guideline for evaluating submissions. This framework is based on international standards/ trends in the field of technology demonstrator evaluation and assessment of the maturity of technologies. The framework provides: • Technology demonstrator Evaluation criteria; • Guidelines for submissions; • Guidelines for the appointment of the panel; • Guidelines for appealing the decision of the panel and • Guidelines for the management of Technology demonstrator evaluation activities.
Data responsibility	CSIR R&D Office.
Method of calculation	Count of technology demonstrators approved by the Technology Demonstrator Evaluation Panel using the Technology Evaluation Framework.
Limitations	None.
Type of indicator	Output.
Exclusions	None.

A.5.3 KPI DESCRIPTIONS (continued)

KPI 5: NUMBER OF TECHNOLOGY LICENCE AGREEMENTS SIGNED

Indicator Title	Number of Licensed Technologies
Definition	• An agreement in terms of which the CSIR grants rights to another party to exploit IP developed by the CSIR, typically in exchange for royalty payments and/or other licence fees. • Technologies licensed in this manner must have been disclosed via the invention disclosure process. • Assignments of IP shall also be included if all other criteria are met, if the assignment is not a conversion of licensed rights to the same IP that have already/previously been licensed to the assignee.
Purpose	Technology licences facilitate commercialisation by other parties of the CSIR's scientific and technological outputs and are an indicator of the uptake of CSIR IP in the market.
Performance assessment	The CSIR considers a performance above 75% of the target as acceptable. Performance in excess of the target is a positive result.
Data source	• Technology licences are proposed and negotiated with other parties by CSIR divisions, and are approved and granted in accordance with relevant legislation and the CSIR Commercialisation and Approval Frameworks. • Copies of signed agreements and records in KSS.
Data responsibility	BEI.
Method of calculation	Number of licence agreements signed.
Limitations	None.
Type of indicator	Output.
Exclusions	Only full licence agreements negotiated and concluded with another party are counted. This KPI excludes: • Instant Access Licences; and • Evaluation agreements (or similar).

A.5.3 KPI DESCRIPTIONS (continued)

KPI 6: NUMBER OF LOCALISED TECHNOLOGIES

Indicator Title	Number of Localised Technologies
Definition	A localised technology is a technology that has been invented or commercialised outside of South Africa and that has been or will be introduced into South Africa for commercial or scientific benefit. • This includes R&D support for local content programmes (e.g. Automotive Industry Development Plan, Supplier Development Plan), and includes the development of a local manufacturing capability for a part/sub-assembly required by a multinational OEM. The OEM is likely to be exporting the relevant product. • The technology may have a licence for the right to use IP for commercial benefit. This may have further terms and conditions attached, which include, but are not limited to, licence fees, linkages to foreground and background IP, timeframes, geographical and territorial aspects, etc. Linked to this process is the identification of a local manufacturing partner that will be developed to adopt the technology for local manufacture.[3]
Purpose	• Accelerate re-industrialisation. • Develop local lower tier manufacturers in multitier industries (e.g. automotive, aerospace, industrial machinery, etc.). Expand the exports of component and sub-assembly manufacturers into global supply chains. • Integrate local manufacturers into global supply chains. • Develop local products that can be used and perfected in the South African context and environment, which can then also be exported to other countries. • Reduce imports of products consumed locally.
Desired performance	Leverage CSIR resources for maximum industry impact.
Performance assessment	The CSIR considers a performance above 75% of the target as acceptable. Performance in excess of the target is a positive result.

3 Example:
A localised technology could also represent the local development of a technology that is currently being imported into the country. This would represent "import substitution".
The process would involve local R&D combined with product and/or material development into a product or system. The local development could be a stand-alone product or a sub-assembly that operates within a large system. During this development process, local expertise and/or IP that could also result in the filing of a patent. Through this process, the design and manufacturing processes will be developed. This development can be conducted with an industry partner and therefore the transfer of technology will be between the CSIR and the partner or a partner can be developed post the development process.

A.5.3 KPI DESCRIPTIONS (continued)

KPI 6: NUMBER OF LOCALISED TECHNOLOGIES

Data source	Technology licences and agreements are proposed and negotiated with external clients by units together with the Licensing and Ventures Office. The CSIR Technology Licensing Framework is used as the guideline for evaluation. The framework provides: • Guidelines for terms and conditions; and • Guidelines for submissions. CSIR may be contracted by OEMs to develop local suppliers or by manufacturers that want to take on additional parts/sub-assemblies made available by OEMs for local manufacture, or through government funded industry development programmes.
Data responsibility	CSIR clusters and divisions.
Method of calculation	Number of technologies localised.
Limitations	• Whether it is a technology or a product being localised (a product is typically a set of technologies). • Ability to identify the individual technologies in a product being localised • Are all in-licensed technologies counted? • Counting only the number of licences covering technologies embedded in parts/products in production in industry leads to under reporting.
Type of indicator	Output.
Exclusions	Excludes a general list of technologies developed by CSIR R&D. Technology should be introduced and transferred for local commercial or scientific benefit.

A.5.3 KPI DESCRIPTIONS (continued)

KPI 7: NUMBER OF JOINT TECHNOLOGY DEVELOPMENT AGREEMENTS BEING IMPLEMENTED WITH INDUSTRY

Indicator Title	Number of Joint Technology Development Agreements being Implemented for Industry
Definition	A joint technology development initiative with an industry partner under a written agreement, where each party brings needed capability for the development and implementation of the technology. The initiative may be funded by a third party.[4]
Purpose	Accelerate re-industrialisation through joint R&D activities with partners from industry.
Desired performance	Targets are set based on projections of joint technology agreements planned in all clusters. The long-term objective is to achieve maximum impact by working with industry to improve the competitiveness of industry.
Performance assessment	The CSIR considers a performance above 75% of the target as acceptable. Performance in excess of the target is a positive result.
Data source	Technology development and implementation agreements are proposed and negotiated with external clients by divisions supported by the divisional BD&C and relevant portfolio. These agreements are kept by the Legal Office of the CSIR. Additional evidence of the existence of joint teams can include: • Agreements; • Minutes of joint meetings; and • Joint R&D outputs (R&D reports, papers, patents, CAD models, technology test reports, etc.).
Data responsibility	Divisional BD&C and portfolios
Method of calculation	Number of signed agreements for joint technology development and implementation. Number of active technology agreements in a particular year.

4 Examples:
- *Concurrent engineering projects where the CSIR provides the technology specialists and the industry partner provides specialists with background in product manufacturability, maintainability, security, etc., leading to the implementation of a new product or manufacturing process.*
- *Joint early stage technology development projects (up to approximately TRL 4), where the industry partner intends to implement later stages (TRL4+) without the CSIR's involvement (e.g. no involvement of CSIR in concurrent engineering).*
- *Joint R&D with TEIs for emerging industries where there is no local industrial activity, where the industry being targeted has been identified as part of a CSIR divisional strategy*
- *CSIR does R&D and the industry partner does market and application and testing.*

A.5.3 KPI DESCRIPTIONS (continued)

KPI 7: NUMBER OF JOINT TECHNOLOGY DEVELOPMENT AGREEMENTS BEING IMPLEMENTED WITH INDUSTRY

Limitations	• This definition of the KPI does not differentiate between large joint projects involving many SET base members, and small teams. • This definition does not prescribe a minimum ratio of hours contributed by each party (this ratio will change as projects progress through TRLs).
Type of indicator	Output.
Exclusions	• Pure contract R&D where there is no joint team with an industry partner or TEI. • Projects where there is no specific product or process development with industry

A.5.3 KPI DESCRIPTIONS (continued)

KPI 8: NUMBER OF SMMES SUPPORTED

Indicator Title	Number of SMMEs Supported
Definition	Support provided by the CSIR to SMMEs through the implementation of interventions that contribute to SMMEs becoming more productive, efficient and sustainable. This may be funded by third parties. The DTIC's definition of SMME's will be used.[5]
Purpose	Contribute to socioeconomic development and industrialisation through the development of manufacturing SMMEs.
Desired performance	Targets are set based on projections of projects planned in all clusters. The long-term objective is to achieve maximum impact by assisting SMMEs to improve their competitiveness.
Performance assessment	The CSIR considers a performance above 75% of the target as acceptable. Performance in excess of the target is a positive result.
Data source	Signed agreements with SMMEs.
Data responsibility	CSIR clusters and portfolios.
Method of calculation	The number of signed agreements with SMMEs Assumption: even under third-party funding an agreement with a specific SMME should be in place.
Limitations	This is a proxy for impact measurement. Actual impact will only be available from SMME revenue, job growth, growth in number of contract which is difficult for the CSIR to obtain.
Type of indicator	Output.
Exclusions	Routine analytical services. Subcontracting of SMMEs, unless there is an agreement in place to do capacity development of the SMME to enable delivery.

5 Examples:
- *Contract manufacturing for SMME's that do not have manufacturing capacity or contract manufacturers with the intent of SMME's building up their capacity to manufacture themselves over time.*
- *Joint technology development and implementation agreements.*
- *Supporting SMMEs to meet OEM requirements, meet technical standards (i.e. international product standard), have standards in place and ISO systems.*
- *Support SMMEs to implement quality standards.*

A.5.3 KPI DESCRIPTIONS (continued)

KPI 9: NUMBER OF REPORTS CONTRIBUTING TO NATIONAL POLICY DEVELOPMENT

Indicator Title	Number of Reports Contributing To National Policy Development
Definition	Evidence-based policy development support provided to various arms of government.[6]
Purpose	To assist government with evidence-based policy development and decision-making that can benefit from a significant SET input.
Desired performance	Targets are set based on projections of projects planned in all clusters and programmes, e.g. Hosted Programmes). The long-term objective is to achieve maximum impact by assisting in increasing the capability of the state.
Performance assessment	The CSIR considers a performance above 75% of the target as acceptable. Performance in excess of the target is a positive result. Policies are only counted if there is external evidence that the policy has been received/accepted/adopted.
Data source	Evidence can include: • Departmental or organisational sign-off on the policy and related reports is filed; • Minutes of policy development team meetings; • Draft policies; • Reports to government department clients; and • Policy-working documents and reports signed off by all participating organisations.
Data responsibility	CSIR clusters and Hosted Programme Management
Method of calculation	Count of final reports related to new or updated policies received, accepted and adopted by government.
Limitations	The KPI as defined here does not account for: • All national policies that do not have the same level of complexity from an SET point of view; and • The effort put in by the CSIR (SET hours), some policy development projects require less input than others. Proof of receipt, acceptance and or implementation from external source (Signed off by relevant department, minuted/Gazetted /implemented.
Type of indicator	Intermediate outcome (uptake and use).
Exclusions	• Development of internal policies for government departments, for example general HR policies, quality management policies and general management policies. • Contribution to creation or updating of CSIR policies.

6 An example of such evidence-based policy work is the CSIR's input into the IRP for South Africa. Detailed technical analysis was used to put forward the optimum energy mix for South Africa, and this work will ultimately find expression in the new Energy Policy. A second example are the CSIR-defined sediment quality guidelines that are used to regulate the disposal of sediment dredged in South African ports, in accordance with South African law (Act of 2008) and in accordance with requirements of the London Convention on the Prevention of Marine Pollution, to which South Africa is a signatory. A third example is a study conducted by the CSIR into spectrum requirements for Wireless Open Access Networks, which resulted in a proposed policy and policy direction gazetted by the Department of Telecommunications and Postal Services in 2018.

A.5.3 KPI DESCRIPTIONS (continued)

KPI 10: NUMBER OF STANDARDS DELIVERED OR CONTRIBUTED TO IN SUPPORT OF THE STATE.

Indicator Title	Number of Standards Delivered or Contributed to in Support of the State.
Definition	New or updated standards adopted by the state and state-owned entities that the CSIR has developed and delivered or to which it contributed.[7]
Purpose	Support for government policy and regulation; enable standardised practice across economic and social sectors (e.g. interoperability standards, accessibility standards, products or infrastructure standards).
Desired performance	Targets are set based on projections of projects planned in all clusters or portfolios (e.g. Hosted Programmes). The long-term objective is to achieve maximum impact by assisting in increasing the capability of the state. Standards are only counted if there is external evidence that they have been received/accepted/adopted.
Performance assessment	The CSIR considers a performance above 75% of the target as acceptable. Performance in excess of the target is a positive result.
Data source	Evidence of departmental or SOE. Sign-off on the standard and or receipt of or use of "CSIR work" as input to a standard.
Data responsibility	CSIR clusters and Hosted Programme Management.
Method of calculation	Count of new or updated standards adopted by government. In the case of updated standards, significant changes from previous versions must be demonstrated.
Limitations	Proof of receipt/acceptance/implementation of standard from external source (signed off by relevant department, minuted or Gazetted/implemented as applicable to target department or industry).
Type of indicator	Intermediate outcome (uptake and use).
Exclusions	None.

7 The CSIR collaborates with the SABS in developing product standards, but develops best practice standards for various government departments. An example is the pothole repairs work conducted for the Department of Transport. This standard on pothole repairs enables the Department of Transport to measure service providers conducting repairs aligned to best practise, leading to a capable state. A second example is where the CSIR has developed the National Domestic Waste Collection Standards for the Department of Environmental Affairs. The Standards were published in Government Gazette 33935 in 2011.

A.5.3 KPI DESCRIPTIONS (continued)

KPI 11: NUMBER OF PROJECTS BEING IMPLEMENTED TO INCREASE CAPABILITY OF THE STATE.

Indicator Title	Number of Projects Implemented to Increase Capability of the State
Definition	The CSIR-facilitated implementation of technologies (CSIR-created or otherwise) that improve the efficiency of Government and SOEs.[8]
Purpose	By accepting and using the work done by the CSIR, a result should be improved efficiency and effectiveness within and between government departments and entities, leading to improved service delivery (across public or private sector). This includes (but is not limited to): • Providing support to departments with the procurement of complex equipment and systems; • Putting complex systems and products into operation in government departments; • Finding and implementing approaches for improving the implementation of systems and products in departments; • Providing training on the operation and support of systems and products; • Development and implementation of systems and products in departments; • Providing enterprise architecting support to departments; • Supporting the upgrade of systems and products; and • Capacity building to ensure a capable state.
Desired performance	Targets are set based on projections of projects planned in all clusters and Hosted Programmes. The long-term objective is to achieve maximum impact by increasing the capability of the state. Technologies are counted if there is external evidence that the technology has been received/accepted/adopted. The CSIR considers a performance above 75% of the target as acceptable. Performance in excess of the target is a positive result.
Performance assessment	• A self-report of improvement or uptake and use of work done by the CSIR and or client report of improvement. • A signed-off close out report from the CSIR and client indicating positive outcomes.

8 An example is the work done by the CSIR on the National Health Patient Registration System that has been rolled out to more than 25 million people, and illustrates how a CSIR-developed solution has enabled the state to deliver services more efficiently. A second example is the work done by the CSIR to establish a cybersecurity capability for the City of Johannesburg (CoJ), which resulted in the establishment of the CoJ Cybersecurity Centre in 2018.

A.5.3 KPI DESCRIPTIONS (continued)

KPI 11: NUMBER OF PROJECTS BEING IMPLEMENTED TO INCREASE CAPABILITY OF THE STATE.

Data source	Potential data sources include: • A client or customer report of improvement or uptake and use of work done by the CSIR; • A signed-off close out report from the CSIR and client indicating positive outcomes • Outputs of relevant projects (reports, etc.) are entered into the CSIR TOdB, which provides the information for reporting; • Project documentation, including milestone reports, project meeting minutes, and others; and • Evaluation of the effectiveness and efficiency of the new capability in the relevant government department.
Data responsibility	CSIR clusters and Hosted Programmes.
Method of calculation	Number of received/accepted/implemented (refer to uptake and use of the CSIR work completed) projects in government departments (see examples above).
Limitations	It is new and might be difficult for the CSIR project staff to negotiate for positive proof. However, it should be part of the original contract or agreement at the start of the project/programme.
Type of indicator	Intermediate outcome (uptake and use).
Exclusions	Diagnostic projects, engineering investigations, root cause analysis. These are important, but may or may not lead to implementation (uptake and use) projects, the focus of this KPI in on implementation of changes in government departments.

A.5.3 KPI DESCRIPTIONS (continued)

KPI 12: TOTAL SET STAFF

Indicator Title	Total SET Staff
Definition	SET staff includes staff on the researcher, research and development, research application, and technical career ladders, research managers, postdoctoral fellows, postgraduate studentships, interns and staff in fixed positions who primarily work on RD&I projects. Bursars and vacation workers are excluded. Counts include all nationalities.
Purpose	SET staff is a measure of the CSIR's capacity to deliver on RD&I projects.
Performance assessment	Performance in terms of the number of SET staff is influenced by financial considerations and should be assessed in the context of financial performance. The CSIR considers a performance above 95% of the target as acceptable. Exceeding the target is a successful result and is not the result of an inappropriate target.
Data source	KPI information is extracted from PeopleSoft through an automated process.
Data responsibility	CSIR HR.
Method of calculation	Head count of SET staff at the end of the financial year.
Limitations	HR ensures the correct classification of staff in PeopleSoft.
Type of indicator	Output.
Exclusions	None.

A.5.3 KPI DESCRIPTIONS (continued)

KPI 13 & 14: PERCENTAGE OF SET STAFF WHO ARE BLACK AND FEMALE, RESPECTIVELY.

Indicator Title	Percentage of SET Staff who are Black and Female, respectively.
Definition	Proportion of black* South African and female South African citizens in SET staff.
Purpose	These measures indicate the degree of demographic transformation within the RD&I capacity of the organisation.
Desired performance	Targets are set based on projections of transformation planned in all divisions, clusters and centres. The long-term objective is to mirror national demographics. The CSIR aims to achieve or exceed the annual targets.
Performance assessment	Performance is influenced by the growth in SET staff numbers and may be negatively affected if the target number of SET staff is not achieved. The CSIR considers a performance within two percentage points of the target as acceptable. Exceeding the target is a successful result and is not the result of an inappropriate target.
Data source	KPI information is extracted from PeopleSoft through an automated process.
Data responsibility	CSIR HR.
Method of calculation	The percentages of black South African and female South African staff of total SET staff at the end of the financial year.
Limitations	HR ensures the correct classification of staff on the HR database.
Type of indicator	Output.
Exclusions	None.

A.5.3 KPI DESCRIPTIONS (continued)

KPI 15: PERCENTAGE OF SET STAFF WITH DOCTORAL QUALIFICATIONS

Indicator Title	Percentage of SET Staff with Doctoral Qualifications
Definition	Proportion of SET staff who have a doctoral level qualifications.
Purpose	The qualification profile is an indicator of the quality of SET capacity.
Desired performance	Targets are set based on the projected growth in SET staff. The long-term aim is for the proportion of PhDs to exceed 30% of all SET staff. The CSIR aims to achieve or exceed the annual targets.
Performance assessment	Performance is influenced by the growth in SET staff numbers and may be negatively affected if the target number of SET staff is not achieved. A performance within one percentage point of the proportion of PhDs will be considered as acceptable. Exceeding the target is a successful result and is not the result of an inappropriate target.
Data source	KPI information is extracted from the HR database.
Data responsibility	CSIR HR.
Method of calculation	The percentage of SET staff with doctoral level qualifications at the end of the financial year.
Limitations	HR ensures the validity of data and that evidence of the qualification is on file.
Type of indicator	Output.
Exclusions	None.

A.5.3 KPI DESCRIPTIONS (continued)

KPI 16: NUMBER OF CHIEF RESEARCHERS

Indicator Title	Number of Chief Researchers
Definition	Number of chief researchers
Purpose	Chief researchers constitute the most senior research level within the CSIR, and are a critical component of the science leadership cohort within the SET base. Chief researchers include SET staff classified as chief researchers, chief engineers, chief project managers or chief knowledge applicators. The number of researchers at this level is an indicator of the quality of SET capacity.
Desired performance	Targets are set based on the projected growth in SET staff. The long-term aim is have at least 30 chief researchers in the CSIR.
Performance assessment	Promotion or appointment at these senior research levels is based on individual performance as measured through the CSIR Career Ladder process. A performance of above 90% of the target is considered acceptable. Exceeding the target is a successful result and is not the result of an inappropriate target.
Data source	Head count of the number of chief researchers at the end of the financial year.
Data responsibility	CSIR HR.
Method of calculation	Count of the number of SET staff who are classified as chief researchers at the end of the financial year.
Limitations	HR ensures the validity of data and that the required evidence is on file.
Type of indicator	Output.
Exclusions	None.

A.5.3 KPI DESCRIPTIONS (continued)

KPI 17 & 18: PERCENTAGE OF CHIEF RESEARCHERS WHO ARE BLACK AND FEMALE, RESPECTIVELY.

Indicator Title	Percentage of Chief Researchers who are Black and Female, respectively
Definition	The percentage of chief researchers who are black South Africans and percentage of chief researchers who are female South Africans.
Purpose	These measures measure the level of demographic transformation within the chief researcher level.
Desired performance	Targets are set based on the projected growth in SET staff. The long-term aim is to steadily grow the proportion of black South African and female South African chief researchers.
Performance assessment	Promotion or appointment at these senior research levels is based on individual performance as measured through the CSIR Career Ladder process. A performance of within five percentage points for the proportion of black South African and female South African chief researchers is considered acceptable. Exceeding the target is a successful result and is not the result of an inappropriate target.
Data source	KPI information is extracted from the HR database.
Data responsibility	CSIR HR.
Method of calculation	The percentage of black South African and female South African chief researchers at the end of the financial year.
Limitations	HR ensures the validity of data and that the required evidence is on file.
Type of indicator	Output.
Exclusions	None.

A.5.3 KPI DESCRIPTIONS (continued)

KPI 19 NUMBER OF PRINCIPAL RESEARCHERS

Indicator Title	Number of Principal Researchers
Definition	Number of principal researchers.
Purpose	Principal researchers constitute a senior research level within the CSIR and are a critical component of the science leadership cohort within the SET base. Principal researchers include SET staff classified as principal researchers, principal engineers, principal knowledge applicators, principal project managers or research group leaders. The number of researchers at this level is an indicator of the quality of SET capacity.
Desired performance	Targets are set based on the projected growth in SET staff. The long-term aim is have at least 290 principal researchers within the CSIR.
Performance assessment	Promotion or appointment at these senior research levels is based on individual performance as measured through the CSIR Career Ladder process. A performance of above 95% of the target is considered acceptable. Exceeding the target is a successful result and is not the result of an inappropriate target.
Data source	KPI information is extracted from the HR database.
Data responsibility	CSIR HR.
Method of calculation	Count of the number of SET staff who are classified as principal researchers at the end of the financial year.
Limitations	HR ensures the validity of data and that the required evidence is on file.
Type of indicator	Output.
Exclusions	None.

A.5.3 KPI DESCRIPTIONS (continued)

KPI 20 & 21: PERCENTAGE OF PRINCIPAL RESEARCHERS WHO ARE BLACK AND FEMALE, RESPECTIVELY.

Indicator Title	Percentage of Principal Researchers who are Black and Female, respectively
Definition	The percentage of principal researchers who are black South Africans and percentage of principal researchers who are female South Africans.
Purpose	These measures measure the level of demographic transformation within the principal researcher level.
Desired performance	Targets are set based on the projected growth in SET staff. The long-term aim is to steadily grow the proportion of black South African and female South African principal researchers.
Performance assessment	Promotion or appointment at these senior research levels is based on individual performance as measured through the CSIR Career Ladder process. A performance of within three percentage points for the proportion of black South African and female South African principal researchers is considered acceptable. Exceeding the target is a successful result and is not the result of an inappropriate target.
Data source	KPI information is extracted from the HR database.
Data responsibility	CSIR HR.
Method of calculation	The percentage of black South African and female South African principal researchers at the end of the financial year.
Limitations	HR ensures the validity of data and that the required evidence is on file.
Type of indicator	Output.
Exclusions	None.

A.5.3 KPI DESCRIPTIONS (continued)

KPI 22: NUMBER OF EXCHANGE PROGRAMMES WITH INDUSTRY

Indicator Title	Number of Exchange Programmes with Industry
Definition	Programmes for the exchange of staff with the potential to create opportunities and contracts. This can be defined as a cooperative activity between industry participants seeking to reduce or eliminate expenditures of resources by sharing information essential during research, design, development, production and operational phases of the lifecycle of systems, facilities and equipment.
Purpose	The purpose is to share domain-level knowledge or system and process information.
Desired performance	Understanding of business environment leading to joint agreements and a working relationship.
Performance assessment	Collaboration, knowledge-sharing, innovation, productivity and diversity of skills.
Data source	KPI information is extracted from the HR database.
Data responsibility	CSIR HR.
Method of calculation	Number of exchange programmes between the CSIR and industry.
Limitations	Industry partner might not provide technical information.
Type of indicator	Output.
Exclusions	None.

A.5.3 KPI DESCRIPTIONS (continued)

KPI 23: INVESTMENT (RM) IN PPE

Indicator Title	Investment in PPE
Definition	The amount invested in CSIR and government grant-funded PPE for a financial year.
Purpose	The CSIR needs to develop and maintain world-class facilities and equipment to provide the quality of RD&I that is expected of it. This indicator provides a measure of the CSIR investment in research infrastructure.
Desired performance	The CSIR annual target is based on 4% of total income, which the CSIR aims to achieve or exceed.
Performance assessment	Performance on financial KPIs needs to be assessed in the context of the prevailing economic climate. Investment in PPE will be deliberately curtailed if total income and margin targets are perceived to be at risk. The CSIR considers a performance above 95% of the target as acceptable. The budget target may be exceeded substantially, arising from additional grant funding. This is a successful result and is not the consequence of an inappropriate target.
Data source	The information for the financial KPIs is obtained from the CSIR financial systems.
Data responsibility	CSIR Finances.
Method of calculation	Value of investment in PPE is the amount of CSIR and grant additions for the year. This information is obtained from reports in the fixed assets system, as well as the CSIR trial balance. Reconciliation is done to analyse the movement in the PPE balance and to break this down among additions, disposals and depreciation. This breakdown is also disclosed in the year-end annual financial statements.
Limitations	None.
Type of indicator	Input.
Exclusions	None.

A.5.3 KPI DESCRIPTIONS (continued)

KPI 24: TOTAL INCOME

Indicator Title	Total Income
Definition	Total income is the total operating income earned. This includes revenue declared on R&D contracts (contract R&D income), income derived from licences and royalties, PG received through the Science Vote, and other income. Interest income is not included in the definition of total income.
Purpose	Total income reflects the ability of the CSIR to ensure financial sustainability. Growth in total income indicates growth in the outcomes and impact achieved by the CSIR.
Desired performance	The CSIR's annual target is the figure for total income in the annual budget, which the CSIR aims to achieve or exceed. Future targets are set to ensure growth in excess of inflation.
Performance assessment	Performance on financial KPIs needs to be assessed in the context of the prevailing economic climate. The CSIR considers a performance above 95% of the target as acceptable. Exceeding the budget target is a successful result and is not the consequence of an inappropriate target.
Data source	The information for the financial KPIs is obtained from the CSIR financial systems.
Data responsibility	CSIR Finances.
Method of calculation	The CSIR annual trial balance from the financial system is updated for audit adjustments and the final figures are incorporated in the CSIR annual financial statements. The annual financial statements are audited and the KPI results are derived from these audited annual financial statements.
Limitations	None.
Type of indicator	Output.
Exclusions	None.

A.5.3 KPI DESCRIPTIONS (continued)

KPI 25: NET PROFIT (%TOTAL INCOME)

Indicator Title	Net Profit
Definition	Profit for a financial year, which is calculated as total operating income; less total operating expenditure (including the performance bonus accrual); plus net finance income.
Purpose	Net profit is a key indicator of financial sustainability and the ability of the organisation to manage its expenses according to the affordability determined by income levels.
Desired performance	The CSIR's annual target is the figure for net profit in the annual budget, based on 3% of the sum of contract R&D income and royalty and licence income. The CSIR aims to achieve or exceed the net profit target.
Performance assessment	Performance on financial KPIs needs to be assessed in the context of the prevailing economic climate. The CSIR considers a performance above 95% of the target as acceptable. Exceeding the budget target is a successful result and is not the consequence of an inappropriate target.
Data source	The information for the financial KPIs is obtained from the CSIR financial systems.
Data responsibility	CSIR Finances.
Method of calculation	The CSIR annual trial balance from the financial system is updated for audit adjustments and the final figures are incorporated in the CSIR annual financial statements. The annual financial statements are audited and the KPI results are derived from these audited annual financial statements.
Limitations	None.
Type of indicator	Output.
Exclusions	None.

A.5.3 KPI DESCRIPTIONS (continued)

KPI 26: SA PUBLIC SECTOR INCOME (% TOTAL INCOME)

Indicator Title	SA Public Sector Income
Definition	South African public sector income is the total income earned from South African public entities. This includes revenue declared on R&D contracts (contract R&D income), PG received through the Science Vote and any other forms of funding received from South African public entities.
Purpose	South African public sector income reflects the degree of public income in the CSIR. A reduction in South African public sector investment, in conjunction with growth in total operating income, is a key indicator of income diversification and impact in other sectors.
Desired performance	The CSIR's annual target is the percentage of South African public sector income included in the annual total operating income budget, which the CSIR aims to achieve or reduce. Future targets are set to ensure increased income diversification and impact in other sectors.
Performance assessment	Performance on financial KPIs needs to be assessed in the context of the prevailing economic climate. The CSIR considers a performance above 95% of the target as acceptable. Reducing the budget target is a successful result and is not the consequence of an inappropriate target.
Data source	The information for the financial KPIs is obtained from the CSIR financial systems.
Data responsibility	CSIR Finances.
Method of calculation	The CSIR annual trial balance from the financial system is updated for audit adjustments and the final figures are incorporated in the CSIR annual financial statements. The annual financial statements are audited and the KPI results are derived from these audited annual financial statements.
Limitations	None.
Type of indicator	Output.
Exclusions	None.

A.5.3 KPI DESCRIPTIONS (continued)

KPI 27: SA PRIVATE SECTOR INCOME (% TOTAL INCOME)

Indicator Title	SA Private Sector Income
Definition	South African private sector income is the total income earned from South African non-public entities. This includes revenue declared on R&D contracts (contract R&D income) and other income received from South African public entities. Licences, royalties and interest income is not included in the definition of South African private sector investment.
Purpose	South African private sector income reflects the degree of private investment in the CSIR. Growth in South African private sector investment is a key indicator of income diversification, as well as strategic alignment to and growth in the outcomes and impact achieved by the CSIR within the South African private sector.
Desired performance	The CSIR annual target is the percentage of South African private sector income included in the annual total operating income budget, which the CSIR aims to achieve or exceed. Future targets are set to ensure increased income diversification and impact in the South African private sector.
Performance assessment	Performance on financial KPIs needs to be assessed in the context of the prevailing economic climate. The CSIR considers a performance above 95% of the target as acceptable. Exceeding the budget target is a successful result and is not the consequence of an inappropriate target.
Data source	The information for the financial KPIs is obtained from the CSIR financial systems.
Data responsibility	CSIR Finances.
Method of calculation	The CSIR annual trial balance from the financial system is updated for audit adjustments and the final figures are incorporated in the CSIR annual financial statements. The annual financial statements are audited and the KPI results are derived from these audited annual financial statements.
Limitations	None.
Type of indicator	Output.
Exclusions	None.

A.5.3 KPI DESCRIPTIONS (continued)

KPI 28: INTERNATIONAL CONTRACT INCOME (% TOTAL INCOME)

Indicator Title	International Contract Income
Definition	International contract income is the total income earned from foreign customers. This includes revenue declared on R&D contracts (contract R&D income) and other income received from foreign entities. Licences and royalties are not included in the definition of international investment.
Purpose	International contract income reflects the global relevance of the CSIR. Growth in international investment is a key indicator of income diversification, as well as the relevance and impact of the CSIR within the global economy.
Desired performance	The CSIR's annual target is the percentage of international income included in the annual total operating income budget, which the CSIR aims to achieve or exceed. Future targets are set to ensure increased income diversification and impact in the global economy.
Performance assessment	Performance on financial KPIs needs to be assessed in the context of the prevailing economic climate. The CSIR considers a performance above 95% of the target as acceptable. Exceeding the budget target is a successful result and is not the consequence of an inappropriate target.
Data source	The information for the financial KPIs is obtained from the CSIR financial systems.
Data responsibility	CSIR Finances.
Method of calculation	The CSIR annual trial balance from the financial system is updated for audit adjustments and the final figures are incorporated in the CSIR annual financial statements. The annual financial statements are audited and the KPI results are derived from these audited annual financial statements.
Limitations	None.
Type of indicator	Output.
Exclusions	None.

A.5.3 KPI DESCRIPTIONS (continued)

KPI 29: B-BBEE RATING

Indicator Title	B-BBEE rating
Definition	The CSIR's assessment of its B-BBEE status is based on the B-BBEE Amendment Act, 2013 (Act of 2013). All targets and definitions are derived from the Codes of Good Practice as published by the DTIC.
Purpose	The CSIR B-BBEE policy seeks to support socioeconomic transformation of society, within and outside the CSIR, by changing the demographic profile of meaningful and productive participation in the country's economic activity.
Desired performance	The CSIR will aim to achieve a level 2 qualification and improve on the current level 3. Any score higher than level 2 would be considered a positive result.
Performance assessment	The CSIR would not consider failure to reach a target because of amended Codes of Good Practice targets as a negative result. Improving on the target is a successful result.
Data source	There are multiple sources of information from which the CSIR assessment is compiled and verified by external audit.
Data responsibility	CSIR Management Services.
Method of calculation	B-BBEE rating is based on a certificate that is issued after an external auditing process. The B-BBEE certificate indicates the CSIR's status with regard to a number of measurements as indicated in the B-BBEE Codes of Good Practice. The B-BBEE rating is a composite score that is made up of the following components: • Management and Control; • Skills Development; • Preferential Procurement; and • Socioeconomic Development. • Equity Ownership.
Limitations	The external audit ensures that there is no subjectivity in the B-BBEE assessment.
Type of indicator	Output.
Exclusions	As the CSIR is a government business enterprise, equity ownership does not contribute to the B-BBEE rating score.

A.5.3 KPI DESCRIPTIONS (continued)

KPI 30: RECORDABLE CASE RATE

Indicator Title	Recordable case rate
Definition	The number of recordable cases x 200 000 divided by the number of hours worked. A recordable incident is a work-related injury or illness that results in one or more of the following criteria: • Death; • Loss of consciousness; • Restricted work or transfer to another job; • Days away from work; and/or • Medical treatment beyond first aid.
Purpose	The CSIR SHEQ policy seeks to establish an effective, accountable and transparent framework for managing, maintaining and implementing SHEQ within the organisation. RIR indicates the effectiveness of health and safety management system within the organisation in a year.
Desired performance	The CSIR aims to achieve its annual target of a an RIR less than 2 (equivalent to 50 recordable incidents/ cases) through identifying health and safety risks and implementing proactive health and safety interventions, in order to reduce the number of recordable incidents/cases.
Performance assessment	The organisation will continuously monitor its health and safety performance and demonstrates leadership and management commitment that would result in improved health and safety culture as part of its vision to achieve a state of zero harm and ensure compliance with the applicable legislation(s) and best practice and supporting guidelines.
Data source	The information for the health and safety KPIs is obtained from the CSIR SHEQ systems.
Data responsibility	CSIR SHEQ.
Method of calculation	The RIR is an indication of the percentage of employees exposed to work related injury or illness and classified as recordable incident per year. It is calculated by the number of recordable cases x 200 000 divided by number of hours worked.
Limitations	None.
Type of indicator	Output.
Exclusions	None.

A.5.3 KPI DESCRIPTIONS (continued)

KPI 31: AUDIT OPINION

Indicator Title	Clean Audit
Definition	The CSIR's assessment of Clean Audit is based on the definition of the Auditor-General, which states; "the financial statements are free from material misstatements (in other words, a financially unqualified audit opinion) and there are no material findings on reporting on performance objectives or non-compliance with legislation."
Purpose	The CSIR will aim to present all the affairs of its financial statements fairly in all material aspects. This opinion embodies the assumptions that the CSIR has observed compliance with generally accepted accounting principles and all statutory requirements. Such a view implies that any changes in the regulatory requirements and accounting policies, their application and effects, will be adequately determined and disclosed.
Desired performance	The CSIR would like to maintain a Clean Audit outcome at the end of each financial year.
Performance assessment	The CSIR Internal Audit Services continuously provides audit assurance in different areas of the organisation over the financial period, with the Auditor-General providing the final statutory audit as required by the PFMA.
Data source	Report of the Auditor-General as published in the annual report.
Data responsibility	Finance function.
Method of calculation	A Clean Audit is based on the overall opinion of the Auditor-General after the performance of the annual statutory audit.
Limitations	Data from the Auditor-General regarding the audit opinion is only available on the third quarter of the financial period. This KPI relates to the audit opinion of the previous financial year.
Type of indicator	Output.
Exclusions	None.

B Annual Plan: 2020/21

B.1 Operational Plan Overview

The operational plan depicts the specific activities for the 2020/21 financial year, which respond to the organisation's longer-term SOs as described in section A.3. These long-term objectives are broken down into more focussed objectives per intervention area as listed in this section. The annual plan is realised through the operational structures (clusters, impact areas, centres, research groups and portfolios). Each of the strategic interventions per strategic objective is listed under the cluster that will be responsible for it (e.g. a strategic intervention responding to Objective 1 is the implementation of Health Information Systems). Therefore, the specific 2020/21 activities for this intervention are listed under the activities of the CSIR NextGen Health in SO1. It must be noted that, while clusters and interventions may span a number of SOs, they have been described under the SO where they predominantly focus (e.g. interventions in CSIR Future Production: Manufacturing are listed under SO1 as the activities of that cluster are predominantly involved in technology development and localisation for the manufacturing sector as a whole. However, when implemented, those technologies should affect the outcomes envisaged through SO2).

This operational plan should also be read in conjunction with the strategic plan (section A). For the sake of brevity, the strategic intent of each cluster and programme is not repeated here.

B.2 SO1: Conduct research, development and innovation of transformative technologies and accelerate their diffusion.

The convergence and the pace of new technologies are fundamentally disrupting industries and require RD&I. This strategic objective will be achieved through accelerating the innovation and diffusion of transformative technologies in South Africa's high-impact industries through high-quality RD&I.

B.2.1 STRATEGIC PROGRAMMES

B.2.1.1 CSIR NEXTGEN HEALTH

Long-term Objective	2020/21 Objectives
Health Systems and Digitisation	
Develop and commercialise integrated health information systems and digital solutions to support and inform health systems planning and treatment interventions.	• National Health Laboratory Services data analytics and governance framework development. This will entail the demonstration of the frameworks for a larger subset of data. • Support the implementation of the NHI through disease profiling for NHI in partnership with CSIR NextGen Health.
Medical devices and diagnostics platform	
1 Implementation of PLM and advanced development of multiplex PoC diagnostics for human and veterinary applications. 2 Facilitating and accelerating the commercialisation of medical devices and diagnostics, through the provision of advanced materials, product testing infrastructure, incubation and regulatory support 3 Apply digitisation tools for data management systems that organise and integrate test results and make them available to the relevant health sector partner.	• Develop new or adapt current Isothermal Amplification technology for application to PoC diagnostics of zoonoses affecting human and animal health. • Develop universal capture and separation systems for the stabilisation of biomolecules from clinical samples (i.e. blood, urine). • PoC MALIA assay development for TB antibody biomarker detection. • African genetic diversity profiling. • Implement digitisation tools for data management systems and integration of devices with at least one commercial health care sector.
Precision Medicine	
1 Catalysing the South Africa companion diagnostics and precision medicine industry. 2 Develop high-throughput sample preparation tools for mass spectrometry-based proteomics to enable drug repurposing and screening. 3 Develop a microbiome database that can be used to support precision medication.	• Establishing Industrial Synthetic Biology: – Developing a roadmap for the Industrial Synthetic Biology Centre for South Africa; and – Establishing Academic and CSIR Future Production: Chemical partnership. • Application of novel Malaria drug screening assays for disease eradication: – Application of high-throughput drug screening technologies to identify novel drug candidates within chemical library provided • Stem-cell based genome engineering screening tools: – Expansion of platform to screen for two additional SNPs relevant for cancer and a communicable disease; and – Development of a screening assay for commercial use.

B.2.1 STRATEGIC PROGRAMMES

B.2.1.2 FUTURE OF PRODUCTION: MANUFACTURING

Long-term Objective	2020/21 Objectives
Advanced Materials and Engineering	
Beneficiation of South Africa's strategic minerals for industrial impact in the 4IR era. Design, manufacture and test metallic mill products and components through powder metallurgy, casting and fabrication processes.	• Conduct techno-economic studies for selected components/parts (titanium and aluminium). • Produced additional titanium metal parts/components fabricated for industry. • Expanded capabilities on primary, semi-fabricated and fabricated Alumininum products. • Establishment of new industries through incubation and transfer of technologies to industrial partners.

B.2.1.2.1 Photonics Centre

Long-term Objective	2020/21 Objectives
Laser-enabled Manufacturing	
Laser materials processing and advanced manufacturing in industries such as aerospace, energy, transport and mining.	• Licensing part manufacturing and Aeroswift machine production. • Implement the moving extraction and moving scanner for increasing the build volume. • Provide laser refurbishment support to SOE, industry and SMMEs. • Qualify laser-based processes for industrial applications. • Industrialise laser shock peening.
Biophotonics	
To develop novel photonics-based PoC diagnostic devices that allow earlier interventions (before occurrence of complex symptoms) through the correct diagnosis and treatment of patients.	• Design and develop a PoC laser-based device for qualitative and quantitative testing of HIV. • Assemble and optimise the optical biosensor detection system called Resonant Mirror. • Use the iPhone 6 smartphone as a spectrometer to perform absorption spectrum measurements, such as in the enzyme linked immunosorbent assay. • Smartphone to be used with photonic crystals biosensor and surface plasmon resonance with metal coated nanopatterns to enhance the detection sensitivity. • Design and build a Surface Enhanced Raman Spectroscopy optical system for substandard drug screening.

B.2.1 STRATEGIC PROGRAMMES (continued)

B.2.1.2.2 Sensor Sciences and Autonomous Systems

Long-term Objective	2020/21 Objectives
Sensor Science and Technology	
Focus is on niche sensor solutions to create impact through local manufacturing, export and localisation. Drive Industry 4.0 principles into existing and new sensor device solutions with the aim of local manufacture and export to secure funding for this direction.	• Identification of new sensor development opportunities, including with the intent to drive 4IR adoption by SA industry. • Support one company to have a localised product that is export-ready. • Establish a funded programme for real-time condition monitoring solution of railway lines. • Secure a contract for a sensor-per-pylon initiative. • Support the needs of Armscor and the SA Navy in wet-end sonar systems.
Research Centre for Robotics and Future Production	
The centre conducts focused scientific research in robotics, with an emphasis on mobile intelligent autonomous systems. This includes autonomous localisation and mapping in dynamic and unstructured environments using single and multi-robot systems, and the autonomous manipulation of objects within the work environment.	• Autonomous 3D mapping for underground applications for UAV. • Autonomous object recognition and inspection. • Development of new robot platform for multi-robot inspection. • Integration of the Intelligent Workcell with the Learning Factory. • Investigation of state-of-the-art R&D solutions for Human-entred Automation and Human Enhancement Technologies. • Continue th eintegraration of the 4IR Technology Centre. (PLM established, Learning Factory under development). • Establish Machine Learning Platform and MES for Production Systems.

B.2.2 EMERGING INITIATIVES

B.2.2.1 CHEMICALS

Long-term Objective	2020/21 Objectives
Pharmaceutical Technology Innovation	
Enable a dynamic African pharmaceuticals manufacturing industry with access to critical and modern drugs through innovative and world-class processing technology aimed at leapfrogging the current batch of manufacturing with continuous manufacturing technology.	• Demonstrator project: Development of a laboratory-scale hybrid process route to TRL 3 for a small molecule oncology drug. • Portfolio expansion project: Translation and scale-up of a HEI developed laboratory scale process route to TRL 6. • Trastuzumab production facility designed in collaboration with third-party engineering service provider. • Techno-economic evaluation of plant-based biosimilar production technology. • Development of digital integrated/converged downstream processing technologies for manufacture of antibodies. • Further mature CAP256 HIV antibody technology for clinical readiness.

B.2.3 RING-FENCED DSI INITIATIVES

B.2.3.1 MANUFACTURING

Long-term Objective	2020/21 Objectives
NLC	
Develop and apply novel laser applications across a variety of sectors and provide access to laser equipment for R&D and skills development through the Collaborative Programme for Additive Manufacturing (CPAM), The Laser RPP and the ALC. PPF - Provide the necessary infrastructure, skills and expertise for the prototyping and product development of photonics technologies.	(See also Laser -nabled Manufacturing and Biophotonics in the Photonics Centre (B.2.1.2.1)) • Expand the CPAM network to include 25 projects at 12 institutions and companies. • Fund 30 projects at HEIs in laser-based research through the RPP. • ALC: Support 15 continental research collaborations, 15 postgraduate students and five continental training events. • Develop four to five prototypes per year in collaboration with industry/commercial partner.
AISI	
To position South African aerospace and defence-related industry as a global leader, in niche areas, while ensuring effective interdepartmental participation and collaboration.	• Defined technology strategies per technology stream. • Industry development and transformation. • Industrialisation of technologies and manufacturing processes for aerospace companies • Economic performance improvement.

B.2.3.2 NICIS

The following key actions will be taken over the next three years:

- Operationalise NICIS as a distinct structure within the new CSIR structure and ensure an efficient business model suitable for a national facility that supports key policies and the realisation of national strategies such as the NDP, TYIP, ICT Roadmap and the recently released Science and Technology White Paper;
- Develop and implement an integrated NICIS communications plan (including the operationalisation of the NICIS brand identity) that will provide users and stakeholders opportunities to engage, influence and provide feedback through advisory and steering committees, as well as national conferences on NICIS' plans and performance;
- Continue strengthening the leadership of NICIS in terms of integrated cyberinfrastructure by providing input to national strategies, e.g. Big Data and Open Science, and HCD by coordinating strategic projects such as the e-Research, Research Cloud Computing, HPC Ecosystem and NEPTTP projects;
- Continue to implement national and international integration mechanisms that enable seamless access across the cyberinfrastructure components through a NICIS service portfolio and with Grand Science projects such as the SKA, CERN, Climate change and H3ABionet;
- Upgrade and maintain the cyberinfrastructure components to position South Africa competitively in responding to technological developments such as 4IR and novel technologies (quantum computing); and
- Foster the development and transformation of HC and research capacity development initiatives to address socioeconomic challenges as presented by the NDP (e.g. poverty, unemployment and inequality).

The outputs of the NICIS programme for 2020/21 are depicted below:

Long-term Objective	2020/21 Objectives
World-class cyberinfrastructure: • HPC computing capacity, availability and average utilisation • Total Available Broadband Capacity • Data infrastructure and services accessibility (and online storage volume)	 >1.6PF, <2PF, 90%, 70% At least 3500 Gbps >90% (8PB)
Accelerated eResearch: • NICIS annual conference • Postgraduate students directly supported by NICIS • Postgraduate students indirectly supported by NICIS • Indirect KPI on peer-reviewed publications • Thought leadership	 NICIS annual conference Seven 30 60 Research data management policy recommendations SADC C.I. Framework and implementation HPC Ecosystem

B.3 SO2: Improve the competitiveness of high-impact industries to support South Africa's re-industrialisation by collaboratively developing, localising and implementing technology.

South Africa has undergone deindustrialisation over the last decade. This strategic objective seeks to improve the competitiveness of SA's high-impact industries through RD&I in a collaborative manner with partners, thereby contributing to the re-industrialisation of the country.

B.3.1 STRATEGIC PROGRAMMES

B.3.1.1 MINING

Long-term Objective	2020/21 Objectives
Mining and Mineral Resource	
• Delivery of research outputs that deliver the SAMERDI Strategy, in collaboration with the Minerals Council of South Africa and partner institutions, through programmes that include : LoCM, Advance AOK, Successful Application of Technology Centred Around People (SATCAP), and Non-explosive Rock Breaking (NERB). • Influence, guide and undertake coal-related research. • Ensuring that the South African mining industry is equipped with the right competency and skills to support modernisation and zero-harm production.	• Contribute to delivery of the SAMERDI strategy. • Participate in LoCM programme and complete 2020/21 research projects. • Develop and do systems modelling for performance and productivity improvement of mines. • Deliver on 2020/21 mechanisation projects, including those under the programme on NERB. • Participate in SATCAP programme and complete 2020/21 research projects. • Deliver on 2020/21 AOK programme and projects. • Develop a standard procedure for the management of hotholes in open cast coal mines. • Participate in SATCAP 2020/21 projects relating to jobs and skills.
Mining Occupational Health and Safety	
To improve mine occupational health and safety by providing testing and skills development services and contributing to health and safety related research.	• Upgrade facilities and testing equipment at Cottesloe labs i.e. SCSR, Rope testing, mechanical testing, Kloppersbos (LIMS upgrade, third breathing simulator installed, 1000 t power pack operational) • Solicit inputs from stakeholders on Kloppersbos business plan, training and testing services and develop training material and trainers. • Sign agreement with MHSC to manage Kloppersbos in medium term and to implement business plan. • Develop business case for air and dust reference laboratory

B.3.1 STRATEGIC PROGRAMMES (continued)

B.3.1.1 MINING (CONTINUED)

Long-term Objective	2020/21 Objectives
Improving socioeconomic sevelopment conditions in mining industry and communities	
To enhance the role and contribution of the CSIR in sustainable socioeconomic development initiatives in mining communities through an integrated and collaborative initiative.	• Support the development of a systemic strategy for at least one province or district with the identified positive impact initiatives to support socioeconomic development • Develop an M&E framework to measure the impact the Impact Catalyst is achieving. • Identify and initiate at least one initiative for community development in area where mining activities are being scaled down • Develop an M&E framework to measure the impact the Impact Catalyst is achieving. • Secure funding (R10 million) for implementing at least one programme in selected sectors.

B.3.1 STRATEGIC PROGRAMMES (continued)

B.3.1.2 CHEMICALS

Long-term Objective	2020/21 Objectives
(Bio)-Chemical conversion	
Replacing and/or enhancing current manufacturing processes using novel bio-based solutions and cutting-edge green chemistry approaches. Focus on biochemical conversions processes to produce specialty chemicals for products formulation in areas such as biopolymers, bioplastic, active ingredients for pharmaceuticals, cosmetic and food additives.	• (Bio)-conversion: – Develop proof of concept for bio-based chemicals and/or products. – Develop technology for bio-based chemicals and/or products at Pilot Scale (50-200L). – Develop technology for commercial manufacture of bio-based chemicals and/or products in partnership with clients(s). – Develop skills and capabilities for the utilisation of unique industrial feed stocks (C1-C4). • BIDC Programme: – Identify and select SMMEs. – Implement projects and develop technologies (natural products and biotechnology). – Transfer technologies for commercial implementation
	• Bioplastics: – Develop bioplastics to meet market requirements for rigid and other flexible film applications, e.g. sanitary pads and applications in the automotive sector. – Pilot-plant process testing with industry partner for furfural to maleic acid and anhydride conversion processes. Re-engineering both lactic and succinic acid production technologies. – Re-engineering catalyst design and process optimisation performance for production of hexitols sugar-free sweeteners. – Demonstration at scale of 1-10 g (laboratory) and 100 g-1 kg pilot-scale. • Biorefinery: – Production and upscaling of cellulose nanocrystals from sawdust waste material. – Upscaled technology for the extraction of C5-C6 sugars from lignocellulosic biomass.

B.3.1 STRATEGIC PROGRAMMES (continued)

B.3.1.2.1 Biomanufacturing Technologies and CeNAM

Long-term Objective	2020/21 Objectives
Advanced Polymers and Emulsions	
This strategic platform aims to develop new and modified materials, while introducing green production methods and focusing on process efficiencies. Polymer nanocomposites, emerging nanofillers, advanced polymer materials, and primary metal production are the main strategic focus areas for this platform.	• Delivery Systems: – Proof of concept demonstrated for encapsulated probiotics using SCF for animal health. – Proof of concept demonstrated for controlled release skin lightening ingredients based on layered double hydroxides. – Proof of concept demonstrated for delivery systems for cannabidiols. – Proof of concept demonstrated for controlled release fertilisers. • Nanostructures: – Proof of concept demonstrated for functional ingredients for topical anti-microbial applications. • Functional Polymers: – Polymer synthesis – proof of concept demonstrated for PBS synthesis. – Catalysis –proof of concept to demonstrate process for production of BDO demonstrate the feasibility for PBS production using solid heterogeneous recyclable catalysts. • Advanced polymer composites: – Clay-based nanocomposites reaching market trials for packaging application. – Carbon-based nanocomposites reaching TRL 3-5. – Bio-based products for single-use reaching market testing levels. – Optimised formulation from CNF and biopolymers for rigid plastic products (TRL 4-5) and 3D printing). • Nanomaterials for sensor development: – Complete the transfer of the Diabetes Breath Analyser to market. – Clinical trials with relevant authorities on the lung cancer breath analyser and development of the technology demonstrator thereof. – Develop nanosensors for CH4, CO and H2S detection. – Research and proof of concept in CO2, ethylene and NH3 sensors for early detection of food spoilage. • Advanced metals processes: – CSIR Titanium Powder Batch Process – reliable operation of pilot batch process with multiple campaigns completed; production of CP Grade titanium powder; demonstrated capability for post- processing titanim powder with down-stream application; optimisation of HFR design; Concept design for integrated HFR into continuous CSIR titaniu -powder process.

B.3.1 STRATEGIC PROGRAMMES (continued)

B.3.1.3 ADVANCED FOOD AND AGRICULTURE

Long-term Objective	2020/21 Objectives
Agro-processing	
• Technology scouting for localisation to provide technology platform for small enterprises growth through the BIDC programme. • Opportunity assessment and packaging through conducting due diligence of existing business plans and facilities, techno-economic feasibility studies and the development of business plans. • Develop commercialisable products in close partnership with existing industry, including SMME's. • Close engagement with the DSI Africa Bilateral Cooperation to design feasible bilateral programmes based on data and experiences in engaging with the research institutions from the SADC region on biosciences. • To implement advanced agro-processing technologies to support the competitiveness of businesses, including SMMEs, in the agri-business sector.	• Work with provincial governments in establishing, modifying or upgrading their agro-processing facilities: – Develop at least three food/cosmetic products and train the entrepreneurs. • Developing value-added processing of indigenous plants and crops: – Finalise dossier/product handover for three THPs(tea bags, liquid product, sachets). – Explore the protection of IP (logo design) for the three THPs by September 2020. – Train an SMME or entrepreneur on the products. • Develop or localise solutions that reduce post-harvest losses of agricultural crops: – Initiate technology transfer and localisation licence to manufacturers in SA and African countries. • Enterprise Creation for Development: – Conduct feasibility studies. – Create and develop new enterprises. – Develop enterprise development strategies and programmes. • Establishment of a Cannabis Centre of Excellence focused on conducting cannabis and hemp-based RD&I. • Develop healthy lifestyle, high nutritious food products for local and international markets. • BIDC Programme to support SMMEs: – Develop and implement Africa strategy through the accommodation of interns, support to SMME's and consultation on implementing BIDC model in SADC countries.
Precision Agriculture	
Transforming agricultural (food crop, livestock, forestry) production through innovative and adaptive earth observation technologies and IoT.	• Develop drone application based on multispectral/hyperspectral/LiDAR data for mapping crop stress variables, e.g. crop nutrient stress, crop water stress, biomass development, disease and pest stress, weed infestation and yield prediction variables. • Develop a regional platform for crop and rangeland assessment and monitoring based on freely available satellites. • Assess spatial distribution of food resources, e.g. biodiversity services, such as pollination services, biomass, regional water balance, and monitor threats, e.g. drought and land use change.

B.3.2 RING-FENCED DSI INITIATIVES

B.3.2.1 Technology localisation and utilisation, and implementation programmes

Long-term Objective	2020/21 Objectives
Technology localisation and implementation	
The objective is to support the development of a competitive South African manufacturing sector that can integrate into the supply chains of the OEMs that are the main contractors to the SOCs in large-state procurement projects.	• Continued delivery of technology transfer and localisation interventions: – Support of 50 Firm Technology Assistance Packages (FTAPs). – Implementation of two Sector-wide Technology Assistance Packages. • Provision of one Technology Development Grant.Delivery of holistic product development solutions linked to state procurement initiatives. • Support the development of two products that will replace products that are being imported into the country. • Through the firm FTAPs, support the: – Creation of 110 new direct jobs and 420 new indirect jobs. – Support the local production of nine products that are being imported through technology and skills transfer programmes with OEMs. – Develop 17 companies that will export products supported through the FTAP process. – Secure co-funding to the value of R20 million from private sector partners. • Secure partnerships with at least two international OEMs for technology and skills support. • Establish two sector-specific centres to provide access to high-end technology and specialised testing linked to localisation projects. • Provide support to the DTIC and SOCs for designated sectors to ensure that these products are developed and manufactured locally to reduce or eliminate the use of foreign-sourced products in designated sectors.
Technology Utilisation Initiative (TUI)	
The TUI programme was established to support the DSI in implementing enabling policy instruments to promote the realisation of commercial products, processes and services from R&D outputs, and to support NIPMO in its objective to abide by the legislation that emphasises its mandate, which is aligned to the IPR Act.	• Translation of a greater proportion of the outputs of publicly funded research and development (R&D) into socioeconomically useful and, where possible, commercialisable technology products and services. • Increased establishment of collaborative technology innovation and commercialisation partnerships between government, industry, universities and public research institutions, with the explicit aim of technology commercialisation. • Positive contribution towards developing new competitive firms and increasing the entrance of South African photonics technologies to relevant markets.

B.3.2 RING-FENCED DSI INITIATIVES (continued)

B.3.2.2 Technology localisation and utilisation, and implementation programmes (continued)

Long-term Objective	2020/21 Objectives
Waste Research, Development, Innovation Roadmap Implementation Programme	
The objective of the Waste RD&I Roadmap Implementation Programme is to drive, guide and support Waste RD&I Roadmap in South Africa, through various funding instruments. The programme also provides thought leadership on the latest trends and opportunities in waste RD&I locally and internationally, playing an important science advocacy role for the sector.	• Implementation of the RD&I objectives of the Waste RD&I Roadmap. • Provision of knowledge-support to implementation activities (e.g. local government) and enterprise development *(as/if required)*. • Producing think-pieces or briefing notes based on research/evidence.
Office of the Digital Advantage (ODA)	
The ODA assists the DSI with driving the achievement of the ICT RD&I Roadmap objectives, which are to: • Enable an increase in public and private investment in ICT RD&I activities to R9 billion over a 10-year period (2013 – 2023). • Position the South African ICT sector as a globally competitive player with the country exporting indigenous ICT technologies and services. • Guide ICT RD&I activities to focus explicitly on the delivery of strategic social and economic advantages. • Improve government performance on national priorities in areas such as health, the environment, poverty alleviation, education and national productivity. • Enable the creation of more than 2 000 new businesses at various levels that can generate more than 4 000 permanent high-tech jobs and almost 20 000 other jobs over a 10-year period.	The proposed new ODA will primarily focus on: • Guiding the allocation, as well as reporting on how the directed allocated funding from the DSI is being spent in the remaining tenure of the 2013-2023 Roadmap. • Enhancing the strategic partnerships among government and its entities, academics, industry and international organisations. • Establishing cross-sectoral themes that seek to develop HC capabilities and local technologies in areas such as agri-tech. • Assisting in overseeing the next five-year National AI Strategy within the 4IR. • Contributing to the improvement of the role of JSE-listed companies and private foundations in ICT-related socioeconomic development activities.

B.4 SO3: Drive socioeconomic transformation through RD&I that supports the development of a capable state.

This strategic objective emphasises the CSIR's role in supporting the development of a capable state and enabling government to drive the socioeconomic transformation of South Africa through research, development and innovation.

B.4.1 STRATEGIC PROGRAMMES

B.4.1.1 SMART PLACES

Long-term Objective	2020/21 Objectives
Functional Building Infrastructure (FBI)	
Provide guidance pertaining to sustainable building infrastructure and construction through the Decision-support Models and Tools, Innovative Building Technologies, building assessment tools, performance modelling, and benchmarking. Provide infrastructure assessment to foster sustainable infrastructure management. Provide solutions in materials for building and civil engineering construction, including phase change materials, cement blends and geo-polymers.	• Designing and piloting FBI IoT network sensors and services. • Development towards an enhanced infrastructure management tool. • Continued development towards a Municipal Service Delivery Analyses Tool (based on review analysis). • Set up CSIR geo-polymer piloting facility for conducting bankable techno-economic feasibility pilot test runs on licensee/user-pays- basis jointly with potential licensees. NB. The facility will also enable in-plant evaluation of various client raw materials for geo-polymers; demonstration and optimisation of geo-polymer-based technologies and training/incubation of licensee staff. • Set up CSIR metakaolin cement blends piloting facility for conducting bankable techno-economic feasibility pilot test runs on licensee/user-pays-basis jointly with potential licensees. NB. The facility will also enable in-plant evaluation of various client raw materials for cement blends; demonstration and optimisation of metakaolin/cement blend-based technologies and training/incubation of licensee staff.
Inclusive Smart Settlements and Regions	
Generate evidence in support of policy, investment and planning decisions to realise developmental goals in urban and rural settlements. This is informed by understanding socioeconomic development dynamics within, and between, cities, towns, villages and regions, which enables modelling of growth and intervention scenarios, and their implications.	• Focus will be on : • The integrated urban growth model for the Gauteng region (movement within settlements). • The settlement growth model for SA (movement of people between settlements). • The optimal placement of social and economic services and goods (inter-settlement focus). • Regional economic development planning and interventions (related to regional industrialisation).

B.4.1 STRATEGIC PROGRAMMES (continued)

B.4.1.1 SMART PLACES (CONTINUED)

Long-term Objective	2020/21 Objectives
Inclusive Smart Settlements and Regions	
Contribute to the development of liveable, sustainable human settlements by providing research-based practical and policy guidance and access to appropriate information to support decisions related to the planning, design and management of cities, towns and neighbourhoods, involving aspects such as settlement layout and design, housing options, urban land and crime science.	• Promoting and activating adaptation actions for South African settlements at risk of climate change (Green Book). • Enhancing human settlement knowledge management. • Establishing a training programme to build capacity in the application of the Red Book.
Sustainable Ecosystems (SE)	
Addressing the unsustainable use of natural resources and mitigating/adapting to the associated adverse effects on social-ecological systems.	Focus will be on : • Developing and diffusing decision-support frameworks for enhancing ecosystem service flows in multifunctional landscapes in both rural and city contexts. • Providing strategic planning support for the management of social ecological systems within coastal and terrestrial ecosystems. • Generating predictive data, and developing tools, models, and knowledge products for understanding coastal vulnerability (in urban and peri-urban areas). • Developing knowledge-based platforms for informed management approaches to blue economy growth. • Developing long-term databases and environmental quality assessment tools in ports and coastal cities. • Developing a physically based model for the assessment of woody biomass, cover and Leaf Area Index, integration in the downscaling of the CCAM-CABLE regional climate model. • Developing earth observation modelling and algorithms for the observation of the physical, biological and biogeochemical marine ecosystems. • Undertaking of EO-based monitoring of regional forests: SA/Namibia maps of woody cover, biomass; mapping infrastructure and algorithm development. • Assessing and mapping freshwater ecosystems and ecosystem services. This new programme will initially focus on building a funding line, literature review and fieldwork.

B.4.1 STRATEGIC PROGRAMMES (continued)

B.4.1.1 SMART PLACES (CONTINUED)

Long-term Objective	2020/21 Objectives
Sustainable Ecosystems (SE)	
	• Developing multidisciplinary resource economic capabilities to identify and measure blue economic domains. • Developing a national capability and tools for a Lifecycle Sustainability Assessment. This will enable the assessment of social, environmental and economic impacts across the full lifecycle of products and materials, in order to inform product design, manufacture and purchasing decisions. • Supporting the private and public industry sectors with guidelines, tools and knowledge products that improve the ability to integrate sustainability principles into development planning, policy and implementation. • Filling national waste data and knowledge gaps through targeted quantitative and qualitative studies to inform the adoption of alternative waste management options in support of moving waste up the waste management hierarchy towards recycling, reuse and minimisation opportunities. • Testing a framework for the benchmarking of solid waste in South African municipalities to support decision-making. • Providing support to decision-making on complex and controversial infrastructure developments by the public sector, through the provision of Strategic Environmental Assessments at regional and national scale, in particular in support of the NDP. • Developing South Africa's capability in Integrated Assessment Modelling to inform trade-off modelling and analysis, especially with regard to resource utilisation, infrastructure planning, climate change and future land use, with a focus on promoting evidence-based and transparent decision-making. • Delivering a wide range of environmental assessment services for industry and the private sector, especially in areas such as renewable energy, electrical grid infrastructure, desalination, ports, pipelines and industrial zones.

B.4.1 STRATEGIC PROGRAMMES (continued)

B.4.1.1 SMART PLACES (CONTINUED)

Long-term Objective	2020/21 Objectives
Holistic Climate Change Impacts	
Generate knowledge and SET tools to assess and predict the impacts of climate change on social, ecological and economic systems and sectors, on a range of time and space scales, in order to inform policy and public and private sector strategy for mitigating and adapting to climate change-related impacts and consequences.	Focus will be on : • Completion of global and regional modelling systems and continued generation of detailed projections of future climate change across the African continent. • Application of new urban and air quality modelling technologies. • Completion of crop yield and streamflow prediction capabilities for Southern Africa. • Development of climate change projections that are used in high-resolution impact models to understand the risks and vulnerabilities facing the industry/sector and to also develop targeted adaptation strategies. • Provision of support to industries and government in developing a complete and transparent greenhouse emissions inventory. • Development and application of tools and methodologies that industries/sectors can use to M&E the effectiveness of their climate change responses. • Continued development of the observation platform and basic research to enhance domain expertise in the ocean-atmosphere- terrestrial environments.

B.4.1 STRATEGIC PROGRAMMES (continued)

B.4.1.1.1 WATER RESOURCE MANAGEMENT RESEARCH CENTRE

The Water Resource Management Research Centre is concerned with the integration of innovative solutions for the challenges spanning the entire water value chain, in order to ensure that water, as a cross-cutting resource, is nationally protected and effectively used within all spheres. This includes the protection and conservation of the current natural resources, identification of alternative resources, water demand and use balance, as well as water supply and wastewater infrastructure for the built environment development, operation and maintenance enhancement.

Long-term Objective	2020/21 Objectives
Develop new technological solutions for the design of smart and robust water purification and distribution infrastructure that will ensure reliable water service delivery in an equitable manner.	Focus will be on : • Smart Water Distribution Networks design, with improved operation and maintenance. • Fit-for-purpose water purification and supply infrastructure designs for off-grid purposes. • Chemical-free and energy conservative water purification technology demonstration plant.
Develop and demonstrate effective technologies for wastewater treatment, re-use and reclamation with concomitant downstream bi-products beneficiation.	Focus will be on: • AMD treatment technology demonstration. • Piloting of innovative domestic wastewater treatment processes and the optimisation of struvite synthesis and sludge beneficiation.
Develop tools, models and techniques to aid the improved maintenance and operation of water infrastructure with the ultimate goal of improved water service delivery	Focus will be on: • Completing the implementation of the CARRS system in all identified local municipalities and submit a close out report.
Enable informed planning and effective decision-making through the development of integrated water resource information and decision-support systems and integrated decision-support processes.	Focus will be on: • Enabling informed planning and effective decision-making through the development of integrated water resource information and decision-support systems and integrated decision-support processes.
Enable smart water use through the development of accurate and site-specific water accounting assessments for industry; improvement of agricultural water management using a range of tools and methods to enable smart water use; and development of a national water use behaviour assessment.	Focus will be on : • Developing a real-time water use predictors for farming. • Land use and water use links and overview for the country.

B.4.1 STRATEGIC PROGRAMMES (continued)

B.4.1.1.1 WATER RESOURCE MANAGEMENT RESEARCH CENTRE (CONTINUED)

Long-term Objective	2020/21 Objectives
Develop and provide required monitoring and modelling expertise to local municipalities for existing managed aquifer recharge and storage systems.	Focus will be on : • The initiation and implementation of R&D projects on sustainable exploitation of groundwater resources along the west coast of South Africa, and the updating of the groundwater flow model for the Windhoek Aquifer.
Securing water resources for sustainable social and economic development, and improving water resilience.	Focus will be on : • Developing Web application to predict water use on farms. • Developing Web application to predict changes in water use from change in land use and climate. • Developing guidelines and recommendations per province.

B.4.1.1.2 ENERGY RESEARCH CENTRE

The Energy Research Centre provides the scientific expertise and essential research infrastructure necessary to address South Africa's growing energy needs and the associated industrialisation opportunities for new products and services. The Energy Research Centre provides thought leadership, innovation and capacity building to address the two main energy imperatives of energy-efficiency and cleaner energy. Our growth and impact plan responds directly to the challenges identified in the NDP by providing unbiased decision support to solve the long-term, sustainable energy needs of South Africa, while concurrently addressing issues such as CO_2 emissions, water use, uncertainty, localisation and regional development.

Long-term Objective	2020/21 Objectives
Energy Supply and Demand	
Assess, test and demonstrate emerging energy-efficient and demand response technologies and systems for deployment in various end-use sectors. Research will be on : • Solar PV (system modelling, failure analysis, quality and reliability research); Mapping the wind energy resources in SA; • Solar and wind forecasting; and • Thermal storage research.	Focus will be on : • Pilot demonstration of thermal energy storage for waste heat recovery. • Establish energy usage assessment methodologies/models. • Developing hardware and software for smart water heater controller. • Demonstrating the value of quality and reliability testing for large PV plants using accelerated stress testing methods. • Developing a machine learning algorithm for defect detection and classification in Electroluminescence images; • Developing WASA and initiating wind observation services. • Developing version 1.0 of forecasting model.

B.4.1 STRATEGIC PROGRAMMES (continued)

B.4.1.1.2 ENERGY RESEARCH CENTRE (CONTINUED)

Long-term Objective	2020/21 Objectives
Energy Systems	
Focuses on new ways to plan, design and operate the power system, with a long-term aim to have sector coupling for the entire energy system.	Focus will be on: • Full sector modeling data sets collected, and tools specified. • Establishing joint study teams for high VRE shares, with multiyear scope for stability studies. • Planning for the support of Africa's integration of VRE. • Creating a beta version of the open source grid model for SA, with GIS spatial context. • Developing a framework for micro-grid model with transactive capabilities. • Scoping of work development of an RTDS laboratory with partners (Eskom, etc.)
Electro-Chemical Energy Technologies	
Develop new materials-based technologies for energy storage and conversion systems. Undertake battery RD&I. Develop catalysts for fuel cells, electrolyser and CO_2 reduction. Develop membranes for fuel cells.	Focus will be on: • Optimising LMO/LMNO cathode material using South African metal precursors. • Developing cathode and anode materials for LIB, SIB, ZIB. • Improving super-capacitor material. • LIB cell manufacturing • Localising battery technologies. • Improving non-PGM and ultra-low PGM-based catalysts for fuel cells, electrolysers and CO_2 reduction. • Improving stable and conductive AEM. • Fabricating MEAs for scaling and application i.e., flash lights for military/mining personnel.
Energy Industry	
Informing policy decision by providing analysis of industrial development scenarios and by using science-based tools to map out various development scenarios.	Focus will be on: • Positioning component localisation in the South African clean energy sector. • Manufacturing analysis in the broader energy value chain and modelling enhanced local content scenarios. • Stakeholder engagement on the reduced reliance on coal. • Development of a consensus-based plan to reduce reliance on coal. • Analysis of economic impacts of energy. • Effective dissemination of research outputs to relevant stakeholders. • Stimulation of socio-economic activities through the participation of SMME's in the energy value chain.

B.4.1 STRATEGIC PROGRAMMES (continued)

B.4.1.1.2 ENERGY RESEARCH CENTRE (CONTINUED)

Long-term Objective	2020/21 Objectives
HySA	
Develop Hydrogen storage and conversion technologies. High Pressure Cylinders. CCU/PtX. Water/gas purification.	Focus will be on : • Registering a technology demonstrator for High Pressure Cylinders and developing a prototype manufacture for commercial evaluation thereafter. • Methanol synthesis from CO_2 and H_2 demonstrated at a lab (milliliter) scale. • Developing waste–derived (e.g. food/beverage packaging) porous/ sorbent material capable of filtering impurities from water or gases.
EAC	
Real-world research platform for designing and operating a primarily renewables-based energy system. Installing rooftop PV on the CSIR buildings with a high share of local content (target high local content). Implementing demand-side management solutions to reduce demand by 20% and to implement demand shaping solutions. Developing an Integrated Energy Plan (IEP) for the CSIR campus. Developing and implementing a smart grid plan. Developing a funding strategy for the EAC programme.	Focus will be on • Installing PV (phase 2). • Conducting Operation and Maintenance for the existing PV plants. • Energy efficiency and demand side management implementation. • Managing the existing electric vehicle fleet. • Managing site visits at the energy autonomous campus.

B.4.1 STRATEGIC PROGRAMMES (continued)

B.4.1.2 NEXT GENERATION INSTITUTION AND ENTERPRISES

Long-term Objective	2020/21 Objectives
e-Government	
Digitalisation of government to enable efficient and effective service delivery through the adoption of advanced ICT's, resulting in the: Reduction of financial wastage in government. Lowering access barriers to government services, thereby contributing to increased transparency and trust in public institutions. Ability of government to effectively plan and monitor programmes.	Focus will be on: • Digital Health: – NHI Beneficiary Registry; – NHI Provider Registry; – NHI Establishment Registry; – NHI Data Analytics Platform; – Revised Health Normative Standards Framework; and – National e-Prescribing and e- Dispensing system. • Oceans Monitoring: – Harmful Algal Bloom Decision-support Tool (Aquaculture Support); – Operations at Sea (support NSRI sea search and rescue); – Monitoring of large mammals (Whales, etc.); – Support Marine Spatial Planning Act and develop viewer tool; – Water quality assessment tool; – Integrated Vessel Tracking systems (expand to Africa); and – Support Energy Research Centre to develop system to evaluate oceans energy potential with Wind energy prioritised.
Operational Intelligence	
Develop computational tools, techniques and technologies to capacitate state and private entities to take appropriate actions and make informed decisions with respect to the prioritisation of challenges, coordination of resources, planning, monitoring and evaluation; as well as ensuring operational setup necessary to address service delivery and business challenges.	Focus will be on : • Developing forecasting and analytical geospatial models for hazards and disasters. • Developing short and long-term forecasting models for defined end-use sectors, in order to guide investments into infrastructure. • Developing and implementing an integrated decision-support solution to inform mitigation and regulation plans of factors influencing demand and supply. • Developing Minimum Viable Products that the public sector and SMMEs can use to make better decisions about a full-scale product. • Deploying smart solutions in client/operational environments to better deliver services and create avenues for public service innovation. • Coordinatingand leading the successor to the DSIDE programme

B.4.1 STRATEGIC PROGRAMMES (continued)

B.4.1.2 NEXT GENERATION INSTITUTION AND ENTERPRISES (CONTINUED)

Long-term Objective	2020/21 Objectives
Networked Systems and Applications	
Enable growth of the ICT sector in South Africa through two key SOs/activities: • Supporting the development of regulatory capacity of the state. • Developing and transfering localised tools, technology products and process to local enterprises – both private and public.	Focus will be on: • Developing rich multimedia know-how, technologies and solutions aimed at the transformation of various service sectors to support local content development and enable e-inclusion of all citizens. • Developing the know-how and technologies that enable efficient utilisation and management of radio frequency spectrum to fuel innovation in wireless network technologies and deployments. • Develop a concept demonstrator of AI based advanced spectrum sharing toolbox for 5G and beyond . • Developing network modernisation and automation tools enabled by emerging technologies such as software defined networks (SDN) and Network Function Virtualisation (NFV) and cloud-based services orchestration to localize emerging connectivity technologies such as 5G • Demonstration of Mobile Edge Computing integration with immersive multimedia environment with 2 South African languages
CSIR Emerging Digital Technologies Research Centre	
Research and development of the emerging technologies underpinned by 4IR digital technology blocks, which aims to enable digital disruption in local enterprises to keep South African organisations relevant and competitive. The areas that the centre will incubate will include AI, Augmented Reality, Advanced IoT, as well as Distributed Ledger Technologies, among others.	Focus will be on: • Developing capabilities (HC, processes, technology tools and infrastructure) in 4IR digital technology blocks, i.e. AI, A-IOT/CPS, Artificial Realities, etc. • Building demonstration tools and platforms that showcase the practical application of transformative technology. • Establishing and strengthening RD&I community in the areas of 4IR digital technology blocks. • Providing CSIR NextGen Enterprises and Institutions and the wider CSIR impact areas and centres with digital tools that will enable the implementation of smart solutions in their domains.

B.4.1 STRATEGIC PROGRAMMES (continued)

B.4.1.3 SMART MOBILITY

Long-term Objective	2020/21 Objectives
Transport Systems and Operations	
The area contributes to the creation of solutions to improve the performance of transport network operations and associated management systems.	Focus will be on : • Building a platform to model transport network performance at a national level for passenger and freight transport. • Collating necessary data to develop network behavioural models. • Developing a road safety risk modelling framework. • Deepening international relationships in respect of sustainable freight transport. • Comprehensively quantifying the public transport industry value chain. • A combined passenger and freight transport modelling platform to dynamically model network performance. • Building capability in sustainable freight logistics. Pilot projects will be in selected industries, e.g. agriculture, mining and retail.
Smart Roads Programme	
Development and utilisation of new-generation road technologies to develop better construction and maintenance processes that are faster, better planned, more cost-effective, safer for workers and users, and exert minimal impact on society and the environment. Development of next-generation road construction products, which will facilitate the creation of new start-ups or strengthen existing private sector companies, and development of products and techniques that support job creation and small contractor development.	Focus will be on : • Synthesising the latest road construction equipment and methodologies and their impact on current practices (design methods, norms and standards). • Identifying, developing and trialling new and smart materials and smart sensors and technologies. • Cataloguing green technologies and products (recycling and alternative materials) and their potential use in road construction. • Developing advanced performance models for high-volume roads (e.g. pavement deterioration models). • Developing and trialling advanced binder technologies (organic/polymeric/cementitious).

B.4.1 STRATEGIC PROGRAMMES (continued)

B.4.1.3 SMART MOBILITY (CONTINUED)

Long-term Objective	2020/21 Objectives
High Performance Rural Transport Infrastructure	
Develop and facilitate the implementation of methods and techniques for the delivery (i.e. planning, financing, design, construction, maintenance and management) of sustainable Access Road Infrastructure. The solutions required to reverse the poor condition of access roads, which impacts mostly on rural communities, are a combination of novel construction and design techniques that are cost-effective, and application of knowledge on asset management and maintenance. It also includes the building of research capacity in Africa and Southeast Asia.	Focus will be on : • Developing and trialling of cost-effective road upgrading methodologies that rely less on non-renewable resources. • Developing labour-intensive community-based approaches for routine maintenance of low-volume access roads. • Cataloguing alternative and novel materials for use in low-volume roads • Piloting the implementation of cost-effective climate adaptation options in three African countries (Ethiopia, Ghana and Mozambique). • Developing a sustainability evaluation toolkit. • Implementing capacity-building programmes. • Establishing road research capacity in at least one African and Southeast Asian countries.
Smart Coastal Infrastructure Technologies	
Development of technologies and support systems that will improve the safety and efficiency of a port. In addition, using technology to inform on the state-of-the marine infrastructure and develop methods to predict possible damage to infrastructure.	Focus will be on : • Improving the confidence level of the Under Keel Clearance decision-support system • Identifying and testing smart sensors and technologies to improve the Integrated Port Operating Support System • Supporting investigations into the development of a new armour unit.

B.4.2 RING-FENCED DSI INITIATIVES

B.4.2.1. ICT RD&I ROADMAP

Long-term Objective	2020/21 Objectives
ICT RD&I Roadmap	
To ensure that the investment is aligned with the ICT RD&I Roadmap, and is utilised to ensure that the CSIR contribution to RD&I, brings the country closer to the goals of the ICT RD&I Roadmap.	Focus will be on : • Developing a biometric recognition system for minors. • Enabling biometric authentication in smart cards. • Developing a secure biometric-enabled terminal. • Developing service delivery platforms (access control using tokens) for government. • Piloting test of service delivery platform at two local municipalities • Deploying a service delivery test bed in one national government department. • Developing a host-based intrusion detection methods that uses pattern recognition and log files to learn future rules. • Developing an anomaly based intrusion detection technology, which involves the accurate and timely detection of intrusions as they occur. • Developing a benchmark network dataset generator, packaged as a software tool. • Developing a network behavioral model

B.4.3.1. C4IR-SA

After the DSI agreed (on behalf of government and with support from the Presidency) to establish the C4IR-SA; it nominated the CSIR to host the Centre. The CSIR has concluded negotiations with the WEF and the DSI. The contracts were signed and rendered effective on 1 October 2019.

Long-term Objective	2020/21 Objectives
C4IR-SA	
To bring together government, leading companies, dynamic start-ups, civil society, academia, experts and international organisations from around the world to co-design, implement and scale-up agile and human-centred technology governance frameworks.	Focus will be on : • Finalising the operating model and funding agreements of the Centre. • Finalising the initiation of Centre. • Launching at least three projects (of which one must be an anchor project).

B.5 SO4: Build and transform human capital and infrastructure

This strategic objective seeks to build and transform the required human capital and infrastructure to drive industrialisation and the advancement of society. It emphasises the need for targeted capability development to leverage emerging technologies and capabilities.

B.5.1 HUMAN CAPITAL DEVELOPMENT

HC development remains a priority to ensure that the organisation is adequately equipped with the right skills for it to meet its SOs. There are a number of pipeline development programmes that aim to improve the attraction and retention of critical skills. The pipeline programmes provide the organisation with access to PhD graduates to address the percentage of staff qualified with doctoral qualifications. There is also a need for the organisation to focus its attention on leadership and management development programmes to equip all levels of management (from supervisory to Executive) with critical management competencies. The organisation will place emphasis on the development of female senior researcher and managerial staff and the inclusion of youth and persons with disabilities.

Our long-term strategy is to build a motivated, high-performing and diverse workforce that is multifaceted and encompassing improvements to the pipeline, a strong focus on leadership development, succession planning and performance management, innovative approaches towards sourcing, developing and retaining talent, and creating prospects for the long-term growth of our people.

The interventions that will be implemented to build, strengthen and transform our HC in 2020/21 are as follows:

- Invest in pipeline development programmes informed by a workforce skills plan and improved retention of supported student pipeline and talent pipeline.
- Support the creation of an enabling environment for meaningful career development and progression, in particular for designated groups to grow from D1 (mid-career) to senior levels of the CSIR career ladders i.e. principal and chief researchers.
- Implement talent management and succession planning strategies.
- Develop effective retention strategies that reduce turnover of critical staff, as well as black and female researchers.
- Improve absorption of student pipeline.
- Review and improve the CSIR learning and development model to provide relevant induction and training.
- Implement leadership development programmes to equip leaders with the critical leadership and management competencies needed to deliver on the CSIR's new strategy and mandate with a focus on succession planning.
- Entrench business development capabilities.
- Develop and maintain strategic partnerships to leverage resources for HC development.
- Upgrade systems (PeopleSoft) and automate key HC approval workflows.
- Drive change management within the business and entrench the CSIR EPIC values, namely excellence, people-centred, integrity and collaboration.

To address these objectives in the short term, the CSIR will focus on the following programmes:

HC Programme	2020/21 objectives
Onboarding	Revitalise and relaunch the onboarding process for new and existing CSIR employees.
Recruitment	Improve talent acquisition ability and utilisation of the full recruitment tool and process.
Change management	Entrench the CSIR EPIC values as part of implementing the new strategy.
Employment equity	Re-launch the EE and Skills Development Committees within the business and drive transformation targets.
Pipeline development	Implement and/or launch pipeline development programmes that include bursaries, in-service training, learner outreach, graduate-in–training programme, internships, postdocs, YES programme, Accelerated Researcher Development Programme, competence-based career paths, leadership development, coaching, mentoring, talent management, succession planning and career development.
Performance management	Launch the e-Performance Management and drive the performance engagement culture within the business.
Attraction and retention	Development and launch of an Employee Value Proposition.
Systems, workflows and data	Upgrade HC systems (PeopleSoft) and key HC approval workflows; and cleanse and improve HC data quality.
ER	Manage the volatile ER environment and improve line managers' ER capabilities.
Partnerships and resources	Forge strategic HC development relationships with industry, government, SOEs, HEIs, SETA and science councils, in collaboration with the Strategic Partnerships function, divisions and clusters.

B.5.2 INFRASTRUCTURE

Capital spending for the year is planned to be R105 million.

A significant portion of the CSIR's projected capital spend has been allocated to research infrastructure to support the new Strategy, the replacement and renewal of existing assets, in order to maintain and sustain current operating levels as well as future growth opportunities.

A large portion of the project capital spending remains unfunded. The Campus Master Planning and Development Office (CPDO) will continue to focus on fundraising campaign in 2020/21 to build partnerships and seek investment opportunities.

B.5.2 INFRASTRUCTURE (continued)

The CPDO has been established to oversee the implementation of the Campus Master Plan. During 2020/21 financial year the CPDO will focus on the following interventions:

- Review and update the Campus Master Plan to ensure alignment with the new CSIR strategy.
- Develop the CSIR regional location strategy and site development plans in line with the principles of the CMP.
- Oversee the implementation of the Capital Investment Plan 2020/21 and update the rolling five-year Capital Investment Plan.
- Undertake stakeholder engagement and communication.

With respect to the Campus Master Plan, the following activities are planned for the coming financial year:

THE ENERGY AUTONOMOUS CAMPUS

The long-term aim is to create an Energy Autonomous Campus at the main Pretoria campus by supplying energy from the three primary energy sources, namely solar, wind and biogas from biogenic waste. The power generators will be combined with electricity and heat storage, integration of electric and hydrogen-driven vehicles, power-to-liquid and power-to-gas processes, demand-side management and energy-efficiency measures. The other CSIR campuses across the country will gradually become part of the programme, where in the long-term supply and demand will be virtually balanced across all CSIR campuses, forming a Virtual Power Plant.

There are approximately 2 MW of Photovoltaic (PV) plants (single axis tracker, dual axis tracker and roof top PV plants) installed at Scientia campus currently. Further interventions will include,

- The installation of another 4 MW of PV phased on an annual basis (1 MW per year) in the coming years,
- Opportunities of demand side management and energy efficiency to reduce consumption by 10%, as well as,
- Further changing of the existing grid into a smart micro-grid, with energy storage options including Power-to-Power, Power-to-X and Power-to-Heat.

Key projects in the 2020/21 financial year will be the addition of a 1 MW of PV, installation of energy efficiency solution (lighting retrofit), as well as changing the CSIR grid into a smart micro-grid.

THE GATEWAY TO SCIENCE AND INNOVATION

The "Gateway to Science and Innovation Centre" is being planned at the CSIR main campus in Pretoria to support the CSIR's scientific and industrial development mandate. The Centre is intended to be a national facility that provides a platform to improve and strengthen engagement with relevant stakeholders in the STI community, in order to foster innovation and economic growth. The envisaged outcomes from the successful implementation of the Centre are:

B.5.2 INFRASTRUCTURE (continued)

- Increased translation of the CSIR's and partner R&D institutions' technological outputs into products and services for the market;
- Increased number of new start-ups and industry partners commercialising public sector technologies;
- Increased number of high-tech jobs created through technology transfer;
- Prolific awareness and enhanced profile of South African SET activities and infrastructure;
- Increased investment in R&D by the private sector; and
- A thriving South African economy.

The Centre will provide an exciting environment that will attract young people, students, small and medium enterprises (SMEs), research and technology organisations and a broad spectrum of other parties with an interest in innovation and scientific development. Various activities, programmes and services will be run with the aim of enhancing SET awareness and appreciation, developing skills, encouraging innovation and promoting the development of new technology enterprises.

The Centre will also serve as a gateway to the modern laboratories and research infrastructure, skills and services dedicated for SMEs. The Centre shall provide access to the research infrastructure, business networks, laboratories in R&D centres, establishing contacts with the scientific community, consulting, aid in technology transfer and commercialisation. The development of the Centre will further be a catalyst to deepen engagement with industry and to stimulate cooperation between science and industry creating conditions for enhancing the competitive edge of local high tech companies. The precinct, inclusive of the Centre, is destined to become one of the most important venues for innovation in the City of Tshwane and in South Africa.

The business case and feasibility study for the Centre will be completed in 2019/20. During the 2020/21 financial year, the focus will be on detailed design, planning and engineering, as well as raising funds for the development and operations of the Centre.

UPGRADE OF ICC ACCOMMODATION

The need for a residential and co-working environment for staff, visitors and conference delegates identified in the CMP will be addressed through an planned upgrade of the ICC accommodatipon. This will provide accommodation for visiting CSIR staff (from other CSIR sites), visiting researchers, visitors to the precinct, and short-term CSIR employees. It will also cater for the International Convention Centre (ICC) and provide accommodation for visitors attending conferences and seminars. The accommodation will be located near the ICC and will entail development of facilities and an environment that will enhance the attractiveness of the conference centre, as well as the CSIR as an employer and collaborator.

B.5.2 INFRASTRUCTURE (continued)

Outline feasibility studies have been carried out and a Transactional Adviser (TA) was appointed during 2019/20. The TA will develop detailed financial and operational plans based on a public-private partnership model for approval and implementation envisaged for 2020/2021.

SHARED INTERDISCIPLINARY RESEARCH LABORATORY

Planning is underway to create a large-scale multidisciplinary/interdisciplinary research facility for advancing research through diverse relationships. The shared interdisciplinary research facility is intended to serve as a valuable equipment and resource hub for researchers from the CSIR and other organisations, including academic, government labs, and industry that are at the leading edge of scientific discovery.

The research facility shall provide access to state-of-the-art technologies, equipment, services and expert consultation, on a fee or reimbursement basis, to enable, facilitate, or enhance the research mission of the CSIR. This facility will provide open access to specialised instrumentation and expertise that enable scientific users from universities, national laboratories and private industry to carry out experiments and develop theories that could not be done at their home institutions.

The project is currently in the planning stage. The outline feasibility study of the shared laboratory model, including international review study has been undertaken. The next steps during 2020/21 are to undertake detailed needs analysis of the CSIR research actors and collaborators; detailed feasibility studies and develop the funding strategy and plan. Furthermore, the CSIR will engage strategic stakeholders to co-invest in the development of the facility.

PILOT AND PRE-MANUFACTURE FACILITIES (PHASE 1)

The CSIR has identified a need on the Scientia site to provide a large flexible space for research and testing of products developed by the CSIR in the pre-manufacturing stage of a product before outside manufacturing is undertaken. Provision has to be flexible to allow short or long-term usage, varying size of products to be produced with a variety of manufacturing equipment, pre-manufacturing and other attributes to be accommodated. The design and funding model proposed for the precinct will include external parties as a significant uptake by the private sector is envisaged.

An outline feasibility study has been carried out for the facility. A business case and funding model for the precinct will be finalised in 2020/21. The project development will draw on CSIR capabilities and experience in this field, and external partnerships will be developed to achieve a workable funding model and implementation plan.

B.6 SO5: Diversify income and maintain financial sustainability and good governance.

The CSIR is rolling out a new strategy ("Project Synapse") as approved by the Board and Minister in 2019/20. Project Synapse is a growth strategy that amplifies the role of the CSIR in industrial development without taking away from the work currently done to support a capable state and public good science. Income diversification remains a key strategic objective and will reduce the financial risk associated with a significant reliance on public sector income. Income diversification is also expected to improve the CSIR's profitability as profit margins are currently between 1% and 2% on public sector income.

The 2019/20 shareholders compact reflected an aggressive 3 year growth strategy aligned to the intentions of Project Synapse with increased contract income targets required to mitigate the impact of 2019/20 MTEF budget cuts. The 3 year plan also included assumptions that targeted loss making areas of the business would be exited completely by the end of March 2019, a new "fit for purpose" organisational operating model would be implemented and parliamentary grant funding would be available to invest into new growth initiatives.

The assumptions supporting the growth strategy have not all materialized according to plan as not all loss making areas of the business have yet been successfully exited, the new "fit for purpose" operating model could not be fully implemented, there have been further budget cuts to parliamentary grant funding and there has been an overall decline in the economic environment affecting secured sales.

Based on the above, the CSIR is forecasting a net loss of R10 million for the 2019/20 financial year. The CSIR has also adjusted the 3 year plan accordingly with reduced growth targets.

Conservative balance sheet practices, including working capital and cash flow management, are important to enable the CSIR to invest in the scientific equipment and infrastructure required to support strategic objectives.

All financial resources are invested in line with the CSIR's mandate.

B.6.1 GROWTH

The CSIR has budgeted for an increase of 11% in total operating revenue on 2019/20 forecast (see Table G.1). Contract income and baseline grant funding increase on a comparative basis by 14.4% and 2.5% respectively.

Income from the South African public sector and South African private sector is budgeted to increase by 12.8% and 46.9% respectively, based on secured contracts and current engagements with stakeholders and clients as aligned to repositioning the CSIR's value proposition within the private sector.

International contract income is budgeted to decrease by 3.2% in 2020/21 due to international deals not materialising within the planned time frames. The CSIR is planning for year on year growth of 20% in international income from 2021/22. This is specifically relating to international commercialisation activities as aligned to Project Synapse.

B.6.1 GROWTH (continued)

Included in contract income from the South African public sector is the Cyber Infrastructure ring-fenced allocation from the DSI. These contracts have historically been reflected as such and are included as part of public sector income for comparative purposes.

It should be noted that the CSIR's Baseline Parliamentary Grant allocation for 2020/21 has been reduced by R21 million from that of 2019/20. This will negatively impact the CSIR's ability to implement growth plans in terms of the new industrialisation strategy as indicated above.

The CSIR will implement the directive and budget cuts on goods and services in the 2020/21 financial year and will continue to actively drive cost containment initiatives / operational efficiencies.

As a business enterprise, the CSIR receives less than a third of its funding from the government as an unrestricted grant. The balance of the income budget is generated through external R&D contracts, which is becoming increasingly challenging in the current fiscus. The ability to generate external income directly relates to attracting and retaining critical expertise. The ability to offer competitive remuneration is a critical enabling factor for income generation as the CSIR competes with local and international institutions, as well as the private sector for scarce skills and expertise.

With regards to the implementation of prescribed employee compensation expenditure ceilings, the CSIR has raised a major concern regarding the negative impact of implementing this with our shareholder and National Treasury. The potential savings on this initiative would be far outweighed by the associate business risk of losing key competencies within the business. As such, and with CSIR Board support, the CSIR has limited planned appointments to fill only critical vacancies required to deliver on strategic objectives, with allowance for an inflationary salary increase of 5.4% across all pay grades.

B.6.2 EXPENDITURE

Total expenditure is budgeted to increase by 10.4% on 2019/20 forecast based on budgeted revenue increase. Employee remuneration costs and operating expenses are budgeted to increase by 9.6% and 9.2% respectively. Depreciation is expected to increase by 35%. This is as a result of critical re-investment into aging infrastructure, as well as a number of planned infrastructure hosting initiatives currently being undertaken by the CSIR.

The increase in employee related costs is determined by taking into consideration the new operating model structure, human capital development costs, annual planned salary increase as well as the growth projections on contract income. Planned recruitment is dependent on the securing of contracts, and resource planning of required skills within the CSIR.

The budget for operating expenses is determined by taking into account contract-specific expenses (directly associated with contract income) as well as operational overheads (inherent in running the business).

Based on the current economic climate and need to improve financial performance, strict cost containment measures have been implemented across the CSIR.

The increase in depreciation is based on affordability and the availability of cash flow. The budget for 2020/21 includes fully funded grant assets. All planned investment in property, plant and equipment will be assessed to ensure alignment with strategy and operational requirements and will be prioritised based on affordability and return on investment. The investment for the campus master plan has not been included in the capital expenditure budget as this is dependent on the securing of external funding.

B.6.3 ROYALTY INCOME AND OTHER INCOME

Royalty income is budgeted at R 1.8 million and is based on current registered license agreements.

Royalty income is budgeted to decrease by R0.06 million (23%) from the 2019/20 forecast (R2.4 million). It is anticipated that sales volumes for royalties on non-commodity products will be very slow in the next financial year and hence the expected royalty stream will decrease slightly. The CSIR is targeting a number of new license agreements on which nominal returns are expected by the end of the 2020/21 financial year.

Included in the 2019/20 forecast is other income of R11 million. This relates mainly to the net effect of foreign exchange gains and losses. The CSIR takes a neutral view on the currency movements going forward and as such has not budgeted for a foreign exchange gain or loss.

B.6.4 FINANCIAL SUSTAINABILITY

The 2020/21 budget indicates break even margin lion against the 2019/20 forecast loss of R10 million. The R10 million increased net margin is due to planned income targets and improved operational efficiencies. The increase in contract income from the 2019/20 forecast is supported by the refocusing of CSIR contribution in the private sector based on the new business model which targets private sector sales growth of 46.8% compared to 2019/20 forecast. The CSIR has also sought support from National Treasury to be exempted from the government tendering process for CSIR mandated services which will allow the CSIR to more effectively partner with the public sector to develop a capable state and deliver services aligned to national priorities. This will assist to mitigate the risks relating to the negative climate that has an effect on contracts not being secured as planned, delays on large contracts, and stringent legislative requirements resulting in time consuming tender processes.

Investment income is expected to amount to R43.8 million based on forecast rates of return on investment.

Table B.1 provides the high-level CSIR statement of comprehensive income reflecting the forecast for 2019/20 and the budget for 2020/21. A statement of comprehensive income for the Medium Term Expenditure Framework (MTEF) period is provided in Table B.2.

B.6.4 FINANCIAL SUSTAINABILITY (continued)

Table B.1: Statement of Comprehensive Income

	Forecast 2019/2020 R'000	Budget 2020/2021 R'000	Budget 2021/2022 R'000	Budget 2022/2023 R'000
Total Operating Revenue	**2 694 354**	**2 988 440**	**3 170 257**	**3 365 304**
R&D Contract Income	**1 926 973**	**2 205 384**	**2 362 526**	**2 526 493**
Public – South Africa	1 470 024	1 658 316	1 732 940	1 802 258
Private – South Africa	194 660	285 992	328 891	378 224
International	180 511	174 800	209 760	251 712
Parliamentary Grant – Ringfenced	81 778	86 276	90 935	94 299
Parliamentary Grant	**765 009**	**781 246**	**805 016**	**834 738**
Royalty Income	**2 360**	**1 810**	**2 715**	**4 073**
Other Income	**11**	**–**	**–**	**–**
Total Expenditure	**2 748 169**	**3 035 013**	**3 203 934**	**3 392 898**
Employees' Remuneration	1 596 602	1 765 662	1 871 410	1 983 694
Operating Expenses	1 044 832	1 122 617	1 185 484	1 251 871
Depreciation	106 735	144 157	147 040	157 333
Operating Profit before Investment Income	**(53 815)**	**(43 815)**	**(33 677)**	**(27 594)**
Investment Income	43 815	43 815	44 691	45 585
Net Profit before non-guaranteed employees' remuneration (Performance bonus)	**(10 000)**	**–**	**11 015**	**17 991**
Non-guaranteed employees' remuneration (Performance bonus)				
NET PROFIT	**(10 000)**	**–**	**11 015**	**17 991**

*Included in contract R&D income from the South African Public sector is the Cyber Infrastructure ring fenced allocation for SANReN and the CHPC.

B.6.4 FINANCIAL SUSTAINABILITY (continued)

Table B.2: Medium Term Expenditure Framework allocation to the CSIR (excl VAT)

	2020/2021 R'000	2021/2022 R'000	2022/2023 R'000
Baseline Parliamentary Grant	**781 246**	**805 016**	**834 738**
Parliamentary Grant	748 653	770 663	799 114
National Laser Centre	32 593	34 353	35 624
Ring fenced allocation	**307 989**	**324 157**	**338 768**
Laser Loan Programme	9 569	10 085	10 458
African Laser Centre	5 227	5 510	5 713
Implementation: ICT R&D Strategy	71 480	75 340	78 128
Cyber Infrastructure (NICIS)	221 713	233 222	244 469
TOTAL	**1 089 235**	**1 129 173**	**1 173 506**

B.6.5 STATEMENT OF FINANCIAL POSITION

A CSIR statement of the financial position for the MTEF period is provided in Appendix G.2. Table B.3 provides a summary projected balance sheet.

Table B.3: Projected CSIR statement of financial position

	FORECAST March 2020 R'000	BUDGET March 2021 R'000	BUDGET March 2022 R'000	BUDGET March 2023 R'000
ASSETS				
Non-Current assets	**759 460**	**720 303**	**693 263**	**685 930**
Property, plant and equipment	752 510	713 353	686 313	678 980
Interest in Joint Ventures and Associates	2 305	2 305	2 305	2 305
Interest in Subsidiaries	4 645	4 645	4 645	4 645
Trade and other receivables	–	–	–	–
Current Assets	**763 116**	**847 177**	**867 113**	**889 872**
Trade and other receivables	269 435	358 613	380 431	403 836
Inventory and contracts in progress	(646 645)	(657 457)	(697 457)	(740 367)
Cash and cash equivalents	1 140 325	1 146 021	1 184 139	1 226 403
TOTAL ASSETS	**1 522 576**	**1 567 480**	**1 560 376**	**1 575 802**
EQUITY AND LIABILITIES				
Reserves	**999 638**	**999 638**	**1 010 653**	**1 028 644**
Retained earnings	999 638	999 638	1 010 653	1 028 644
Non-current liabilities	**10 906**	**11 015**	**11 125**	**11 236**
Post retirement medical benefits	10 906	11 015	11 125	11 236
Current Liabilities	**512 031**	**556 826**	**538 598**	**536 031**
Advances received	134 718	149 422	126 810	100 959
Trade and other payables	377 314	407 404	411 787	435 072
TOTAL EQUITY AND LIABILITIES	**1 522 576**	**1 567 480**	**1 560 376**	**1 575 912**

One needs to consider the budgeted cash balance of R1.1 billion in conjunction with the current liabilities of R512 million. The current ratio (current assets/current liabilities) is expected to be approximately 1.5.

B.6.6 INVESTMENT IN PROPERTY, PLANT AND EQUIPMENT

The budgeted investment in property, plant and equipment for the 2020/21 financial year is R 105 million.

Notwithstanding the fact that an item is included in the property, plant and equipment budget, the investment remains subject to approval as per the Approval Framework of the CSIR and additional considerations such as strategic alignment, return on investment and available cash flow.

B.6.7 CSIR SUBSIDIARIES

Details of CSIR subsidiaries and associates are provided in Appendix G. The subsidiaries account for a marginal portion of the total Group's budget.

The CSIR and its subsidiaries do not pay dividends and, accordingly, have a zero dividend policy.

The five-year borrowing plan is provided in Appendix G.3.

B.6.8 GOVERNANCE

The CSIR will continue to sustain its role as a good corporate citizen through greater investments in implementing and effective B-BBEE programme and maintaining is environment, health and safety record.

To improve its B-BBEE Status, the CSIR will:

- Improve its performance on employment equity in line with its employment equity goals;
- Review it's B-BBEE strategy to ensure alignment with the new Codes of Practice;
- Develop an enterprise and supplier development framework; and
- Improve its preferential procurement spend.

Health and safety of CSIR employees and visitors will remain a priority in all CSIR operations and at all CSIR sites. The organisation will continue to focus on:

- Instilling a safety culture and improve staff behaviour and ownership at various levels in the organisation;
- Implementing an effective health and safety performance monitoring and evaluation system;
- Continually reviewing the organisation's health, safety and environmental management system to ensure effectiveness and efficiency; and
- Continued compliance to relevant legislation and to international health, safety and environmental standards such as OHSAS 18001 and ISO 14001.

B.7 Annual and quarterly targets: 2020/21

Table B.4: CSIR Quarterly Targets: 2019/20

Indicator	Q1	Q2	Q3	Q4
SO 1: Conduct research, development and innovation of transformative technologies and accelerate their diffusion				
KPI 01: Publication equivalents	87	183	297	390
KPI 02: New priority patent applications filed	0	1	1	5
KPI 03: New patents granted	3	6	10	15
KPI 04: New technology demonstrators	0	4	19	57
KPI 05: Number of technology licence agreements signed	0	5	12	26
SO2: Improve the competitiveness of high-impact industries to support South Africa's re-industrialisation by collaboratively developing, localising and implementing technology.				
KPI 06: Number of localised technologies	0	1	3	13
KPI 07: Number of joint technology development agreements being implemented for industry	3	10	20	31
KPI 08: Number of SMMEs supported	34	56	81	118
SO3: Drive socioeconomic transformation through RD&I that supports the development of a capable state				
KPI 09: Number of reports contributing to national policy development	1	3	8	19
KPI 10: Number of standards delivered or contributed in support of the state	1	3	6	11
KPI 11: Number of projects implemented to increase the capability of the state	6	13	22	35
SO 4: Build and transform human capital and infrastructure				
KPI 12: Total SET staff	1315	1350	1385	1410
KPI 13: – Percentage of SET staff who are black	63%	63%	63%	63%
KPI 14: – Percentage of SET staff who are female	37%	37%	37%	37%
KPI 15: – Percentage of SET staff with a PhD	21%	21%	22%	22%
KPI 16: Total Chief Researchers	13	13	14	15
KPI 17: – Percentage of chief researchers who are black	8%	8%	14%	20%
KPI 18: – Percentage of chief researchers who are female	13%	16%	22%	20%
KPI 19: Total Principal Researchers	156	163	172	184
KPI 20: – Percentage of principal researchers who are black	32%	34%	37%	37%
KPI 21: – Percentage of principal researchers who are female	15%	17%	19%	20%
KPI 22: Number of exchange programmess with industry	0	3	6	13
KPI 23: PPE investment (Rm)*	24	50	79	105
SO 5: Diversify income and maintain financial sustainability and good governance				
KPI 24: Total income (Rm)	694	1439	2457	2991
KPI 25: Net Profit (Rm)	-26	-15	-24	0
KPI 26: SA public sector income (% Total Income)	56%	56%	55%	55%
KPI 27: SA private sector income (% Total Income)	8%	8%	9%	10%
KPI 28: International contract income (% Total Income)	6%	6%	6%	6%
KPI 29: B-BBEE rating*	4	4	3	3
KPI 30: RIR*	2.0	2.0	2.0	2,0
KPI 31: Audit opinion				Unqualified audit opinion

B.8 RDI initiatives in Africa: 2020/21

CSIR developed a draft "Africa Strategy" in 2017 to stimulate and direct research, development and innovation activities in support of development and economic growth in the region (SADC) and the continent. In the 2020/21 financial year we will review and enhance the strategy to enable greater impact through Africa. The CSIR has ,however, continued to support African countries through a number of projects. In the coming financial year, we will build on these projects and initiate new programmes:

CLIMATE MODELING

Carry out long-term strategic observations and assessments of essential climate parameters in order to develop a thorough understanding of globally and locally significant earth system components that drive southern African climate. This will include:

- Completion of global and regional modeling systems and continued generation of detailed projections of future climate change across the African continent.
- Application of new urban and air quality modeling technologies; and
- Completion of crop yield and streamflow prediction capabilities for southern Africa

ACCELERATED PAVEMENT TESTING

The CSIR will develop, appropriate solutions for low - volume roads and capacity building in Africa and South- Asia through:

- Pilot implementation of cost-effective climate adaptation options in three African countries (Ethiopia, Ghana and Mozambique); and
- The establishment of Road Research Capacity in at least one African and Southeast Asian countries.

AFRICAN LASER CENTRE

CSIR will continue to manage the African Laser Centre programme which support 15 continental research collaborations, 15 post graduate students and 5 continental training events.

NEXTGEN HEALTH CLUSTER

The cluster will drive a number of projects with African collaborators including:

- African genetic diversity profiling;
- Development of point-of-care molecular diagnostic assays, devices and technologies for veterinary health diagnostics, particularly for agricultural, livestock, poultry, aqua-culture and wildlife industries;

B.8 RD&I INITIATIVES IN AFRICA: 2020/21 (continued)

- The development of novel POC multiplex assays for priority diseases in Africa that have a co-mobility effect such as HIV/Syphillis, HIV/TB etc; and
- The develop the framework for an African Digital Health Platform.

SANBIO

The CSIR has played a very pivotal role in the region in galvanising some of the technical gaps that befall our collaborating partners. CSIR has demonstrated the feasibility of human capital development with BIUST (Botswana) on Agroprocessing where specific training has been tested and in the pipeline for funding from the Botswana Innovation Hub. The CSIR and its spinoff Tokabio have been doing projects in Zambia (quail export regulation), Rwanda, Lesotho, Uganda and Angola. The company with CSIR support has trained technicians, veterinarian and agriculture experts from the region on the modern technologies for diseases surveillance. Through continued hosting of the NEPAD SANBio programme, and associated initiatives, the CSIR will drive the following programmes in the 2020/21 financial year:

- The FemBioBiz Programme is a NEPAD SANBio initiative and the biggest women entrepreneurship support programme in the SADC region. Eight African countries (Zimbabwe, Botswana, Malawi, Namibia, South Africa, Seychelles, Zambia and Mozambique) have formed a consortium and asked the CSIR to provide technical support towards product development through the BIDC.
- Support capacity building for the 4IR and technical incubation of their SMMEs to improve product quality. This programme will involve the CSIR platforms, BIDC, BIDF, NIDF and PPF and will be implemented over a 5 year period.
- Aquaculture programme outputs will include diagnostic technologies for aquaculture diseases such as the Tilapia Lake Virus, cost effective feed to enable small-scale farmers to grow in this sector, value addition to fish, and a regional/continental disease notification system for biosecurity.

C Governance Structure

The Executive Authority of the CSIR is the Minister of Science and Innovation. The Accounting Authority of the CSIR is the CSIR Board, duly appointed by the Minister. The Practice Note issued by National Treasury dealing with the Submission of Corporate Plans requires the inclusion of the following in the Corporate Plan:

- The composition of the Board of Directors and its subcommittees; and
- The members of the Executive Management team.

C.1 CSIR Board

The members of the CSIR Board are:

- Prof. Thokozani Majozi (Chairperson)
- Dr Thulani Dlamini (CEO)
- Ms Phindile Baleni
- Dr Amber-Robyn Childs
- Dr Ramatsemela Masango
- Mr Stafford Masie
- Ms Tiny Mokhabuki
- Dr Vuyo Mthethwa
- Mr Joel Netshitenzhe
- Dr Christine Render
- Mr Cassim Shariff

The Board has three sub-committees, namely Research, Development and Industrialisation; Audit and Risk; and HR and Social and Ethics (HRSEC). The members of these committees are as follows:

RESEARCH, DEVELOPMENT AND INDUSTRIALISATION COMMITTEE

- Dr Christine Render (Chairperson)
- Dr Amber-Robyn Childs
- Dr Ramatsemela Masango
- Mr Stafford Masie
- Mr Joel Netshitenzhe
- Mr Cassim Shariff

ARC

- Ms Tiny Mokhabuki (Chairperson)
- Ms Phindile Baleni
- Mr Stafford Masie
- Dr Christine Render
- Dr Vuyo Mthethwa

HR AND REMUNERATION COMMITTEE

- Dr Vuyo Mthethwa (Chairperson)
- Ms Phindile Baleni
- Dr Ramatsemela Masango
- Mr Cassim Shariff

Additional details on each board member are provided in Table C.1.

C.1 CSIR BOARD (continued)

Table C.1: CSIR Board

Age	Sex	Race	Qualification	Years	Position(s) on other Boards
Prof. Thokozani Majozi (Chairperson)					
46	Male	Black	*University of Manchester Institute of Science and Technology* PhD (Process Integration) *University of Natal* MSc (Engineering) BSc (Chemical Engineering)	5	*Director* A1 Consulting Engineers CC A2 Consulting Engineers CC Zyblue Pty Ltd
Dr. Thulani Dlamini (CEO)					
50	Male	Black	*University of the Witwatersrand* BSc Chemistry BSc (Hons) Chemistry PhD Chemistry, Catalysis *University of South Africa* Master of Business Leadership	3	*Council Member:* University of KwaZulu-Natal Council *Council Member:* National Advisory Council on Innovation (NACI) *Director* Vumelana Trade 120 CC Kusile Invest 125 CC Mavela Consulting Services CC
Dr Ramatsemela Masango					
44	Female	Black	*Pennsylvania State University* PhD (Nuclear Engineering) MSc (Nuclear Engineering) *Lyceum College* Diploma in Project Management *Cape Peninsula University of Technology* B.Tech Degree (Chemical Engineering)	5	*Executive Director* Mzansi Energy Solutions and Innovations Mzesi Energy Mzesi Academy Mzesi Holdings *Non-Executive Director* ArioGenix Face to Face Foundation Redhorn Holdings Mzesi Water & Construction Yonga Energy Tingo Technologies Amanzi Technologies Miyezi Investments Vito Ario Metapower Keavaya and Home

C.1 CSIR BOARD (continued)

Age	Sex	Race	Qualification	Years	Position(s) on other Boards
Dr Amber-Robyn Childs					
40	Female	White	*Rhodes University* PhD (Ichthyology) MSc (Cum Laude) (Ichthyology) BSc (Hons) Ichthyology BSc Ichthyology, Zoology, Mathematical Studies	1	None
Dr Christine Render					
62	Female	White	*Leeds University (England)* PhD (Chemical Engineering) BSc Hons. (Chemical Engineering)	1	None
Dr Vuyo Mthethwa					
52	Female	Black	*University of KwaZulu-Natal* PhD Higher Education governance	1	*Senior Director* Durban University of Technology Hucad CC Bizdom CC
Ms Phindile Baleni					
52	Female	Black	*University of the Witwatersrand* B.Proc LLB	5	*Employee (Director General)* Gauteng Provincial Government *Council Member (Non-remunerative)* Wits University Council *Board Member (Non-remunerative)* IIASA NMO (RSA) *Trustee (Non-remunerative)* Rev LW Mbethe Trust *Trust* First Rand Black Directors BEE Scheme
Mr Cassim Shariff					
50	Male		*Leicester Business School, DeMontfort University* Master's in Business Administration	1	*Director* Aquaworx Remediator & Infrastructure Solutions Lirazest Southern Cross Diamonds SDB Gas Indigo Diamond Trading Greenstone Energy Zinah Investments Acapulco Trade and Invest 149 Silver Crown Trading 25 *Shareholder* Opulent Energy

C.1 CSIR BOARD (continued)

Age	Sex	Race	Qualification	Years	Position(s) on other Boards
Mr Stafford Masie					
46	Male			1	*Non-Executive Director and Shares* Thumbzup South Africa Thumbzup Australia/AsiaPac Thumbzup International (London) Thumbzup USA Sauron AI ZA *Shareholder/Funder* Green Moon Transact *Executive Director and Shareholder* GATTACA SnapTutor Razologix *Shareholder* LRXYM *Non-Executive Director and Board Member* Advtech
Ms Tiny Mokhabuki					
37	Female	Black	*SAICA* CA (SA) *CIMA* Adv Dip in MA Acma, CGMA *University of KwaZulu-Natal* PGDA (with CTA) *University of the Witwatersrand* Bachelor of Commerce *Global Institute of Business Sciences* Aspen Management Programme	1	*Director* Business Entrepreneur Community (Dormant, Deregistration process) Equata World in a Bag Mokhabuki Building and Construction Sphimokha Digiten *Employee* Multichoice Support Services
Mr Joel Netshitenzhe					
63	Male	Black	*University of London* M.Sc (Financial Economics) Post-graduate Diploma (Economic Principles) *Institute of Social Sciences, Moscow* Diploma (Political Science)	5	*Executive Director* Mapungubwe Institute for Strategic Reflection *Director* Nedbank Group Nedbank Life Healthcare Group Camel Rock Trading 434 *Member* African National Congress NEC

C.2 Executive Management

A number of changes have been made to the CSIR Executive Portfolios in order to improve efficiency in the organisation. In particular, these changes have been implemented in order to address:

1. Misalignment between strategy and operations, leading to mixed messages and confusion in the organisation;
2. The need to better align our strategic partnerships with our investment strategy, innovation strategy and operations; and
3. Streamlining our decision-making and ensuring that there is single-point accountability.

To address these concerns and augment the impact of our key deliverables for organisational efficiency, the CSIR Executive Portfolios have been consolidated into the following portfolios:

- **Finance** – Vacant, Ms Nomcebo Monama acting.
- **Business Excellence and Integration** – Group Executive: Ms Khungeka Njobe
- **Chemicals, Agriculture, Food and Health** – Divisional Group Executive: Dr Rachel Chikwamba
- **Mining, Manufacturing, Defence and Security** – Divisional Group Executive: Dr Motodi Maserumule
- **Natural Resources, Enabling Infrastructure, Public and Professional Service**s – Vacant, Dr Thulani Dlamini acting
- **Human Capital** – Vacant, Mr Andile Mabindisa acting
- **Legal, Compliance and Business Enablement (LCBE)** – Group Executive: Adv Esmé Kennedy

Additional information on each member of the Executive Management Team is given in Table C.2.

C.2 EXECUTIVE MANAGEMENT (continued)

Table C.2: CSIR Executive Management

Age	Sex	Race	Qualification	Years	Position(s) on other Boards
Adv Esmé Kennedy. Group Executive: LCBE					
42	Female	White	*University of Pretoria* B.Proc *Potchefstroom University* LLB LLM (Import and Export Law) *High Court of South Africa* Admitted as an Advocate *General Council Bar of South Africa* *Admitted as member of the Johannesburg Bar* *University of the North West – Potchefstroom Business School* MBA	1	*Trustee* CSIR Pension Fund *Professional Membership* Institute of Directors S.A.
Mr Andile Mabindisa, Group Executive: HC (Acting)					
50	Male	Black	*University of Natal* B Soc Sc *University of Natal* B Sco Sc (Hons) *University of Natal* Postgraduate Diploma in IR	1	None
Dr Motodi Maserumule, Divisional Group Executive: Mining, Manufacturing, Defence and Security					
52	Male	Black	*Rensselaer Polytechnic Institute (USA)* PhD Mathematics *Clark Atlanta University* MSc Mathematics. Applied Math *Morris Brown College* BSc Mathematics *IMD, Lausanne, Switzerland* Mastering Technology Enterprise *SA National Defence College* Executive National Security Programme	1	*Professional Membership* Institute of Directors S.A. Society of Industrial and Applied Mathematics

C.2 EXECUTIVE MANAGEMENT (continued)

Age	Sex	Race	Qualification	Years	Position(s) on other Boards
Ms Nomcebo Monama, Chief Financial Officer (Acting)					
46	Female	Black	*Chartered Institute of Purchasing and Supply* *MCIPS* *Gordon Institute of Business Science* *Global Leadership Executive Programme* *University of Swaziland* *LLB* *University of Swaziland* *BA Law*	1 m	*Professional Membership* *Chartered Institute of Purchasing and Supply* *Chairperson of the Audit Committee – Government Communication and Information System*
Ms Khungeka Njobe, Group Executive: Business Excellence and Integration					
49	Female	Black	*University of Pretoria* M.Sc Zoology *University of California, Los Angeles (USA)* B.Sc (Hons), Biology *Santa Monica College (USA)* Associate Arts Degree *International Institute for Management Development (IMD), (Switzerland)* *Mastering Technology Enterprises (MTE)*	11m	*Sasol Khanyisa Public and Public Fundco RF* *Hans Merensky Foundation* *Fusion Energy Holdings* *Kay Ann Investments* *Professional Membership: Institute of Directors of SA*
Dr Rachel Chikwamba, Divisional Group Executive : Chemicals, Agriculture, Food and Health					
49	Female	Black	*University of Queensland* M.Sc (Agricultural studies) *Iowa State University* PhD (Genetics) *Gordon Institute of Business Science* MBA	14	*Member* Academy of Science of South Africa Global Governing Board, ICRISAT South African Medical Research Council Board *Advisory Board* Institute for Science and Technology Education, UNISA Wits Health Consortium (Pty) Limited *Chair of Advisory Board* Applied Centre for Climate & Earth System Science

D Risk Management Plan

D.1 Introduction

D.1.1 BACKGROUND

Every enterprise exists to provide optimal value for its stakeholders. All entities face uncertainty and the inherent risks therewith. The challenge for management is to determine how much risk (both upside and downside risk) to accept as it strives to grow stakeholder value. This is achieved through an effective system of risk management

Adequate and effective risk management is fundamental to sound corporate governance and is at the core of corporate governance frameworks. Risk management is both a corporate and individual responsibility. The establishment of effective systems of risk management underpins the framework of internal control. Risk management's primary tenet is the proactive identification and understanding of the factors and events that may impact the achievement of strategic and operational objectives, then managing, monitoring and reporting these risks. Therefore, effective risk management is not about eliminating or avoiding risks, but is concerned instead with anticipating and taking acceptable risks and managing them well, thereby increasing the enterprise's ability to proactively respond to risks and release value.

A thorough understanding of risk accepted by the CSIR in the pursuance of its SOs, together with those strategies employed to mitigate risks, is thus essential for a comprehensive appreciation of the CSIR's affairs by the Executive Management Committee (Exco) and the Board of Directors of the CSIR.

To this end, CSIR management is responsible for ensuring that all risks, both internal and external, faced by the CSIR are managed effectively. The approach to risk management utilised, provides a mechanism to specifically allocate responsibility and establish accountability for all risk management activities, i.e. a consolidated risk report culminating in a Risk Management Plan (RMP). The formalisation of risk management activities is achieved through the ARC, which recommends approval of the RMP to the CSIR Board of Directors. The RMP assists the CSIR to improve and sustain performance by enhancing its system of risk management to protect against adverse outcomes and optimise opportunities.

This document sets out the CSIR's RMP through the adoption of ERM. The CSIR has revised and reorganised its ERMS function, formerly known as Enterprise Risk Management Office (ERMO), to be fit for purpose. The repositioning of the ERMS function was informed by the drive to align to the organisational needs and requirements as defined by the new CSIR Strategy and new operating model.

D.1 INTRODUCTION (continued)

D.1.2 GLOSSARY OF TERMS AND ABBREVIATIONS

Throughout this document, unless otherwise stated, the word/abbreviation in the first column below have the meanings assigned to them in the second column (and cognate expressions shall bear corresponding meanings):

Abbreviation/Term	Meaning Ascribed
ARC	Audit and Risk Committee – a CSIR Board of Directors committee constituted for and tasked with reviewing the control, governance and risk management practices within the CSIR and determining appropriate policies, controls and procedures to manage them, proportionate to the risk or opportunity involved.
Combined Assurance Plan	Is a planned approach, based on continuous risk analysis, designed to highlight the relevant high risk areas and the assurance to be provided by management, compliance, external audit, internal audit and other consultants or service providers in order for the CSIR Board of Directors to be appraised of the risk management efforts undertaken to manage the risks to an acceptable level and for assessing the extent and the adequacy of assurance on key organisational risks and reporting on those risks to senior management and the ARC.
Control	Is a measure employed to modify risk, the existing risk processes, policy, devices, practices or other actions that act to minimise risks or to identify opportunities.
COSO	Committee of sponsoring organisations of the Treadway Commission (an international risk management standard).
DSI	Department of Science and Innovation.
ERM	Enterprise Risk Management.
ERMO	Enterprise Risk Management Office.
ERMS	Enterprise Risk Management Services.
Event	Is an occurrence or a change of a particular set of circumstances.
Exco	Executive Management Committee.
Inherent risk	The exposure arising from risk factors in the absence of deliberate management intervention(s) to exercise control over such factors.
Institutional Review Report	The report generated periodically in terms of section 3 of the 1997 White Paper on Science and Technology requiring periodic institutional reviews to be carried out on SET institutions by and independent panel.
Internal Control	Is a system designed to promote efficiency, to assure the implementation of a policy to safeguard assets or avoid fraud and error. These set of rules/measures are put in place to prevent or to mitigate an undesired event or condition.

D.1 INTRODUCTION (continued)

Abbreviation/Term	Meaning Ascribed
ISO 31000	ISO 31000 is a family of standards relating to risk management codified by the International Organisation for Standardisation that provides generic guidelines for the design, implementation and maintenance of risk management processes throughout an organisation.
King IV	The King IV Report on Corporate Governance for South Africa, 2016.
PFMA	Public Finance Management Act (Act 1 of 1999), as amended.
Residual risk	The remaining risk exposure after management has put measures in place to control the inherent risk.
Risk	An unwanted outcome, actual or potential, to the CSIR's performance objective caused by the presence of risk factors (may also present as an upside potential available for exploitation).
Risk tolerance	The amount of residual risk an organisation is willing to accept.
Risk factor	Any threat or event that creates or has the potential to create risk.
Risk management	A systematic and formalised process to identify, assess, manage/mitigate and monitor risks.
Risk owner	The person accountable for managing a particular risk.

D.1.3 LEGISLATIVE CONTEXT

The CSIR RMP has been developed in terms of the prescripts of applicable legislation, including, but not limited to:

- The PFMA;
- Treasury Regulations issued in terms of the PFMA;
- The Scientific Research Council Act;
- Occupational Health and Safety Act, 1993 (Act 85 of 1993), as amended by the Occupational Health and Safety Amendment Act, 1993 (Act 181 of 1993); and
- Labour Relations Act.

The CSIR RMP also incorporates the requirements of the King IV Report on Corporate Governance for South Africa (King IV), aas far as it concerns risk management, as well as the principles of ISO 31000 and COSO.

D.2 CSIR RMP

D.2.1 RISK MANAGEMENT PHILOSOPHY

The CSIR maintains a broad view of risk as any event, positive or negative, that could affect its ability to achieve its mandate, mission, vision, and SOs.

The CSIR acknowledges that risk, in one form or another, is present in virtually all its endeavours, and that successful risk-taking will often be necessary to achieve SOs. Therefore, the CSIR does not seek to eliminate all risk, but seeks to be risk-aware as opposed to risk-averse, and to manage the uncertainty inherent in its environment effectively.

To this end, the CSIR seeks to identify, understand, assess, and respond to the risks and opportunities faced, taking into account their impact on CSIR resources, reputational standing, financial position, and performance. Furthermore, the CSIR seeks to pursue and leverage prudent risks opportunities that support sustainable performance and value, avoid intolerable risks, manage residual risk within defined levels, and be prepared to respond to risks and opportunities when necessary.

For the 2020/21 financial year, the CSIR will put structures in place to embed a combined assurance model. CSIR Exco and the Board of Directors, acting through the ARC, will assess the CSIR risk philosophy on an annual basis, and report and implement any recommended and approved changes.

To ensure that there is no uncertainty among employees and stakeholders about the policies and procedures that shape the CSIR's approach to risk management, the CSIR develops and implements a dedicated Risk Management Policy and Risk Tolerance and Tolerance Framework aligned with the RMP and the associated strategy.

D.2.2 PURPOSE OF THE RMP

The CSIR RMP is developed to support the successful implementation of the CSIR Strategy, and to outline what risk management activities are necessary during the financial year. In addition, the RMP aims to entrench a risk management culture throughout CSIR, creating a corporate culture aligned with the CSIR's core organisational values, namely (EPIC).

These planned activities form the basis for quarterly reporting to the DSI as required by the DSI Governance Framework. The development of the RMP for 2020/21 takes into account the CSIR Strategic Plan and the Annual Performance Plan for the year.

The CSIR approach to the identification and treatment of risks is informed by the King IV principles and applied in accordance with the principles and guidelines of ISO 31000. Risk management, as set out in King IV, addresses a wider spectrum of risk than in the past. In addition, the corporate governance drivers behind risk management today require new ways of reporting and monitoring the CSIR's risk exposures. In addition, the CSIR is on a journey to embed and mature risk management, and its reporting and monitoring, within core business activities. Therefore, it is important to note that the RMP is, by necessity, an evolving risk management instrument. The contents of the plan

D.2 CSIR RMP (continued)

reflect the current risk management requirements of the CSIR. The document is reviewed and updated annually by the ARC of the CSIR Board.

The concept of "enterprise" is the undertaking of risk for reward. In support of positively undertaking "enterprise" a comprehensive understanding of the risks, and their associated risk mitigations, accepted by an organisation in pursuance of its SOs is essential. Risk management is the capability of proactively identifying and understanding the factors and events that may impact the achievement of strategic and operational objectives, then managing, monitoring and reporting these risks. Good risk management is not about eliminating or avoiding risks, but rather taking acceptable risks and managing them well. The CSIR manages its risks through the adoption of the practice of ERM.

ERM is a process applied in strategy determination, and across all organisational operations, to identify potential events that may affect the entity. It enables the management of associated event risks to be within the acceptable levels and to provide reasonable assurance regarding the achievement of entity objectives in the face of uncertainty. Uncertainty presents both negative risk and opportunity, with the potential to erode or enhance value. ERM enables the organisation to deal with uncertainty and associated risk and opportunity effectively, enhancing the capacity to build value. Value is maximised when management sets objectives to achieve an optimal balance between growth and related risks, and effectively deploys resources in pursuit of the entity's objectives.

ERM, when applied to all aspects of the organisation, assists the CSIR in making informed choices which:

- Provide assurance that current significant risks are managed effectively;
- Improve business performance by assisting and improving decision-making and planning;
- Promote a more innovative, less risk averse culture in which the taking of calculated risks in pursuit of opportunities to benefit the organisation is encouraged; and
- Provide a sound basis for integrated risk management and internal control as components of good corporate governance.

The benefits accrued to the CSIR through the adoption of ERM include:

- Alignment of risk and strategy;
- Enhanced risk response decisions;
- Reduced operational surprises and losses;
- Identification and management of multiple cross-enterprise risks;
- Leveraged opportunities;
- Improved deployment of resources; and
- Increased probability of enterprise success.

D.2.3 SCOPE OF APPLICATION

The RMP applies to all business activities of the CSIR.

D.3 Components of the CSIR RMP

The CSIR manages risk through a well-defined governance model. Each component of this governance model is defined through a number of supplementary guidelines, templates and implementation tools that provide clarity and enhancement for stakeholder use and ensure a single approach to enterprise wide risk management. The governance model comprises the elements outlined below.

D.3.1 RISK GOVERNANCE MODEL AND FRAMEWORK

The CSIR adheres to a three lines of defence model when approaching risk management as outlined in Figure 1 below:

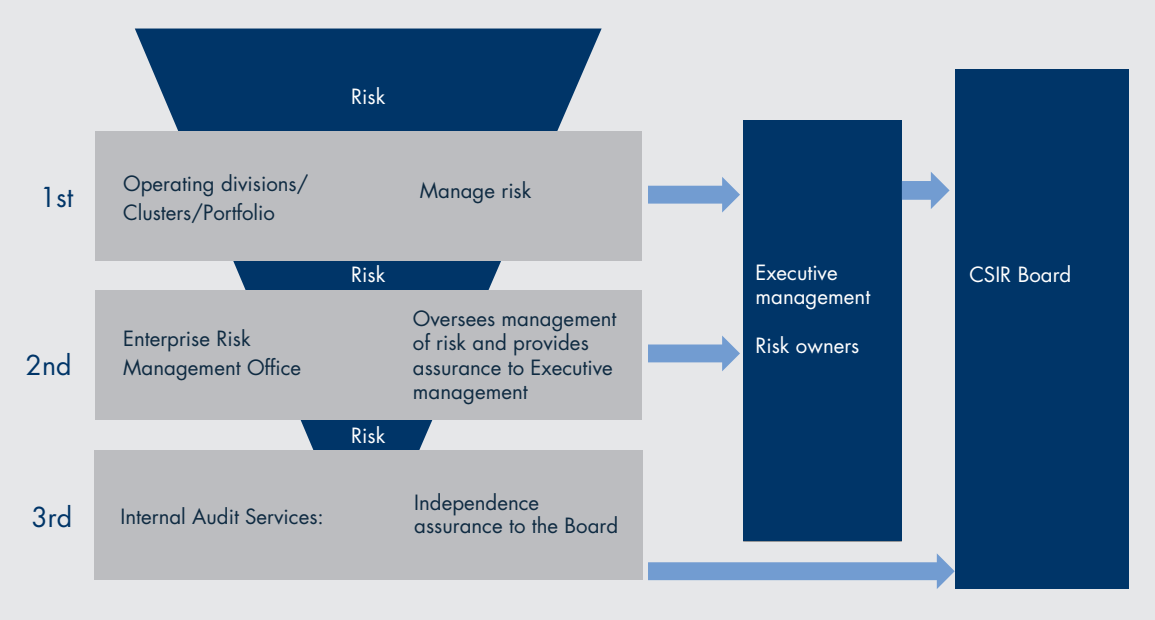


Figure D.1: CSIR Three Lines of Defence Model

As this model illustrates, the ownership and management of risk lies with those who undertake the operations within the organisation. Operational staff are also responsible for implementing corrective actions to address process and control deficiencies, for maintaining effective internal controls, and for executing risk and control procedures on a day-to-day basis. They identify, assess and mitigate risks, guiding the development and implementation of internal policies and procedures and ensuring that activities are consistent with goals and objectives.

ERMS coordinates the management of risk in support of the risk owners (Exco), who, in turn, report to the Board of Directors. The latter remains ultimately accountable for the governance of risk. The Internal Audit function provides independent assurance directly to the Board of Directors on the effectiveness of risk management frameworks, systems and implementation. ERMS, Internal Audit and Compliance are the joint custodians of the combined

D.3 COMPONENTS OF THE CSIR RMP (continued)

assurance model, which incorporates and optimises all assurance services and functions so that, taken as a whole, these enable an effective control environment, support the integrity of information used for decision-making by management, the Board of Directors and its committees; and support the integrity of the organisation's external reports. King IV's recommendations do not prescribe the design of the model, but allow for the governing body to exercise its judgement in this regard.

Robust oversight by the Board of Directors and Exco, establishes the cornerstone of effective risk management. To give effect to their fiduciary responsibility, the Board is supported by the ARC. The ARC is an oversight body with the delegated responsibility of implementating an effective risk strategy, supported by an appropriate risk management framework that include adequate control mechanisms to ensure effective risk management. The ARC also reviews the overall effectiveness of risk management structures and response strategies.

D.3.2 RISK MANAGEMENT FRAMEWORK OVERVIEW

The main elements of the CSIR's risk management framework, as per the ISO 31000 standard, are reflected in the Risk Management Process depicted in Figure 2.

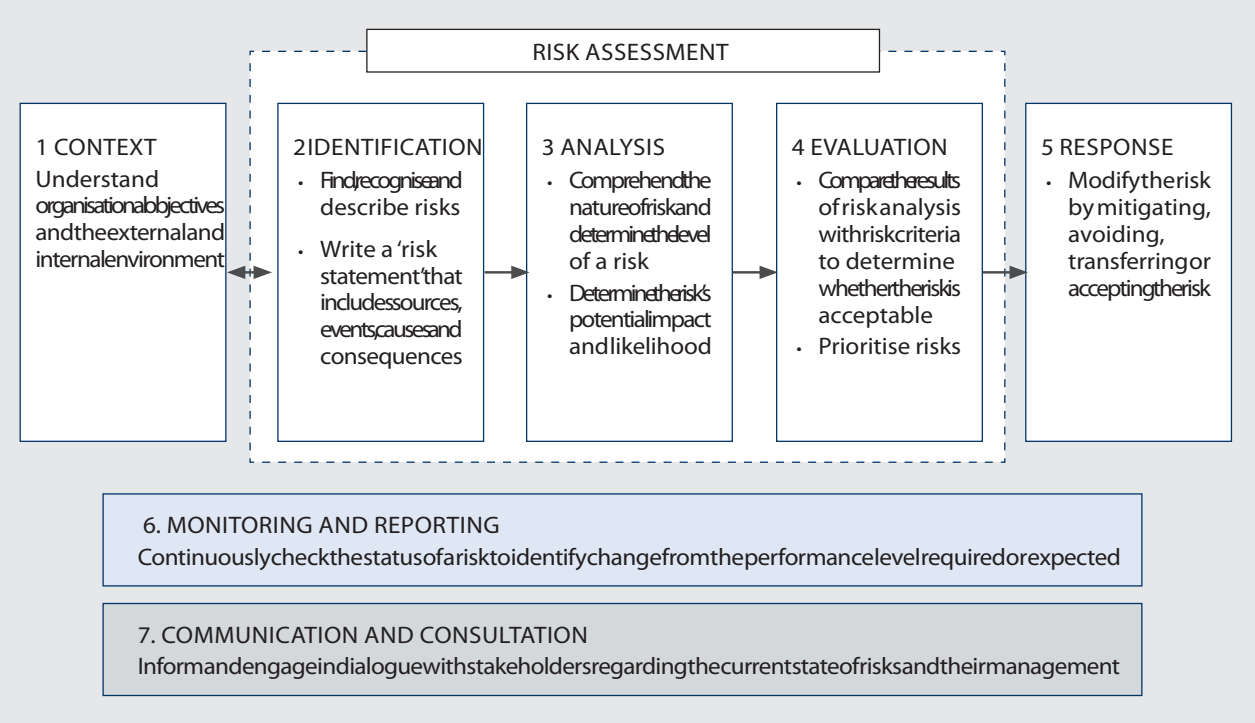


Figure D.2: Risk Management Process

D.3 COMPONENTS OF THE CSIR RMP (continued)

A general description of each step of the process is given in the following sections.

D.3.3 ESTABLISHING THE RISK CONTEXT

Determining and periodically reviewing the CSIR risk context to establish a common understanding of the risk universe affecting strategic objective achievement needs to be taken into account, as per Figure 3. This environment remains in flux. Therefore, the relevant risk universe is continuously reviewed, updated and agreed upon.

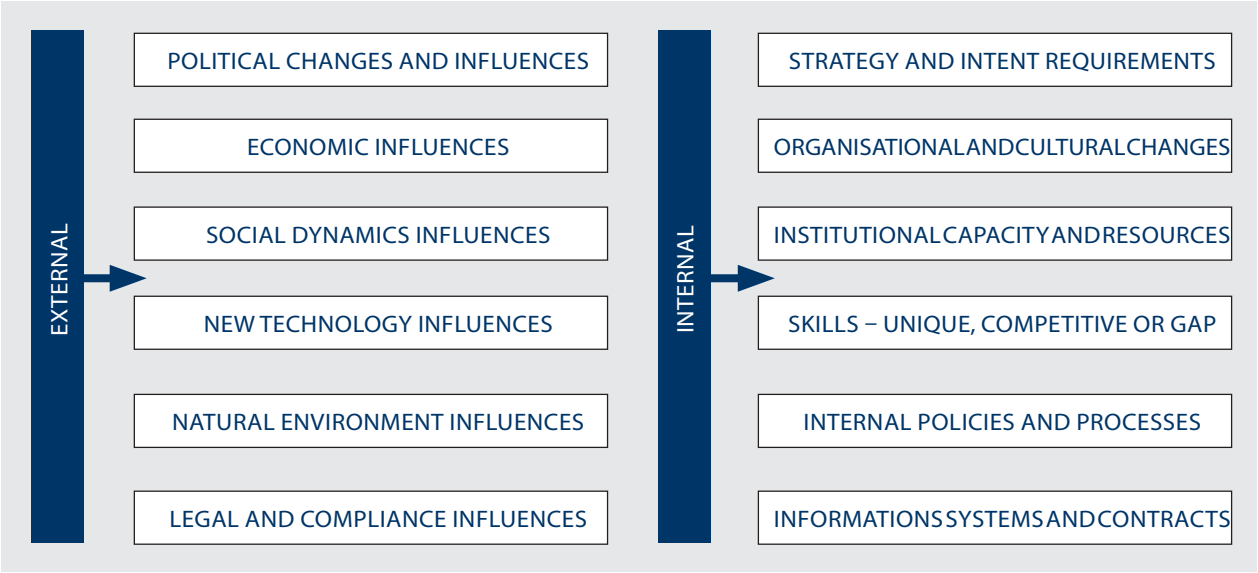


Figure D.3: Risk Context

As the ownership and management of risk lies primarily with those who undertake operations within the organisation, the CSIR's operational and portfolio management is largely responsible for identifying risk within the frameworks set by ERMS. ERMS consolidates the risk universe for further analysis, development of informed risk mitigation strategies and eventual agreement, based on relevance and potential impact.

D.3.4 THE RISK ASSESSMENT PROCESS

In aligning the systematic approach taken for risk management to ISO 31000, the following steps are undertaken:

- Profiling the key aspects of the CSIR and the context in which the organisation operates to highlight dependencies, critical parts of the business and to pinpoint (potential) vulnerabilities. Identifying and understand organisational objectives – the ultimate objectives of the CSIR guide the risk tolerance within each operational area, while adhering to the prescribed (by ARC) overall CSIR risk tolerance mandate. The profile of the individual operating environment objectives should take into consideration:
  - Revenue and expenditure targets,
  - Customer objectives and targets,
  - Socioeconomic targets, and
  - Other business objectives;

D.3 COMPONENTS OF THE CSIR RMP (continued)

- Identifying and understanding operational activities;
- Identifying and categorising/prioritising risks;
- Determining risk response strategising/identifying current controls/risk mitigation - putting controls in place to manage the risk. The approaches to risk mitigation are tolerate, treat, transfer or to terminate the activities that give rise to the risk;
- Determining an action plan, responsible person and the target date;
- Developing risk registers - in order to enable the comparison and consolidation of the different risk registers in CSIR, a common risk register structure has been adopted and an in-house tool will be introduced in the 2020 / 2021 financial year to provide alignment and escalation-tracking, as well as multilevel dashboard reporting;
- Monitoring and reviewing the risk and the response to it; and
- Reporting.

Risk Identification and Categorisation

Risk identification involves the identification of risk sources and events, their causes and potential consequences. Management meetings, strategy sessions, engagements with heads of divisions, clusters, research centres and portfolios are all part of the risk identification process.

The process of identifying top risks also entails the:

- Review of historical top risks and current relevance and threat assessment;
- Review of the CSIR's external operating environment through external macro-economic risk monitoring specialists;
- Consideration of the organisational strategy and risk implications;
- Review of CSIR strategy work stream reports;
- Review of the CSIR Institutional Review Report;
- Review of the CSIR operating model;
- Analysis of internal audit reports and reporting through a combined assurance model, highlighting weaknesses in the control environment; and
- Analysis of organisational incidents, lessons learnt and current local and international incident trends.

Risk Analysis and Evaluation to Determine Prioritisation

The outcomes of the risk identification and classification processes are compiled into risk registers within each operational area of the organisation. An escalation process is utilised, as outlined in Figure 4, wherein each level of the organisation identifies, evaluates and then prioritises the risks it faces, and reports the major risks to the next level in the organisation.

D.3 COMPONENTS OF THE CSIR RMP (continued)

Risks are thus identified for each cluster or portfolio in CSIR, with major risks reported to the next level, ultimately culminating in the formulation of the CSIR's top risks. This escalation process involves executive-level, in-depth analysis of risks that might not be identified at the level below, but which often represent the most critical risks for the organisation as a whole. All operational areas are required to compile a risk register and maintain it continuously through risk assessment workshops coordinated by ERMS.

Risk registers are reviewed and updated on a quarterly basis through meetings with risk and action plan owners coordinated by ERMS. After any strategic, policy, mandate or structural change, a risk assessment workshop is conducted to review and update the applicable risk register.

Risks in the CSIR have been classified into the following three broad categories:

- Systemic risks - originate from macro-economic and national challenges affecting the NSI and National Government Business Enterprise space in which the CSIR operates;
- Strategic risks – risks that directly impact the ability of the CSIR to deliver on its SOs and statutory mandate; and
- Operational risks - include financial, legal and compliance risks and are those risks that affect the systems, people and processes through which the CSIR operates.

Assessing and prioritising the total identified risk universe consists of a detailed classification and analysis of the likely impact and likelihood of occurrence of a risk. A consequence/impact table is used in this process with clearly defined parameters that express the consequence/impact for each category of risk in order to determine the inherent risk, i.e., risk without controls. An assessment of the effectiveness of the controls is done to determine the residual risks and prioritisation of the risks, including additional controls required to mitigate the risk further and escalation to the relevant levels.

In order to enable the comparison and consolidation of the different risk registers in the CSIR, a common risk register structure has been adopted. Annexure A to this document identifies the top organisational risks that have been identified through the bottom-up risk evaluation process. The process is based on the following:

- Risks are identified from the bottom up and require analysis by each level of the specific risks pertaining to that level, culminating in a top down evaluation to determine organisational relevance and the top organisational risks; and
- Risk management is integrated into existing management processes, such as planning, budgeting and performance management and evaluation.

D.3 COMPONENTS OF THE CSIR RMP (continued)

The risk register, as well as the management of risk events, is built and managed through an escalation from project level to division/cluster/portfolio level as illustrated by the following diagram:

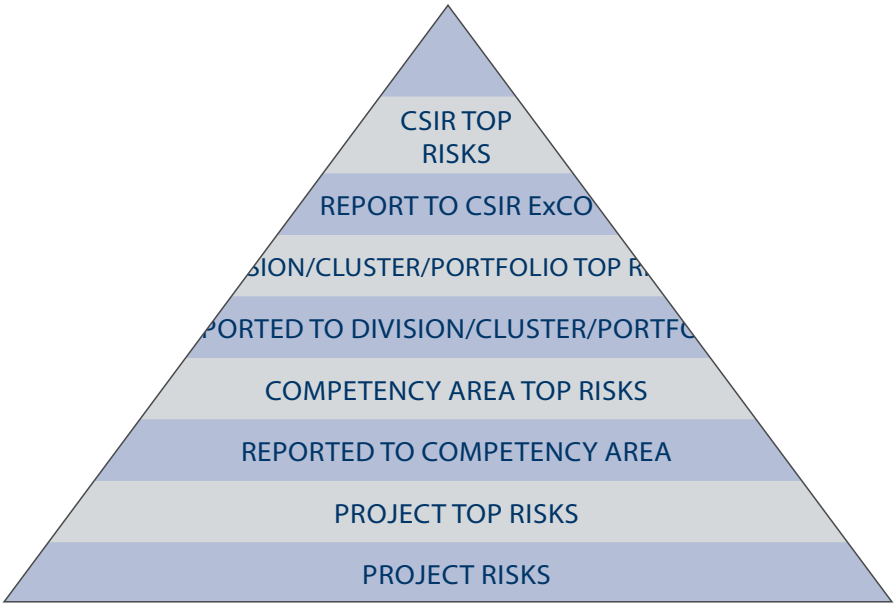


Figure D.4: Risk Escalation

Risk Mitigation

Risk mitigation entails implementing controls to manage the risk. This involves the options listed below:

- **Tolerate** – accepting the risk by keeping activities unchanged. This option is applied when exposure is tolerable, control is impossible or the cost of control exceeds potential benefit. The question of whether a particular risk can be tolerated is a key management decision;
- **Treat** – adjusting (adding or revising) relevant activities;
- **Transfer** – sharing the risk by involving relevant stakeholders. This works well for financial risks and risks to assets, and includes securing conventional insurance or sourcing a third party to manage or undertake the risk; and
- **Terminate** – avoiding or cancelling the activities that give rise to the risk after considering the cost/benefit analysis.

D.3 COMPONENTS OF THE CSIR RMP (continued)

Mitigation strategies are translated into mitigation activities with defined implementation timelines. For those areas and items for which the risk owner recommends the option "treat", i.e. mitigate the risk, actions are taken to reduce the probability of the risk occurring or to reduce the impact of the risk. Mitigation measures are also linked to the best use of resources.

Mitigation strategies consider the results/reports of the combined assurance efforts and ensure that appropriate action is taken to address identified areas for improvement.

D.3.5 MONITORING AND REPORTING

After the establishment of a detailed risk register and associated mitigation strategies, each risk is monitored by ERMS, in partnership with the risk owner, to verify implementation of the proposed mitigation strategies. ERMS also facilitates the review of the risks taking into consideration:

- Changes in the assessment of the risk;
- Changes to risks as forced by the macro environment;
- Suggested changes to the risk mitigation strategy; and
- Progress made against the detailed action plans.

Internal audits and ad hoc risk assessments, either in accordance with the combined assurance plan or due to a perceived risk, will be undertaken to monitor and evaluate the extent of compliance with policies, procedures and proposed controls. The role of the Internal Audit function is to actively monitor the internal and external environment and, if identified risks are not responded to appropriately, to be the catalyst for ensuring that risk mitigation strategies are continually tested and advanced to address risk effectively.

Furthermore, the CSIR will establish a combined assurance collaboration forum to steer and take responsibility for the CSIR RMP, and ensure the effective implementation thereof, in support of combined assurance, and ensuring that key risks are being managed appropriately.

The objectives of the combined assurance collaboration forum will mainly be to:

- Identify and specify the sources of assurance on the CSIR's risk mitigation initiatives;
- Provide the ARC, the Accounting Officer and Executive Management with a framework of the various assurance parties;
- Link risk management activities with assurance activities;
- Assist the Accounting Officer to review the effectiveness of the risk management system; and
- Provide a basis for identifying any areas of potential assurance gaps.

D.3 COMPONENTS OF THE CSIR RMP (continued)

In compliance with King IV, the CSIR Board of Directors will receive assurance regarding the effectiveness of the RMP through the following principles:

- On a monthly basis, ERMS will provide Exco with progress updates against the combined assurance plan and progress against the implementation of the RMP.
- On a quarterly basis, ERMS will provide assurance to Exco that the RMP has been integrated into the daily activities of the CSIR. The CSIR CEO, as part of his quarterly report to the Board of Directors, will provide assurance to the Board of Directors, via the ARC, on the effectiveness of the risk management system;
- On a quarterly basis, the Enterprise Risk Manager will provide assurance to the Board of Directors that the planned risk management activities are being implemented according to this RMP. This assurance shall be communicated to the Board of Directors via the ARC; and
- On a quarterly basis, the Internal Audit function will provide a written assessment of the effectiveness of the system of internal controls and risk management to the Board of Directors via the ARC.

Risk monitoring is an integral part of the CSIR RMP as it gives assurance that measures remain effective, and ensures that the Board of Directors discharge their duty of ensuring effective and continual monitoring of risk management.,

D.4 Conclusion

The CSIR consequently proposes a proactive approach towards risk management and will continue to take the necessary measures to improve is ERM practices. The top risks identified for the CSIR for the financial year 2020/21 are depicted in Annexure A hereto.

Annexure A

SYSTEMIC RISKS:

These are risks that originate from macro-economic and national challenges that affect the NSI and National Government Business Enterprise space in which the CSIR operates.

1. Systemic risks: These are risks that originate from macro-economic and national challenges affecting the National System of Innovation and National Government Business Enterprise space in which the CSIR operates

1.1 Risk Description: Regulatory constraints to delivery on the CSIR mandate.

Risk Source:
2018 CSIR Institutional Review Report
CSIR Portfolio Risk Identification Workshops
CSIR Divisional Risk Identification Workshops

Detail Risk Definition	Risk Impact	Inherent Risk Rating	Mitigation Controls Implemented	% Completion	Residual Risk Rating	Additional Controls	Required End State Risk Rating	Risk Movement
Collaborative initiatives treated by National Treasury (NT) as standard Public Sector Procurement → inhibits competitiveness and market agility.	1. Compromised financial sustainability. 2. Inhibited delivery on mandate. 3. Increased risk of irregular expenditure. 4. Protracted NT dependent procurement and tendering processes.	High	1. CSIR leadership engagement with National Treasury and DSI Director General (DG) on the exemption process. 2. Engage National Treasury regarding CSIR mandate and operating model. 3. Appointment of the business development and commercialisation managers in the divisions. 4. CSIR (client facing) line management continuously engage clients (In the private and public sectors) on the CSIR mandate and requirements for NT tendering process	20% completed. Engagement with all stakeholders still ongoing. The engagements with DSI and NT are ongoing and the necessary impact has not yet been realised.	High	• Continuously engage Shareholder on continued negotiations with policy owners. • Document processes followed for consortiums present to NT.	Medium	1. Risk has not moved, due to nature of the risk traction and impact to be seen in long term - engagement with revised shareholders structure planned to implement revised risk response. 2. The DG DSI wrote a letter to NT to address the exemption. 3. The DG (DSI) has request the CSIR to identify the NT legislations, instructions and practice notes that pose challenges and hindrances when dealing with the procurement process. 4. The issue was also discussed at the budget meeting between the DSI and CSIR.

1.2 Risk Description: Macro-economic environment - market conditions and local economic downturn

Risk Source:
2019 South African Risk Report
CSIR Portfolio Risk Identification Workshops
CSIR Divisional Risk Identification Workshops

Detail Risk Definition	Risk Impact	Inherent Risk Rating	Mitigation Controls Implemented	% Completion	Residual Risk Rating	Additional Controls	Required End State Risk Rating	Risk Movement
Local economic downturn results in added cost pressures due to inflation, increased overheads and maintenance related costs. Economic instability could potentially affect the levels of foreign revenue secured and the operating cost profile due to exchange rate pressure. Low appetite by private and public sector to fund/invest in R&D initiatives. Unfavourable profile rating-by-the rating agencies. 4th industrial revolution introducing technological changes, making indigenous/ old technologies and working methods redundant.	1. Impact on financial sustainability - hampers CSIR's ability to deliver on its mandate 2. Deferred/ delayed realisation of strategic objectives.	High	1. Continued rollout and implementation of the CSIR strategy. 2. Build capacity (Capacity through the cluster executives as well as business development and commercialisation managers) for monitoring and reaction to macro-economic events - agile responsiveness. 3. Increased focus and drive towards income generating product commercialisation and income diversification 4. Opportunity identification aligned to market demand 5. Appointment of level 4&5 in the line business completed and is expected to improve responsiveness to economic and market conditions.	70%-80% complete. The CSIR year to date performance has shown significant improvement compared to the previous reporting. This shows that the CSIR still manage to reach targets even under the tough economic and market conditions. Short-term optimisation of organisational resources targeted at reduced overhead and increased revenue generating output – experiencing some delays in full implementation	Medium	1. Streamline costs by redesigning organisation that is fit for purpose as defined in the CSIR operating model. 2. Establish business development capability with scope to source international funding. 3. Drive commercialisation of technology.	Medium	1. A significant risk movement will be visible when the local and global economic and market conditions become positive. 2. Delays and challenges in the implementation of the revised support structure introduce inefficient support services to the line business, therefore impacting negatively on the responsiveness to business opportunities (The delays defeats the desired fit-for-purpose structure that enables agility). 3. Strategy implementation on track - impact to be seen in medium to long term

2. Strategic risks: These are risks that directly impact on the ability of the CSIR to deliver on its mandate								
2.1 Risk Description: Successful implementation of the CSIR strategy **Risk Source:** Project Synapse Risk Register 2018 CSIR Institutional Review Report CSIR Portfolio Risk Identification Workshops CSIR Divisional Risk Identification Workshops								
Detail Risk Definition	**Risk Impact**	**Inherent Risk Rating**	**Mitigation Controls Implemented**	**% Completion**	**Residual Risk Rating**	**Additional Controls**	**Required End State Risk Rating**	**Risk Movement**
Comprehensive and complex strategy implementation requiring significant change management with corresponding impact on organisational business and operating model.	1. Impact on financial sustainability - hampers CSIR's ability to deliver on mandate. 2. Deferred/ delayed realisation of strategic objectives. 3. Loss of key human capital.	High	1. Drive execution of strategy implementation plan. 2. CSIR has established a nerve centre that is used to drive the implementation of the key initiatives that will ensure the implementation and delivery of the strategy 3. Bi-weekly strategy implementation steering committee 4. Deploy a team of dedicated implementation staff and organisation wide change agents. 5. Collaborate with key stakeholders on CSIR strategy. 6. Deploy strategy communication plan and stakeholder engagement plan. 7. Develop and implement a human capital strategy and plan.	1. 60-70% - change management initiatives being deployed to manage impact. 2. Change agent forum established. 3. CSIR strategy implementation unit established. 4. Regular business plans reviews and monitoring process.	Medium	1. Human capital retention strategy and resource development initiatives underway. 2. Recruit for key vacant positions and roles to deliver on the strategy. 3. Clear milestones for strategy roll out. 4. Regular staff engagement by cluster executives.	Low	1. Risk is reducing incrementally - risk rating to be maintained until organisational stability more evident, in particular with regard to HC retention and attraction of skills to deliver on strategy. 2. The development and implementation of the terms of reference (ToR) and change activity plan by CAF. 3. Summarised booklet on the new strategy being finalised (Currently with the CEO for review. 4. Delays and challenges in the implementation of the revised support structure introduce delays into the full implementation of the strategy.

3. Operational risks: These include financial, legal and compliance risks and are those risks affecting the systems, people and processes through which the CSIR operates

3.1 Risk Description: Inadequate business operating systems and lacking integration

Risk Source:
Project Synapse Operating Environment Work stream
CSIR Portfolio Risk Identification Workshops
CSIR Divisional Risk Identification Workshops
AT Kearney external benchmark and capability assessment

Detail Risk Definition	Risk Impact	Inherent Risk Rating	Mitigation Controls Implemented	% Completion	Residual Risk Rating	Additional Controls	Required End State Risk Rating	Risk Movement
Reduced productivity, higher manpower requirements and lack of agility in responding to business intelligence requirements due to lack of digitised, integrated business operating systems.	1. Lack of agility and responsiveness to business intelligence requirements. 2. Increased manpower requirements. 3. Cumbersome manual data analysis hampering agility. 4. Frustration and inefficiency for stakeholders.	High	1.Use of current ICT systems to support the CSIR operations 2. Manual controls to supplement and integrate with systems/ automated controls	10% -20% ICT strategy development on tender. The required mitigation controls will mature with the implementation of the ICT strategy.	High	1. Develop and implement ICT strategy (Develop and plan holistic and strategic integrated systems improvement and implementation to achieve agility, data integrity and seamless reporting). 2. Portfolio, programme and project management capability development - proof of concept. 3. CRM - testing phase. 4. CSIR Systems reconfiguration to align with revised Operating Model - 80% complete. 5. Various operational infrastructure improvements in various stages of implementation.	Low	No risk movement. Lack of systems integration and multiple sources of data continue to be indicated as severe pain points for the organisation. Impact of recent developments in financial reporting systems is yet to be demonstrated. The development and implementation of the ICT strategy with have a medium to long-term positive impact on systems and infrastructure integration.

3.2 Risk Description: Lack of adequate human capital capacity to deliver on the CSIR strategic objectives and to respond to market needs/requirements

Risk Source:
Project Synapse Risk Register
2018 CSIR Institutional Review Report
CSIR Portfolio Risk Identification Workshops
CSIR Divisional Risk Identification Workshops
AT Kearney external benchmark and capability assessment

Detail Risk Definition	Risk Impact	Inherent Risk Rating	Mitigation Controls Implemented	% Completion	Residual Risk Rating	Additional Controls	Required End State Risk Rating	Risk Movement
1. Loss of key SET-base skills to the market 2. Inadequate and low supply of the SET-base skills by the labour market (skills demand exceeds the supply). 3. Human capital strategy not addressing staff retention and skills attraction. 4. Positions becoming redundant as a result of changes in the business, stakeholder needs, industry, technology and government policy.	1. Resource compliment and skills sets not available to exploit market opportunities fully. 2. Inability to diversify income sources. 3. Financial losses and aggravating constraint to continued financial feasibility.	High	1. Human capital strategy development and implementation. 2. Retention and human capital development strategy development and implementation. 3. Level 4&5 appointments in the line is completed. 4. PHD is a requirement for certain level 4 & 5 positions. This is to pursue scientific excellence value proposition.	1. 1. Strategy presentation Q1 FY2019/20 - 100%. 2. Implementation Q2-Q4 FY2019/20.	Medium	1. Develop and implement a robust and comprehensive human capital strategy and related policies that will boost the recognition of the CSIR as an employer of choice by introducing: • Flexible Working Practices • Talent Mapping (High Potential candidates identification) • Succession Planning • Career pathing • Leadership Programmes • On boarding Revitalisation Programme • CSI activities • Develop and effectively 2. Implement bursary programmes, internship/mentoring programmes, Pipeline development and graduate programmes.	Low	1. Risk impact anticipated in medium- to long-term - risk remains medium with continued exit of staff. 2. NT remuneration limitations currently under discussion could impact risk rating negatively. 4. Challenges being experienced with the implementation of the revised operating model for support functions.

3.3 Risk Description: Poor Health and Safety Culture

Risk Source:
Project Synapse Risk Register
2018 CSIR Institutional Review Report
CSIR Portfolio Risk Identification Workshops
CSIR Divisional Risk Identification Workshops

Detail Risk Definition	Risk Impact	Inherent Risk Rating	Mitigation Controls Implemented	% Completion	Residual Risk Rating	Additional Controls	Required End State Risk Rating	Risk Movement
Misalignment with CSIR values and increased probability of injuries and fatality.	1. Health hazards/ injuries/loss of human life inhibit on CSIR objective of "ZERO HARM". 2. Environmental impacts. 3. Loss of valuable assets. 4. Reputational damage. 5. Legal liability associated with fines and penalties, civil claims and potential criminal liability.	High	1. Pursue Behavioural Based Safety (BBS) initiative. 2. Implementation and roll out of the SHEQ strategy, policy and action plans. 3. Increased and continuous SHEQ education and awareness. 4. Regular and periodic SHEQ audits. 5. Increase SHEQ operational embedded resources and support. 6. Resource SHEQ function with required skills and capabilities. 7. Develop Green House Gas (GHG) inventory and report annually on GHG emissions 8. SHEQ communication and training programme for CSIR employees. 9. Development and implementation of the new SHEQ policy. 10. SHEQ external audit reviews by DEKRA. Process to implement the corrective actions underway. 11. SHEQ appointments (16.2) completed in most areas.	1. BBS - 10% Roll out of the SHEQ strategy, policy and action plans - on track. SHEQ Audits - implemented, annual plan 20% complete. 2. Resourcing - planned, implementation subject to restructuring of support functions. 3. GHG baseline 100% complete, target setting and continued monitoring commenced. 4. Communication strategy rolled out - efficiency being assessed. 5. Programme scheduled FY2019/20 in progress	Medium	1. Introduce key performance indicators (KPIs) for S16.2s and other SHE role players in the 2019/20 performance management contracts to assist in instilling a culture of accountability and consequence management - 100% complete. 2. Develop and implement a contractor and tenant SHE management plan to treat the risk. 3. Plan to include regular random SHE audits and management by walk about being conducted to improve adherence to CSIR requirements - high risk tenants 100% complete, remainder 35% complete.	Low	1. Risk rating remains medium - requires longer-term impact assessment to determine risk mitigation effectiveness and various initiatives in early phase of deployment. 2. Regular management walkabouts. 3. No major SHE incidents reported during the period.

3.4 Risk Description: IP Management Strategy not aligned with strategic business needs

Risk Source:
Project Synapse Risk Register
2018 CSIR Institutional Review Report
CSIR Portfolio Risk Identification Workshops
CSIR Divisional Risk Identification Workshops

Detail Risk Definition	Risk Impact	Inherent Risk Rating	Mitigation Controls Implemented	% Completion	Residual Risk Rating	Additional Controls	Required End State Risk Rating	Risk Movement
IP not adequately protected against theft, loss and sabotage.	1. Loss of valuable IP and/or low return/no return investment. 2. Impact on financial sustainability - hampers CSIR's ability to deliver on mandate. 3. Deferred/delayed realisation of strategic objectives.	High	1. Implemented all the necessary security and protection controls to protect CSIR from unauthorised access to its IP assets, infrastructure, systems and data. 2. Assessment and audit of complete CSIR IP asset base. 3. Awareness and education on IP management and protection to all employees. 4. Align CSIR Information Security Policy and ICT Policy with the IP management strategy. 5. Develop and implement an IP defence strategy. 6. Appointment of the business development and commercialisation managers.	1. Implementation FY2019/20 on track. 2. Drive commercialisation of technology aligned with CSIR strategy - aligned for improvement.	Medium	1. Assessment and audit of complete CSIR IP asset base currently underway. 2. IP and Technology Transfer Office is being resourced to deliver on the additional remedial actions. 3. Implement a holistic IP management strategy.	Low	1. Risk movement to Medium, however, severe resource constraints in Information Security threatening return to High rating. 2. CISO appointed. To ensure implementation of the necessary technical cyber controls for the protection of the organisational IP 3. Privacy specialist was appointed to oversee POPIA implementation.

3.5 Risk Description: Lack of business continuity management strategy

Risk Source:
Business Impact Analysis undertaken by ERMO and external service provider
Incident reports
Tshwane Disaster Recovery Report on scenario audit

Detail Risk Definition	Risk Impact	Inherent Risk Rating	Mitigation Controls Implemented	% Completion	Residual Risk Rating	Additional Controls	Required End State Risk Rating	Risk Movement
Constraints to business continuity following disruptive incidents or events.	1. Additional operational costs and loss of business opportunity and income. 2. Reputational damage. 3. Negative impact on insurance profile and premiums. 4. Contractual and related liabilities due to non-performance. 5. Increased, safety, health, environmental and security risks. 6. Potential liability associated with tenants and hosted parties.	High	1. Approved BCM strategy. 2. Defined BCM strategy, risk scenarios and response protocols. 3. Embed strategy and plans in the organisation.	1. BCM strategy and plan 80% complete 2. Q2-Q4 FY 2019/20 dedicated to embedding BCM strategy and plan in organisation and to resource adequately. 3. Employee response training and scenario testing. 4. Appointment of privacy specialist assists in preventing disruption due to privacy related incidents in organisation and its projects and operations.	Medium	1. Regular review of key risk scenarios and effectiveness of the BCM strategy and plan - minimum annual review and immediate review upon key risk scenario probability identified. 2. Refinement of phase III BC recovery to normal status quo. 3. Targeted awareness and training of key role players in BC scenarios (SHEQ, Security Services, Facilities Management, Strategic Communications, ICT services, etc.)	Low	Risk movement from high to medium due to initiatives implemented to address risk.

3.6 Risk Description: Quality and market relevance of research, development and innovation outcomes

Risk Source:
2018 CSIR Institutional Review Report
CSIR Portfolio Risk Identification Workshops
CSIR Divisional Risk Identification Workshops

Detail Risk Definition	Risk Impact	Inherent Risk Rating	Mitigation Controls Implemented	% Completion	Residual Risk Rating	Additional Controls	Required End State Risk Rating	Risk Movement
Production of inferior research, development and innovation outcomes that lack commercial relevance and impact on the social-economic transformation/ prosperity in South Africa.	1. Impact on financial sustainability - hampers CSIR's ability to deliver on mandate. 2. Deferred/ delayed realisation of strategic objectives. 3. Relevancy and continued funding.	High	1. Investment in research resources (human resources, and infrastructure) that ensures quality research outcomes. 2. Discontinuance of research areas that are no longer financially feasible or aligned with market requirements and strategy. 3. Alignment of organisation business an operating model with the outcomes highlighted by the CSIR strategy.	60% complete. Appointment of cluster executives and business development managers have a positive impact on the risk mitigation	Medium	1. Ensure implementation and/ or effectiveness of: • Research Ethics Committee • Strategic Research Panels • Strategic Research Managers Forum • Industry Advisory Panel. 2. Implementation of: • BD&C structures per operating division • Research policies to guide research agenda • Monitoring and evaluation of research work demand, relevance and market opportunities • Invest in RD&I infrastructure aligned with the CSIR strategic objectives • Development of a Parliamentary Grant investment strategy.	Low	1. Risk movement from high to medium due to initiatives implemented to address risk. 2. The appointment of the BD & C will have a positive impact on the market relevance of the CSIR R&D products.

3.7 Risk Description: Outdated/obsolete infrastructure and equipment to support RD&I activities

Risk Source:
2018 CSIR Institutional Review Report
Building Condition Assessment Report
CSIR Portfolio Risk Identification Workshops
CSIR Divisional Risk Identification Workshops

Detail Risk Definition	Risk Impact	Inherent Risk Rating	Mitigation Controls Implemented	% Completion	Residual Risk Rating	Additional Controls	Required End State Risk Rating	Risk Movement
Significant infrastructure and property investment required - remains a shortfall in funding to address all the equipment and infrastructure needs across the CSIR.	1. Poor quality of R&D outputs. 2. Increased risk of projects failures. 3. Increased SHEQ risks. 4. Damage to CSIR brand Increased insurance liability. 5. Marketability of rental space compromised.	High	1. Explore private public partnerships and alternative funding sources. 2. Implement Campus Master Plan. 3. Continue to investigate collaborative and shared models with HEIs, Science Councils and the private sector.	Funding remains constraint against significant progress. Annual infrastructure project plan has now been approved and projects commenced.	Medium	1. Ongoing investment against CMP timeline and funding resources. 2. Routine and critical maintenance continuous and prioritised based on risk and funding availability.	Low	1. Risk movement to medium as infrastructure maintained and enhanced whenever funding allows 2. Ongoing CAPEX budget prioritisation to address gaps in the R&D infrastructure.

3.8 Risk Description: Business interruptions due to the reorganisation process								
Risk Source: Ongoing section 189 process in the organisation Disruption of business activities								
Detail Risk Definition	**Risk Impact**	**Inherent Risk Rating**	**Mitigation Controls Implemented**	**% Completion**	**Residual Risk Rating**	**Additional Controls**	**Required End State Risk Rating**	**Risk Movement**
The ongoing reorganisation process remains a big concern and poses significant instability issues to the CSIR	1. Leaking of company sensitive and confidential data/information 2. Delays in the implementation of the fit-for-purpose support model 3. Reputational damage to the CSIR due to negative media coverage and political interest/ interference 4. Low staff morale that could result in an inefficient support to SET base activities and operations.	High	1. CCMA mediation process. 2. Employer (CSIR) proposed operating model for the reorganisation 3. Appointment of task teams from the employer, labour unions and Unionised staff members 4. Improved physical security operations to prevent potential interruptions and ensure staff safety 5. Established a dedicated reorganisation intraweb site and email address to ensure effective communication.	The appointed CCMA facilitator/ commissioner will guide the process.	Medium	Follow the CCMA facilitation Implementation of the suggested changes to the operating model/ support structure (Where possible and feasible) Continues engagements between the CSIR, CCMA, labour unions and the appointed task team	Low	A new risk that should be carefully managed to bring stability in the organisation and to enable the delivery of the strategic objectives.

E Fraud Prevention Plan

E.1 Introduction

E.1.1 BACKGROUND

The CSIR FPP has been developed in compliance with section 3.2.1 of the Treasury Regulations of the PMFA. The CSIR subscribes to the principles of good corporate governance, which require business to be conducted in an honest, ethical and transparent manner. Consequently, the CSIR is committed to eradicating fraudulent behaviour at all levels within the organisation.

This FPP is premised on the CSIR's core ethical values driving the business of the CSIR, the development of its systems, policies and procedures, interactions with upstream and downstream stakeholders in its value chain and overall value proposition, including public and private sector customers, members of the public at large, suppliers and service providers, employees and its shareholder.

In alignment with the CSIR's core organisational EPIC values, this FPP is the cornerstone in promoting ethical conduct and determining how incidents or suspected incidents of fraud and corruption will be prevented, detected and investigated.

The CSIR has a zero-tolerance appetite to fraud and corruption. The organisation has, to this end, established a whistleblowing facility to support the efforts of this FPP. The whistleblowing facility is operated on a 24/7 basis through an independent service provider.

The re-organisation of the CSIR support structure resulted in the establishment of a fit-for-purpose compliance function, under the Legal and Compliance portfolio. This repurposed compliance function will add value and establish the much needed investigative and forensic capability to the CSIR. A combined assurance model will also be established with other key role-players in the business to drive an adequate and effective GRC capability.

The FPP is a dynamic plan and will continuously evolve as the CSIR strives to further promote ethics and prevent fraud.

E.1.2 GLOSSARY OF TERMS AND ABBREVIATIONS

Throughout this FPP, unless otherwise stated, the words/abbreviations in the first column below have the meanings assigned to them in the second column (and cognate expressions shall bear corresponding meanings):

E.1 INTRODUCTION (continued)

E.1.2 GLOSSARY OF TERMS AND ABBREVIATIONS

Abbreviation/Term	Meaning ascribed
Accounting Officer	A person as defined in terms of section 36 of the PFMA.
Approval Framework	Is the CSIR policy document specifying the decision matrix and levels of maximum approval authority for different role players within the CSIR, as approved by the Board of Directors of the CSIR and as amended from time to time.
ARC	A committee constituted in terms of the requirements as prescribed by the Treasury Regulations of the PFMA and sound corporate governance practices. The ARC is established to assist 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 and accounting standards.
Code	The CSIR Code of Conduct/Ethics.
Conditions of Service	The CSIR Conditions of Service as approved by the Board of Directors of the CSIR in terms of section 12 of the Scientific Research Council Act and as amended from time to time.
Combined Assurance Plan	A planned approach, based on continuous risk analysis, designed to highlight the relevant high-risk areas and the assurance to be provided by management, compliance, external audit, internal audit and other consultants or service providers in order for the CSIR Board of Directors to be appraised of the risk management efforts undertaken to manage the risks to an acceptable level and for assessing the extent and the adequacy of assurance on key organisational risks and reporting on those risks to senior management and the ARC, and in the context of fraud prevention, to the HRSEC.
Corruption	An act whereby anybody who accepts any gratification from anybody else or offers or gives any gratification (benefit) to anybody else in order to influence the receiver to conduct herself or himself or itself in a way that amounts to the unlawful or irregular exercise of any duties.
CSIR	Council for Scientific and Industrial Research.
Disciplinary Code and Procedure	A document that provides guidance when dealing with misconduct and poor work performance. It promotes regulated fairness, certainty and consistency in the application of discipline, establishes standards, principles and procedures when addressing misconduct, and encourages all employees to adhere to the appropriate standards of conduct by providing for progressive and corrective action, as approved by the Board of Directors of the CSIR and as amended from time to time.
ERMS	Enterprise Risk Management Services.

E.1 INTRODUCTION (continued)

Abbreviation/Term	Meaning ascribed
Ethics Hotline Procedure	Provides employees with an independent mechanism to bring any unethical business practices to the attention of management via telephone, e-mail, web-based tip-off facility, facsimile or post.
Event	An occurrence or a change of a particular set of circumstances.
Fixed Asset Policy	A document that governs the controls associated with the recognition, de-recognition, financing and transfer of assets as approved by the Board of Directors of the CSIR and as amended from time to time.
Fraud	The unlawful and intentional making of a misrepresentation, which causes actual prejudice or which is potentially prejudicial to another.
Fraud Risk	The CSIR's vulnerability to fraud based on the adequacy of the mechanisms designed and implemented to prevent, deter and detect fraud.
FPP	Fraud Prevention Plan.
Fraud prevention strategy	Is the CSIR's strategy to facilitate fraud prevention/fraud risk management and is a process that is adopted by the CSIR in putting mechanisms in place to manage CSIR's vulnerability to fraud. Such mechanisms are designed to prevent, deter and detect fraud.
HRSEC	The HR and Social and Ethics Committee is constituted in terms of Companies Regulation 43 and has to monitor the company's activities with regard to matters relating to: • Social and economic development, including the company's standing in terms of the goals and purposes of: – The 10 principles set out in the United Nations Global Company Principles, – The OECD recommendations regarding corruption, – The EE Act; and – The B-BBEE Act; • Good corporate citizenship, including the company's: – Promotion of equality, prevention of unfair discrimination and measures to address corruption, – Contribution to development of the communities in which its activities are predominantly conducted or within which its products or services are predominantly marketed, and – Record of sponsorship, donations and charitable giving; • The environment, health and public safety, including the impact of the company's activities and of its products or services; • Consumer relationships, including the company's policies and record relating to advertising, public relations and compliance with consumer protection laws; and • Labour and employment matters.

E.1 INTRODUCTION (continued)

Abbreviation/Term	Meaning ascribed
ICT Policy	Provides the framework within which the CSIR's computing facilities and assets that are provided to employees and CSIR representatives, for the purpose of conducting CSIR business, are administered and managed, as approved by the Board of Directors of the CSIR and as amended from time to time.
Information Security Policy	Expresses the CSIR's position and intent to implement, maintain and improve its information security measures as approved by the Board of Directors of the CSIR and as amended from time to time.
PFMA	The Public Finance Management Act.
Treasury Regulations	The regulations issued by National Treasury in support of the PFMA.

E.1.3 PURPOSE OF THE FPP

The purpose of the CSIR FPP is to establish an approach in dealing with fraud risk, and it recognises the basic fraud prevention initiatives within the CSIR, as well as identifies the custodians responsible for the creation of awareness, enforcement and investigation of incidents or suspected incidents of fraud and corruption.

The primary objectives of the CSIR FPP are to:

- Provide guidelines in preventing, detecting and reporting fraudulent activities within the CSIR;
- Create and encourage a culture within the CSIR where all employees and stakeholders continuously behave ethically in their dealings with, or on behalf of, the CSIR;
- Improve the application of applicable systems and compliance with applicable policies, procedures and regulations;
- Encourage all employees and stakeholders to strive towards the prevention and detection of fraud impacting, or having the potential to impact on the CSIR;
- Encourage all employees and stakeholders to report suspicions of fraudulent activity without fear of reprisals or recriminations; and
- Provide a governance framework within which the initiatives that support the creation of awareness, enforcement and investigation of incidents, or suspected incidents of fraud and corruption, are implemented and overseen.

E.1 INTRODUCTION (continued)

E.1.4 LEGISLATIVE CONTEXT

The FPP was developed with the aim of giving effect to the requirements and stipulations of the following legislations, among others, as amended from time to time:

- The Constitution of the Republic of South Africa;
- The PFMA
- Treasury Regulations issued in terms of the PFMA;
- The Scientific Research Council Act;
- The Protected Disclosures Act, 2000 (Act 26 of 2000);
- The Prevention of Organised Crime Act, 1998 (Act 121 of 1998);
- The Prevention and Combatting of Corrupt Activities Act; and
- All mandatory policies adopted by the Board of Directors of the CSIR contextualising legislative and related compliance requirements.

E.1.5 SCOPE OF APPLICATION

The FPP applies to all corruption, fraud, theft, financial misconduct and maladministration or suspected irregularities of such nature involving the following persons or entities:

- All members of the CSIR Board of Directors;
- All employees of the CSIR;
- Consultants, suppliers, contractors and other providers of goods or services to the CSIR; and
- All parties representing the CSIR and its business activities in an official capacity.

E.1.6 POLICY STANCE

The policy of the CSIR is one of **zero tolerance** to fraud and corruption. All alleged cases of fraud and corruption will be investigated and followed up by the application of all remedies available, within the full extent of the law, and the implementation of appropriate prevention and detection measures. These measures include existing financial and related controls and verification mechanisms as prescribed in the systems, policies and procedures of the CSIR.

The CSIR wishes to facilitate a culture of disclosure of information relating to suspected fraud and related misconduct by employees in a responsible manner. Employees and stakeholders are encouraged to report suspicions of fraudulent activity without fear of reprisals or recriminations.

The efficient application of instructions contained in the regulations, policies and procedures of the CSIR is one of the most important duties of every employee in the execution of his/her daily tasks.

E.1 INTRODUCTION (continued)

The CSIR's policy stance is currently encapsulated in various CSIR policies and procedures, including, but not limited to, the Code, the CSIR Conditions of Service, CSIR Disciplinary Code and Procedure, CSIR ICT Policy, the IS Policy and the CSIR Ethics Hotline Procedure.

To ensure that there is no uncertainty among employees and stakeholders about the policies and procedures that shape the CSIR's approach to fraud, the CSIR has established a dedicated Compliance function within the Legal and Compliance portfolio.

The Compliance function serves a management function primarily focused on devising, implementing and overseeing organisational processes to meet its statutory and regulatory obligations. The Compliance function's objective is to integrate legal analysis, design and implement appropriate controls and form part of the Combined Assurance Plan of the organisation. Compliance services focus on educating the Board of Directors, senior management and other employees, and prevent and root out misconduct, whether legal, ethical, criminal or otherwise. Upon its implementation, the Compliance function will serve as the dedicated custodian of fraud prevention, fraud risk management and the process that is adopted by the CSIR, in putting mechanisms in place, to manage the CSIR's vulnerability to fraud. Such mechanisms are designed to prevent, deter and detect fraud.

E.2 Components of the FPP

E.2.1 GUIDING PRINCIPLES

The FPP of the CSIR is based upon the following main principles:

- Creating a corporate culture that is ethical, fair and intolerant to fraud and thereby aligned with the CSIR's core organisational EPIC;
- Deterring fraud and corruption;
- Reporting suspicious fraudulent activity without fear of reprisals or recriminations;
- Detecting fraud;
- Investigating any detected fraud;
- Taking appropriate action in the event of fraud, e.g. disciplinary action, recovery of losses and prosecution; and
- Applying sanctions such as blacklisting the suppliers/service providers guilty of corrupt practices.

This plan applies to all allegations, attempts and incidents of fraud that have an impact on or with the potential to impact the CSIR.

All CSIR employees and management must comply with the spirit and content of the plan.

A person who holds a position of authority as stipulated in section 34 of the Prevention and Combatting of Corrupt Activities Act, should report any suspected corrupt activity and/or an offence of theft/fraud to the police.

E.2.2 COMPONENTS

The CSIR's FPP encompasses controls that have three SOs:

- Prevent instances of fraud and corruption from occurring;
- Detect instances of fraud and corruption when they do occur; and
- Respond appropriately and take corrective action when fraud and corruption happens.

The FPP provides the CSIR with tools to manage fraud and corruption risk and has four phases:

- Assessment of organisational needs, based upon the nature of fraud and corruption risks and existing control environment;
- Design of programmes and controls in a manner that is consistent with legal and regulatory requirements, as well as best practices;
- Implementation of programmes and controls through the assignment of roles, building of internal competencies, training and deployment of resources; and
- Evaluation of programme and control design, implementation and operational effectiveness.

E.2 COMPONENTS OF THE FPP (continued)

Fraud prevention is a business imperative, and a shared responsibility between management and employees. The FPP forms part of the Shareholder's Compact that is approved by the CSIR Board of Directors annually.

The components of the FPP as follows:

- The CSIR's core organisational EPIC values;
- The Code;
- CSIR systems, policies, procedures, rules and regulations;
- The CSIR Disciplinary Code and Procedure;
- Internal controls to prevent and detect fraud;
- Physical and information security management;
- Internal Audit function;
- Ongoing risk assessments;
- Reporting and monitoring of fraud allegations;
- A Fraud Policy and fraud response plan that clarify the policy stance of the CSIR and the steps for the reporting and resolution of allegations and incidents of fraud (under development);
- A Whistle Blowing Policy that facilitates a culture of disclosure of information by employees in a responsible manner (under development);
- Creation of fraud and corruption awareness among employees and relevant stakeholders through communication and education;
- Establishment of a combined assurance forum to steer and take responsibility for the FPP and ensuring the effective implementation thereof, in support of combined assurance that key fraud risks are being managed appropriately in the CSIR; and
- Ongoing maintenance and review of the FPP.

The key deliverables of the FPP are to raise awareness about potential fraud and corruption, and to put fraud prevention and response strategies in place.

In addition to the generic risks and mitigation strategies identified below, the CSIR has also developed and maintains a CSIR Fraud Risk Register as a sub-set of the overall organisational Risk Register. The Fraud Risk Register is a key outcome of the risk identification and assessment process and includes all key risks that require a mitigating response as they fall outside of the CSIR's risk tolerance levels and pose a significant potential impact on the ability of the CSIR to achieve the primary objectives of the FPP.

E.3 Approach to Fraud

E.3.1 PREVENTING FRAUD

Fraud prevention strategies are the first line of defence and provide the most cost-effective method of controlling fraud within the CSIR. To be effective, fraud prevention requires a number of contributory elements, including an ethical organisational culture, a strong awareness of fraud among employees, suppliers, service providers and clients, and an effective internal control framework.

I. The Code

The Code establishes clear guidelines for employees and representatives of the CSIR regarding the standard of conduct required in their internal and external dealings for and on behalf of the CSIR.

The generic risks identified by the CSIR in application of the Code, are as follows:

- Lack of buy-i, or compliance with the requirements of the Code by management and employees or official CSIR representatives;
- Lack of awareness and/or inadequate communication and training strategy relating to the Code;
- Employees with low integrity and/or standards of professional conduct seeking to enhance personal benefit; and
- Lack of control over the acceptance of gifts and/or benefits by employees.

Strict compliance with the Code by employees and CSIR representatives, both in its spirit and content, addresses the aforementioned risks. However, recognising that striving to achieve such a status and culture of compliance in totality, is idealistic, the CSIR will pursue the following tactics to improve the professional ethics and conduct of its employees and representatives:

- A copy of the Code will be circulated to all employees and CSIR representatives and will be included in induction packs for new employees/representatives;
- All employees will be required to sign a declaration annually, serving as an indication of their understanding of, commitment to and compliance with the Code; and
- Relevant aspects of the Code will be included in awareness presentations, training sessions and communication programmes to create awareness thereof among employees and relevant stakeholders. Further objectives of this training will include the following:
  - Assisting employees to understand the meaning of fraudulent and corrupt behaviour;
  - Presenting case studies to assist employees in developing behaviour to articulate and encourage attitudes and values that support ethical behaviour in all conduct; and
  - Communicating the implications of unethical behaviour and its impact for individuals, the workplace, professional relationships, the CSIR as a whole, external stakeholders and the public.

E.3 APPROACH TO FRAUD (continued)

The CSIR Manager: Compliance will be responsible for reviewing and reviving the relevance and implementation of the Code, its communication and supportive education.

II. Systems, Policies, Procedures, Rules and Regulations

The CSIR has a number of systems, policies, procedures, rules and regulations designed to ensure compliance with prevailing legislation, and to limit the risk of fraud. Fundamentally, all CSIR employees and representatives should be fully conversant and compliant with these. In addition, several operational measures have been designed to control business activities.

The generic risks identified by the CSIR, in terms of systems, policies, procedures, rules and regulations, are as follows:

- Lack of knowledge and understanding of prevailing policies and procedures among employees;
- Lack of structured awareness and training programmes for employees in applicable policies, procedures, rules and regulations;
- Non-adherence with policies and procedures, as a result of weaknesses in systems and tools;
- Lack of proper delegation; and
- Non-compliance due to an absence of a culture of compliance and shared value system.

The aforementioned risks suggest that controls should be reviewed continuously to secure tolerable levels of compliance.

The CSIR recognises that its employees are often best placed to identify shortcomings or weaknesses in systems and procedures. Therefore, it is committed to harnessing this knowledge through the development of a structured programme aimed at encouraging employee commitment and effort in reporting such weaknesses.

In addition, the CSIR will undertake the following actions to mitigate the risks identified:

- The existing CSIR policies and procedures and any updates or amendments thereto will be communicated and made accessible to all CSIR employees and representatives for them to be informed of all the applicable policies and procedures;
- Provisions for all employees to acknowledge, in writing, that they have read the policies and procedures applicable to their duties, have undergone relevant training and/or are aware of these policies and procedures;
- Keeping of adequate records serving as proof that employees have been made aware of the policies and procedures applicable to the CSIR and relevant to their duties;
- Internal audits and ad hoc risk assessments, either in accordance with a combined assurance plan or due to a perceived risk, will be undertaken to monitor and evaluate the extent of compliance with policies and procedures;

E.3 APPROACH TO FRAUD (continued)

- In instances where breaches occur, swift and appropriate disciplinary action will be undertaken to set an example to other potential wrongdoers; and
- A specific effort will be made to ensure that measures are put in place, for the censure of suppliers and/or other providers of goods and/or services who are found guilty of unethical conduct or other irregularities. Any employee found to be colluding with suppliers will be subjected to immediate disciplinary action with a possible sanction of dismissal and/or personal liability for losses suffered.

III. Disciplinary Code and Procedure

The CSIR Disciplinary Code and Procedure prescribes appropriate steps to be taken to resolve disciplinary matters. The identified risks of fraud with regard to discipline and the application thereof, are as follows:

- In some instances, the disciplinary process is too lengthy;
- Inadequate training of investigating officers presenting the case and parties chairing or adjudicating the charges;
- Inadequate maintenance and security of source documents to be used at disciplinary, criminal and civil proceedings; and
- Inconsistent application of disciplinary actions and outcomes.

The CSIR recognises that the consistent and efficient application of disciplinary measures are an integral component in making the FPP a success. The CSIR will continue to pursue the following steps to ensure the consistent, efficient and speedy application of disciplinary measures:

- That all managers are aware of the content of the Disciplinary Code and Procedure, their responsibility for maintaining discipline, the standards of discipline expected, the procedure for the application of disciplinary measures and the disciplinary process, through communication and awareness exercises;
- Ongoing training of managers and investigating officers with regard to the content of the Disciplinary Code and Procedures, the application of disciplinary measures and the disciplinary process, and sustaining this training in conjunction with the Compliance function and HR department;
- The development of a system to facilitate the consistent application of disciplinary measures, e.g. a monitoring system that includes proper record keeping of all disciplinary actions taken; and
- The developing a system where managers are held accountable for the management and addressing of misconduct and fraud within their areas of oversight.

IV. Internal Controls

This section of the FPP relates to basic internal controls to prevent and detect fraud. The systems, policies, procedures, rules and regulations of the CSIR prescribe various controls, which, if effectively implemented, will limit fraud within the CSIR. These controls may be categorised as follows, it being recognised that the categories contain overlapping elements:

E.3 APPROACH TO FRAUD (continued)

- Prevention controls: These are divided into two sub-categories, namely;
  - Authorisation, and
  - Physical;
- Detection controls: These are divided into four categories, namely:
  - Arithmetic and accounting,
  - Physical,
  - Supervision, and
  - Management Information; and
- Segregation of Duties.

Prevention Controls

- **Authorisation:**

  All transactions require authorisation or approval by a responsible person with appropriate the authority limits. The authority limits are specified in the CSIR Approval Framework.

- **Physical:**

  These controls are mainly concerned with the custody of assets and involve procedures and security measures designed to ensure that access to assets is limited to personnel, who have been duly authorised, in writing. The CSIR Fixed Asset Policy governs the controls associated with the recognition, de-recognition, financing and transfer of assets.

Detection Controls

- **Arithmetic and accounting:**

  These are basic controls within the recording function that check that transactions to be recorded and processed have been authorised and that they are completely and correctly recorded and accurately processed. Such controls include checking the arithmetical accuracy of the records, the maintenance and checking of totals, reconciliation and accounting for documents.

- **Physical:**

  These controls relate to the security of records. Therefore, they underpin arithmetic and accounting controls. Their similarity to preventive controls lies in the fact that these controls are also designed to limit access to unauthorised persons.

- **Supervision:**

This control relates to managers' supervision of day-to-day transactions and the recording thereof.

- **Management Information:**

This relates to the review of management accounts and budgetary control. These controls are normally exercised by management outside the day-to-day routine of the system.

E.3 APPROACH TO FRAUD (continued)

Segregation of Duties

The lack of segregation of duties, or the overriding of existing internal controls, is a generic risk that exposes the CSIR to the inherent risk of fraud and manipulation of data. One of the primary means of control is the separation of those responsibilities or duties, which, if combined, enables one individual to record and process a complete transaction, thereby providing him/her with the opportunity to manipulate the transaction irregularly and commit fraud.

Segregation of duties reduces the risk of intentional manipulation or error and increases the element of verification.

Functions that should be separated include those of recording, checking, authorisation, approval, custody, execution and, in the case of computer-based accounting systems, system controller functions and daily operations.

In the context of fraud, segregation of duties lies in separating either the authorisation or the custodial function from the verification function.

To ensure that these internal controls are applied effectively and consistently, deficiencies and non-compliance identified by internal audit will be addressed as follows:

- The CSIR will continue to regularly re-emphasise to all managers that consistent compliance by employees with internal control is in itself one of the fundamental controls in place to prevent fraud. Managers will be encouraged to recognise that internal control shortcomings identified during the course of audits are, in many instances, purely symptoms and that they should strive to identify and address the causes of these internal control weaknesses.
- The CSIR will ensure that the performance appraisal of senior managers will take into account the number of audit queries raised and the level of seriousness of the consequent risk to the CSIR, as a result of the internal control deficiency identified. This is intended to raise the level of accountability for internal control by the Accounting Officer and managers. Where managers do not comply with basic internal controls, e.g. non-adherence to the limits of the CSIR Approval Framework, firm disciplinary action will be considered.

V. Physical and Information Security

- **Physical Security:**

  Recognising that effective physical security is one of the "front line" defences against fraud, the CSIR will take regular steps to improve physical security and access control at its sites of operation, in order to limit the risk of theft of assets. The CSIR will also conduct a regular review of the physical security arrangements at its offices and facilities, and improve on weaknesses identified.

- **Information Security:**

  The CSIR will ensure that employees are sensitised to the risks of fraud associated with poor management of information security on a regular basis, in order to enhance their understanding thereof and the risks to the CSIR associated with poor control over confidential information.

E.3 APPROACH TO FRAUD (continued)

Regular reviews of information and computer security will also be considered. Weaknesses identified during these reviews will be addressed with the respective managers. The CSIR Information Security Policy expresses the CSIR's position and intent to implement, maintain and improve its information security measures.

E.3.2 DETECTING, REPORTING AND INVESTIGATING FRAUD

Detection controls are designed to discover any fraud or corruption as soon as possible after it has occurred. In spite of best practice prevention activities, fraud and corruption may occur. The next line of defence is a robust suite of detection strategies to discover any incident of fraud and corruption as soon as possible to minimise any detrimental impacts. The CSIR's detection controls include:

- Maintaining an effective system of internal controls;
- Review and approval of financial transactions;
- Review and approval of management reports;
- Internal and external audits;
- Monitoring and evaluation;
- Data analysis; and
- The CSIR Ethics Hotline Procedure to report allegations of fraud, corruption and unethical conduct.

I. Response

The CSIR's response strategies that ensure appropriate mechanisms are in place to:

- Take corrective actions;
- Minimise the impact of fraud and corruption risks;
- Improve prevention and detection strategies; and
- Report any occurrences to the relevant stakeholders.

All identified occurrences of fraud and corruption will be investigated in accordance with the principles enshrined in the Protected Disclosure Act, 2000 (Act 26 of 2000), the CSIR Ethics Hotline Procedure and this FPP. The principles include confidentiality, protection from victimisation and the application of justice.

CSIR key response strategies include:

- Investigation of all allegations of fraud and corruption;
- Central registry of all fraud and corruption allegations maintained, reported and monitored;
- Disciplinary procedure;
- Review of internal controls post incident;
- Implementation of corrective and preventative actions and recommendations;
- Recovery of losses; and
- Fidelity and employee dishonesty insurance.

E.3 APPROACH TO FRAUD (continued)

II. Fraud Policy and Fraud Response Plan

The CSIR's policy stance is currently encapsulated in various CSIR policies and procedures including but not limited to, the CSIR Code of Conduct/Ethics, the CSIR Conditions of Service, CSIR Disciplinary Code and Procedure, CSIR ICT Policy, the IS Policy and the CSIR Ethics Hotline Procedure. To ensure that there is no uncertainty amongst employees and stakeholders about the policies and procedures that shape the CSIR's approach to fraud, it is the intent of the CSIR to develop and implement a dedicated Fraud Prevention Policy aligned with the FPP and the associated strategy.

III. Whistle Blowing Policy

In order to limit the risk of employees being victimised for whistle blowing, in contravention of the Protected Disclosures Act, the CSIR is undertaking the development of a Whistle Blowing Policy. The Whistle Blowing Policy is based on the Protected Disclosures Act, which guarantees protection to employees against victimisation, following disclosure of fraudulent activity by employees, and is intended to encourage and enable employees to raise serious concerns without fear of victimisation.

E.3.3 FURTHER IMPLEMENTATION AND MAINTENANCE

I. Creating Awareness

This component of the plan comprises two approaches, namely education and communication. The strategic weaknesses identified in this area are as follows:

- Lack of a formalised strategy to create awareness among employees of the manifestations of fraud and the risks of fraud facing the CSIR; and
- Lack of knowledge of approaches to prevent and detect fraud in specific processes and transactions.

CSIR key response strategies include:

- **Education:**

The CSIR will ensure that regular presentations and formal training are carried out for employees to enhance their understanding of the manifestations of fraud, prevention and detection techniques and the components of the FPP.

- **Communication:**

Communication is crucial in creating awareness of the FPP among employees and other stakeholders. This is intended to facilitate a culture where all stakeholders strive to make the FPP a success and to sustain a positive, ethical culture within the CSIR. This will increase the prospect of fraud being reported and improve the CSIR's prevention and detection ability.

E.3 APPROACH TO FRAUD (continued)

The CSIR will consider various means of communicating its fraud prevention initiatives, including the following:

- Conducting workshops and creating awareness of the FPP;
- Developing a poster campaign aimed at all stakeholders to advertise the CSIR stance to fraud and its expectations with regard to the ethics and integrity of all stakeholders;
- Circulating appropriate sections of the Code to other stakeholders, e.g. consultants and contractors;
- Publicising "lessons learned" following investigations into allegations of fraud amongst employees;
- Circulating successes related to the FPP and fraud modus operandi;
- Placing notices or other communiqués related to the FPP on notice boards and other areas to which employees and the public have access;
- Giving copies of the Code to suppliers of goods and services;
- Developing a fraud prevention suggestion box where all employees can make suggestions on how to prevent fraud and corruption and further improve the FPP;
- Developing promotional items communicating the FPP or components thereof; and
- Using the intranet to communicate issues relating to the prevention and detection of fraud, including matters reported and action taken.

- **Combined Assurance Forum**

The CSIR will establish an operationally based combined assurance collaboration forum to steer and take responsibility for the FPP and ensure the effective implementation thereof, in support of combined assurance and ensuring that key fraud risks are being managed appropriately in the CSIR.

The objectives of the combined assurance forum are mainly to:

- Identify and specify the sources of assurance over the CSIR's risks;
- Provide the ARC, HRSEC, Accounting Officer and Executive Management with a framework of the various assurance parties;
- Establish a combined assurance strategy and plan;
- Link risk management activities with assurance activities;
- Assist the Accounting Officer with reviewing the effectiveness of the risk management system; and
- Provide a basis for identifying any areas of potential assurance gaps.

E.3 APPROACH TO FRAUD (continued)

Once established it has been, the forum will be responsible for the ongoing maintenance and review of the FPP. This will include:

- Evaluating reports of fraud and highlighting areas of risk within the CSIR;
- Considering fraud threats to the CSIR and addressing them;
- Monitoring action taken to implement recommendations relating to incidents of fraud;
- Steering and taking responsibility for the FPP;
- Reviewing and making appropriate amendments to the FPP; and
- Ensuring that ongoing implementation strategies are developed and carried out.

II. Control Environment

The CSIR's ARC and HRSEC significantly influence the fraud control environment, particularly by overseeing the tone at the top. This is done in the discharge of its duties in terms of the PFMA and Treasury Regulations.

The ARC and HRSEC systematically oversee, and periodically review the internal controls established by the management of CSIR. Oversight extends to:

- Enterprise risk and fraud risk management;
- The potential for management to override controls or exercise other inappropriate influence over the financial reporting process;
- Mechanisms for employees to report concerns;
- Receipt and review of periodic reports describing the nature, status and eventual resolution of alleged or suspected fraud;
- An internal audit plan that addresses fraud risk, and a mechanism to ensure that internal audit can express any concerns about management's commitment to appropriate internal controls, or to report suspicions or allegations of fraud;
- The involvement of other experts, such as legal and HR, as needed to investigate any alleged or suspected wrongdoing;
- The review of accounting principles, policies and reasonableness of significant estimates used by the CSIR;
- The review of significant non-routine transactions (if any) entered into by management and employees; and
- Functional reporting by internal and external auditors to the ARC.

E.3 APPROACH TO FRAUD (continued)

III. Independent assurance

The Internal and External auditors will provide an independent assurance on the adequacy and effectiveness of CSIR's internal controls to prevent, detect and manage fraud and corruption. The independent risk assurers will also advise on the effectiveness of the CSIR's FPP.

E.4 Conclusion

The CSIR proposes a proactive approach towards managing fraud risk in the organisation. It has adopted a zero tolerance approach towards fraud, theft and corruption and will continue to take the necessary measures to ensure that the risks are managed effectively.

F Materiality/Significance Framework

F.1 Introduction

EXECUTIVE SUMMARY

In terms of Treasury Regulations for government departments, trading entities, constitutional institutions and public entities, issued in terms of the PFMA, 1999, the CSIR must have a materiality framework of acceptable levels of materiality and significance within the organisation.

The CSIR's reputation, built over more than half a century, depends on the nature of every business transaction, conducted by every employee, on a daily basis. It is built on an implicit set of values, which inspires our employees to maintain the highest ethical standards in all their dealings with our clients and stakeholders, as well as their relationships within the CSIR.

The CSIR is committed to a policy of fair dealing and integrity in conducting its business. This commitment is based on a fundamental belief in honest, fair and legal conduct in all business activities. We expect all our employees to share this commitment to high morals, ethics and legal standards.

Ethics involve the ability to distinguish right from wrong and a commitment to do what is right. Values are core beliefs that create individual attitudes. Although individual values may differ, this does not imply a choice about behaving ethically in the business environment of the CSIR. Our Code of Conduct, as well as the Constitution of the Republic of South Africa and the national laws and regulations, prescribe the legal conduct that embodies values based on ethical principles, while respecting cultural diversity.

F.1 Treasury Regulation 28.1.5

"For purposes of "material" [sections 50(1), 55(2) and 66(1) of the Act] and "significant" [section 54(2) of the Act], the Accounting Authority must develop and agree on a framework of acceptable levels of materiality and significance with the relevant Executive Authority in consultation with the external auditors."

(HOWEVER, THE CSIR HAS BEEN EXEMPTED FROM SECTION 54 (2) AND THIS SCHEDULE DOES NOT INCLUDE THIS SUBSECTION.)

F.1 TREASURY REGULATION 28.1.5 (continued)

		Material
Section 50 (1)	1 The Accounting Authority for a public entity must –	
	(a) exercise the duty of utmost care to ensure reasonable protection of the assets and records of the public entity;	Significant audit findings that could negatively impact on the CSIR's operations and the attainment of strategic goals.
	(b) act with fidelity, honesty, integrity and in the best interest of the public entity in managing the financial affairs of the public entity;	The CSIR sets high standards on fidelity, honesty and integrity. The best interest of the public entity is always relevant in fulfilling its mandate and in the execution of the Shareholder's Compact. Any acts of dishonesty, infidelity and others that are not in the best interests (from a research, financial and reputation perspective) of the CSIR are viewed in a serious manner.
	(c) on request, disclose to the Executive Authority responsible for that public entity or the legislature to which the public entity is accountable, all material facts, including those reasonably discoverable, which in any way influence the decision or actions of the Executive Authority or that legislature; and	The CSIR is committed to disclosing any relevant information to its stakeholders. Materiality can only be determined if the nature of the information is known.
	(d) seek within the sphere of influence of that Accounting Authority, to prevent any prejudice to the financial interests of the state.	The CSIR employs an ongoing Enterprise Risk Management System, as well as controls that are aimed at the prevention/mitigation of any prejudice to the financial interest of the entity. Lack of the required governance processes, lack of due diligence in conducting business, and fruitless and wasteful expenditure are inherently regarded as material.

F.1 TREASURY REGULATION 28.1.5 (continued)

		Material
Section 55 (2)	2 The annual report and financial statements referred to by PFMA Subsection 55 (1)(d) must –	
	(a) fairly present the state of affairs of the public entity, its business, its financial results, its performance against pre- determined objectives and its financial position as at the end of the financial year concerned;	As per guidelines issued by National Treasury: Significance/materiality is calculated as 0.75% of revenue, which amounts to R22 413 300.
	(b) include particulars of –	
	(i) any material losses through criminal conduct and any irregular expenditure and fruitless and wasteful expenditure that occurred during the financial year;	R1 000 000. All cases are unique and will thus be treated as such. These will be subject to internal audit reviews.
	(ii) any criminal or disciplinary steps taken as a consequence of such losses or irregular expenditure or fruitless and wasteful expenditure;	R1 000 000. All cases are unique and will thus be treated as such. Issues that inform steps to be taken are: • The level of responsibility and position of the person involved; • The affected core business/support/operational; and • The impact on other areas of operation of the CSIR. • These will be subject to internal audit reviews.
	(iii) any losses recovered or written off;	R1 000 000 (excluding losses incurred through normal operating activities)
	(iv) any financial assistance received from the state and commitments made by the state on its behalf; and	Will disclose as prescribed.
	(v) any other matters that may be prescribed; and	Will disclose as prescribed.
	(c) include the financial statements of any subsidiaries	All subsidiaries are consolidated.

F.1 TREASURY REGULATION 28.1.5 (continued)

		Material
Section 66 (1)	(1) An institution to which this Act applies may not borrow money or issue a guarantee, indemnity or security, or enter into any other transaction that binds or may bind that institution or the Revenue Fund to any future financial commitment, unless such borrowing, guarantee, indemnity, security or other transaction – (a) is authorised by this Act; and (b) in the case of public entities, is also authorised by other legislation not in conflict with this Act; and (c) in the case of loans by a province or a provincial government business enterprise under the ownership control of a provincial executive, is within the limits as set in terms of the Borrowing Powers of Provincial Governments Act, 1996 (Act No 48 of 1996).	The CSIR complies with this requirement.

G Financial Plan

G.1 CSIR Budget and Parliamentary Grant Cash flow 2020/21

G.1.1 CSIR STATEMENTS OF COMPREHENSIVE INCOME OVER THE MTEF PERIOD

Table G.1: Statement of Comprehensive Income – MTEF Period

	Forecast 2019/2020 R'000	Budget 2020/2021 R'000	Budget 2021/2022 R'000	Budget 2022/2023 R'000
Total Operating Revenue	**2 694 354**	**2 988 440**	**3 170 257**	**3 365 304**
R&D Contract Income	**1 926 973**	**2 205 384**	**2 362 526**	**2 526 493**
Public – South Africa	1 470 024	1 658 316	1 732 940	1 802 258
Private – South Africa	194 660	285 992	328 891	378 224
International	180 511	174 800	209 760	251 712
Parliamentary Grant – Ringfenced	81 778	86 276	90 935	94 299
Parliamentary Grant	**765 009**	**781 246**	**805 016**	**834 738**
Royalty Income	**2 360**	**1 810**	**2 715**	**4 073**
Other Income	**11**	**–**	**–**	**–**
Total Expenditure	**2 748 169**	**3 035 013**	**3 203 934**	**3 392 898**
Employees' Remuneration	1 596 602	1 765 662	1 871 410	1 983 694
Operating Expenses	1 044 832	1 122 617	1 185 484	1 251 871
Depreciation	106 735	144 157	147 040	157 333
Operating Profit before Investment Income	**(53 815)**	**(43 815)**	**(33 677)**	**(27 594)**
Investment Income	43 815	43 815	44 691	45 585
Net Profit before non-guaranteed employees' remuneration (Performance bonus)	**(10 000)**	**–**	**11 015**	**17 991**
Non-guaranteed employees' remuneration (Performance bonus)				
NET PROFIT	**(10 000)**	**–**	**11 015**	**17 991**

G.1 CSIR BUDGET AND PARLIAMENTARY GRANT CASH FLOW 2020/21 (continued)

G.1.2 CSIR STATEMENTS OF FINANCIAL POSITION OVER THE MTEF PERIOD

Table G.2: Statement of Financial Position over the MTEF Period

	FORECAST March 2020 R'000	BUDGET March 2021 R'000	BUDGET March 2022 R'000	BUDGET March 2023 R'000
ASSETS				
Non-Current assets	**759 460**	**720 303**	**693 263**	**685 930**
Property, plant and equipment	752 510	713 353	686 313	678 980
Interest in Joint Ventures and Associates	2 305	2 305	2 305	2 305
Interest in Subsidiaries	4 645	4 645	4 645	4 645
Trade and other receivables	–	–	–	–
Current Assets	**763 116**	**847 177**	**867 113**	**889 872**
Trade and other receivables	269 435	358 613	380 431	403 836
Inventory and contracts in progress	(646 645)	(657 457)	(697 457)	(740 367)
Cash and cash equivalents	1 140 325	1 146 021	1 184 139	1 226 403
TOTAL ASSETS	**1 522 576**	**1 567 480**	**1 560 376**	**1 575 802**
EQUITY AND LIABILITIES				
Reserves	**999 638**	**999 638**	**1 010 653**	**1 028 644**
Retained earnings	999 638	999 638	1 010 653	1 028 644
Non-current liabilities	**10 906**	**11 015**	**11 125**	**11 236**
Post retirement medical benefits	10 906	11 015	11 125	11 236
Current Liabilities	**512 031**	**556 826**	**538 598**	**536 031**
Advances received	134 718	149 422	126 810	100 959
Trade and other payables	377 314	407 404	411 787	435 072
TOTAL EQUITY AND LIABILITIES	**1 522 576**	**1 567 480**	**1 560 376**	**1 575 912**

One needs to consider the budgeted cash balance of R1.1 billion in conjunction with the current liabilities of R512 million. The current ratio (current assets/current liabilities) is expected to remain at approximately 1.5.

G.1 CSIR BUDGET AND PARLIAMENTARY GRANT CASH FLOW 2020/21 (continued)

G.1.3 CSIR CASH FLOW STATEMENT

Table G.3: CSIR Cash-Flow Statement

	March 2021 R'000
Cashflow from operating activities	
Cash receipts from external customers	2 232 710
Parliamentary Grant income	781 246
Cash paid to suppliers and employees	(2 947 659)
Cash generated from operating activities	**66 297**
Net finance income	43 815
Net cash from operating activities	**110 112**
Cashflow from investing activities	
Increase in interest in joint ventures and associates	–
Decrease in long term receivables	584
Acquisition of property, plant and equipment	(105 000)
Net cash utilised in investing activities	**(104 416)**
Cashflow from financing activities	
Increase in non current liabilities	–
Net cash generated from financing activities	–
Net increase in cash and cash equivalents	**5 696**
Cash and cash equivalents at beginning of the year	1 140 325
Cash and cash equivalents at end of the year	**1 146 021**

G.1 CSIR BUDGET AND PARLIAMENTARY GRANT CASH FLOW 2020/21 (continued)

G.1.4 TWELVE MONTH CASH FLOW PROJECTION FOR PARLIAMENTARY GRANT: 2019/20 (INCLUDING VAT)

Table G.4: Cash-Flow for Parliamentary Grant

R'000	Total	April	July	October	January
	1 252 620	313 155	313 155	313 155	313 154
Baseline	860 951				
National Laser Centre	37 482				
Laser Loan Programme	11 004				
African Laser Centre	6 011				
Implementation: ICT R&D Roadmap	82 202				
Cyber Infrastructure (NICIS)	254 970				

G.1.5 PPE BUDGET SUMMARY

Table G.5: PPE Budget Summary

Category	2020/21 R'000
Equipment	34 125
ICT equipment	62 475
Furniture and fittings	1 890
Vehicles	1 260
TOTAL	105 000

The budgeted investment in property, plant and equipment for the 2020/21 financial year is R105 million, which includes fully funded grant assets.

Notwithstanding the fact that an item is included in the property, plant and equipment budget, the investment remains subject to approval as per the Approval Framework of the CSIR and additional considerations such as strategic alignment, return on investment and available cash flow.

G.1 CSIR BUDGET AND PARLIAMENTARY GRANT CASH FLOW 2020/21 (continued)

G.1.6 ALIGNMENT OF PARLIAMENTARY GRANT BUDGET AND STRATEGIC OBJECTIVES

Table G.6: Link between Parliamentary Grant and CSIR Strategic Objectives

PG ALLOCATION DESCRIPTION	2020/21 Allocation R'000	Strategic Objectives
Baseline Allocation to clusters (previously Business Units)	**R547 883**	SO1,SO2 & SO3
Portfolios and Support Functions	**R187 877**	
Leadership Team	R33 927	SO5
Campus Master Plan Office	R5 624	SO4
Internal Audit	R8 267	SO5
CSIR Board and sub committees	487	SO5
Research and Development Office	R12 292	SO1,SO2 & SO3
Planning and Reporting	R10 064	SO1,SO2 & SO3
Information and Knowledge Management	R13 757	SO1,SO2 & SO3
Business Excellence & Integration	R16 070	SO1,SO2 & SO3
Strategic Communications and Stakeholder Relations	R14 328	SO5
Legal, POPI and Enterprise Risk Management	R11 903	SO5
Compliance	R5 132	SO5
Knowledge Commons	R3 021	SO5
Information and Communication Technology	R33 243	SO5
Human Resources	R8 762	SO4
Human Capital development	R11 000	SO4
Strategic Programmes	**R106 950**	
Emerging Research Areas	R51 750	SO1,SO2 & SO3
Thematic Programme	R41 400	SO1,SO2 & SO3
Young Researcher Empowerment Fund	R13 800	S04
Non-Discretionary Special Initiatives	**R45 395**	
Research Ethics Training	R421	SO1, SO2 & SO3
Research Ethics Committee	R600	SO1,SO2 & SO3
CSIR Board and sub committees	R2 407	SO5
Communications Projects / Rebranding	R11 094	SO5
Bursary program	R14 873	SO4
Health & Wellbeing	R1 000	SO4
CSIR Conference / Excellence awards / Rebranding	R2 000	SO4
SEED Fund: L&V office	R1 000	SO1,SO2 & SO3
Senior Researcher Acceleration Programme	R12 000	S04
Discretionary Allocations (To be invested upon receipt of motivations)	**R10 328**	
Project Synapse: New Indstrial Development strategy Implementation	R10 328	SO1, SO2, SO3
Ring-Fenced Allocations	**R354 187**	
Implementation: ICT R&D Roadmap	R82 202	SO2 & SO3
African Laser Centre (NLC)	R6 011	SO2 & SO3
Laser Loan Programme (NLC)	R11 004	SO2 & SO3
Cyber Infrastructure	R254 970	SO2 & SO3
Total	**R1 252 620**	

G.1 CSIR BUDGET AND PARLIAMENTARY GRANT CASH FLOW 2020/21 (continued)

G.1.6 ALIGNMENT OF PARLIAMENTARY GRANT BUDGET AND STRATEGIC OBJECTIVES

Table G.7: Summary of PG Investment by Strategic Objectives

Programs		Strategic Objectives	Investment	%
Programme 1:	Administration: Financial Sustainability and Good Governance	SO5	R112 715	9%
Programme 2:	Research, Development and Innovation	SO1,SO2 & SO3	R1 070 846	85%
Programme 3:	Human capital and infrastructure development	SO4	R69 059	6%
Total			**R1 252 620**	**100%**

G.2 CSIR Group 3 Year Financial Plan

G.2.1 SUBSIDIARIES AND ASSOCIATE COMPANIES

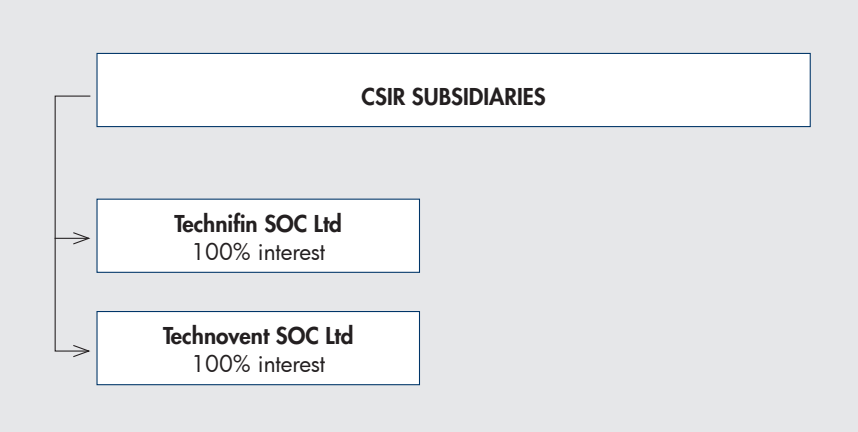
Table G.8: CSIR Subsidiaries and Associated Companies: Income and Expenditure 2020/21

2020/21						
	Total	Technifin SOC Ltd	Technovent SOC Ltd	SERA (Pty) Ltd	Ellipsoid Technology (Pty) Ltd	Persomics AB
Incorporated % Holding		South Africa 100	South Africa 100	South Africa 50	South Africa 50	Sweden 37.89
Annual budget – R'000						
Total Income	**–**	**–**	**–**	**–**	**–**	**–**
Contract income	–	–	–	–	–	–
Royalty income	–	–	–	–	–	–
Finance income	–	–	–	–	–	–
Other income	–	–	–	–	–	–
Expenses	**–**	**–**	**–**	**–**	**–**	**–**
Operating expenses	–	–	–	–	–	–
Employees' remuneration	–	–	–	–	–	–
Depreciation/amortisation	–	–	–	–	–	–
Share of (loss)/profit of joint ventures and associates	–	–	–	–	–	–
Net profit	**–**	**–**	**–**	**–**	**–**	**–**

CSIR GROUP 3 YEAR FINANCIAL PLAN

The CSIR subsidiary companies have duly appointed Boards. The subsidiary companies are audited by the Auditor-General.

The subsidiary companies have a zero dividend policy. CSIR Subsidiary Companies



CSIR GROUP STATEMENTS OF COMPREHENSIVE INCOME

Table G.9: Group Statement of Comprehensive Income – MTEF Period

	Forecast 2019/2020 R'000	Budget 2020/2021 R'000	Budget 2021/2022 R'000	Budget 2022/2023 R'000
Total Operating Revenue	**2 694 354**	**2 988 440**	**3 170 257**	**3 365 304**
Contract R&D Income	**1 926 973**	**2 205 384**	**2 362 526**	**2 526 493**
Public – South Africa	1 470 024	1 658 316	1 732 940	1 802 258
Private – South Africa	194 660	285 992	328 891	378 224
International	180 511	174 800	209 760	251 712
Parliamentary Grant – Ringfenced	81 778	86 276	90 935	94 299
Parliamentary Grant	**765 009**	**781 246**	**805 016**	**834 738**
Royalty Income	**2 360**	**1 810**	**2 715**	**4 073**
Other Income	**11**	**–**	**–**	**–**
Total Expenditure	**2 748 169**	**3 032 255**	**3 203 934**	**3 392 898**
Employees' Remuneration	1 596 602	1 765 481	1 871 410	1 983 694
Operating Expenses	1 044 832	1 122 617	1 185 484	1 251 871
Depreciation	106 735	144 157	147 040	157 333
Operating Profit before Investment Income	**(53 815)**	**(43 815)**	**(33 677)**	**(27 594)**
Investment Income	43 815	43 815	44 691	45 585
Share of (losses)/profit of joint ventures and associates	–	–	–	–
Net Profit before non-guaranteed employees' remuneration (Performance bonus)	**(10 000)**	**–**	**11 015**	**17 991**
Non-guaranteed employees' remuneration (Performance bonus)				
NET PROFIT	**(10 000)**	**–**	**11 015**	**17 991**

CSIR GROUP 3 YEAR FINANCIAL PLAN

G.2.2 CSIR GROUP STATEMENTS OF FINANCIAL POSITION

Table G.10: Group Statement of Financial Position over the MTEF Period

	Forecast March 2020 R'000	Budget March 2021 R'000	Budget March 2022 R'000	BUDGET March 2023 R'000
ASSETS				
Non-Current assets	**754 815**	**715 658**	**688 618**	**681 285**
Property, plant and equipment	752 510	713 353	686 313	678 980
Interest in Joint Ventures and Associates	2 305	2 305	2 305	2 305
Interest in Subsidiaries	–	–	–	–
Trade and other receivables	–	–	–	–
Current Assets	**770 149**	**854 210**	**874 146**	**897 015**
Trade and other receivables	269 435	358 613	380 431	403 836
Inventory and contracts in progress	(646 645)	(657 457)	(697 457)	(740 367)
Cash and cash equivalents	1 147 359	1 153 054	1 191 172	1 233 545
TOTAL ASSETS	**1 524 964**	**1 569 868**	**1 562 764**	**1 578 300**
EQUITY AND LIABILITIES				
Reserves	**1 002 026**	**1 002 026**	**1 013 041**	**1 031 032**
Retained earnings	1 002 026	1 002 026	1 013 041	1 031 032
Non-current liabilities	**10 906**	**11 015**	**11 125**	**11 236**
Post retirement medical benefits	10 906	11 015	11 125	11 236
Current Liabilities	**512 031**	**556 826**	**538 598**	**536 031**
Advances received	134 718	149 422	126 810	100 959
Trade and other payables	377 314	407 404	411 787	435 072
TOTAL EQUITY AND LIABILITIES	**1 524 964**	**1 569 868**	**1 562 764**	**1 578 300**

G.3 CSIR Group Cash Flow

Table G.11: CSIR Group Cash-Flow Statement

	March 2021 R'000
Cashflow from operating activities	
Cash receipts from external customers	2 232 796
Parliamentary Grant income	781 246
Cash paid to suppliers and employees	-2 947 271
Cash generated from operating activities	**66 771**
Net finance income	43 815
Net cash from operating activities	**110 586**
Cashflow from investing activities	
Decrease in interest in joint ventures and associates	–
Decrease in non-current trade and other receivables	–
Acquisition of property, plant and equipment	(105 000)
Net cash utilised in investing activities	**(105 000)**
Cashflow from financing activities	
Increase in non-current liabilities	109
Net cash generated from financing activities	**109**
Net increase in cash and cash equivalents	**5 695**
Net increase in cash and cash equivalents	**1 147 359**
Cash and cash equivalents at beginning of the year	**1 153 054**

G.4 5 Year Borrowing Plan

Table G.12: CSIR 5 Year Borrowing Plan

	Performance bonds	Bid bond	Payment guarantee	Advance payment guarantee	Total annual limit
Financial year ending			**R'000**		
31 March 20	25 000	5 000	20 000	50 000	100 000
31 March 21	35 000	5 000	20 000	50 000	110 000
31 March 22	45 000	5 000	20 000	50 000	120 000
31 March 23	50 000	5 000	25 000	50 000	130 000
31 March 24	55 000	5 000	25 000	55 000	140 000