R&D and Innovation Capabilities in South African State-Owned Enterprises: The case of the South African Forestry Company SOC Ltd

Centre for Science, Technology and Innovation Indicators, Human Sciences Research Council

WORKING PAPER SERIES
No. 2d | February 2022

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

HSRC Human Sciences Research Council

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CeSTII, 2022. *R&D and Innovation Capabilities in South African State-Owned Enterprises: The Case of South African Forestry Company SOC Ltd (SAFCOL).*
Cape Town: Human Sciences Research Council.

Date of publication: February 2022
Copy editing: Katharine McKenzie
Design and layout: Tracey Watson

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This report forms part of WORKING PAPER SERIES 2a-d (February 2022)

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Cape Town: Human Sciences Research Council.

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EXECUTIVE SUMMARY

This case study research report, commissioned by the Department of Science and Innovation (DSI), analyses R&D and innovation capabilities in the South African state-owned enterprise, the South African Forestry Company SOC Ltd (SAFCOL). It situates SAFCOL within its unique innovation system, examining five key dimensions within the organisation: human capabilities, technological capabilities, networks, research infrastructure, and governance. The research also explores the plans and strategies that SAFCOL has set in place to develop its R&D and innovation capabilities. Where possible, the analysis is punctuated with examples of the SOE's R&D and innovation outputs as well as unit-level R&D Survey data pertaining to SAFCOL.

Formed in 1992, SAFCOL has a dual mandate: a commercial mandate—to conduct forestry business, mainly timber harvesting, processing, and other related activities both nationally and internationally—and a socio-economic development mandate—to show an effective return to its shareholder, the Department of Public Enterprises, whilst contributing to economic development mainly in rural areas. In South Africa, SAFCOL currently manages 189 760ha of pine, eucalyptus and wattle forest, including 121 585ha of commercial plantation. In Mozambique, it manages 82 547ha of pine and eucalyptus forest, of which 15 258ha is commercial plantation. SAFCOL processes about ten percent of South Africa's logs; and SAFCOL's nurseries produce more than ten million seedlings and cuttings annually.

In terms of its governance, R&D and innovation are integral to SAFCOL's core business and are reported in its annual integrated report with varying degrees of detail. While R&D collaborations are encouraged within SAFCOL, as is strengthening the country's broader national R&D capabilities in wood science and technology, it is notable from SAFCOL's 2018/19 Integrated Report that capital investment key performance indicators were not achieved. However, the appointment of an acting executive for innovation, marketing and strategy, and the inclusion of product and process innovation at the centre of its strategic pathway, signals that SAFCOL prioritises innovation at the highest level. SAFCOL has 13 Social Compacts with community clusters that form the governance basis of its community engagement. Internationally, routine audits by the Forest Stewardship Council provide a critical foundation for SAFCOL standards.

Technologically, SAFCOL's capabilities can be considered as twofold: timber capabilities and non-timber capabilities. Its timber capabilities span the entire timber value chain, from genetic engineering and breeding to sawmilling and beneficiation of timber products. SAFCOL has substantial capabilities across the value chain. SAFCOL's non-timber capabilities encompass community-based forestry and cooperatives, training, and eco-tourism.

Within a workforce of over 2 000, a relatively small combined team of less than ten scientists, technicians and managers deliver wide-ranging research on silviculture practices, pest and disease tolerance, genetic improvements, wood-quality testing, growth and yield modelling, and engineered wood products. To redress longstanding national capacity gaps in wood science and technology, SAFCOL builds R&D capacity in partnership with local universities, including through bursary support, and a SARCHI Chair at the University of Pretoria. More broadly, SAFCOL's human capabilities to perform innovation extend beyond its R&D team, to include training, eco-tourism, and agro-forestry personnel at both operational and executive levels.

In terms of research infrastructure, SAFCOL has a dedicated R&D Centre at Sabie in Mpumalanga province, situated in close proximity to the Tweefontein plantation and nursery. The centre contains a tissue culture laboratory, and is in the process of expanding its suite of equipment, to include cryogenic freezers.[1] On the R&D team's 'wishlist' is a databank to

1 Cryopreservation retains cells or tissue matter at sub-zero temperatures.

enable it to improve its R&D performance in line with industry trends. Infrastructure-related challenges experienced by the R&D team include procurement delays and on-plantation transportation challenges; although, on the whole, the R&D team reported that their infrastructure needs are well supported.

SAFCOL does not pursue R&D and innovation in isolation. Working with a wide range of university, industry, international, and community partners, collaboration helps SAFCOL to solve different kinds of operational problems, leverage research infrastructure, promote capacity development of its researchers and the organisation more broadly, and to grow its relationships with the communities in which it works.

Looking forward, R&D and innovation strategies include: evolving plans to develop a techno park at Sabie to drive sector industrialisation; to increase the productive capacity of its Timbadola Sawmill; a multi-faceted training programme; and a host of capacity building R&D partnerships with universities, and international organisations.

In terms of R&D specifically, this report argues that while SAFCOL has an advanced R&D capability, this could be strengthened and enhanced through increased investment in personnel, especially at research assistant level, and greater operational support to the R&D team in infrastructure and equipment procurement. Continued investment in collaboration and networking, including formal R&D partnerships, could enhance SAFCOL's competitiveness in the longer run.

In terms of innovation capability more broadly, SAFCOL has a diversified portfolio of non-R&D driven innovation activities—from cooperatives and training to eco-tourism and cultural and creative industry initiatives, but it was found that these remain constrained by a corporate social investment paradigm.

An important question addressed in this study is which dimensions are crucial to gear an SOE like SAFCOL to perform R&D and innovation effectively and efficiently in the future. There are two areas in particular to highlight. The first is SAFCOL's technological capabilities to develop and beneficiate its biological asset, including and especially increasing its R&D capacity and the productive capacity of its Timbadola Sawmill. The second concerns SAFCOL's 13 Social Compacts with communities. Compacts could be leveraged, beyond the CSI paradigm, for greater impact on the SAFCOL dual mandate. There is encouraging evidence that SAFCOL is leveraging its community partnerships, particularly, for example, in terms of training and eco-tourism. This could be strengthened through deeper and more focussed engagement on livelihoods, enterprise development and innovation in the informal economy, including working with local, provincial and national government departments, as well as private sector actors, to scale up impact.

In summary, this case study report provides a snapshot of the unique character of R&D and innovation at SAFCOL in terms of critical dimensions such as human and technological capabilities, research infrastructure, and governance, highlighting challenges and opportunities for consideration by the entity and stakeholders within its innovation system.

SUMMARY FINDINGS AND PRELIMINARY RECOMMENDATIONS

Finding	Preliminary recommendations
While SAFCOL has prioritised R&D and innovation in its strategic plans, to include provision for a dedicated R&D Centre and a host of physical sites to support innovation, for example, the Timbadola Sawmill, capital investment is constrained by financial performance.	R&D and innovation require dedicated strategies and accompanying investment portfolios if these are to become drivers of future SAFCOL growth.
SAFCOL has developed its human capabilities to perform R&D and innovation, though there are some capacity gaps, both at the level of research performance and at the level of research management.	Fill capacity gaps through strengthening R&D and innovation support and management structures, including enhanced data and databank capabilities.
SAFCOL's R&D collaborations enable performance through local and international knowledge networks, training and infrastructure sharing.	Deepen SAFCOL's 'collaborative capital' through dedicated investments and new partnerships, across both timber and non-timber technological capabilities.
SAFCOL's 13 Social Compacts serve to organise the productive relationship between SAFCOL and the communities within which it works. Activities with communities are predominantly organised within a corporate social investment paradigm.	Map local innovation and production systems in each community to leverage new innovation and innovative potential through expanding activities, including training, eco-tourism, and cooperatives.

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ACRONYMS

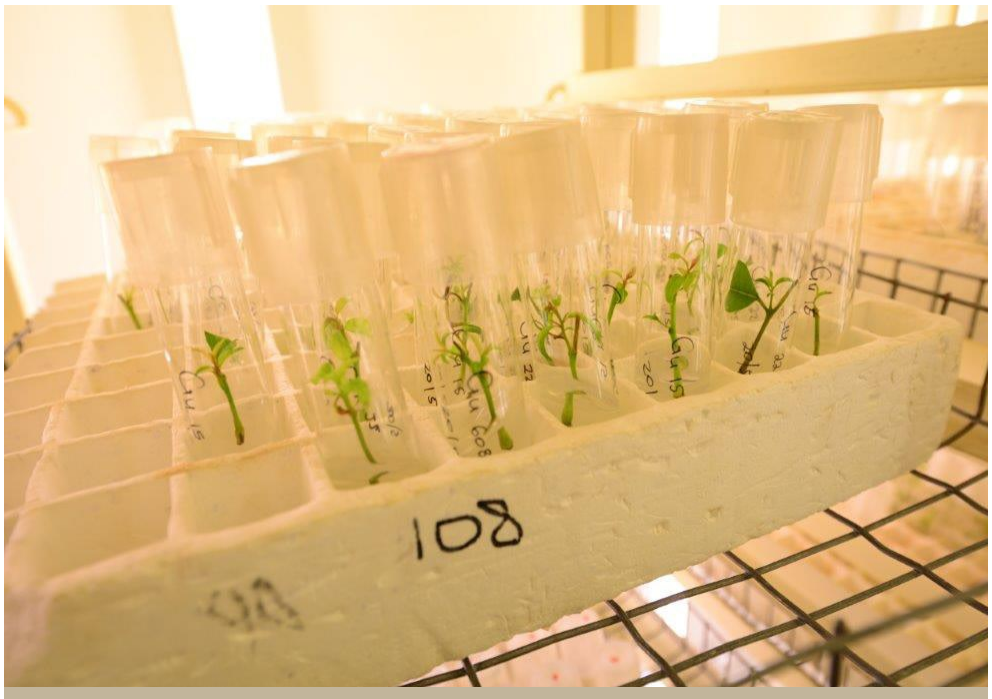
ARC	Agricultural Research Council
CSI	Corporate social investment
CSIR	Council for Scientific and Industrial Research
CeSTII	Centre for Science, Technology and Innovation Indicators
DAFF	Department of Agriculture, Forestry and Fisheries
DSI	Department of Science and Innovation
FSC	Forest Stewardship Council
FABI	Forestry and Biotechnology Institute
IFLOMA	Indústrias Florestais de Manica, Mozambique
IUFO	International Union of Forest Research Organisation
KLF	Komatiland Forests
KPI	Key performance indicator
OECD	Organisation for Economic Co-operation and Development
PFMA	Public Finance Management Act
R&D	Research and experimental development
SAFCOL	South African Forestry Company Limited
SAPPI	South African Pulp and Paper Industry
SARIR	South African Research Infrastructure Roadmap
SOE	State-owned enterprise

1 | INTRODUCTION

Founded pre-democracy in the early 1990s, the South African Forestry Company SOC Ltd (SAFCOL) is responsible for managing and controlling the majority of the country's state-owned forests. In terms of the Management of State Forests Act (No. 128 of 1992), SAFCOL manages 272 307 hectares of forest and commercial plantation in South Africa and Mozambique. Its dual mandate requires it to conduct forestry business and contribute to rural development. SAFCOL operates on a for-profit basis, and is self-funded through revenues generated from timber and non-timber products and services. SAFCOL has developed 13 Social Compacts with community clusters in the geographical areas where it manages forests, and is audited annually by the global forestry regulator, the Forest Stewardship Council (FSC).

This case study research report, commissioned by the Department of Science and Innovation (DSI), analyses SAFCOL's R&D and innovation capabilities. It situates SAFCOL within its unique innovation system, examining five key dimensions within the organisation: human capabilities, technological capabilities, networks, research infrastructure, and governance. The research explores plans and strategies that SAFCOL has set in place to develop its R&D and innovation capabilities. These include evolving plans to increase the productive capacity of its Timbadola Sawmill, a multi-faceted training programme, as well as a host of capacity building R&D partnerships with universities, and international organisations. Where possible, the analysis includes examples of the SOE's R&D and innovation outputs as well as unit-level R&D Survey data pertaining to SAFCOL.

In terms of structure: Section 2 describes the research methodology followed in the preparation of this report; Section 3 describes the study's analytical framework; Section 4 presents and discusses research data in relation to the study's analytical framework; and Section 5 discusses challenges and opportunities for SAFCOL in respect of its R&D and innovation capabilities and plans.



Seedlings in development at SAFCOL's research facilities. [Image credit: SAFCOL]

2 | RESEARCH METHODOLOGY, IN BRIEF

Research questions

The research methodology adopted in the preparation of this case study is an exploratory, qualitative mixed methods approach, applied in the context of a larger project comprising three case studies, of which this is one.[2] This research aimed to answer the following question and sub-questions: **To what extent and how are South African SOEs geared—in terms of their human and technological capabilities, networks, research infrastructure and governance—to perform R&D and innovation?** Two stated sub-questions emphasise a present and future orientation studied in this research:

- **Sub-question 1**: What are the current human and technological capabilities, networks, research infrastructure and governance of SOEs to perform R&D and innovation?
- **Sub-question 2**: What strategies or plans do SOEs have in place to develop these dimensions?

Definitions of R&D and innovation

Research and experimental development (R&D) is defined in this study according to the OECD's Frascati Manual (2015), and innovation is defined according to the OECD's Oslo Manual (2018). These definitions are:

- **Research and experimental development (R&D)** comprise creative and systematic work undertaken in order to increase the stock of knowledge—including knowledge of humankind, culture and society—and to devise new applications of available knowledge.[3]
- **Innovation** is defined as a new or improved product or process (or combination thereof) that differs significantly from the unit's previous products and processes and that has been made available to potential users (product) or brought into use by the unit (process).[4]

It is important to note that, in studies of innovation, R&D is considered to be one innovation activity among others.

Data collection and preparation

To develop an in-depth understanding of SAFCOL, the study team engaged primary sources, notably SAFCOL's 2016/17, 2017/18 and 2018/19 integrated annual reports, as well as corporate brochures and other grey literature sources, such as presentations, magazine and news articles. Some of these materials were shared with the research team by SAFCOL, while some were located through keyword web searches. In addition, the study team visited the SAFCOL R&D centre at Sabie in South Africa's Mpumalanga province.

To supplement these information sources, semi-structured interviews administered with key informants from SAFCOL were conducted in 2018.[5] Key informants included two senior managers, two research specialists, and two researchers.[6] Interviews were semi-structured, which involved a clear list of questions (see *Synthesis Report* for full interview schedule), and the expectation of a flexible sequence in which questions are asked. Respondents could elaborate more broadly on question topics, and follow up with the research team telephonically, in-person, or by email.

2 A more detailed account of the research methodology is included in the annexures of the *Synthesis Report*, accompanying this report.

3 Organisation for Economic Co-operation and Development (OECD), *Frascati Manual: Guidelines for Collecting and Reporting Data on Research and Experimental Development*. OECD Publishing: Paris, 2015.

4 Organisation for Economic Co-operation and Development (OECD), *Oslo Manual Guidelines for Collecting, Reporting and Using Data on Innovation, 4th Edition*. OECD Publishing: Paris, 2018.

5 Interviews took place on 25 October 2018 (three interviews).

6 Cited in this report respectively as **INTERVIEW.ROLE DESCRIPTION. CASE STUDY NUMBER, DATE**: ITV.SPEC1.CS3, 25 October 2018; ITV.SM1.CS3, 25 October 2018; ITV.SPEC2.CS3, 25 October 2018; ITV.SM2.CS3, 25 October 2018; ITV.RES1.CS3, 25 October 2018; ITV.RES2.CS3, 25 October 2018.

In terms of data preparation, interviews were transcribed verbatim from the audio recordings. Transcript data was descriptively coded by grouping and categorised into the study's five dimensions.[7] Due to the limited number of key informant exchanges, no specialist coding software was required. Report writing, critical review, and improvement took place concurrently, commencing in April 2019 and concluding in final draft form in February 2020.

Ethical considerations and dissemination

The study's researchers made use of and explained informed consent forms to key informants before each interview. In line with these, key informants remain anonymous in the draft written reports and access to the original recordings and transcriptions is restricted to CeSTII researchers. It was expressly agreed with key informants at the time of interviews that draft reports would be shared with SAFCOL key informants first, to correct inaccuracies, and, as part of the validation of the research. This took place during 2020 and 2021. The validated reports will be shared widely with the relevant government departments, other researchers, and the general public, for further validation and to enhance the dissemination and uptake of the research findings.

7 R. Tesch, Qualitative Research, Types and Software Tools. Falmer Press: New York, 1990. Also: J. Saldana, 2016. The Coding Manual for Qualitative Researchers. Sage: London.

3 | ANALYTICAL FRAMEWORK

The concept of gearing

Unlike the concept of gearing in financial accounting, which reflects the proportion of debt to equity, the concept of 'gearing' from an automotive perspective refers to the capacity of the engine and gears, working together, to alter a vehicle's rate of acceleration. The study team chose this as a useful organising concept for the research—to help shape our assessment of the extent to which SOEs are prepared, ready and capacitated, through R&D and innovation. The study team hypothesised that if an SOE is *gearing*—or indeed, *geared*—appropriately, then it is in a position to leverage R&D and innovation to achieve its mandate efficiently and effectively. If not, then a set of questions arise as to what investment or organisational change is required to facilitate the development of R&D and innovation capabilities in the future.

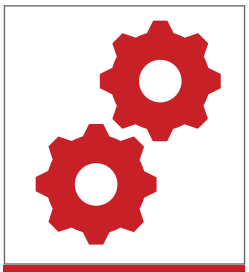


Figure 1: Gearing reflects the capacity of SOEs to utilise R&D & innovation activities to achieve their mandates efficiently and effectively.

A caveat is in order. While there are indicators against which SOEs can report on their R&D and innovation activities to their shareholders, for example through integrated annual reports, this case study research is not generalisable to the extent that it can yet provide a normative framework for 'gearing' (which is to say that if a given SOE meets certain pre-defined criteria, then it is geared 'correctly', and vice versa). Rather, it aims to develop a set of qualitative suggestions, based on the individual case study's research findings, for consideration by national policymakers and SOE organisational leaders in determining future plans for R&D and innovation within the specific SOEs studied. Indeed, more case study research could contribute empirical evidence to allow for the generalisability of findings, and further enhance indicator development and evidence-based policymaking within this domain.

Systems approach

State-owned enterprises, like non-state firms, are actors within particular national policy and industrial systems that span a range of boundaries: commercial, technological, political and geographical.[8] When it comes to R&D and innovation, SOEs also nest within particular knowledge and technical systems (innovation systems) that can enable or circumscribe their capacity. The systemic nature of R&D and innovation, therefore, represents a conceptual starting point for this research.

8 B.Å. Lundvall, *Product Innovation and User-Producer Interaction, Industrial Development.* Research Series 31, Aalborg University Press: Aalborg, 1985.

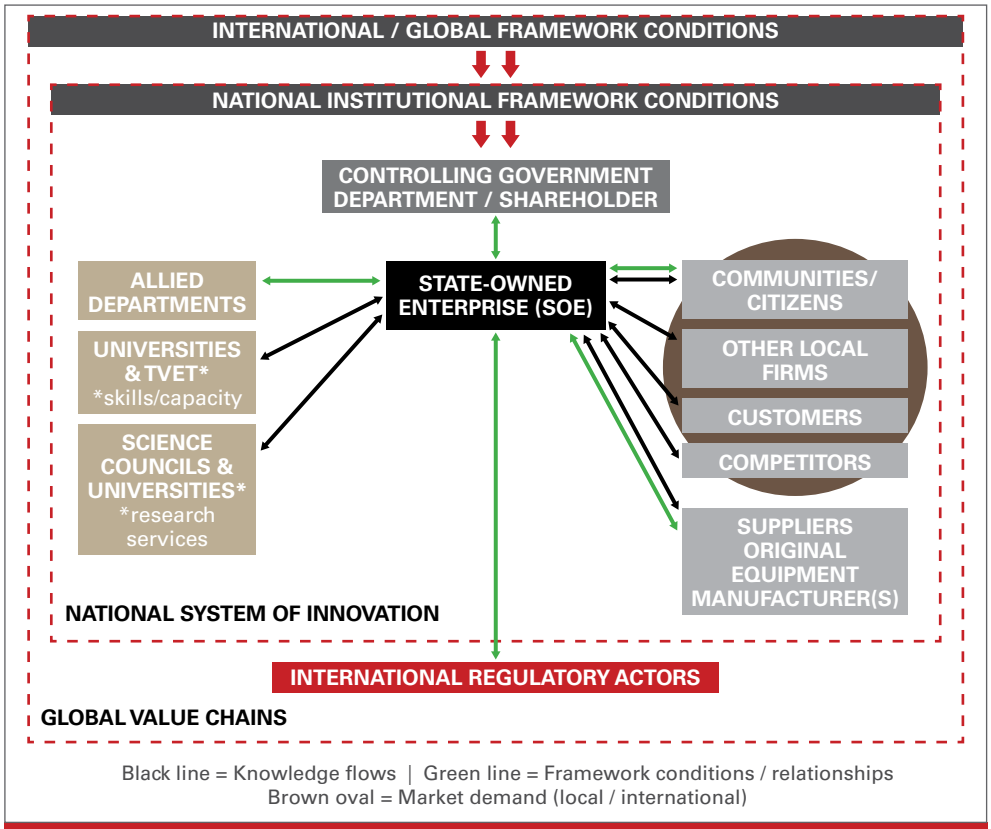


Figure 2: SOEs are nested within technical and knowledge systems as well as national policy and industrial systems

R&D and innovation capabilities of the SOE: Five study dimensions

Within this systems context, the case study focuses on five dimensions within the organisation—the unit of analysis—to assess SAFCOL preparedness ('gearedness') to perform R&D and innovation. These dimensions, defined in more detail below are human capabilities; technological capabilities; networks; research infrastructure; and governance. The particular dimensions were developed during stakeholder consultations in 2017, with SOEs and government departments, which identified areas for investigation through case study research.[9] A critical assumption the study team makes is that how these dimensions are established can affect the way the organisation operates and therefore its ability to deliver goods and services to customers within its resource-base constraints.

Human capabilities

The ability of people as a whole or as individuals to perform and manage their affairs successfully is how the OECD defined human capabilities in 2006.[10] In the specific context of this research, human capabilities refers to the abilities of R&D and innovation personnel within a given state-owned enterprise to generate R&D and innovation outputs and outcomes in line with their organisational mandate.

9 See Key Outcome 7.4 and 7.5 in ANNEXURE A: KEY OUTCOMES FROM THE CLUSTER WORKSHOP ON PUBLIC RESEARCH AND DEVELOPMENT (R&D) INVESTMENT TRENDS AND POLICY IMPLICATIONS DATE: 13 APRIL 2018, UNION BUILDINGS.

10 Organisation for Economic Co-operation and Development, Development Assistance Committee (OECD-DAC), *The Challenge of Capacity Development: Working Towards Good Practice.* OECD DAC, DAC Network on Governance (GOVNET), 2006.

Technological capabilities

In this study, technological capabilities refers to the entity's ability, based on its accumulated knowledge, to perform R&D and innovation, which results in new technological knowledge development to achieve positive results.[11] Similarly, technological capabilities, as defined by Guerra and Carmago in 2016, refer to the ability of a firm to execute a technical function.[12] Following these definitions, technological capabilities within this research includes technologies and knowledge of technologies.

Networks

Networks, as defined in this research incorporates relationships enacted by and through SOE personnel and institutional processes, and the form of formal partnership agreements and/or informal collaborative work undertaken in the conduct of R&D and innovation activities.[13] Partners or collaborators could be private firms, professional bodies, other SOEs, universities, or other actors. Networks have the potential to increase R&D and innovation productivity and performance, through transferring skills and expertise through inter-organisational knowledge flows.[14]

Research infrastructure

The 2016 *South African Research Infrastructure Roadmap* (SARIR) defines research infrastructure as facilities, resources and services used by the scientific community across all disciplines for conducting cutting-edge research for the generation, exchange and preservation of knowledge.[15] According to the SARIR definition, this includes major facilities, equipment or sets of instruments, collaborative networks and knowledge-containing resources such as collections, archives, databanks and biobanks. Research infrastructure may be single-sited, distributed, or virtual. SOEs require access to research infrastructure in order to conduct cutting-edge research, which in turn nurtures and sustains the SOEs R&D and innovation capabilities.

Governance

Governance, read in a corporate context as opposed to a national or international context, according to Camay and Gordon refers to systems, processes, policies and structures available to direct, manage and control an organisation.[16] Governance also involves the effective and equitable allocation and management of resources for the common good.[17] Following these definitions, this research interprets governance of the SOE broadly, focussing on actors within the SOE (as opposed to external governance actors) and focussing specifically on R&D and innovation activities.

11 PA Zawislak & FM Reichert, Technological Capability and Firm Performance. *Journal of Technology Management and Innovation*, 9 (4), 2006, p. 21.

12 Guston, D. A & Sarewitz, D, *Shaping Science and Technology Policy: The Next Generation of Research*. The University of Wisconsin Press: Madison, 2014.

13 R. Hamann & F. Boulogne, Partnerships and Cross-sector Collaboration. In: R. Hamann, R., Woolman, S. and Sprague, C., eds., *The Business of Sustainable Development in Africa: Human Rights, Partnerships, Alternative Business Models*. Pretoria: Unisa Press, 2008, pp. 54-82.

14 G. Kruss, *Creating Knowledge Networks: Working Partnerships in Higher Education, Industry and Innovation*. HSRC Press: Cape Town, 2006.

15 South African Research Infrastructure Roadmap (SARIR), 1st edition, Department of Science & Technology, 2016.

16 P. Camay & AJ Gordon, *Evolving Democratic Governance in South Africa*. The Co-operative for Research and Education (CORE): Johannesburg, 2004.

17 Ibid., p. 17.

4 | ANALYSIS: HOW IS SAFCOL GEARED TO PERFORM R&D AND INNOVATION?

This section provides a holistic description of the SAFCOL innovation system, and a basis for more in-depth discussions using the study's key dimensions. The starting point is a description of the SAFCOL mandate, business model, and operating context; an illustration and brief description of key features of the SAFCOL R&D and innovation system and an analysis of SAFCOL unit-level data from the SA R&D Survey to assess R&D expenditure trends.

SAFCOL mandate, business model and operating context

Mandate

SAFCOL has a commercial mandate—to conduct forestry business, mainly timber harvesting, processing, and other related activities both nationally and internationally—and a socio-economic development mandate—to show an effective return to its shareholder whilst contributing to economic development mainly in the rural areas. The entity's vision, as stated in its 2017/18 Integrated Report, is to "be a world leader in an integrated forestry business by powering sustainable growth and creating wealth through partnerships with stakeholders and communities."[18]

With R4.65 billion in total assets in 2018/19, SAFCOL carries out its mandate through 100% shareholdings in Komatiland Forests, Abacus Forestries, and Kamhlabane Timber, as well as four minority shareholdings.[19] Through these entities, SAFCOL manages 10.5% of South African state-owned commercial forests, amounting to 189 790ha, two-thirds of which is under conservation.[20] SAFCOL manages 82 547ha of Mozambique's commercial forestry land in the Manica and Safala provinces, through its 80% shareholding in *Indústrias Florestais de Manica* (IFLOMA).[21]

Business model and strategy

A business model expresses the rationale of how an organisation delivers value to its customers.[22] In the case of SAFOCL, its value proposition includes timber logs, processed timber products, and non-timber related goods and services, such as eco-tourism. With 5% of the lumber market share in 2018/19 (up from 2.6% in the previous year),[23] SAFCOL is funded from revenues generated through sales and operations, which was R1.04 billion in 2018/19 (up from R0.93 billion in 2017/18).[24] SAFCOL generated a net profit of R114.44 million in the 2016/17 financial year, but sustained operating losses of R136 million and R142 million in 2017/18 and 2018/19, respectively. Nearly 50% of SAFCOL's cost-base is the cost of employment.

SAFCOL's financial performance, including three consecutive qualified audits, presents a strategic challenge to the organisation and its board, particularly in the context of waning public confidence in SOEs. "SAFCOL needs to optimise volume output, with a clear focus on being cost-competitive, if it is to maximise long term sustainability and profitability," wrote board chair, Mpho Makwana, in his foreword to the *SAFCOL 2017/18 Integrated Report*.

18 SAFCOL Integrated Report 2017/18, p. 15.

19 Siyaqhubeka Forests (Pty) Ltd (25.00%); Amathole Forestry Company (Pty) Ltd (16.00%); MTO Forestry (Pty) Ltd (17.58%); and Singisi Forest Products (Pty) Ltd (10.90%). SAFCOL Integrated Report 2018/19, p. 4, 11.

20 SAFCOL Integrated Report 2017/18, p. 8. Approximately 83% of forests in SA are privately-owned.

21 According to the 2018/19 SAFCOL Integrated Report, "SAFCOL intends to reposition IFLOMA to be a direct subsidiary of it, and operationalise the dormant entities (Abacus and Kamhlabane) to grow the business." (p. 4)

22 J. Magretta, Why Business Models Matter, *Harvard Business Review* (May 2002). Available at: https://hbr.org/2002/05/why-business-models-matter, last accessed 4 March 2019.

23 SAFCOL Integrated Report 2018/19, p. 31.

24 SAFCOL Integrated Report 2018/19, p. 11.

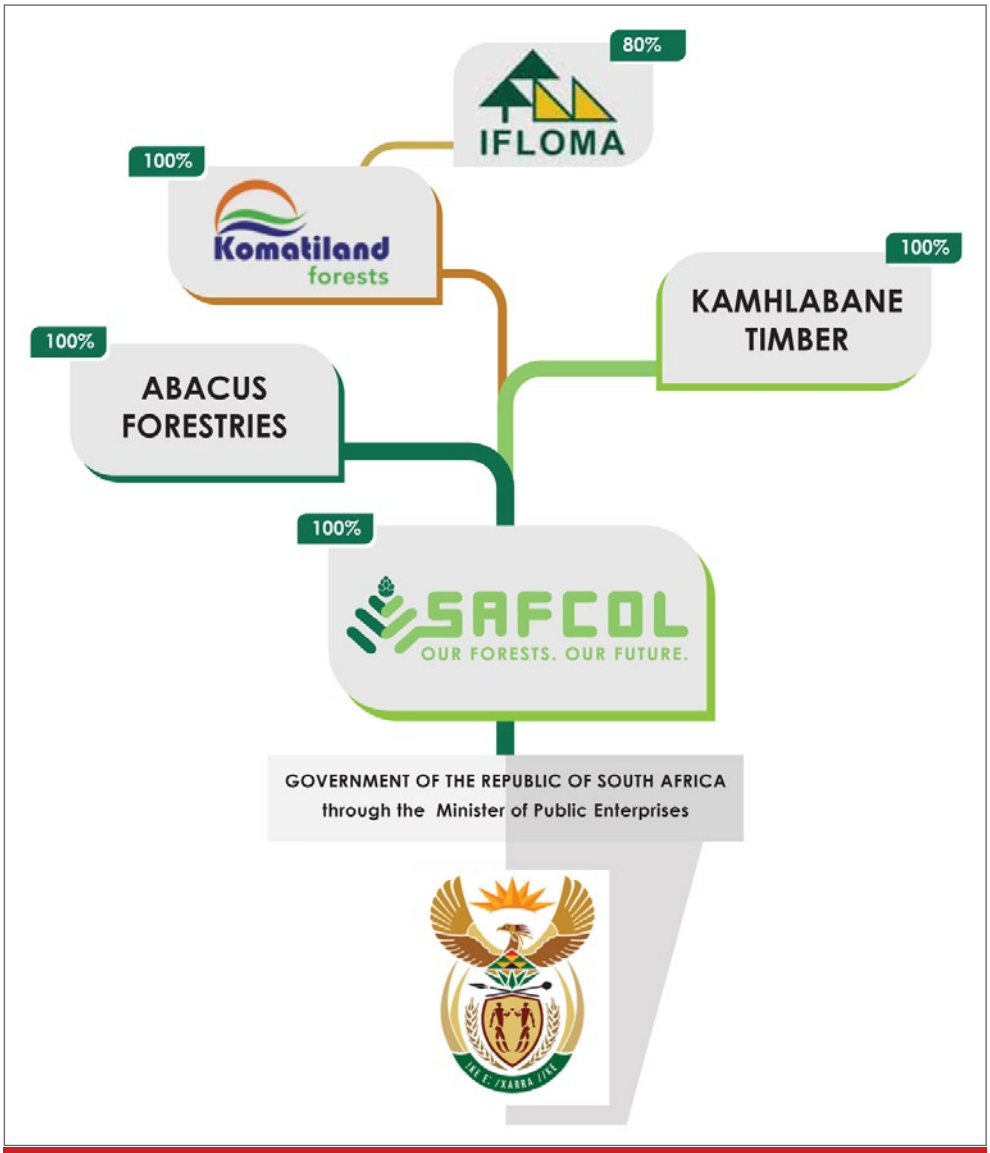


Figure 3: SAFCOL holdings in 2018/19

Framed within the context of its 'six capitals' (finance, human, manufacturing, intellectual, social, natural), SAFCOL's current four strategic objectives are succinctly stated as:

1. Growth and new markets;
2. Financial sustainability;
3. Operational excellence; and
4. Rural development.

Its strategic pathway is shown in **Figure 4** (overleaf).

Figure 4: SAFCOL's current strategy. [Source: SAFCOL; authors' depiction]

Operating context

The forestry management sector in South Africa, and more specifically research on forestry and related matters, predates apartheid.[25] By the end of apartheid, however, the distribution of managed forestry land reflected the geo-political ambitions of racial segregation. As Grundy and Wynberg (2001) explain:

> *By 1985 the Department of Forestry controlled 1.6 million ha of land in the former 'white' areas, of which 263,000 ha was under commercial plantations. The former black 'Homeland' governments controlled a further 350,000 ha, of which more than 150,000 ha were plantations. The area under private ownership was estimated at 800,000 ha.*[26]

The establishment of SAFCOL in the early 1990s formed part of the then government's strategy to re-build the economy and its institutions, including SOEs. However, in the early 2000s, SAFCOL's status was uncertain with instructions to the entity to sell off assets in a bid to privatise.[27] In 2007, Cabinet announced its intention to exit commercial forestry, by selling SAFCOL and its key subsidiary Komatiland Forests.[28] This decision was reversed in 2009, under then public enterprises minister, Malusi Gigaba, following a change of administration. It is in this wider context—of a newly established organisation and subsequent political uncertainty—that the evolution of R&D and innovation at SAFCOL should be viewed.

The South African forestry industry employs 158 400 people, including 88 200 in the primary sector (growing, harvesting), and 70 200 in processing (sawmilling, mining timber, pulp and paper, and other).[29] According to Klerck, in 2000 the industry employed 100 000 people, with 60 000 in the primary sector, and the balance in processing.[30]

Figure 5 shows the regional split of forests under SAFCOL management, predominantly in the north-eastern parts of the country. It is important to note that SAFCOL is not a land owner: land and natural resources under SAFCOL management in the South African operation is owned by the Department of Agriculture, Forestry and Fisheries and the Department of Public Works, of which 57% is subject to land claims.[31]

25 I. Grundy and R. Wynberg, "Integration of Biodiversity into National Forest Planning Programmes: The Case of South Africa," Paper prepared for an international workshop on "Integration of Biodiversity in National Forest Planning Programme", Indonesia, 13-16 August 2001. Available at: https://www.cbd.int/doc/nbsap/forestry/southafrica.pdf, last accessed 30 January 2020. The Journal of the South African Forestry Association (now Southern Forests: A Journal of Forest Science) was established in 1938.

26 Ibid., p. 4.

27 https://pmg.org.za/committee-meeting/4028/

28 Available at: https://www.gov.za/cabinet-decision-south-african-forestry-company-and-komatiland-forests, last accessed 30 January 2020.

29 SAFCOL Integrated Report 2018/19, p. 14.

30 G. Klerck, 'Biotechnology research and technology networks: the dynamics of competition and co-operation', in G. Kruss (ed.), *Creating Knowledge Networks: Working Partnerships in Higher Education, Industry and Innovation*. HSRC Press: Cape Town.

31 According to recent integrated reports, SAFCOL would like to expand nationally, through the procurement of municipal and DAFF-owned forests, and continentally. In his foreword to the SAFCOL Integrated Report 2017/18, then board chair, Lungile Mabece, said: "As part of our Africa penetration strategy, we intend to expand our footprint into a number of the SADC countries but we are also open to […] the rest of the continent. […] With the current economic challenges in South Africa including resolution of land restitution claims it makes sense that SAFCOL look beyond our borders to ensure the continued sustainability of the brand" (p. 23). Countries identified by SAFCOL in this context include Zimbabwe, Zambia, Kenya and Angola.

Other key factors within the SAFCOL operating context include the global, regional and local impacts of climate change, increasingly stringent international standards for sustainable forestry, as well as the current economic downturn in South Africa.

Substantial sector-specific risks faced by SAFCOL include fire risk, timber theft, pests and disease.

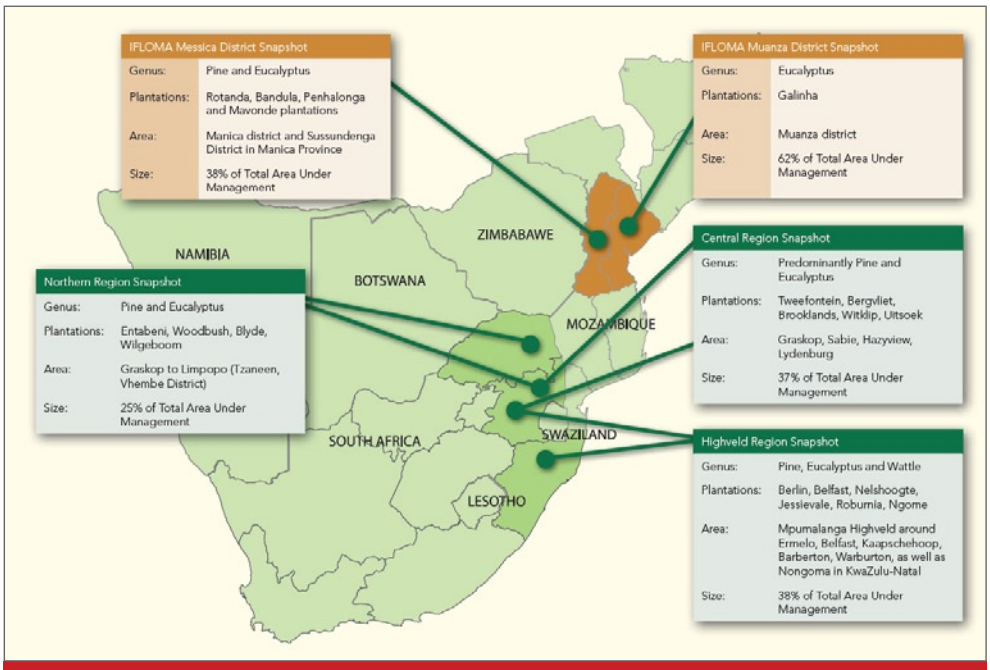


Figure 5: SAFCOL forests under management, by genus, plantation name, area and size [Source: SAFCOL Integrated Report 2017/18, p. 20]

Situating SAFCOL within an R&D and innovation systems context

A mapping of the SAFCOL R&D and innovation system is provided in **Figure 6**. It is not exhaustive, but illuminates the interconnections and linkages between the organisation and the systemic determinants of its performance. At least four features of the system are noteworthy:

- the significant presence of local communities within the geographical areas of forests under SAFCOL's management;
- the large number of allied institutions, including and especially industry associations, as well as university collaborators;
- the Forest Stewardship Council (FSC), as the key international regulator of SAFCOL activities;
- the presence of a limited number of multinational corporations including South African multinational corporations, such as Sappi and Mondi.

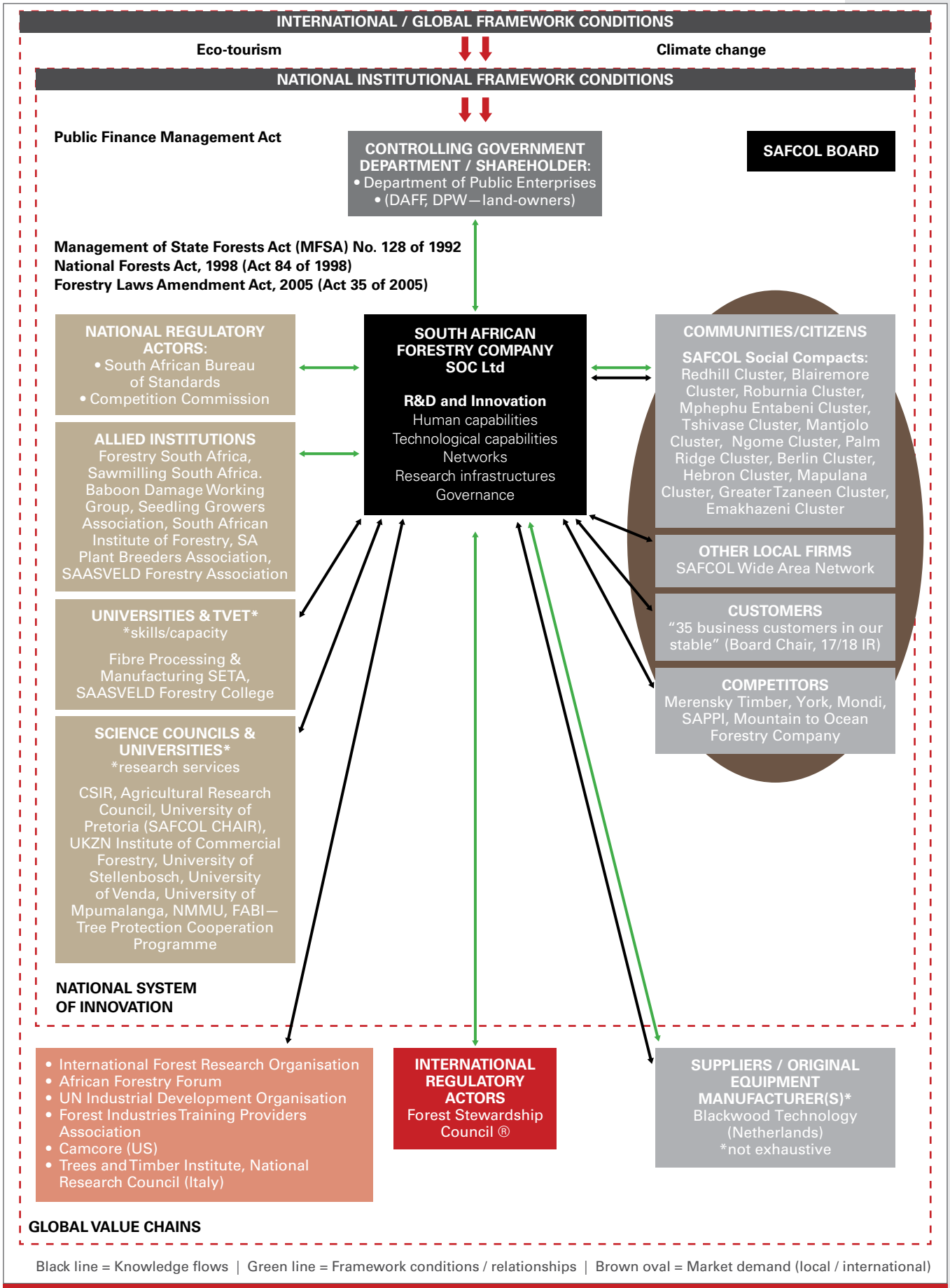


Figure 6: SAFCOL's R&D and innovation system

These key aspects of the SAFCOL R&D and innovation system permeate the analysis of key informant data, presented below.

R&D expenditure trends (2012/13 to 2017/18)

Total R&D expenditure is calculated as the sum of expenditure on R&D-relevant vehicles, plant, machinery and equipment; land, buildings and other structures; labour; and other current expenditure. **Figure 7** reflects fluctuating year-on-year R&D expenditure between R12 million and R18 million, over the period 2012/13 and 2017/18.

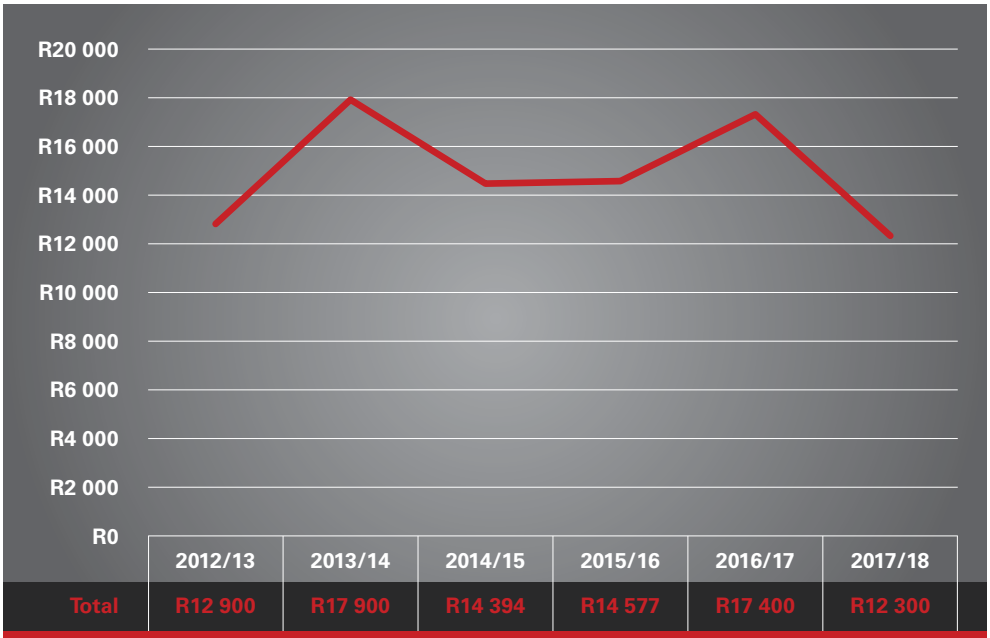


Figure 7: Total R&D expenditure (R'000) at SAFCOL (2012/13 to 2017/18) [Source: CeSTII]

When benchmarked against total R&D expenditure in the SOE sector for the years where comparative data is available, the entity's expenditure reflects a largely inverse relationship.[32] That is, to the extent that sectoral spend generally increased year-on-year, SAFCOL expenditure proportionally decreased (with the exception of 2012/13). The proportion declined more rapidly from 2016/17 onward, when only 16 SOEs reported R&D expenditure through the R&D Survey (**Table 1** and **Figure 8**).

Table 1: Comparison of SAFCOL and SOE total R&D expenditure (2012/13 to 2017/18)

Year	Number of R&D performing SOEs	R&D expenditure (R'000)	SAFCOL R&D expenditure (R'000)	Proportion of SAFCOL to SOEs
2012/13	19	R1,512,021	R12,900	0.85%
2013/14	19	R1,609,771	R17,900	1.11%
2014/15	19	R2,019,919	R14,394	0.71%
2015/16	18	R1,973,416	R14,577	0.74%
2016/17	16	R2,621,883	R17,400	0.66%
2017/18	16	R2,536,374	R12,300	0.48%

32 The data source is the South African National Survey of Research and Experimental Development (R&D Survey) Statistical Report 2017/18, produced by CeSTII for DSI.

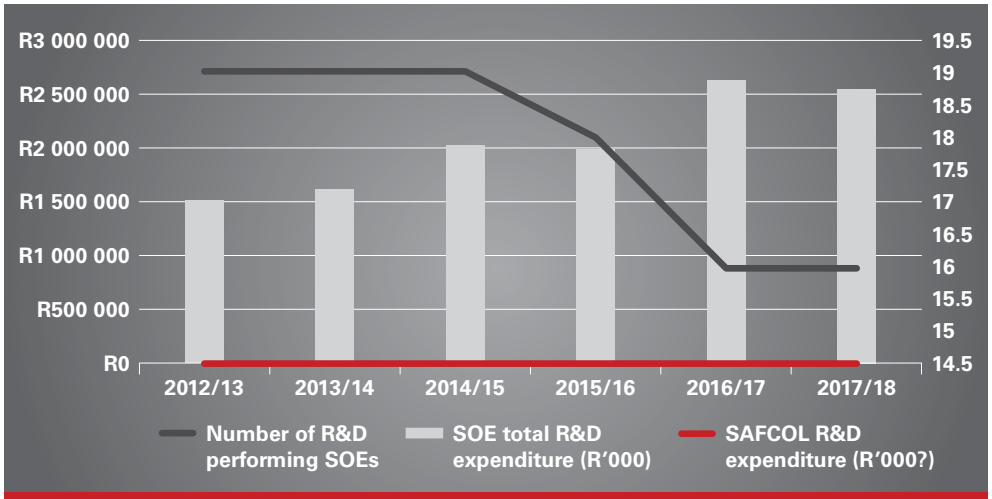


Figure 8: SAFCOL benchmarked against SOE R&D expenditure, including number of R&D performers (2012/13 to 2017/18) [Source: CeSTII]

In terms of its R&D performance, SAFCOL conducts predominantly applied research (70%) (**Figure 9**), defined by the OECD's Frascati Manual as "original investigation to acquire new knowledge directed primarily towards a specific practical aim or objective"; and experimental development (20%) defined as "systematic effort, based on existing knowledge from research or practical experience, directed toward creating novel or improved materials, products, devices, processes, systems, or services". The split of R&D by type has not changed at all over six R&D surveys, reflecting a consistent focus on firm-level problem solving as the rationale for R&D, rather than 'blue skies' research.

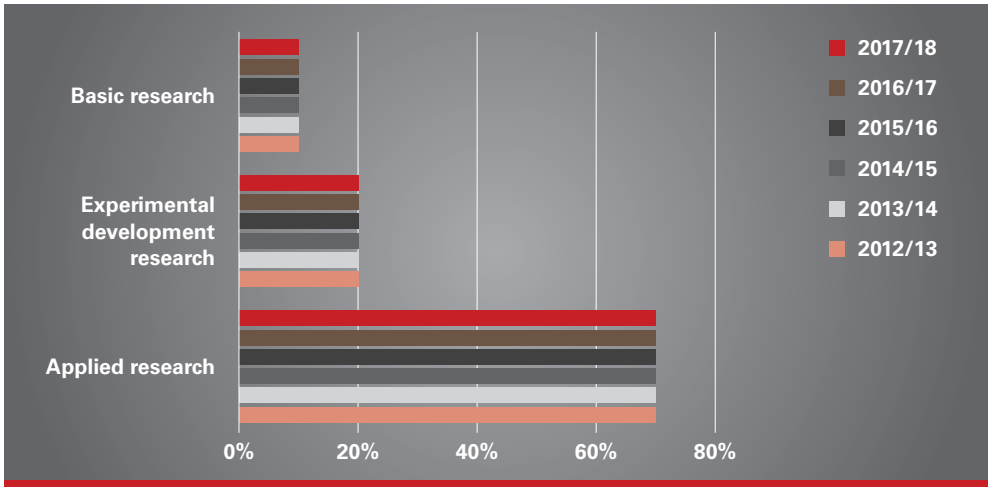


Figure 9: SAFCOL R&D expenditure by type of research (2012/13 to 2017/18) [Source: CeSTII]

Summary of system mapping and R&D data trends

National political uncertainty and large-scale global change are major factors in the assessment of SAFCOL's operational performance. SAFCOL's R&D expenditure equates to less than 1% of South African SOE R&D spending, and has been fluctuating. The SAFCOL innovation system has large concentrations of research institutions (universities, for example), industry associations, and community clusters. These three groupings provide potential sources of information, know-how, and knowledge. SAFCOL's activities are stringently regulated, both nationally, as well as internationally, by the FSC.

Analysis of five dimensions of R&D and innovation capability

Building on the foundation of these conditions and trends, this section assesses how SAFCOL is gearing up for R&D and innovation, by examining the data collected on each dimension outlined in the conceptual framework. By studying key informant interview data, information derived from desktop research, and R&D Survey unit-level data for SAFCOL, this section aims to provide an empirical basis to discuss challenges and opportunities for R&D and innovation capability building at SAFCOL.

Governance

Governance is an increasingly critical for SOEs globally, and the OECD has published numerous guidelines on aspects thereof in recent decades.[33] In the South African context, iterations of the King Report on Corporate Governance in 1994 (I), 2002 (II), 2009 (III) and 2016 (IV), set important standards for the governance of SOEs, together with the Public Finance Management Act and the Companies Act. In this context, South African SOEs face a crisis of public confidence, in the wake of recent developments in SOEs such as Eskom, SAA and the SABC, to name a few. SAFCOL has not escaped unscathed.[34] But what is the state of governance at SAFCOL, in as far as R&D and innovation are concerned?

In terms of the governance of R&D and innovation, we are interested in the systems, processes, policies and structures available to direct, manage and control the organisation's R&D and innovation activities, from inside the organisation. Principally, this concerns the role of executive management but also the board. It helps to understand how SOEs are supported through the institutional governance structure, including funding allocations and other mechanisms for new and improved ideas to flow through the organisation.

One entry point for a discussion on SAFCOL governance is its 2018/19 performance against stated KPIs (**Figure 10**). There are two obvious points an examination of this chart highlights: the first is that the company achieved less than 50% of its targets overall in 2018/19; the second is the nil achievement within its CAPEX programme and strategic investments and/or industrialisation KPIs. Taken together with the entity's recent financial performance (pp.11-12), the result is not necessarily surprising, though if it persists could further constrain the entity's long-term organisational performance, including the achievement of its current strategic objectives.

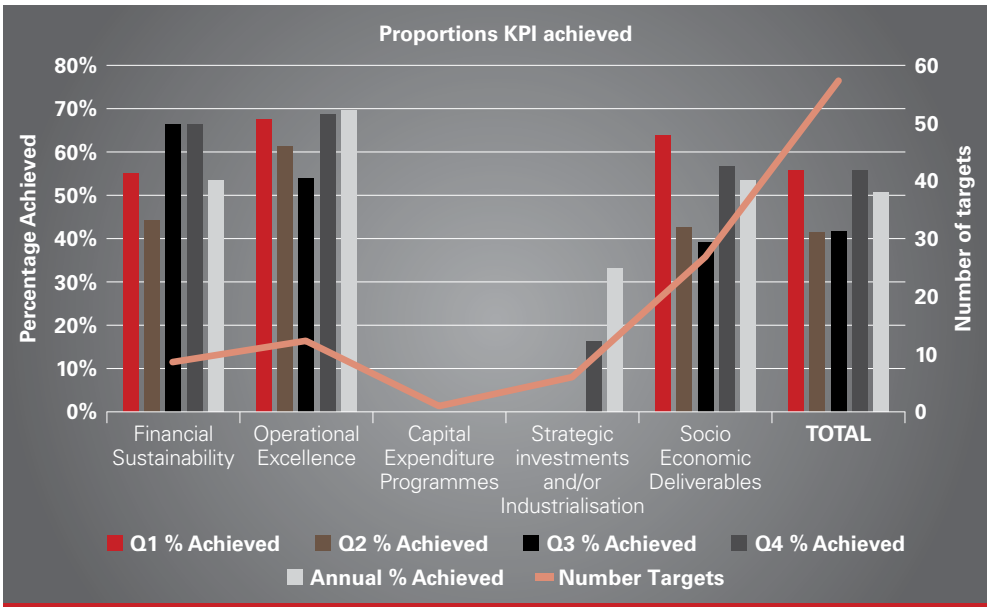


Figure 10: Proportion of SAFCOL's 2018/19 key performance indicators achieved [Source: SAFCOL]

33 Since the early 2000s, the OECD has homed in on SOE governance and governance reform. For example: Corporate Governance of State-Owned Enterprises: A Survey of OECD Countries, 2005; State-Owned Enterprise Governance Reform: An Inventory of Recent Change, 2011; Boards of Directors of State-Owned Enterprises: An Overview of National Practices, 2013; OECD Guidelines on Corporate Governance of State-Owned Enterprises, 2015; Broadening the Ownership of State-Owned Enterprises: A Comparison of Governance Practices, 2016; State-Owned Enterprises as Global Competitors: A Challenge or an Opportunity?, 2016.

34 D. Potgieter, SA forests under the axe, *The Citizen*, 12 January 2017. Available at: https://citizen.co.za/news/south-africa/1745888/sa-forests-under-the-axe/, last accessed 31 January 2020.

At a more granular level, the 2016/17 SAFCOL Integrated Report set a wide agenda for R&D:

> *Our research and development team have not only been investigating ways to increase our wood production and enhance the quality of the harvested products, they are also developing innovative forestry management practices which we aim to leverage.*[35]

In general, R&D is identified as a key opportunity for the business, as in the 2018/19 SAFCOL Integrated Report. In **Figure 4**, it is notable that process, product and marketing innovation are the central tenets of the strategic pathway (lime green middle trapezium). The 2017/18 SAFCOL Integrated Report outlines new mechanisms to achieve these objectives, such as a proposed Sabie 'techno park' to drive forestry industrialisation as well as a timber frames structure plan to supply housing and other infrastructure in 2018/19.[36]

There is some evidence of new strategic thinking within SAFCOL about the role of communities within its business model, which extends beyond a narrow CSI paradigm to a broader conceptualisation of sectoral transformation. As former CEO, Gabriel Theron, wrote in the 2016/17 SAFCOL Integrated Report:

> *We are exploring a model in which we partner with the industry and communities to drive true transformation in the industry, to ensure our own sustainability, and to be a leader in the forestry industry in South Africa.*[37]

This model found expression in the 2017/18 Integrated Report, where SAFCOL refers to "Community Transformation Initiatives", under which it includes enterprise and supplier development, CSI, and agro-forestry cooperatives.

> *We are consciously interacting with land claimants as part of our training strategy, by educating them that having the forests as they are is in everyone's interests. Our approach is a partnership approach. What we are saying is "Let's work the forests together." We are working towards ensuring that the communities surrounding our forests and others, particularly the historically disadvantaged, appreciate the value of forests as well as see the need to participate throughout the entire value chain including developing new products.*[38]

The risks and challenge associated with climate change appear to be addressed proactively through governance statements such as this one:

> *Our R&D team works with experts in the industry and academia to highlight major trends in climate change and to develop strategies to mitigate against the impact of climate change. R&D is targeted to the development of drought resistant species able to better withstand the effects of climate change. We have reviewed our Climate Change Strategy and a three-year Response Plan approved by the Board is in place in an effort to address aspects of climate change relevant to forestry operations.*[39]

Intellectual property and technology transfer

SAFCOL does not report on activities pertaining to IP or technology transfer in its integrated reports for 2016/17 to 2018/19.

Summary of governance dimension

R&D is identified as a key opportunity for SAFCOL in its recent integrated reports. This is underpinned by continued investment in R&D at SAFCOL, as well as the incorporation of an innovation portfolio within its executive structure. Concerning perhaps, from an innovation perspective, is that SAFCOL has not achieved capital investment KPIs, and does not appear to have a strategy for intellectual property management or technology transfer.

35 SAFCOL Integrated Report 2016/17, p. 40.

36 SAFCOL Integrated Report 2017/18, p. 24.

37 SAFCOL Integrated Report 2016/17, p. 40.

38 SAFCOL Integrated Report 2017/18, p. 24.

39 SAFCOL Integrated Report 2018/19, p. 18.

Technological capabilities

This sub-section is divided into two parts—the first focussing on timber capabilities, and the second focussing on non-timber capabilities (for example, eco-tourism).

Timber capabilities

Figure 11 provides a schematic view of the timber value chain, and a window into the development of technological capabilities at SAFCOL. While R&D forms a critical component of this value chain, the diagram illustrates the range of agricultural, operational, manufacturing, and logistical activities undertaken by SAFCOL within the timber sector. The industrial applications of SAFCOL's timber products include structural construction, including roofs trusses; pallets and packaging; desks and furniture; firewood; and chips.[40]

A key SAFCOL capability is timber breeding. This is a highly specialised domain, and its time horizon is decades long; as is the nature of the 'innovation' it gives rise to, as described by this senior manager:

> *We have our original trees, our wild trees, they selected those trees, they collected and established Progeny trials. Progeny trials, you have to keep the identity of different families and family is a group of trees that comes from one mother tree. Those trees are measured … at height and diameter, calculate the volume, we look at the stem form, we look at the branches. … in recent years [we] determine the density of the timber and standing trees, it's a non-destructive method of measuring South African [timber] including our selection criteria because we are actually breeding timber... Those are the things we want to include in the criteria when we do high breeding. So, we are working towards getting a resistant graph procurement process… And then we test the different processes, and … identify the best ones, the wood and all those things and then we supply the best ones to the nurseries, the innovation comes years later when those trees grow very fast.*[41]

SAFCOL considers its R&D centre at Sabie state-of-the-art.[42] It is located in close proximity to the SAFCOL nursery facility and produces about 10 million seedlings and cuttings annually supplying all SAFCOL plantations, as well the commercial seed market.[43] To expand its knowledge capabilities in this domain, SAFCOL is a member of a seedling growers' association, which includes other forestry companies.

40 In 2013 Minister of Public Enterprises, Malusi Gigaba, mandated SAFCOL to diversify its business model. "The new model would include product and market diversification, the exploration of alternative export markets and the entry into vertically integrated industries. It would have to look at other products such as biofuels and biomass for Eskom," the Minister said. Blackwood Technology, which produces industrial scale torrefaction technology, reports on its website that it has signed "licensing agreement with South African utility Eskom for the construction of torrefaction plants in the SADC region." See Blackwood Technology online. Available at: http://www.blackwood-technology.com/company/about-us/, last accessed 27 February 2020.

41 ITV.SM2.CS3, 25 October 2018

42 SAFCOL Integrated Report, 2017/18, p. 19.

43 SAFCOL Integrated Report 2016/17, p. 27.

Figure 11: SAFCOL timber technological capabilities [Source: SAFCOL Integrated Report 2018/19, p. 6]

As concisely expressed in the SAFCOL 2017/18 Integrated Report, the purpose of the SAFCOL R&D team is to ensure: *"the best genetic material available is planted, the material is best matched to the correct plantation, and the most appropriate Silvicultural practices are applied."*[44] It elaborates the purpose of R&D activities:

> *R&D serves as means to diversify our product offering, revenue stream and client base through greater participation in the overall timber value chain. Other options also exist with research into important community projects to the benefit of both the Company and the adjacent communities.*[45]

Within this context, specific R&D activities span from tree breeding, wood science, genetic improvements, wood quality testing, growth and yield modelling.[46] In the view of one senior manager, there is a direct link between R&D and innovation:

> *We [are] working towards reducing the rotation age of the timber … instead of taking 25 to 30 years just before harvest we can harvest at 16 or 17 years. So, we are getting more and more timber or the same amount of timber in less time which can do a lot for the company bottom line… We are looking at other hybrids as well … between different species because with maize we can get two generations in a year inbred like in four years. You can [get] hybrids that are in production in 10 years, we get a hybrid in 20 years. The new material that goes into the plantation, commercial, I would look at that as innovation.*[47]

The senior manager explained how R&D is directly performed to meet client needs:

> *Once we get those clones, we can produce timber that is requirement specific, for a wood client if they want a certain [density] or … a certain colour or … disease tolerant or whatever we can work towards that. But it's not [going to] be an instant thing, it's [going to] take time.*[48]

The SAFCOL Timbadola Sawmill, based in Limpopo, is an award-winning[49] facility processing between 70 000m3 and 130 000m3 of softwood per financial year (i.e. wood from a conifer tree, such as a pine, fir or spruce tree). There has been a focus on the sawmill in recent annual reports, and upgrading it to meet market demand and achieve the business goals of increased output and market share.

Box 1: Timbadola Sawmill Upgrade Objectives

- Leverage industry technological advancements
- Increase processing capacity for all available raw material in the area
- Improve raw material and operational efficiencies
- Reduce unit production costs to be more competitive and profitable
- Produce high-value lumber products to reduce availability of competing low-value products
- Increase high-skilled employment opportunities in the rural area

Source: SAFCOL Integrated Report 2016/17

Non-timber capabilities

Similarly, SAFCOL has developed technological capabilities in a range of non-timber areas, notably cooperatives, eco-tourism, and CSI. Within its eco-tourism function SAFCOL manages a wide variety of hiking trails, horse trails, picnic sites, waterfall sites, the Lakenvlei Forest Lodge and Conference Centre, and the Sabie Forestry Museum.[50] As Stella Moosa, Marketing and Advertising Officer: Eco-Tourism, Mpumalanga, says in the 2015/16 SAFCOL Integrated Report: *"Eco-Tourism in the forestry business presents exciting job creation opportunities.*[51]

44 SAFCOL Integrated Report 2017/18, p. 34.

45 Ibid.

46 Current programme areas include: Seed Orchards & Wood and Lumber Research Programme; Tree Breeding Programme; Reestablishment Research Programme.

47 ITV.SM2.CS3, 25 October 2018.

48 The SAFCOL Integrated Report 2015/16 reports that preliminary results from trials run by the R&D Centre have shown that "new hybrid species are yielding more volume at an earlier age, and are more resistant to diseases and pests than current species" (p. 25).

49 Recipient of the Productivity SA Award for public sector company with most improved productivity. Parliamentary Monitoring Group online. Available at: http://pmg-assets.s3-website-eu-west-1.amazonaws.com/180206SAFCOL.pdf, last accessed 10 February 2020.

50 For a full list, visit http://www.safcol.co.za/ecotourism/.

51 SAFCOL Integrated Report 2015/16, p. 2

Some of SAFCOL's research concerns the field of 'agro-social' forestry, according to one scientist interviewed, which is community-oriented in nature.[52] Community cooperatives include: the Mambitheni Bee-keeping Cooperative, a registered business with five members; Peanut and Bambara Beans (Tzaneen); Entabeni Agroforestry; Ngome Agroforestry Livestock; Limpuma Furniture Cooperative; Themba Labasha Cooperative; and Mankhithi Primary Cooperative, among others. SAFCOL estimates that it impacts the lives of 20 000 individuals through its CSI work.[53] For example, SAFCOL has an extensive portfolio of facilities it has constructed for various schools with CSI focussed on the provision of timber-frame structures, as well as 'brick and mortar' structures, boreholes, and furniture supply. **Table 2** lists SAFCOL's CSI initiatives.

Table 2: SAFCOL CSI initiatives from integrated reports 2016/17–2018/19

Timber frame structures	Brick & Mortar	Other
• Beketelani Primary classrooms • Bhekimfundo Primary • Construction of dining hall at Ekucathuzeni Primary • Khuphukani Early Childhood Development Centre • Sinethemba ECD Centre • Davidale ECD Centre • Construction of administration block at Ratshitanga Primary • Muledani Life Care Centre • Leroro Disability Centre • Thembisa Stimulation Centre • Mantjolo Arts & Crafts Market • Palm Ridge Multipurpose Hall • Vriesland Kitchen • Oncweleni Community Hall • Sandford ECD • Phutaditshaba ECD • Reashuma ECD • Buhlebuyeza Primary School Classrooms • Dientjie Primary School Kitchen • Reashuma ECD Centre Foundation • Murangoni Primary School • Upgrading of Harmony Hill Clinic • Matsila Arts and Crafts Centre, Limpopo • Tsolobolo ECD Centre • Vriesland Primary School kitchen • Makhambane / Palm Ridge Community Hall • Marongwane Primary School kitchen • Evane Primary School Renovations • Modjadji ECD Centre • Phutaditshaba ECD Centre • Sandford ECD Centre • Mapheleni Community Hall • Enkhanini Secondary School fence • Mooiplaas ECD Centre fence and ablution block	• Khayelihle Early Childhood Development Centre store-room • Muzomuhle Multi-purpose Centre • Radzilani Community Hall • Tshitavhadulu Community Hall	• Supply of school furniture and play structures • Borehole water supply • Food support for Maths and Science learners • Wi-Fi Project • capacity building for JCF Members • Dignity Drive • Mandela Day • Fire Awareness

52 ITV.SPEC1.CS3, 25 October 2018.

53 SAFCOL online. Available at: http://www.safcol.co.za/we-care/our-communities/, last accessed 27 February 2020.

Summary of technological capability dimension

Key technological capabilities have been developed by SAFCOL through its timber and non-timber operations. Its timber capabilities span the entire value chain, from genetic engineering and breeding to sawmilling and beneficiation of timber products. Its non-timber capabilities encompass community-based forestry, training, and eco-tourism.

Human capabilities for R&D and innovation

According to its 2018/19 integrated report, SAFCOL has 1 546 permanent employees in its South African businesses, and 606 in the Mozambique business, a total of 2 152 people. Against this backdrop, SAFCOL's expenditure on R&D personnel, in **Figure 12**, shows a steady rise from R4.9 million in 2012/13 to a high of R7.5 million in 2015/16, and then a sharp decline to R2.7 million in 2017/18. R&D personnel numbers remained largely static between 2012/13 and 2017/18. Comparing the data in **Figure 12** and **Figure 13** warrants further investigation into why the cost of personnel fell, given that the total number of employees remained between seven and nine people over the period.

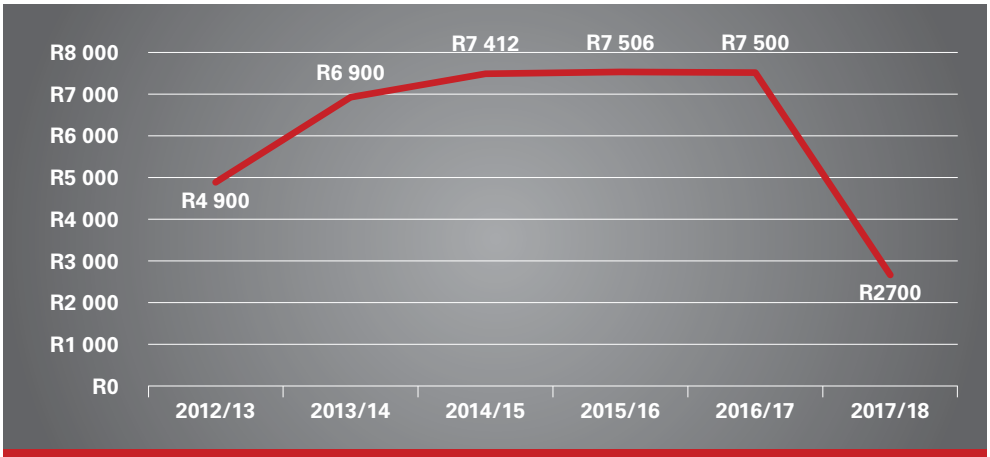


Figure 12: Labour cost of in-house SAFCOL personnel directly supporting R&D, including researchers, technicians, and other personnel, 2012/13 to 2017/18 (R'000) [Source: CeSTII]

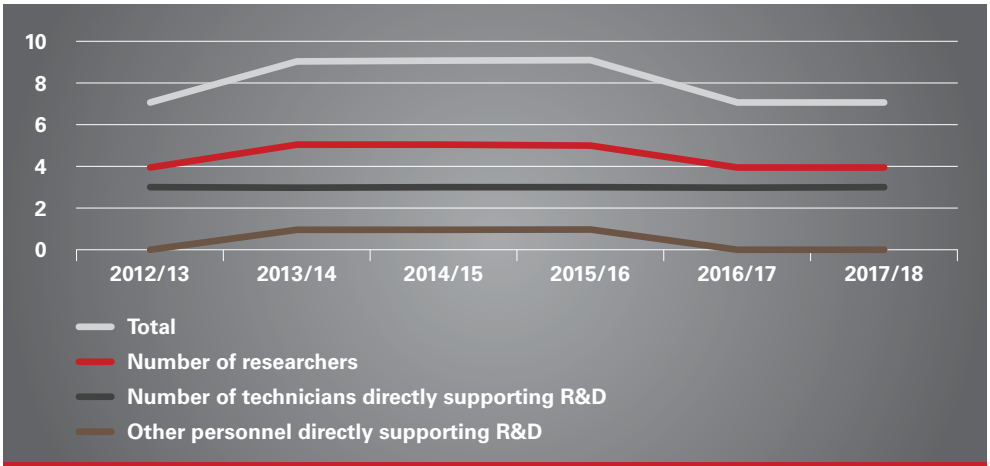


Figure 13: SAFCOL R&D personnel profile (2012/13 to 2017/18) [Source: CeSTII]

At the time of research for this case study in 2018, SAFCOL's R&D Centre on the Tweefontein Plantation, near Sabie, Mpumalanga, had a staff component of eight full-time scientists and three technicians. Interviews with research and management staff at the centre, however, indicated that research capacity shortages posed a challenge.

> *We also have currently a few vacancies. Sometimes we advertise previously and they couldn't find people with the right qualifications, so that's also a problem [...] If we could get a candidate with a strong stats background. Or we could appoint [...] a general statistician and we collect the data and they do the analysis, and I think that would help.*[54]

A senior manager reflected that additional research assistant capacity would benefit the performance of the team.[55]

Minutes of a 2003 meeting of the parliamentary portfolio committee to which SAFCOL reports points to the root of R&D capacity challenges at SAFCOL. In response to a question by an ANC parliamentarian, Mr S Kholwane, about the declining numbers of forestry graduates in South Africa, Mr Breed, CEO of SAFCOL at the time, explained:

> *The forestry industry was not an easy industry because of the history of the industry, and because the majority of the graduates were from Stellenbosch University and were white students. The bursaries provided over the past 10 years were given primarily to historically disadvantaged people, but Stellenbosch University currently has one graduate in wood technology that was promising. There was thus a major problem in the industry as a whole with regard to technical expertise, which was high on the Forestry South Africa (FSA) agenda.*[56]

To promote forestry research capabilities in South Africa, and to fill capacity gaps, SAFCOL works with South African universities to support qualifications in the field (see **Box 2**), including universities that offer under-graduate and post-graduate qualifications in forest science, forest management and environment, and wood science and technology. This includes the SAFCOL Chair in Forest Management, at the University of Pretoria, which offers MSc and PhD degrees. Wood science is "highly specialised" as one respondent noted.[57]

Box 2: SAFCOL-University of Limpopo Bursary Scheme (2019/20)

SAFCOL partnered with the University of Limpopo to provide bursaries for the 2020 academic year. Bursaries are awarded to undergraduate and post-graduate students in the following categories:

- Wood Science/ Wood Technology
- Construction/Structural Engineering & Management
- Human Settlement Development
- Electrical & Electronic Engineering
- Mechanical Engineering
- Agro-Forestry
- Forest Scientific Research
- Wood Lumber Research
- Marketing & Sales
- Business Management
- Human Resource Management
- Project Management
- Eco/Agro-Tourism

Source: University of Limpopo

54 ITV.SPEC2.CS3, 25 October 2018

55 ITV.SM2.CS3, 25 October 2018

56 Parliamentary Monitoring Group online. Available at: https://pmg.org.za/committee-meeting/4028/, last accessed 27 February 2020.

57 ITV.SPEC1.CS3, 25 October 2018

As far as non-R&D based innovation is concerned, a wide range of SAFCOL personnel work on activities such as eco-tourism, beneficiation, agroforestry cooperatives, and training. SAFCOL's acting executive includes a dedicated marketing, strategy and innovation officer —a position currently occupied by an industrial engineer.

SAFCOL also runs the Platorand Training Centre, which "facilitates accredited training for employees and communities in surrounding areas."[58] Training on timber frame structure building is targeted, for example, at youth. A member of the Forestry Industry Training Providers Association, the centre has multiple Sector Education and Training (SETA) accreditations, including from the Fibre Processing and Manufacturing SETA and the Media, Information and Communication Technologies SETA. Its services include learnerships; apprenticeships; internships for graduates; bursaries; adult education and training (AET); mentorship and caching; management and leadership development; information, communication and technology (ICT) and short skills programmes (**Table 3**). The centre is run by the SAFCOL learning and development directorate, and focuses on upskilling both employees and individuals from the communities in which SAFCOL works:

> *The training of communities living adjacent to our operations and land claimants contribute to alleviating poverty and unemployment, and fosters good mutual relationships. A special focus is placed on black women and youth from previously disadvantaged communities, as well as people living with disabilities.*[59]

A SAFCOL presentation to Parliament on its 2016/17 results, included key highlights of its human capability development (**Table 3**). Notable is the focus on a broad range of training—from formal post-graduate opportunities to apprenticeships.

Table 3: SAFCOL indicators reported to Parliament based on 2016/17 Integrated Report

Indicator reported	2016/17
No. of employees	2 283
No. of foresters	65
Black	*59*
Women	*26*
Youth	*20*
No. of apprentices appointed	15
No. of learners trained on timber-frame structures	43
No. of successfully completed post-graduate study bursaries	12
No. of new further education and training (FET) bursaries awarded	37

Source: SAFCOL[60]

Summary of human capability dimension

The discussion above provides a snapshot of SAFCOL's human capabilities to perform R&D and innovation. SAFCOL's R&D team is less than 1% of the entity's overall workforce. Non-R&D based innovation activity employs a broader range of personnel with services roles, such as eco-tourism and training. The SAFCOL training academy provides a wide range of programmes to both employees and to communities within the SAFCOL catchment. It also supports sector capacity building through a post-graduate student bursary scheme.

58 SAFCOL Integrated Report 2017/18, p. 9.

59 SAFCOL online. Available at: http://www.safcol.co.za/what-we-offer/training-centre/, last accessed 27 February 2020.

60 SAFCOL Integrated Report 2016/17 Presentation to the Portfolio Committee on Public Enterprises, January 2018. Parliamentary Monitoring Group online. Available at: http://pmg-assets.s3-website-eu-west-1.amazonaws.com/180206SAFCOL.pdf, last accessed 13 February 2020.

Research infrastructure

Are South African SOEs sufficiently resourced with research infrastructure to achieve their R&D and innovation goals? SAFCOL's R&D expenditure on research infrastructures, as shown in **Figure 14**, has increased since 2012/13 in the case of vehicles, plants, machinery equipment (blue line) and land, buildings and other structures (dark grey line), with some decline in other capital expenditure.

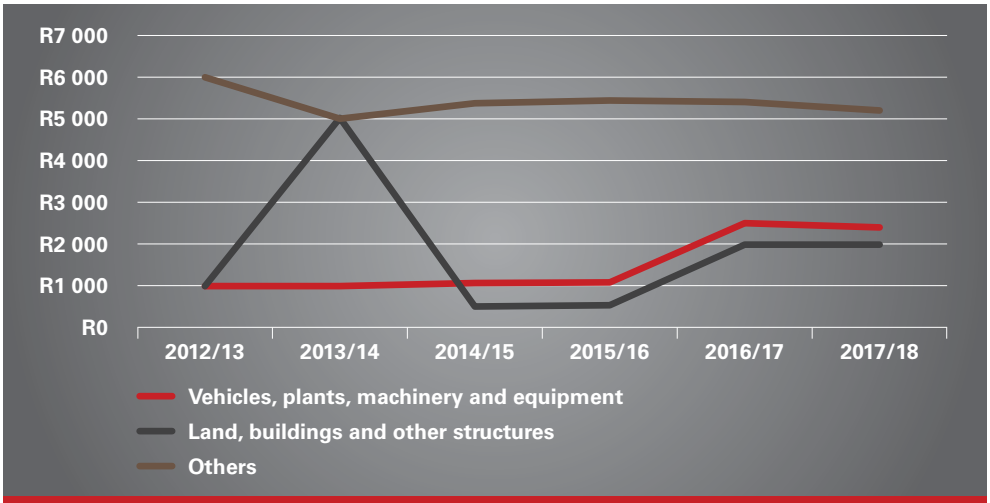


Figure 14: SAFCOL R&D expenditure on research infrastructures, 2012/13–2016/17 (R'000) [Source: CeSTII/DSI]

As indicated, SAFCOL's R&D Centre at Sabie is one site at which R&D activities are conducted. Other sites include its nursery at Tweefontein. Specific research equipment includes a tissue culture laboratory, which is complemented by statistical and business intelligence software packages. One respondent noted that research infrastructure sharing with Sappi is undertaken. A research databank is on the SAFCOL R&D team's 'wishlist'. In this regard, one team member compared SAFCOL facilities to Sappi:

> *At Sappi they had this programme, which allowed you to remotely, or even when you're in the office, get access to your trial data to the information on the climate, soil and is something that we are busy working on. I thought it's important to do that from a risk point of view.*

Key informants consulted reported some challenges, for example the availability of vehicles. Additionally, plans to purchase new equipment and to grow the laboratory facilities of the organisation were noted, hampered by procurement regulations.

> *We are extending the lab, we are buying new cryo freezers and in the process of installing, and [the] procurement process is delaying us severely. The procurement policy it's a big problem […] finding suppliers, getting them on CSD, making sure you do the correct stuff. It is painful, very demotivating […] and it's also very costly*

By contrast, researchers interviewed for this study noted that the research infrastructures are enabling of R&D.

> *We have the measuring equipment that we need.*[61]

In terms of innovation, SAFCOL collaborates with Eskom to explore torrefication of biomass. Plant equipment is licensed from Dutch renewables firm, Blackwood Technology, through an agreement between Eskom and Blackwood.

61 ITV.SM2.CS3, 25 October 2018.

Summary of research infrastructures dimension

SAFCOL has dedicated facilities for the performance of R&D, including a nursery and R&D Centre. The Centre is equipped with some state-of-the-art equipment, with more to come on stream. Procurement remains a challenge and collaboration is used to fill gaps.

R&D and innovation networks

Collaborating with other organisations has really helped move us forward.[62]

This quote by a SAFCOL scientist reflects the consensus of all interviewees that collaboration is key to R&D performance at SAFCOL. The types of collaboration that it engages in differ in their purpose and scope. For example, the formation of research joint ventures between SAFCOL, universities and other organisations, such as the SA Plant Breeders Association, benefits SAFCOL in terms of the acquisition and creation of new knowledge, development of new products, improvement of technological and organisational capabilities, and continuation and acceleration of existing forestry research.

Table 4 reflects the wide range of R&D and innovation collaboration partners engaged with for distinct purposes, both nationally and globally. **Figures 5 and 16** summarise the collaborations with each institutional sector and type of collaboration.

Table 4: R&D collaboration between SAFCOL and sectoral actors

Partner	Sector (SA/ International)	Country	Focus of collaboration
University of Pretoria Forestry and Biotechnology Institute	Higher Education/ Research – SA	South Africa	Bursaries/ Training
University of Stellenbosch	Higher Education/ Research – SA	South Africa	R&D
University of Venda	Higher Education/ Research – SA	South Africa	Bursaries/ Training
University of KwaZulu-Natal, Institute of Commercial Forestry	Higher Education/ Research – SA	South Africa	R&D
University of Limpopo	Higher Education/ Research – SA	South Africa	Bursaries/ Training
University of Mpumalanga	Higher Education/ Research – SA	South Africa	Bursaries/ Training
Council for Scientific and Industrial Research (CSIR)	Science Council – SA	South Africa	R&D
Agricultural Research Council (ARC)	Science Council – SA	South Africa	R&D
SA Plant Breeders Association	Science Council – SA	South Africa	R&D

Continues overleaf...

62 ITV.SPEC2.CS3, 25 October 2018.

Partner	Sector (SA/ International)	Country	Focus of collaboration
Sappi	Business sector (SOCs) – SA	South Africa	R&D
Eskom	Business sector (SOCs) – SA	South Africa	Innovation
Mondi	Business sector (private) – SA	South Africa	R&D
Mountain to Ocean Company	Business sector (private) – SA	South Africa	R&D
Trees and Timber Institute, National Research Council	Science Council – international	Italy	R&D
International Union of Forest Research Organizations	NPO – international	Austria	Bursaries/ Training
Camcore	NPO – international	US	Bursaries/ Training

Note: Data sources include interviews with respondents, SAFCOL integrated reports

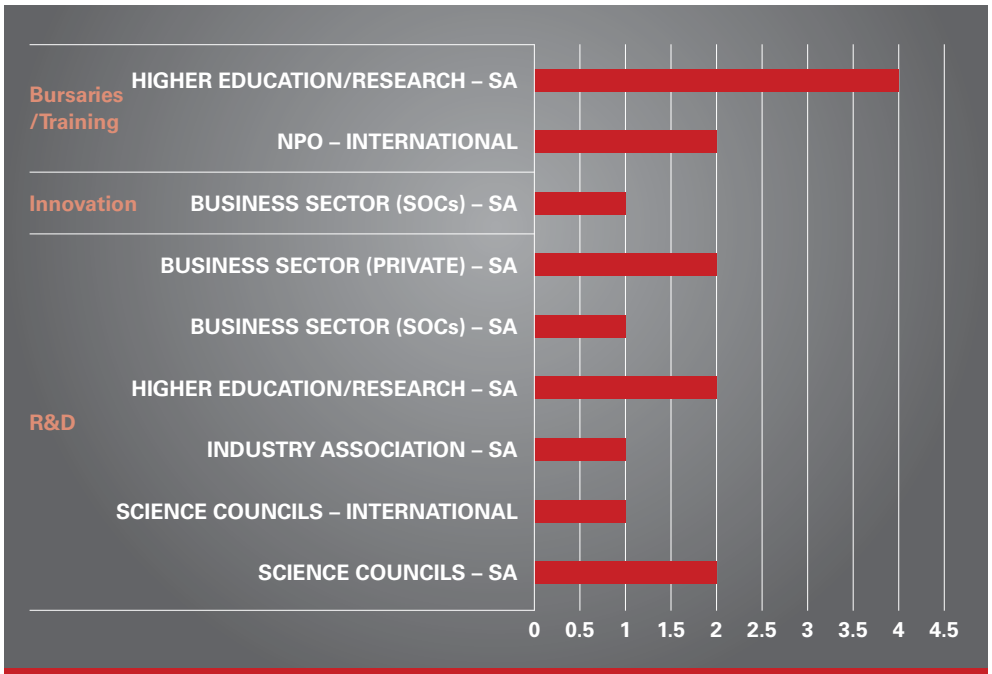


Figure 15: SAFCOL collaboration partner, by sector and type of collaboration

Networks

Networks are vital to R&D and innovation performance at SAFCOL. A proactive networking strategy is evident in recent activities reported. For example, in 2017, it hosted the SAFCOL Forestry Industrialisation Conference:[63]

> *The purpose of the FIC2017 was to bring together forestry-related decision makers and corporates from both the public and private sectors, forestry technical practitioners, product end-users, forest managers, academics, researchers and the public at large to explore and to promote the creation of a wood culture in South Africa.*[64]

63 The event took place on 4-5 November 2017, in Johannesburg. http://itc-sa.org/portfolio_item/safcol-forestry-industrialisation-conference-2017/, last accessed 12 February 2020.

64 SAFCOL Integrated Annual Report 2017/18, p. 40.

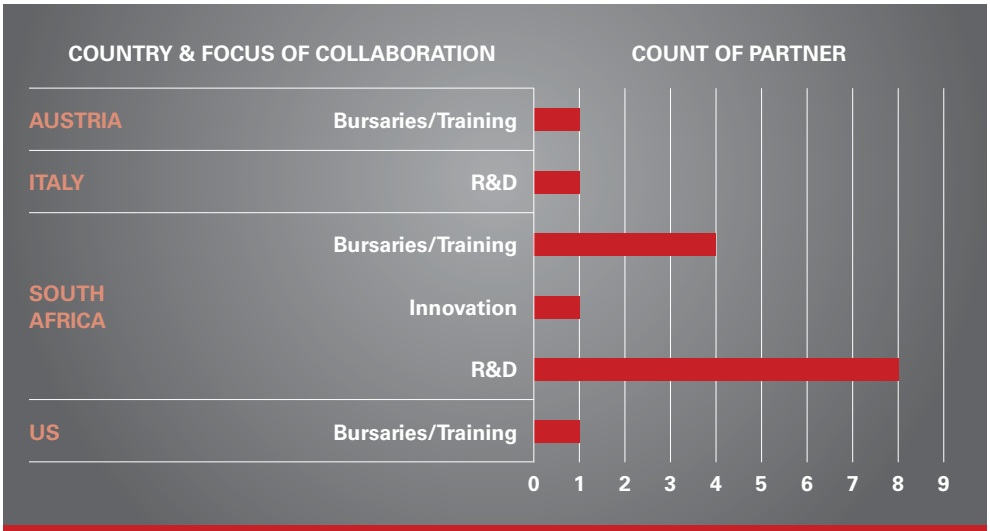


Figure 16: SAFCOL collaboration partner by country and sector

According to Forestry South Africa's 2017 annual report, SAFCOL's convening of the event was a significant step for the industry as a whole.

> *This initiative is similar to the one initiated by the Institute for Timber Construction and Sawmilling South Africa some years ago but which failed to get off the ground. The fact that an organ of State is now driving this initiative may offer a somewhat greater chance of success for the following reasons: there are none of the private sector relationship factors in the sawmilling sector, which presented a major challenge when the Industry itself attempted the initiative; and being an organ of State, there may be greater support from Government to address the regulatory challenges which need to be overcome before real progress can be made. FSA welcomes this initiative as if it succeeds in its objective, the benefits will be positive for the entire Industry, especially for those growing sawlogs and poles.*[65]

SAFCOL also participates in the activities of the African Forestry Forum,[66] a membership organisation based in Nairobi, Kenya, as well as attendance at global colloquia. As one respondent interviewed stated:

> *You learn a lot from interacting with other folks from different organisations. It helps one keep abreast of what other people are doing.*[67]

Applied research collaboration

Collaboration also helps to solve tree health problems, as this respondent explained with reference to SAFCOL's collaboration with FABI:

> *We recently had a problem with, until now, Physarum cinereum. It's a pine disease that attacks the seedlings and your older trees. So they helped with screening our material and also from that working group was formed the Physarum working group and they address issues of hygiene and … how to improve your planting stock.*[68]

To fill capacity gaps, SAFCOL's R&D team also works with global partners, such as Camcore, an international non-profit organisation based at Carolina State University in Raleigh, North Carolina, which offers tree breeding and data management training, the United Nations Industrial Development Organisation (UNIDO), and the International Union of Forest Research Organisation (IUFRO).

SAFCOL is also a member of the Tree Protection Cooperation Programme. A 2000 study on biotechnology research and technology networks by Klerck[69] mapped knowledge networks

65 Forestry South Africa, 16th Annual Report for the Year Ended 31st December 2017, p. 40.

66 https://afforum.org/

67 ITV.SPEC2.CS3, 25 October 2018

68 ITV.SPEC2.CS3, 25 October 2018

69 G. Klerck, 'Biotechnology research and technology networks: the dynamics of competition and co-operation', in G. Kruss (ed.), Creating Knowledge Networks: Working Partnerships in Higher Education, Industry and Innovation HSRC Press: Cape Town.

in the forestry industry, in particular with reference to the Tree Protection Cooperation Programme (TPCP). Klerck writes of its significance:

> *The tree-protection network allows forestry companies to have access, in a cost-effective manner, to advanced research expertise on tree pathology. […] Some of [its member organisations] are strange bedfellows who would not, were it not for the TPCP, ordinarily be collaborating with each other.*[70]

Community interaction

SAFCOL established social compacts with 13 communities (see **Figure 6**) with joint community forums (JCFs) to promote regular interaction.

> *These compacts are agreements which assist in continuous engagements with the communities through JCFs which sit at least quarterly. The JCFs are used as a platform where community needs are submitted and prioritised, which informs the CSI projects that are implemented. Furthermore, SAFCOL is also provided with an opportunity to present prospects and discuss challenges that affect both parties.*[71]

A research specialist interviewed provided a clear rationale for SAFCOL's work with communities:

> *[B]ecause we operate in the rural environment it's important that we remain commercially viable in terms of timber but need to ensure that communities that surround us [are] also happy and that they develop and benefit from operations.*[72]

Other collaboration

Other collaborative arrangements include membership of the South African Plant Breeders Association and Baboon Damage Working Group.

Summary of networks dimension

This discussion highlights SAFCOL's attempts to foster proactive networking and collaborative activities with universities, research councils, communities, and other global and local organisations. Collaboration helps SAFCOL to solve different kinds of operational problems, is valuable for the capacity development of its researchers and the organisation more broadly, and helps to grow its relationships with the communities in which it works.

70 Ibid., p. 33.

71 SAFCOL Integrated Report 2016/17, p. 73.

72 ITV.SPEC2.CS3, 25 October 2018

5 | CHALLENGES & OPPORTUNITIES FOR SAFCOL R&D AND INNOVATION CAPABILITY BUILDING

The case study data is useful to the extent that it contributes to a quantitative and qualitative, albeit incomplete, snapshot of R&D and innovation in the SAFCOL entity. What can we glean from this data about opportunities and challenges for capacity building in R&D and innovation at SAFCOL? The brief discussion that follows weaves together threads from the data described and analysed.

Strengths and constraints in the SAFCOL R&D operational environment

R&D is central to the sustainability of SAFCOL's business model and its biological assets, and its R&D centre at Sabie plays a critical role in this respect. Challenges faced by R&D personnel at SAFCOL include procurement and capacity, such as long procurement lead times and vacant posts. These are not insurmountable operational challenges, but require dedicated management support personnel to provide an enabling environment for R&D.

SAFCOL has substantial potential to play a leading innovation role within the forestry industry as well as ancillary industries, such as eco-tourism. Even though strategic plans position innovation at the centre of its growth pathway, financial losses and poor performance, reflected in the capital investment key performance indicators, weakened its position in practice.

Communities as a source of dynamic innovative potential and sites for technology diffusion

SAFCOL's social compacts provide an excellent foundation for cooperation between SAFCOL and the communities where it is located. Cooperation covers a host of activities, including corporate social investment, training, land claims, and enterprise development. The current CSI paradigm focussed on discrete improvement projects and training, could be widened to include a broader conception of local innovation and production systems.[73] This would draw in a wider constituency of potential businesses and individuals, to work in more systemic ways with each other and with the SAFCOL entity and forestry sector, more broadly.

Investment in research and data infrastructures critical to R&D productivity and sustainability

The SAFCOL R&D team pointed to an important need: data and data bank capabilities. In an era where big data and data analytics are shown to drive business growth, enhancing SAFCOL's capabilities in this domain over the long-term could form part of an important strategic shift within the organisation and position it to respond to new research and business trends. Equally, it could assist SAFCOL position itself to respond more appropriately to the risks and opportunities presented by climate change.

73 See J. E. Cassiolato, M. Pessoa De Matos, H. M. M. Lastres, M. Szapiro, Local Innovation and Production Systems: RedeSist's conceptual framework and analytical methodology. Report number: 02/2018 Affiliation: Federal University of Rio de Janeiro, Brazil.

CONCLUSION

Even under conditions of financial austerity, SAFCOL is very strongly geared to perform R&D, though its innovative potential is not being fully harnessed for maximum social and economic benefit.

The evidence suggests that while SAFCOL has an advanced R&D capability, this could be enhanced through 'quick wins', such as increased investment in personnel, especially at research assistant level, and through greater procurement support to the R&D team. Continued investment in collaboration and networking, including formal R&D partnerships, could enhance SAFCOL competitiveness over the longer run. SAFCOL has a diversified portfolio of non-R&D innovation activities—from cooperatives and training to eco-tourism and cultural and creative industry initiatives.

An important question is to identify which dimensions could be crucial in gearing SAFCOL to perform R&D and innovation effectively and efficiently in the future. There are two areas in particular to highlight. The first is SAFCOL's technological capabilities to develop and beneficiate its biological asset, including and especially increasing its R&D capacity and the productive capacity of its Timbadola Sawmill. The second concerns SAFCOL's 13 social compacts with communities. These could be leveraged, beyond a narrow corporate social investment paradigm, for greater impact on the SAFCOL dual mandate. While there is encouraging evidence, in terms of training and eco-tourism for example, that SAFCOL is leveraging its community partnerships, this could be strengthened through deeper, more focussed engagement on livelihoods, local innovation and production systems, enterprise development and innovation in the informal economy. This could include working with local, provincial and national government departments, as well as private sector actors, to scale impacts.

ACKNOWLEDGEMENTS

The research for this case study report was undertaken by the Centre for Science, Technology and Innovation Indicators (CeSTII) within the Human Sciences Research Council (HSRC). Desktop research and key informant interviews were conducted by a team comprising Jerry Mathekga, who also managed the overall project, Dr Nazeem Mustapha, who conceptualised the project, and Gerard Ralphs who analysed the data.

We acknowledge any errors contained in this report as our own.

The research team wish to acknowledge the support of CeSTII's Executive Head, Dr Glenda Kruss, in guiding project progress, research design and instrumentation, as well as for valuable contributions to data analysis.

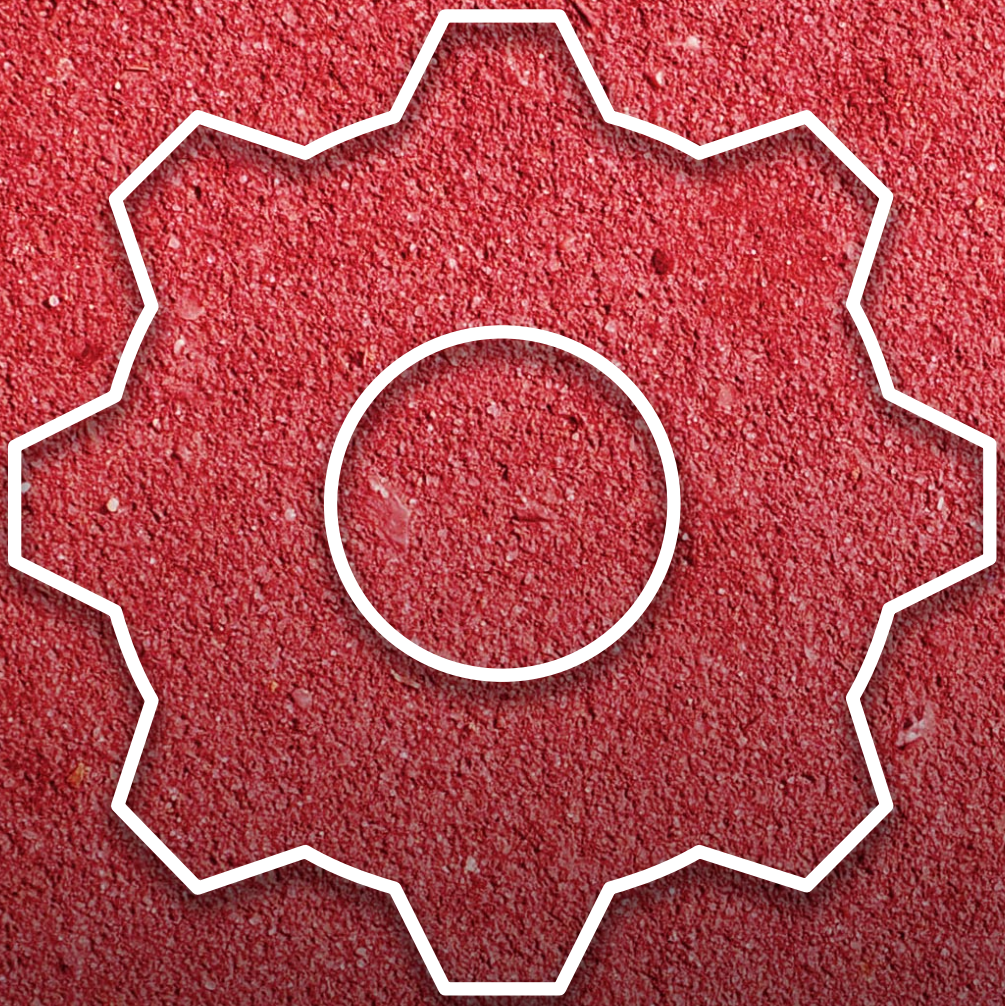
We also wish to acknowledge SAFCOL, and the officials who participated in the research, for their time, expertise and valuable insights into the R&D and innovation capabilities of the organisation. We are especially grateful to the SAFCOL officials that supplied relevant research materials, photographs, and arranged research interview logistics.

Funding for this research was facilitated by CeSTII, which is supported by the Department of Science and Innovation. The DSI's Godfrey Mashamba, Tshidi Mamogobo and Kgomotso Matlapeng are thanked for their contributions to the leadership of this research.

We are grateful to Katharine McKenzie for the copy editing of earlier drafts of this report and Tracey Watson for design and layout.

To cite this report:

Centre for Science, Technology and Innovation Indicators. 2022. R&D and Innovation Capabilities in South African State-Owned Enterprises: The Case of the South African Forestry Company SOC Ltd. Working Paper, 2d (February 2022). Human Sciences Research Council: Cape Town.



Working Paper Series on R&D and Innovation Capabilities in South African State-Owned Enterprises

State-owned enterprises (SOEs) are important national assets with a mandate to contribute to sustainable economic growth and South Africa's broad developmental goals. In March 2019, the Department of Science and Innovation (DSI), published the White Paper on Science, Technology and Innovation. This recognised the importance of SOEs in the South African economy and the need to revitalise them to play a meaningful role in South Africa's science, technology, innovation and economic development. As key institutions for human capital development and international and national knowledge sharing, the White Paper also aimed to position SOEs as innovation-driven for the knowledge economy. But to what extent and how are South African state-owned enterprises geared to perform R&D and innovation? Based on in-depth case study research with three SOEs—SANEDI, ATNS and SAFCOL—as well as analysis of the academic literature, the Human Sciences Research Council's Centre for Science Technology and Innovation Indicators (CeSTII) identified dimensions key to effective R&D and innovation 'gearing' by these SOEs, including: human capabilities; technological capabilities; networks; research infrastructure; and governance. Out of this research, indicators on R&D and innovation are also proposed to guide national policy discussion on the future of SOEs in South Africa.

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