Article

The Success and Failure of South Africa's Ten-Year Innovation Plan (2008) as Measured by Research Output

Lara Skelly
https://orcid.org/0000-0002-2301-1242
University of Stellenbosch, South Africa
lara.skelly@gmail.com

Abstract

Investment into research is a vital key to positively impacting on society. Research policies are the instruments which prescribe the direction in which the funding flows. This article shows how South African researchers have responded to the Ten-Year Innovation Plan (TYIP) of the Department of Science and Technology (DST), particularly in light of identified areas of specialisation. It discusses the specialisation among the universities in the country. It comments on the problems with metrics relating to research output in an attempt to explain why South Africa has not shown the desired output. The activity index, which shows the relative specialisation of a country or a university, was used as the primary metric to evaluate the effectiveness of the TYIP. Publication counts were drawn from Web of Science. It was found that South Africa fell short of the goal expressed in the TYIP. In areas of specialisation, the five Grand Challenges showed varying changes: from a decrease in "global change science with a focus on climate change" to a significant increase in "human and social dynamics". Universities in South Africa are shown to be multi-focused in their research. Drawing from the literature, this article provides five possible explanations as to why the output was not at the expected level. The use of the activity index as a tool to evaluate policy does not give a full picture of the impact of research. This article provides suggestions for future policymakers and researchers on the development of a more appropriate method of evaluating research policies.

Keywords: activity index; bibliometrics; research impact; research specialisation; science policy

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Introduction

One would assume that any investment in research would have a positive impact on society. However, this assumption has been questioned since the early 1970s (Bornmann 2013). As Nightingale and Scott explain, a gap is often found between the research and its applicability outside of academia. One of their suggestions to close this gap is to "encourage and protect research that is aiming to be relevant and interdisciplinary" (2007, 547).

Measuring the societal impact of research is not an easy task, as Bornmann (2013) shows, and returns on investment are likely to be low, with only 10% capturing between 48% and 93% of the returns (within the sample, Scherer and Haroff 2000, 559). With such low returns, it becomes imperative to develop methods of measuring the impact of research. Morton (2015) presented one method of measurement that expands the notion of impact into different facets, such as changes to behaviour or changes in knowledge. Other examples of measurement instruments are the Research Excellence Framework in the UK and Excellence in Research for Australia, both of which attempt to systematise the reporting of research impact.

At the macro level, societal impact would be reflected in the Gini coefficient. The Gini coefficient, a measure of inequality, typically measures socioeconomic status. South Africa has one of the highest measures of the Gini coefficient in the world (Stats SA 2019, 5; this source reports on the latest available calculation of 2015), which is a great developmental challenge. It would thus be prudent for policymakers to address this challenge. This is the overarching principle behind the Ten-Year Innovation Plan (TYIP), published in 2008 by the South African Department of Science and Technology (DST). The DST claimed the "highest socioeconomic returns" would be achieved by funding the following Grand Challenges (2008, 5):

- The "Farmer to Pharma" value chain (hereafter Farmer to Pharma)
- Space science and technology (hereafter Space Science)
- Energy and security (hereafter Energy)
- Global change science with a focus on climate change (hereafter Global Change)
- Human and social dynamics (hereafter Social Dynamics).

In this, the TYIP embodies the suggestion by Nightingale and Scott (2007) that research should be relevant and interdisciplinary.

An assumption driving the TYIP is that funding incentives can change the behaviour of researchers, and so by looking at the behaviour of researchers, the effect of funding can be seen. The relationship between funding and the increase in research output is by no means a simple one. By comparing the funding model for research across eight countries, Auranen and Nieminen (2010) aimed to ascertain whether there is a positive relationship between competition for funding and research efficiency, as measured by publication output. They found no apparent relationship, raising questions around the use of competitive funding policies to motivate research efficiency. They pointed out that too much competition might negate research efficiency. This is in stark contrast to the findings of Kahn (2011), who looked at the introduction of the publication subsidy by the South African Department of Higher Education and Training (DHET). As this subsidy financially rewards researchers on publication, Kahn's study showed that there was a marked increase in the production of research output. He noted that there was a shift to disciplines with higher productivity, indicating that researchers are willing to change their research focus if they are financially inspired to do so. Pouris (2012) has also shown how the research output from South Africa has grown in past years in response to the funding model. While this funding policy has received some criticism (see Mouton and Valentine 2017), the South African evidence strongly suggests that there is a distinct relationship between funding and research output.

It would follow then that one of the measures of success outlined in the TYIP would be publication counts. This is frequently used to evaluate research policy (Vinker 2010, 223). Few articles offer an assessment on the validity of this metric as a tool for evaluation. Rather than using raw publication counts, which might simply show the direction in which all fields are moving, it is better to use the share of research output, which would show whether one field is growing faster than another (or whether one country's output is growing faster than another's). However, this metric is not without its problems. One of the aims of this article is to critique a commonly used measure of science policy.

The TYIP's aim was to increase South Africa's share of the global research output to 1%. In 2002 it was reported at 0.5% (DST 2008, 8) and in 2006 it was still at 0.5%; later in the DST report it is stated that the 2018 goal is 1.5% (DST 2008, 28). Now that the ten-year period has drawn to a close, the question is whether the goal has been achieved. This study seeks to show how South African researchers have responded to the public declaration of research focus areas. Insights into the publishing patterns of South African researchers could guide policymakers to define measures of success more effectively and to draft policies that will more likely lead to the desired outcomes, whatever these outcomes might be in the future.

The study addressed the following questions:

1. Have South African researchers responded to the TYIP by publishing more research output?
2. Is there evidence that South Africa's areas of research specialisation have aligned to the Grand Challenges?
3. Which universities in South Africa have demonstrated an increased specialisation in line with the Grand Challenges over time?
4. What are the possible problems with the metrics relating to research output?

Research Method and Design

Publication counts, such as the measure of success given in the TYIP, fall within the scope of bibliometrics—the measure of research through output and citation counts.

This measurement of science is a long-standing tradition. However, there has been a move beyond simple counts and now methods are used to estimate interdisciplinarity, impact, and a variety of other metrics referred to as scientometrics (for a thorough discussion of all matters relating to bibliometrics and scientometrics, see Todeschini and Baccini 2016).

Bibliometric or scientometric methods have been used to explore specific disciplines, gain insight into publishing patterns within institutions, examine the behaviour of researchers, and evaluate policies, to name a few. Table 1 gives examples of research studies that used bibliometric and scientometric methods.

Table 1: Examples of studies using bibliometric and scientometric methods

Citation	**Detail**
Studies exploring disciplines	
Mitha and Leach (2006)	AIDS research in South Africa
Molatudi, Molotja, and Pouris (2009)	Bioinformatics
Siebrits, Winter, and Jacobs (2014)	Paradigm shifts in water research
Studies looking at the behaviour of institutions	
Cheng and Cai Liu (2006)	Attempted to categorise the top 500 universities by their disciplinary strengths
Ani and Onyancha (2012)	Research output in Nigeria
Chiware and Skelly (2016)	Publication patterns at Cape Peninsula University of Technology
Studies examining the behaviour of researchers	
Jacobs and Ingwersen (2000)	Publishing patterns
Maluleka and Onyancha (2016)	Collaboration patterns in library and information science schools
Sooryamoorthy (2014)	Productivity of researchers
Studies evaluating policies	
Tijssen et al. (2006)	Visibility of local South African journals to international audiences
Pouris (2012)	Effects of the South African DHET’s subsidy policy
Mouton and Valentine (2017)	Criticism of the DHET’s subsidy policy

Measuring science through the proxy of research output is a straightforward method that is simple to execute and easy to understand. More challenging is measuring the real impact of research. However, since the TYIP explicitly states that the measurement of research output would be a method of evaluating the success of the TYIP, this was selected as the focus of this study.

A commonly used database for studies using bibliometric methods is Web of Science by Clarivate Analytics. Still occasionally called the ISI Science Citation Index, this database indexes highly ranked journals, creating citation links between the articles. It has not escaped criticism (see Harzing and Alakangas 2016), the strongest of which relates to the coverage of research included in the database. A recent report by the Academy of Science of South Africa (ASSAf 2018, 61) reports that about 62% of South African research can be found on Web of Science. Despite this, numerous South African studies have been based on Web of Science data, such as Pouris (2007), Sooryamoorthy (2009), and Tijssen et al. (2006).

The process of data collection was as follows: For the various search strings, the publication counts were recorded as the variable of interest. The advanced search feature allowed for a multidimensional search: for date parameter, geographic location, and research area. The date parameter was set to include articles published in the ten years before the publication of the TYIP in 2008, as well as in the ten years after publication of the TYIP. The geographic location was set to "South Africa" to answer the first and second research questions, and then to the various South African academic institutions for the third research question. Every journal indexed by Web of Science has been assigned to at least one of the predefined research areas. Table 2 shows the research areas used in this article.

Table 2: Research areas linked to the Grand Challenges

Grand Challenge	**Web of Science research area(s)**
Farmer to Pharma	Agriculture; biochemistry and molecular biology; biodiversity and conservation; biotechnology and applied microbiology
Space Science	Astronomy and astrophysics; telecommunications; engineering, instruments, and instrumentation
Energy	Energy and fuels
Global Change	Environmental sciences and ecology
Social Dynamics	Social issues; development studies

The activity index was calculated using the publication counts found in various searches. This index has been in use for over forty years and was first proposed by Frame (1977). Authors who have used the activity index include Schubert and Braun (1986), Schubert, Glänzel, and Braun (1987), and Pouris (2012).

The activity index (AI) is defined as "the degree of specialization of a country N in a research field F" (Todeschini and Baccini 2016, 4). The AI for an institution would then be defined as the degree of specialisation of an institution (M) in a research field (F). If AI > 1, it shows that that country or institution has relative specialisation in a given field. Of particular interest in this study is how the activity index has changed over time in response to the TYIP. Mathematically, these definitions are represented as:

$$AI(N,F) = \frac{N\ country's\ share\ in\ the\ world's\ publication\ output\ in\ field\ F}{N\ country's\ share\ in\ the\ world's\ publication\ output\ in\ all\ fields}$$

$$AI(M,F) = \frac{M\ institution's\ share\ in\ country\ publication\ output\ in\ field\ F}{M\ institution's\ share\ in\ country\ publication\ output\ in\ all\ fields}$$

Rousseau and Yang highlighted some mathematical problems. If the denominator is too small, then theoretically it is possible to show a decrease in the index with an increase in real activity. They continue by saying, "The problem we pointed out has no real consequences for the interpretation of large-scale activity indices" (2012, 417). Given that the smallest denominator used in this study was 75, it was felt that this was sufficiently large to avoid the problems outlined by Rousseau and Yang.

Results

The first question that this article seeks to address is whether South African researchers have responded to the TYIP by publishing more research output. Looking at South Africa's share in the world's research output in the period 1999 to 2018, an increase over time is evident, as is shown in Figure 1. The figure has grown steadily over the period under investigation, from just under 0.004% to 0.008%. (Of the 1 293 931 articles published in 1999, 5 090 can be attributed to South African authors, while 22 921 of the 2 804 595 articles published in 2018 were by South African researchers. The TYIP claimed that South Africa's share was 0.5%, but it does not acknowledge the source of these figures.) While there was growth in the number of publications in the ten years following the publication of the TYIP, there was no sharp increase following the publication of the TYIP, which was expected given the publication lag. Unfortunately, the goal expressed in the TYIP of achieving a global share of 0.5% (or 1.5% in 2018) was not achieved, meaning that South Africa is falling short of that goal.

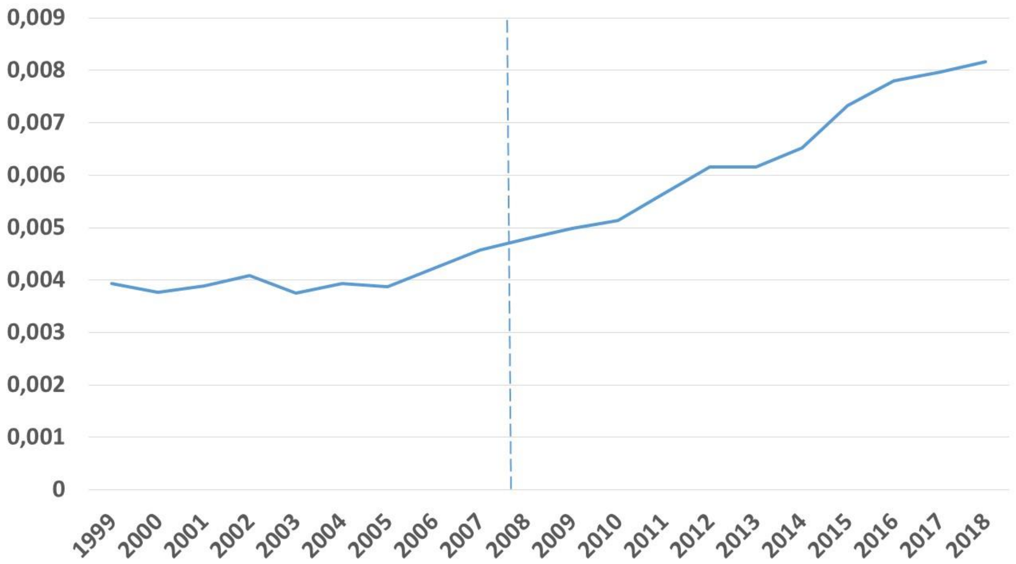

Figure 1: The percentage of articles originating from South Africa
(Note: The dotted line shows the year that the TYIP was introduced.)

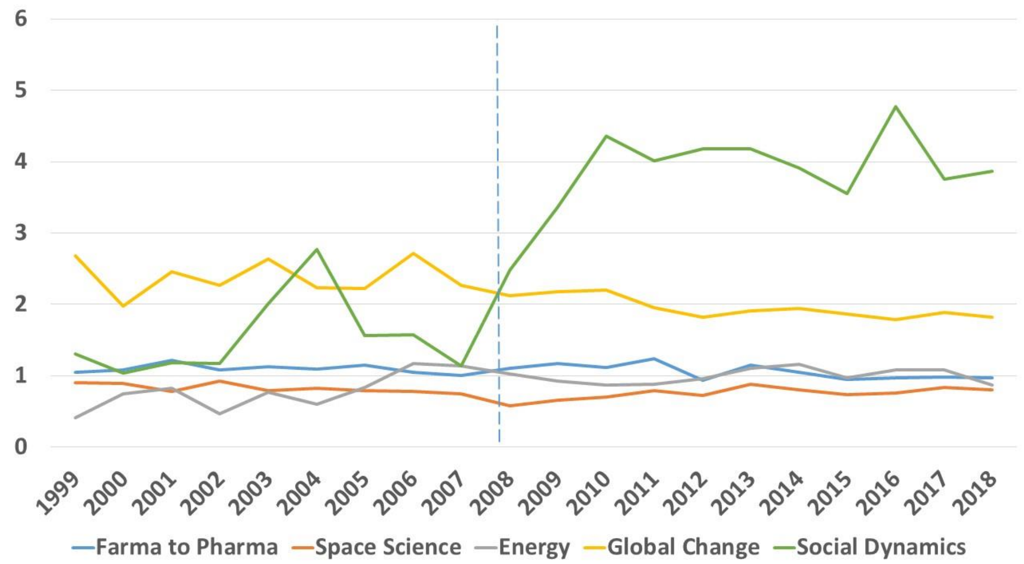

Figure 2: South Africa's activity indexes relating to the Grand Challenges
(Note: The dotted line shows the year that the TYIP was introduced.)

The second question that this article sought to address was whether the publications aligned with the Grand Challenges, and whether South Africa has a specialisation in any of these areas. Figure 2 shows the country's activity index for each of the Grand Challenges. The index varies widely between the different Grand Challenges: Global Change saw a decrease, Space Science and Farmer to Pharma appear to have changed minimally, and there was a slight increase in the specialisation of Energy and a significant increase in Social Dynamics.

Any index above 1 shows that South Africa has a specialisation in the field in question. Despite the decrease in the Global Change activity index, South Africa still has relative strength within that research area. Farmer to Pharma and Energy are on the borderline of showing a specialisation. Undoubtedly, Social Dynamics is where South Africa contributes the most to global science. The activity index related to Space Science shows that South Africa does not have a specialisation in this field, and the emphasis on this field in the TYIP did not change that.

The third question relates to institutional differences: Which universities demonstrated an increased specialisation in line with the Grand Challenges over time? Table 3 shows the activity index relating to the Grand Challenges for each university, for two ten-year periods: 1999–2008 and 2009–2018. It is curious to see that nearly all the institutions show a relative strength aligned to one or more of the Grand Challenges, and not only the research-intensive institutions, as one might expect. Figures that show the relative research foci are highlighted in Table 3. Except for the University of Cape Town, all other institutions showed an increased specialisation in one or more of the Grand Challenges. It is likely that, as the University of Cape Town has more articles attributed to it on Web of Science than any other institution, the specialisations focused on the Grand Challenges appear diluted.

Without having intimate knowledge of the research drivers within each institution, it is impossible to say whether the specialisations shown here were intentional. For example, the Cape Peninsula University of Technology (CPUT) published their *Research, Technology and Innovation (RTI) 10-Year Blueprint* in 2012, highlighting their intention to build on their existing strengths in seven focus areas, three of which align directly with the Grand Challenges in Energy, Global Change, and Space Science (CPUT 2012). This public statement does not explain why the institution shows a marked decrease in the specialisation of Space Science while maintaining a relative strength in all three areas.

Some interesting patterns are shown in Table 3. It is thought-provoking to see that there is not one institution with a single relative strength aligned with a Grand Challenge. It shows that the academic institutions in South Africa are multi-focused in their research, which one would expect by looking at the academic offerings. The Grand Challenge in which the fewest institutions displayed a research strength Social Dynamics; this is interesting to note particularly in light of the results given in Figure 2, where it was shown that South Africa's contributions to this area of research showed the highest increase. While South African research has grown in this area, there is still room for improvement.

Table 3: Activity indexes of South African institutions

	Farmer to Pharma		**Space Science**		**Energy**		**Global Change**		**Social Dynamics**	
	99–08	**09–18**	**99–08**	**09–18**	**99–08**	**09–18**	**99–08**	**09–18**	**99–08**	**09–18**
Cape Peninsula University of Technology	1.67	1.19	2.34	1.61	3.26	4.29	1.21	1.28	0.67	0.27
Central University of Technology	2.83	0.80	2.42	2.33	3.89	5.51	1.68	0.29	0.00	0.00
Durban University of Technology	1.84	1.69	2.02	1.82	1.19	3.24	1.28	1.21	0.65	0.40
Mangosuthu University of Technology	2.52	2.12	1.67	2.32	1.73	4.88	2.91	0.81	0.00	0.74
Nelson Mandela University	1.05	1.05	0.51	0.78	2.31	0.64	2.29	2.31	0.42	0.79
North West University	0.86	0.86	1.85	1.02	3.02	2.31	0.90	1.12	0.72	1.53
Rhodes University	1.22	1.26	0.38	0.98	0.37	0.22	1.75	2.02	1.30	0.61
Stellenbosch University	1.73	1.69	0.82	0.70	0.87	0.94	1.08	1.19	0.85	1.03
Tshwane University of Technology	0.66	1.12	1.96	2.17	5.07	2.73	1.32	1.31	1.28	0.31
University of Cape Town	0.76	0.69	0.90	0.89	0.85	0.62	1.12	1.01	1.12	0.78
University of Fort Hare	2.79	2.75	0.48	0.24	2.60	1.24	2.32	1.64	0.53	0.82
University of the Free State	2.24	1.48	0.38	0.47	0.31	0.18	0.74	0.78	0.20	1.89
University of Johannesburg	0.49	0.45	1.59	1.59	1.77	1.32	0.55	0.76	0.85	1.19
University of KwaZulu-Natal	1.11	1.29	0.70	0.90	0.66	0.94	1.21	1.13	1.52	0.65
University of Limpopo	0.96	1.37	0.22	0.23	0.36	0.30	0.47	1.20	0.88	0.47

	Farmer to Pharma		**Space Science**		**Energy**		**Global Change**		**Social Dynamics**	
	99–08	**09–18**	**99–08**	**09–18**	**99–08**	**09–18**	**99–08**	**09–18**	**99–08**	**09–18**
University of South Africa	0.19	0.50	0.54	0.79	0.30	0.60	0.14	0.63	0.67	1.69
University of Venda	1.48	1.74	0.46	0.56	2.12	0.62	1.93	1.91	1.16	0.20
University of Pretoria	1.13	1.26	1.07	1.03	0.53	1.03	1.21	1.07	0.55	0.95
University of the Western Cape	1.33	0.73	0.42	1.26	0.98	1.22	0.82	0.65	4.00	1.65
University of Zululand	0.57	1.03	1.18	0.75	0.00	0.36	1.19	0.82	0.00	0.25
Vaal University of Technology	0.66	0.85	1.35	2.22	0.00	2.74	0.59	1.43	0.00	0.31
University of the Witwatersrand	0.47	0.50	0.76	0.73	0.64	0.38	0.65	0.61	1.25	0.71
Walter Sisulu University	0.23	0.75	0.29	0.23	0.00	0.00	1.00	0.76	1.05	0.25

Note: The shaded areas show areas of relative specialisation.

Discussion

When evaluating the effect of the TYIP on the number of publications, it would seem that the TYIP has failed. Neither the identification of the Grand Challenges nor the bigger TYIP showed the desired effect of increasing the share of publications from South African authors to 1.5% of the world’s publications.

This section provides five possible reasons why the research output was not at the desired level, drawing from other examples in the published literature, in answer to the fourth question that this article addresses. For each possible reason, suggestions for future research are offered, as well as suggestions for policymakers.

The first possible reason why the research output was not at the desired level is that the funding provided to address these Grand Challenges was obscured by other funding opportunities. This argument is based on a study by Jacob and Lefgren (2011), who looked at successful and unsuccessful applicants for funding from the UK National Institute of Health (NIH). They concluded that the NIH funding resulted in a small increase in the productivity of successful applicants (as could be the case with the funding from the National Research Foundation). They speculated that unsuccessful applicants would seek, and likely find, funding from other sources, which would obscure the effects of the NIH funding. In the case of the TYIP, funding for research interests outside the Grand Challenges was available, and it could well be that these other funding agencies obscured the effects that the TYIP had. Future researchers could undertake a holistic examination of all funding sources available to South African researchers to determine which was most successful in changing the direction of research. This suggests that policymakers should acknowledge obscuration and provide clear direction to funders on the research priorities of the nation.

It could be that this study was premature. Defazio, Lockett, and Wright (2009) looked at the relationships between funding, collaboration, and research activity. Their research asked whether, if collaboration received preferential funding, this would result in higher output and greater collaboration. They found an increase in research productivity during the period of funding: the positive impact on collaboration was only seen after the funding period. Collaboration, in the post-funding period, was seen to have a positive effect on output. This study showed that funding could have an immediate direct effect on output, and a delayed, indirect effect through collaboration. In the case of the TYIP, the output from the funding could still be forthcoming in the next few years. In the case of Space Science, this would seem particularly likely. The National Research Foundation funded the construction of a giant radio telescope that will be a source of astronomical data for decades to come, and that thus forms the basis of many research outputs. Perhaps the analysis offered in this article can be repeated in a decade to reveal a more accurate picture of the impact of the investment. Policymakers should maintain a long-reaching vision in their policies.

A third consideration could be that South Africa's economy is not mature enough. Comparing African countries, Dragos and Dragos (2014) looked at the productivity and efficiency of research and development financing. Their research showed that there is a level of maturity that a country needs to achieve before it can claim a balance between productivity and efficiency. Regarding this point, Dragos and Dragos (2014) showed that South Africa far exceeds other African countries concerning productivity. This could imply that South Africa has reached the required level of maturity and that there is likely a relationship between funding and productivity. Furthermore, Dragos and Dragos (2014) did not explore the directionality of the relationship. Future researchers could explore whether or not higher productivity and efficiency attract more funders, or whether an increase in funding pushes researchers to produce more and to produce better. Policymakers should consider strategies that will push the maturity of the South African economy and create research policies that align accordingly.

Fourthly, it could even be that the funding directed at the Grand Challenges had the opposite of the desired effect, namely reducing the number of publications in certain areas. This contention could be explained by a study conducted in Italy, where a new policy was introduced in 2003 that led to the consolidation of research units (Coccia and Rolfo 2007). The policy intended to increase the productivity of the research units, but it had the opposite effect. The authors concluded that the creation of large research units reduced the flexibility that smaller units offered. Large research units require significant funds, while smaller units were able to produce research with little or no funds. Taking these learnings into the South African environment, perhaps the TYIP has had the unintended consequence of reducing research by attracting researchers to bigger, well-funded research units and away from smaller, flexible research teams. This is a topic that future researchers could address. Policymakers should bear in mind that their policies could have unintended consequences.

A fifth reason for the output addressing the Grand Challenges not having the desired effect is that perhaps the funding was not sufficient. Perhaps there is a critical mass that needs to be attained before the desired result will be visible. Pouris and Inglesi-Lotz (2014) showed that South Africa lags far behind other countries in terms of expenditure on research and development. Looking at the spread of research foci within institutions, one can see that the available funding might be spread too thinly. A key principle of the TYIP is that "investment into key research must be at a critical mass" (DST 2008, 5). In the *Department of Science and Technology Strategic Plan for the Fiscal Years 2011–2016*, the Minister of Science and Technology stated: "South Africa will be able to spend R45 billion on research and development by 2014 and reach its target for gross expenditure on research and development of 1.5% of GDP" (Pandor, in DST 2011, 2). In 2014, the nominal GDP for the country was R3.8 trillion (Stats SA 2014, 5), 1.5% of which would have been R57 billion. Actual spending on research and development in that year is reported to be R30 billion (World Bank 2019), or 0.08% of GDP. Over that period, R5 billion was channelled through the National Research Foundation towards the Grand Challenges.[1] Future researchers could compare the relationship between amounts of funding and the number of research outputs. Policymakers could provide more definite funding plans, rather than broad statements.

While there certainly could be more reasons behind the lack of success of the TYIP, these five reasons are offered as a starting point for future research and as input into future policies.

Conclusion

Ascribing the lack of desired output purely to the TYIP and its funding is too simplistic. There are many factors that could influence the productivity of researchers. Strategic direction and associated funding are just two possibilities. One must ask: What would the publication output have been in South Africa if there had been no funding allocated to the Grand Challenges? Would South Africa have fallen further behind in the identified missions? It is impossible to say, but this is worth considering before one dismisses the TYIP as a failure. Not all Grand Challenges showed slow growth in

1 Calculated by adding the figures reported in the annual reports of the National Research Foundation from 2009 to 2018, available from https://www.nrf.ac.za/information-resources/annual-performance-reports.

publication output. This growth could well be the result of the TYIP and its funding. The TYIP provides several other success measures. It would be a worthy exercise to evaluate the success of the TYIP based on those measures too.

Counting research output or the number of participating researchers does not give a full picture of the impact of research. It is too early to tell if the research produced in the previous ten years will have a lasting impact on the trajectory of science in South Africa, and for that matter on the socioeconomic situation of the nation. Future research should continue to monitor the impact of the research produced in this period, to further inform the DST regarding the effectiveness of the TYIP as a strategic tool. Greenhalgh et al. (2016) provide a narrative overview of a variety of research impact evaluation schemes, including the UK's Research Evaluation Framework. They show that there is no one-size-fits-all approach. It will be of interest to see what other evaluations are undertaken and how this contributes to the next plan of the DST.

There are two suggestions for examining the impact of research that could provide an entry point into this discussion for future researchers. Firstly, McNie, Parris, and Sarewitz (2016) provide a typology that researchers can use to unpack who might find value in a research project. Their paper gives a more nuanced perspective than the typical basic/applied dichotomy. Others evaluating the effectiveness of the TYIP could use the typology provided by McNie, Parris, and Sarewitz (2016) to qualitatively gauge the value offered by the research, which could further inform future policies. Secondly, Bhogal (2018) gives a very positive evaluation of the contribution of the Square Kilometre Array to the South African economy. The Square Kilometre Array was the destination for the majority of the funds earmarked for the Grand Challenges from the National Research Foundation. Despite South Africa not showing a specialisation in the area of Space Science, the funding towards this Grand Challenge has had a positive effect on the economy, according to Bhogal's findings.

The evaluation of research policies is a valuable exercise, which is all too often overlooked. Such evaluations keep the stated focus in check, allowing policymakers and researchers to work together towards a clear objective. Despite the apparent lack of success of the TYIP, this study illuminated several confounding issues, an investigation which will hopefully lead to better policies in future. In a time of limited resources and developmental challenges, it is vital to choose direction wisely, in a manner that will have the most significant impact, lest resources be wasted and the progress of research and societal growth be driven off course. The DST must continue to plan for the future, set goals, and encourage others to do the same.

Competing Interests

The author declares that she has no financial or personal relationship(s) that may have inappropriately influenced her in writing this article.

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