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The Future of State-Owned Enterprises in South Africa: Why R&D Matters

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INTRODUCTION

State-owned enterprises (SOEs) in South Africa are critical to industrial development. The future role of SOEs depends on their ability to form the bedrock of the economy while remaining efficient and internationally competitive. This requires them to be strategic about the research and experimental development (R&D) activities that they perform continually, and the capabilities necessary for such work. However, there are a range of bottlenecks in the R&D functioning of SOEs currently, a study performed by the Human Sciences Research Council for the Department of Science and Technology has found. For example, there are shortages of highly skilled technical workers in SOEs that are critical for the support of R&D work conducted by scientists and engineers. There is also little evidence on the nature and extent of SOE linkages with global sources of such expertise, and insufficient evidence on existing local capabilities and future needs. In order to optimally utilise R&D capability, SOEs need to position themselves to form part of the broader innovation network including universities and research institutions. In this way, SOEs could form the core of a nexus for technological growth geared towards development. A greater understanding of the existing R&D capabilities of SOEs, and the potential of SOE intellectual property outputs for commercialisation, requires further, more focused, empirical research, to inform the design of policy interventions.

This Working Paper draws on a baseline exploratory study conducted by the HSRC's Centre for Science, Technology and Innovation Indicators (CeSTII). The study aimed to raise questions for new policy to promote R&D in State-owned Enterprises (SOEs) that could enhance their contribution to economic development, and to identify avenues for future research. The study drew on statistical data from the South African National Survey of Research and Experimental Development, as well as information published in the annual reports (2010/11 and 2014/15), of the ten largest R&D performing SOEs. It also considered published studies and articles on investments and performance of SOEs.

1 | THE CRITICAL ECONOMIC ROLE OF EFFICIENT AND INNOVATIVE STATE-OWNED ENTERPRISES

Infrastructure investment has been at the heart of the South African government's economic policies and strategies for more than a decade, with its ambitions to leverage local business growth off infrastructure upgrades and expansions. There has been an investment of R2.2 trillion by the state and its agencies in infrastructure between 1998/99 and 2014/15; and a further R865.4 billion in public sector infrastructure development is planned over the years 2016/17-2018/19[1]. A strong focus of this "leveraging" is crowding infrastructure investments to promote a localisation of procurement opportunities, skills development and job creation. In this context, the repositioning and boosting of the role of SOEs is an important part of the 'Nine Point Plan' that was introduced by the government in February 2015 as a response to the slow growth of the economy[2]. Recent estimates reveal that the largest four South African SOEs (Eskom, Transnet, Denel and Telkom)—all of whom perform R&D—account for 91% of the assets, 86% of turnover, and 77% of total SOE employment[3].

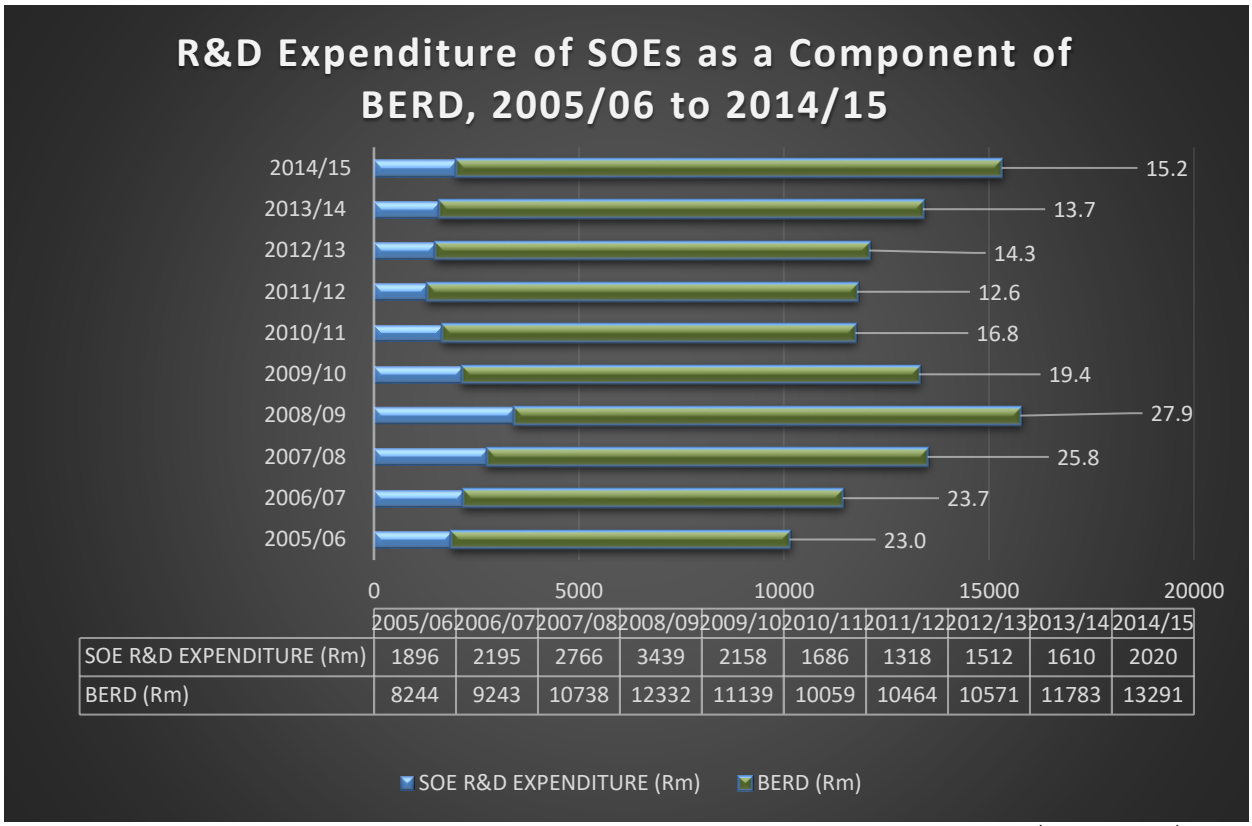
In recent years, many developing countries, among them South Africa[4], have recognised that SOEs are the key to services that promote economic development, but, vitally, that they need to provide these services in a manner that is efficient. Historically, operational efficiency required that South African SOEs perform R&D geared toward improving and maintaining their sustainability, as has been the case for major public sector corporations around the world.

It is therefore essential that we evaluate the performance and understand the commitment of SOEs, and in particular, the top South African SOEs to R&D. These SOEs, in terms of R&D expenditure, contribute 99% of all R&D performed by SOEs. Included in their ranks are the likes of Denel, Armscor, Transnet, Telkom and Eskom, which are all considered key entities for economic development under the new strategic path.

Current levels of R&D performance of South African SOEs

All over the world, SOEs have been set up to secure the provision or supply of energy, fuel, water, sanitation, transport and communications. These are operations-intensive businesses, with performance measured generally in terms of the efficiency of the service/supply and cost effectiveness of the operations. In South Africa, there is pressure in the current economic environment for SOEs to operate entirely off revenues, and to source technology upgrades or recapitalisation programme funding from financial markets, without government guarantees or bail-outs[5]. Prioritisation of investments and expenditure are influenced by how 'burning' the requirement is, and since the output or delivery of efficient and reliable infrastructure is driven by an immediacy of need, research and technology investments are made within short-to-medium term (1-5 year) horizons.

[1] National Treasury. (2016). Budget Review 2016: Annexure B. Pretoria: National Treasury, Republic of South Africa. Retrieved from http://www.treasury.gov.za/documents/national%20budget/2016/review/Annexure%20b.pdf.
[2] The Presidency. (2015, February). President Jacob Zuma: State of The Nation Address 2015. Pretoria: The Presidency, Republic of South Africa. Retrieved from http://www.gov.za/president-jacob-zuma-state-nation-address-2015.
[3] Sultan Balbuena, S. (2014). *State-owned Enterprises in Southern Africa: A Stocktaking of Reforms and Challenges*. OECD Corporate Governance Working Papers, No. 13. Paris: OECD Publishing. Retrieved from http://dx.doi.org/10.1787/5jzb5zntk5r8-en.
[4] The Presidency. (2013). *Presidential Review Committee on State-Owned Entities Volume 1, Executive Summary*. Pretoria: The Presidency, Republic of South Africa.
[5] PwC. (2015). *State-owned enterprises: Catalysts for public value creation?* PricewaterhouseCoopers.



	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
SOE R&D EXPENDITURE (Rm)	1896	2195	2766	3439	2158	1686	1318	1512	1610	2020
BERD (Rm)	8244	9243	10738	12332	11139	10059	10464	10571	11783	13291

Figure 1: The R&D expenditure (in R millions) of R&D performing SOEs in South Africa from 2005/06 to 2014/15 provides an indication of the contribution of public enterprises to R&D expenditure in the overall business sector. The percentage contribution is displayed on the right hand side for each year.
Source: Adapted from the CeSTII report *Research and Development Trends in State-Owned Enterprises*[6].

South African SOEs report on a set of indicators that are self-selected from international industry standards. On one level this makes sense, because they are a group of very disparate organisations performing widely varying functions. Therefore they need to benchmark themselves against international organisations with similar functions. Given local policy directions, however, the targets do require some reassessment. This is especially true when it comes to indicators of R&D performance.

The Top 10 SOEs show very small growth in R&D investment, amounting to 15.2% of BERD in 2014/15 (up one and a half percentage points from 13.7% in 2013/14). They appear to be growing in concert with the rest of SA business, as shown in **Figure 1**, in the wake of the volatility in the business sector growth in R&D since 2009 (see also **Figure 2** for the effect on R&D personnel). Overall, while business expenditure on R&D is increasing, the increase is only marginal across the SOEs (**Figure 1**).

It is striking how much the contribution of SOEs to R&D activity has decreased over ten years, from a high of 27.9% in 2008/09 to current levels half that amount. Much of this loss of R&D activity was due to major R&D operations shutting down in ESKOM soon after 2008/09.

[6] CeSTII. (2017). CeSTII. (2017). Centre for Science, Technology and Innovation Indicators. *Research and Development Trends in State-Owned Enterprises*. Pretoria: Human Sciences Research Council. Data obtained from that report was updated with the most recent available data.

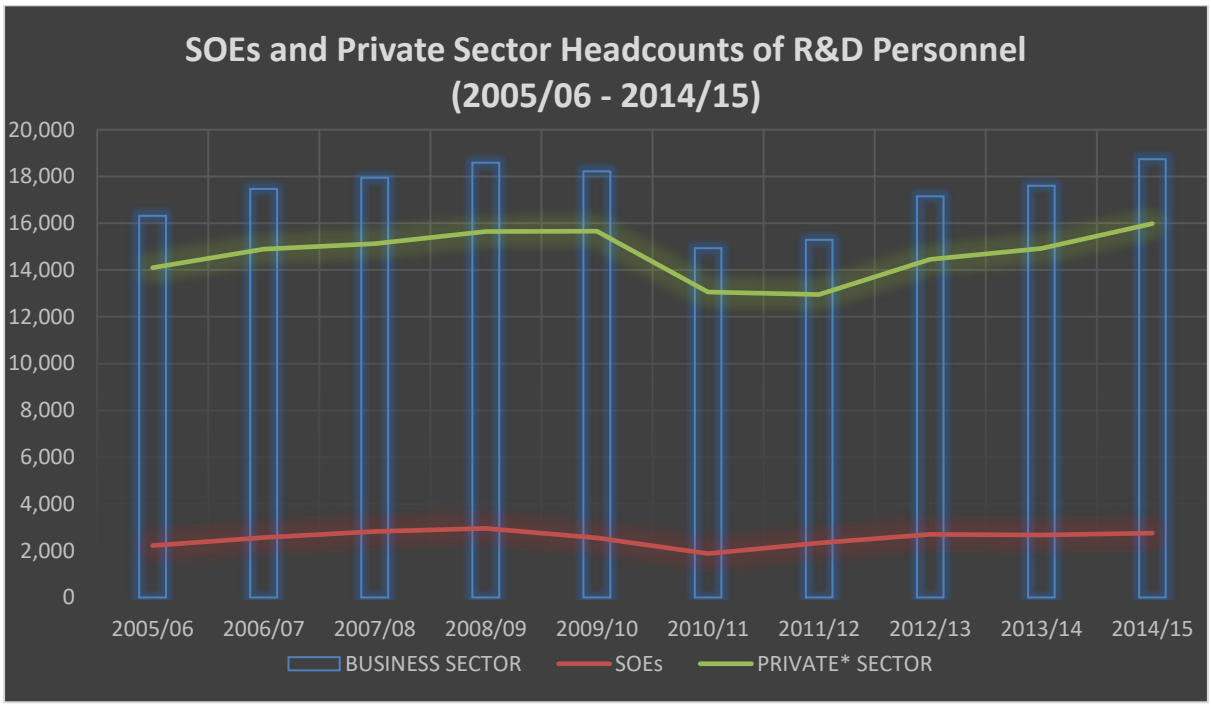


Figure 2: Trends in headcounts of R&D personnel in the private and public business sectors.
Source: R&D data extracted from SA National Survey on Research and Experimental Development[7].

What is cause for major concern is the *apparent underspending* by some of the largest SOEs, of board-approved R&D budgets, over the 2011/12 to 2013/14 period considered in the study. This does not necessarily reflect that the relevant SOEs have reprioritised the importance of spending on R&D, but rather, that there may be problems at a practical level in deploying R&D funds. Poor management of decision-making procedures or a shortage of research or R&D management expertise within the institution or research community could be the explanation. Especially important to note is that some SOEs are *not* setting targets for R&D expenditure levels as part of their Shareholder Compacts. With some SOEs, the R&D expenditure as a key performance indicator was dropped about three years ago, about the time the first indicators of underspending on board-approved R&D budgets appeared. It is not known whether this is a mistake or an oversight, but R&D indicators need to be re-institutionalised.

Finally, what is potentially of concern is the absence of some SOEs that would be expected to perform R&D, from the group of SOE R&D performers. The identification of these units needs to form part of a strategy to promote R&D in SOEs geared towards economic development. Furthermore, some forms of R&D that they perform may have produced outputs with currently unknown economic benefits—that is, until they are utilised for commercialisation. Armscor appears to be the only SOE where a structure has been set up to promote technology commercialisation.

[7] CeSTII. (2017). *South African National Survey of Research and Experimental Development (Statistical Report: 2014/15)*. Pretoria: Department of Science and Technology.

2 | LINKAGES WITH THE NATIONAL SYSTEM OF INNOVATION

SOEs need a large and robust base of human resources from which to draw research and engineering expertise. South Africa's research base as a proportion of the workforce (**Figure 3**) is low (historically at around 1.5 FTEs per 1000 employed labour force). This is low, compared not only to other countries with a relatively small employed labour force, in East Asia (Singapore and Taiwan) for example, where one would expect high ratios of researchers to employed persons, but even to the countries with a large research base, such as the OECD grouping of countries. It should be arguably an order of magnitude larger to compare favourably[8] with any of these countries. There has been no real growth of researchers in the country as a whole, when compared with the growth in general employment in the economy. This is a systemic problem, not specific to the SOEs.

An element of this shortage of skills supply is identified in the proportion of female researchers, which in the business sector was around 36% in 2013/14. In the SOEs, this proportion was even lower, at 26%.

Challenges with high-end capabilities and technical performance

Furthermore, the number of technicians at SOEs has grown faster than the number researchers engaged in R&D.

The operations of SOEs depend on infrastructure that is technology-intensive. The annual reports of SOEs indicate that many are currently grappling with the challenge of addressing decades of neglect of technical modernisation. A considerable proportion of applied (and also experimental development research) is dedicated to technical performance optimisation and testing. This is an area that should utilise and strengthen local competency. While the level of outsourced R&D by SOEs is relatively low, it is not clear whether this is due to SOEs competing overseas for highly-skilled and scarce knowledge workers, or due to the unavailability of skilled technicians required for the maintenance of specialised research equipment.

The number of technicians for every researcher is therefore a useful (as well as an internationally comparable) indicator that could be used to monitor this risk factor at the SOE level. **Figure 3** shows that, at a national level, this ratio has been climbing since 2005/06, reaching a value of 1.1 in 2014/15. For the purposes of long-term labour supply planning in the US, this ratio has been recorded[9] at one technician for every four engineers in R&D operations for utilities (and manufacturing enterprises). The suggestion is that there has been a shift from strategic experimental research projects to a mode of operation that is more focused on maintaining production in South African SOEs. This is borne out by the evidence, where it can be seen that there has been a trend towards applied research at the cost of experimental development[10].

The benchmark value for the ratio of technicians to researchers would need to be determined by every SOE for the specific industry within which they function. It would also depend on the type of research they perform, whether applied research, required for maintenance of operations improvement, or more strategic research and experimental development.

[8] OECD. (2017). Researchers (indicator). doi:10.1787/20ddfb0f-en

[9] *BLS. (1987). National Survey of Professional, Administrative, Technical, and Clerical Pay: Private Service Industries, March 1987.* Bureau of Labor Statistics. Washington, D.C.: U.S. Department of Labor.

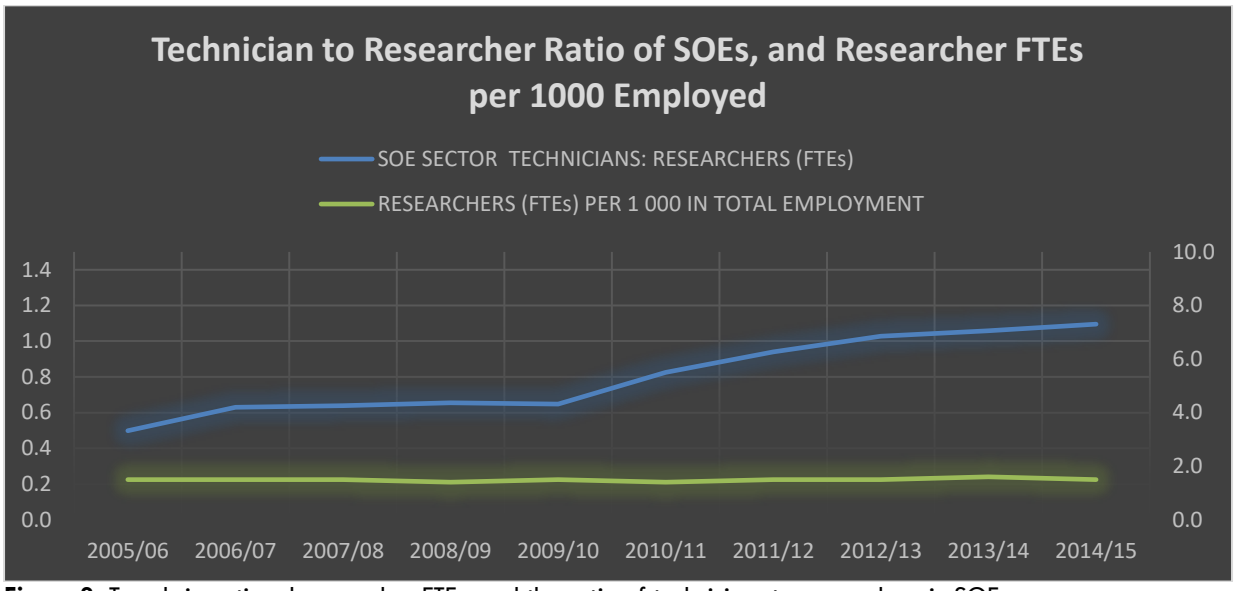


Figure 3: Trends in national researcher FTEs, and the ratio of technicians to researchers in SOEs.
Source: R&D data extracted from SA National Survey on Research and Experimental Development[10].

The annual reports of SOEs reviewed for purposes of the study show that many SOEs are battling with an ageing skilled section of their core workforce and relatively low-skilled young employees.

Only one of the Top 10 SOEs explicitly mentioned the concept of the "National System of Innovation" in their annual reports, but a number of SOEs address the lack of high-end capability through the establishment of Centres of Excellence and linkages with university researchers. Many SOEs leverage off the local R&D "base" by collaborating with universities and research institutions to support the development of their infrastructure and technologies, and for continuous operational optimisation. Even if they do not all expressly use the National Innovation System concept, their annual reports indicate that they are making progress with integration into the knowledge and innovation networks that include universities and research institutions. The available data (**Figure 4**) from the National R&D Survey records the extent of collaboration activity, for those SOEs that perform in-house R&D[11], reflecting the importance of universities and science councils.

[10] CeSTII. (2017). *South African National Survey of Research and Experimental Development (Statistical Report: 2014/15)*. Centre for Science, Technology and Innovation Indicators. Pretoria: Department of Science and Technology.

[11] The National R&D Survey design excludes those companies that only perform extramural (i.e. "outsourced") R&D.

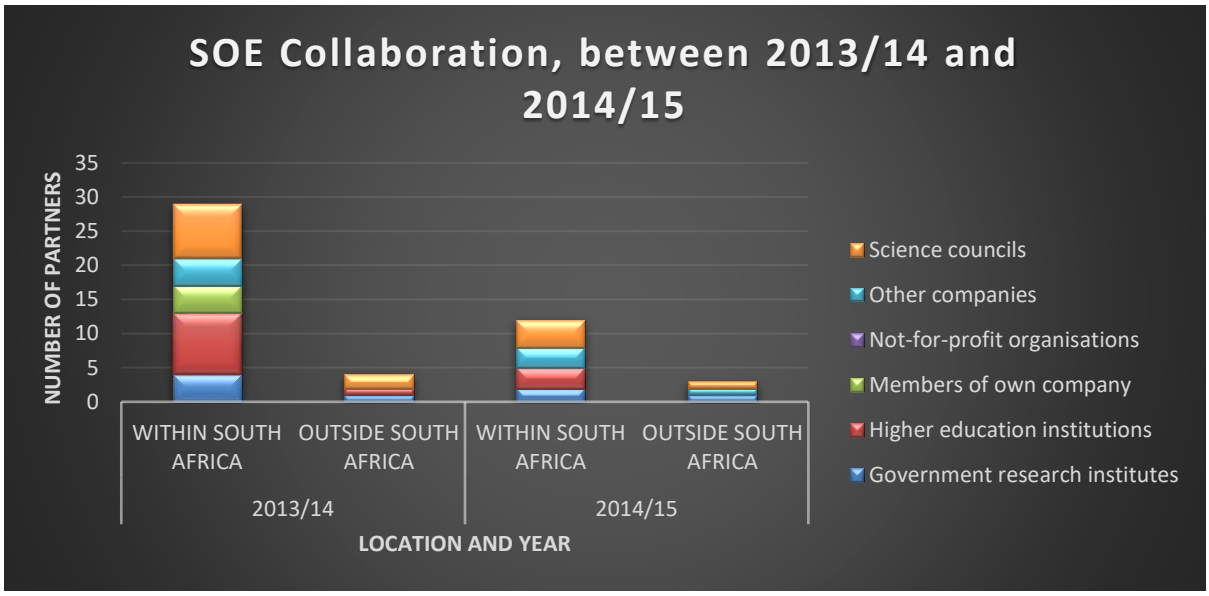


Figure 4: Number of partners engaged in partnerships, alliances and collaborations with SOEs. The number of such collaborations may be more than unity for some partners. The number of SOEs engaged in in-house R&D activity was 19 (including subsidiaries) for these two years.
Source: Data extracted from SA National Survey on Research and Experimental Development[12].

Competitiveness in international trade and electricity generation

Developing countries have placed the responsibility for establishing and operating economic infrastructure on SOEs financed from service revenues, government sources and loan capital from international financing institutions such as the World Bank. Globally, some SOEs demonstrated such outstanding delivery performance in 2011—more lucrative than many private operations—that an OECD report estimates the SOEs to have accounted for about 6% of the world's GDP[13]. The same study found that ten percent of the world's largest firms are state-owned firms (204 SOEs), and that their joint sales for 2011 amounted to $3.6 trillion. The OECD study uses *Forbes Global 2000*[14] data from 2011 and has calculated that 96% of China's top ten (best performing) companies are SOEs; with the share of state owned companies at 81% in the top ten for Russia; 59% for India; and 50% in Brazil. South Africa only had one SOE in the 2011 Forbes Global 2000 ranking, which was Telkom. Note that the Forbes Global 2000 does not include SOEs whose shares are not traded on stock exchanges, which excludes large SOEs such as Eskom, Transnet and Denel.

Compared to the BRICS grouping of countries, South Africa rates poorly when assessed on indicators pertaining to trade performance and access to electricity for businesses[15]. For example, consider performance in trading across borders: China outperforms the rest of the BRICS countries, and is ranked 96 amongst 189 countries for trading across borders. This results from China boasting lower domestic transport costs to the border, as well as shorter times for documentary plus border compliance, and again, time to transport. Brazil and Russia's profiles

[12] CeSTII. (2017) R&D Survey database (unpublished).
[13] Kowalski, P., Büge, M., Sztajerowska, M., & Egeland, M. (2013). *State-Owned Enterprises: Trade Effects and Policy Implications*. Trade Committee, Trade and Agricultural Directorate. Paris: Organisation for Economic Cooperation and Development. Retrieved from http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=TAD/TC/WP(2012)10/FINAL&docLanguage=En
[14] The Forbes 2000 is a list of the world's largest 2 000 companies. Other rankings of large companies use different methodologies, resulting in lists which are different.
[15] World Bank. (2016). *Doing Business 2016: Measuring Regulatory Quality and Efficiency*. Washington, DC: World Bank. doi:10.1596/978-1-4648-0667-4

show up very badly when it comes to export-compliance costs, but are far less expensive than South Africa regarding domestic transport costs for exports. Specific areas that contribute to South Africa's weak position in the ranking is the time (not costs) that it takes to finalise procedures for exports, as well as the high cost of domestic transport, shown here as 72% of the 'cost to export'. The other BRICS countries carry domestic transport costs as 31% up to 46% of costs to export. While there are various factors besides the efficiency of the freight systems that might account for the higher efficiency of other BRICS partners, in South Africa, in terms of trading across borders, domestic transport costs include road, rail freight and ports infrastructure, all under the control of Transnet.

Table 1: BRICS performance: Trade across borders and reliability of electricity supply

Country	Time to export (hours)	Cost to export ($US)	Cost of domestic transport as a % of cost to export	Reliability of electricity supply (index* 0-8)	Cost of electricity % income per capita
Brazil	102,4	2344,1	49,4	5.6	28.6
Russia	153,8	2369,1	31,4	8	93.1
India	178,6	950,3	45,8	5.5	442.3
China	53,8	913,0	33,5	6	413.3
SA	184,0	2148,0	72,2	0	670.5

Source: Doing Business 2016: Measuring Regulatory Quality and Efficiency * 0= low, 8=high

Viewed in this context, it is encouraging to note that R&D efforts at Transnet are geared towards finding alternative energy solutions, including second-generation bio-fuels, natural gas and fuel cells for locomotives and equipment; and harnessing wasted energy from exhaust systems. Given that energy generation in the form of diesel and electricity is responsible for most of its operational costs, these initiatives have the potential to improve the competitiveness of South African industry.

Corporate governance and impact on R&D decision-making

The linkages between poor corporate decisions and low impact research and technology investments cannot be ignored, as a very real concern in environments where operational recommendations are overturned without consideration of the risks.

While objectively, South African SOEs perform rather poorly compared to those in the OECD countries[16], South Africa still has rigorous, transparent and balanced policy systems and procedures for approval of board appointments, assessment and review of SOE performance and board oversight. However, serious concerns have been raised that these oversight mechanisms are not operating as they should, to prevent the mismanagement or abuse of public office for private gain.[17] The growing evidence suggesting abuse of procurement mechanisms may

[16] OECD. (2015, July). OECD Better Policies Series: South Africa Policy Brief. *Corporate governance: State-owned enterprise reform* . Paris: Organisation for Economic Cooperation and Development. Retrieved from https://www.oecd.org/corporate/south-africa-state-owned-enterprise-reform.pdf

[17] Ncayiyana, D., J., (2012). Preventing fraud and corruption in social services: context, progress and lessons from South Africa. Public protector report. (2015, August). "Derailed": a report on an investigation into allegation of maladministration relating to financial mismanagement, tender irregularities and appointment irregularities against Passenger Rail Agency of south Africa (PRASA). Report No: 3 of 2015/16.

impact negatively on expenditure of SOE R&D budgets.[18] Given the significant role that SOEs have played historically in South Africa, and their current policy elevation as drivers of industrialisation, the potential risks need to be taken into account.

3 | CONCLUSION

SOEs as potential drivers of innovation

The evidence shows that State Owned Enterprises have dropped R&D activity by close to 50% of their maximum R&D activity in 2008/09 over the last ten years, as proxied by R&D expenditure (**Figure 1**). The implication is that there is underutilisation of R&D capacity in the system by at least this amount, and that SOEs can perform at double the 2014/15 levels of 15.2% of business sector R&D expenditure. There has been scant growth in the number of researchers employed in SOEs, after normalising for employment growth. This is true at a national level, and is not specific to SOEs, necessarily. But what has also been evident in SOEs is the growth of technicians to researchers over the same period, which is an indication of the type of research that is performed at the SOEs. There appears to have been a decline in the more strategic type of experimental development research, with a concomitant growth in applied research over the last ten recorded years in SOEs.

The research workforce at SOEs is an aging one. However, several SOEs have instituted, timeously, targeted training interventions for further capacitation of their skilled staff, and many of them are still actively engaged in the National System of Innovation.

All of these are indications that there is much capacity for SOEs to become the nexus of knowledge capability and technological growth, *provided* the long-term strategic planning for such a transformation is in place, and well-implemented.

The need for richer data and greater study

Discussions on the role of SOEs in advancing R&D and technological innovation have hitherto suffered from a lack of evidence. The baseline study has shown that some insights may be gained by appealing to existing surveys on R&D and Innovation. As a counterpoint to the surveys, data obtained from company annual reports have been used to narrow the gap. However, these methods have their limitations.

As the baseline study has indicated, there may be under-reporting taking place in the annual reports of SOEs. There may also be under-reporting of R&D activity taking place in the R&D Survey, because the survey methodology is designed to collect data only from enterprises that conduct intramural R&D, which therefore does not accommodate the collection of information on the specifics of outsourced R&D from SOEs. In particular, data on the interactions with institutions that are registered outside the Republic of South Africa may provide critical information on the functioning of SOEs when it comes to areas of technology diffusion or support services for researchers at SOEs.

[18] Bhorat, H., Buthelezi, M., Chipkin, I., Duma, S., Mondi, L., Peter, C., Mzukisi, Q., Swilling, M., & Friedenstein, H. (2017, May). *Betrayal of the Promise: How South Africa is Being Stolen.* (M. Swilling, Compiler) South Africa: State Capacity Research Project

Which areas of expertise are the ones that can be filled by capable local technicians or by capacitating the same, rather than searching overseas at great expense of time and money to get the job done? Questions such as this have implications for assessing the methodology of the National R&D Survey so as to enhance the scope of the survey to include data on outsourcing behaviour of not just likely R&D *performing* SOEs but also those that outsource their R&D activities. Depending on the outcome of such an evaluation process, other data collection instruments may also need to be considered.

Finally, more detailed and more in-depth study, on a *case by case*, basis needs to be conducted to provide context and understanding to the quantitative data that is available.

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