CHAPTER
3

The Republic of Science meets the Republics of Somewhere: Embedding scientific excellence in sub-Saharan Africa

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Introduction

Research excellence is often equated with publication in journals which have a high-impact factor. Yet ample evidence exists of distortions associated with defining research excellence solely in relation to publishing breakthrough research in high-impact journals. A recent study, conducted in the context of the African Science Granting Councils Initiative (SGCI), reviews the issue of research excellence in sub-Saharan Africa (SSA) and the need for an approach which expands the notion of excellence beyond publications altogether (Tijssen and Kraemer-Mbula 2018). The SGCI is a multi-funder initiative that aims to strengthen the capacities of science granting councils (SGCs) in SSA in the management of research, the design and monitoring of research programmes, knowledge exchange with the private sector, and partnerships between SGCs and other science system actors. SGCs[1] refer to science councils, research councils or agencies responsible for the funding and/or management of science and research in SSA.

The study by Tijssen and Kraemer-Mbula (2018) reveals that publications in high-impact-factor and influential journals are thought by many SSA actors to be important. However, in relation to defining

excellence in research, other factors were judged to be equally important. These factors include potentials for, or the ability to, generate significant societal impact, research relevance or research alignment with socio-economic objectives, the choice of indicators (or metrics) and the research criteria being evaluated.

A clear challenge is the need to construct measures of performance and evaluation which foster research that relates to social, economic and environmental challenges. Such measures of performance and evaluation must be aligned to national-level SGC attempts to build capacities and capabilities (AOSTI 2013; Chataway et al. 2017a), and knowledge (AAS 2018) that align with SGC missions [2] to contribute to national development agendas and science, technology and innovation (ST&I) policies in SSA (AUC 2014, 2015). At the same time, the Tijssen and Kraemer-Mbula (2018) study highlights a clear desire by researchers and funders to promote the production of rigorous and high-quality research.

The discussion about whether, given this complexity, conventional metrics (e.g. number of publications and ranking, or citations) should be used as the sole criterion for research evaluation is closely aligned to a broader discussion of whether academic peer review is an effective mechanism with which to judge academic research. Although metrics is often correlated with peer review, the two issues, although sometimes conflated, are not the same. They can also have quite different implications. One approach has been to treat them as a sort of trade-off between the autonomy and strength of the academic community. In this trade-off approach, the strength of the academic community, often operating at an international level, is at odds with the power of other actors, often local, to get their voices heard in relation to the quality and relevance of knowledge production. The two sides of the argument are referred to in the title of this chapter as the 'Republic of Science' and the 'Republics of Somewhere'.[3]

In this chapter, we explore the idea that the discussion does not necessarily have to hinge on that classical trade-off approach and narrative. Although more work needs to be done, the work of Tijssen and Kraemer-Mbula begins to demonstrate that often researchers and funders want to reconcile 'excellence' and 'relevance'. The underlying

tension then looks different. When the academic community and the SGCs that support them have insufficient autonomy and 'capital' in their national environments, they are limited in their capacity to embed their research effectively in addressing societal challenges. Looked at from this perspective, the issue of autonomy is related to the variety and strengths of 'capitals' and capabilities that SGCs, and the researchers which they support, can draw on in their role as national actors.

The Republic of Science: Autonomy and peer review

The following section of the chapter links debates around scientific autonomy and embeddedness or relevance to challenges facing SGCs.[4] As background to that section, it is useful to briefly reflect on publishing, peer review and definitions of 'excellence' (Benner 2011). The Republic of Science is a fascinating and powerfully argued essay authored in 1962 by Michael Polanyi. In the essay, Polanyi sets out arguments in favour of high degrees of autonomy and freedom in relation to governance structures for scientists and science-funding bodies. The influence of The Republic of Science notion of scientific excellence continues to influence modern debates in science and research. Under this notion of excellence, academic peer review is a key mechanism through which academic autonomy is exercised.

With respect to dealing with the undue influence of metrics and impact factors and the need to open up publishing options, the pressure to reform could be seen as one of reform of the Republic by its own citizens. In this formulation, academic peer review is retained as a key role and this ensures high degrees of autonomy. From this perspective, the Republic has become corrupted in a sense by the power exercised by particular publishing regimes and conventions. Reform does not necessarily signify revolution in relation to governance of the Republic and academic peer review can still be viewed as the bedrock for excellence, but within the context of a changed approach to the importance attached to impact factors. Many open science initiatives such as those hosted by F1000 and the African Academy of Sciences are examples of this reforming approach.

So, from this view, after reform of a publishing system gone awry, the autonomy of scientists to determine what is excellent can remain more or less intact. However, in this chapter, we focus on the related but different problems and tensions which arise in relation to securing mechanisms to ensure relevance and embed research excellence in national contexts, while protecting the autonomy of scientists. It is useful to separate out these two issues because with respect to increasing the immediate relevance of science, more radical reform of the Republic might be needed with 'non-scientists'; that is, non-academic, taking a greater role in the determination of excellence. For many scientists this is more challenging and in extreme forms can undermine the authority and autonomy of scientists. The following part of the chapter looks briefly at some of these debates and lays out particular ways in which The Republic of Science is challenged by national agendas or The Republics of Somewhere.[5]

The concluding part of the chapter develops some preliminary thinking about how research councils – namely SGCs, in the context of this chapter – can orient themselves in the context of needing to respond to the critiques of conventional assessment and its foundations, which are related to the 'Republic of Science' model of research. We outline some thinking, which underpins a notion of embedded excellence as an alternative to the notion of excellence based on publications, or on the distinction between applied and basic research. We suggest some practical ways in which that concept might guide the work of SGCs in SSA, but also of science councils elsewhere

SGCs: Between the Republic of Science and the Republics of Somewhere

An implication of the opening paragraphs of this chapter is that we might relate debates about the tensions between scientific autonomy on the one hand and relevance and embedded excellence on the other hand, in part at least, as an issue of national versus global and regional level decision-making authority. Viewed from this perspective, SGCs have a key role to play in resolving and negotiating different demands

made on science/research and researchers. This section explores the role of SGCs in more detail.

To reiterate, science granting councils (SGCs), as used in this chapter, refer to organisations that fund, direct or manage science and/or research in 15 countries in SSA. These countries are part of the Science Granting Councils Initiative (SGCI) set up and funded by Canada's International Development Research Centre (IDRC), the United Kingdom's (UK) Department for International Development (DFID) and South Africa's National Research Foundation (NRF) (Chataway et al. 2017a, 2019). The objective of the SGCI is to strengthen the SGCs' ability to manage, design and monitor research programmes; promote and support knowledge exchange with key ST&I stakeholders; and establish and foster partnerships among SGCs and ST&I stakeholders.

In order to carry out these activities, SGCs need to utilise robust ST&I indicators and metrics, and engage with ST&I ecosystem actors, comprising the private sector, funders, policy-makers and scientists or researchers. The need to engage with a wide range of actors highlights the issue of retaining autonomy for scientists, while relating to national policy agendas and national priorities. As mentioned earlier, Polanyi's 'The Republic of Science' is an impassioned plea for scientists to be given the freedom to determine research agendas and to judge scientific excellence (Polanyi 1962; Rip 1994; Flink and Kaldewey 2018; see also Bush 1945; Benner 2011). Over the decades, these ideas have been called into question from a number of angles and perspectives. These critiques point to the flaws in the classic 'autonomy framing' and the priority it gives to academic peer review. They also highlight the flaws in associated 'linear model' thinking. In relation to these arguments, various schools of thought associated with the nature of innovation systems and socio-technical systems have emerged. A recent debate in *The New Atlantis* provides powerful arguments against some of the fundamental constructs of the Republic of Science (Sarewitz 2017[6]) and, on the other hand, concern that the approach ignores the importance of serendipity in scientific findings and research (Curry 2017).

A group of research and innovation scholars have pointed to the gains for researchers and research funders that can come from defining themselves in relation to social contexts in which they exist.

These researchers and research funders can, in addition, promote overall visions for national and global sustainable development agendas that are more inclusive and do not exacerbate challenges such as inequality and environmental degradation (de Saille 2015; Arocena et al. 2018; Genus and Stirling 2018; Mazzucato 2018; Schot and Steinmueller 2018).

Very broadly, arguments against any notion of 'purity' in relation to the Republic of Science norms and governance structures calls for university researchers, and the SGCs which support them, to embed themselves as engaged actors working directly and closely with others in the interests of social and economic development. Research funders must enable this embeddedness (AAS 2018; Arocena et al. 2018). These perspectives coincide with critical assessments of the power relations embedded in high degrees of scientific autonomy. Science, technology and society (STS) scholars such as Andrew Stirling and Brian Wynne have analysed the power structures related to autonomy from the perspective of the privileged position that it gives scientists and a scientific elite (Stirling 2007, 2014; Wynne 2007, 2010).

Whilst the case against an ivory tower mentality is extremely strong, critics often ignore important political economy dimensions in debates about scientific autonomy. Whereas STS arguments pertain to the issue of autonomy and control in relation to scientists, there are other facets to the various framings and complex debates around scientific autonomy that are too easily ignored. The issue of autonomy for scientists is often treated as one in which, in the interests of efficacy and justice in science funding, influential academic knowledge-producing actors need to acknowledge the credibility and legitimacy of others.

However, whilst the Republic of Science portrays a world dominated by merit and reason, academic knowledge producers do not share power equally. Rather than one pure Republic of Science, which those striving for relevance have to reign in, the view from low- and middle-income countries (LMICs) national-level research environments is often that it is the lack of effective autonomy for researchers and SGCs aiming to fund academic research at national level which inhibits productive engagement.[7] International research collaborations and international funders, looking for high-profile research publications relating to the

scientific frontier, skew prioritisation (Chataway et al. 2019). Rather than a straight trade-off between a cohesive collective of scientists on the one hand and policy-makers on the other hand, the issue of autonomy from this perspective relates to the degree of space that national-level actors have.

For example, in our recent study of SGCs, interviewees from SGCs and researchers themselves framed the issue of autonomy in different ways. In one framing, lack of political and economic space and resources was seen by a number of interviewees in different East African countries as a problem for national science funders (Chataway et al. 2019) who have fragile and compromised capacities to define agendas, which are truly in the public interest in SSA countries. Lack of various sorts of capital (social, political and economic) can inhibit effective operation and engagement between scientists and broader society at the national level. Low levels of political, economic and social capital and space for autonomy limits the extent to which scientists and science funders can engage effectively with policy-making communities and with international counterparts.

The problem of retaining capabilities to make local decisions about science, based on the relevance of expertise generated, is therefore partly to do with an ability to resist 'capture' by international conventions and establishments (Tilley 2011; Beigel 2013; Roy 2018). A recent article in *Nature* (Nordling 2018) discusses some of these issues in relation to the decolonisation of education, curriculum and research, using South Africa as the illustrative case. An evaluation of European Commission funding for research and development (R&D) for Poverty-Related and Neglected Diseases (PRND) revealed a widespread feeling amongst researchers that research conducted by international partnerships was often based on targets and priorities that limit the extent to which such research impacted on healthcare research partners in LMICs (Cochrane et al. 2017). A study by Pouris (2017) seems to confirm this finding.

The issue of lack of autonomy runs deep and includes different capabilities and capacities in the production and use of ST&I data and indicators which would allow SGCs to argue their corner more effectively (Manyuchi and Mugabe 2018), determine the direction of science and research, and play a leadership role in setting research agendas in SSA.

There are of course numerous and well-known examples of the damage that can result from extreme cases where scientific agendas correspond more to national political power than to rigour and excellence. Strong arguments are made that while there may be different ways of configuring SGCs in relation to strategic autonomy (Cruz-Castro and Sanz-Menéndez 2018), operational autonomy must be protected in more absolute terms.

Another dimension to the need for a degree of autonomy may rest on the ability of SGCs in SSA or regional and international research funders[8] to promote alternatives to dominant scientific and innovation trajectories. Current initiatives relating to the momentum behind calls for research funding to support transformative innovation experiments and mission-oriented approaches (Schot and Torrens 2017; Mazzucato 2018; Schot and Steinmueller 2018) argue that leadership needs both to be demand and user-led, but also have the ability to break with convention and avoid capture either by existing powers or regime actors or by existing convention (Russell 2015).

Thus, the challenge of constructing research agendas in ways which serve social, economic and environmental agendas raises a multitude of interesting and important questions about the relationship and dynamics between researchers and funders in relation to embeddedness and autonomy (Evans 1995). In addition, it highlights the importance, in some contexts, that academics and other stakeholders have attached to autonomy (Algańaraz Soria 2013; Beigel 2013).

The preceding paragraphs indicate that actually there is not a simple trade-off between autonomy and the power of scientists on the one hand and relevance and embeddedness on the other hand. To be effective societal actors, academic researchers and the SGCs which support them need to engage, based on having political, economic and social capital and a degree of autonomy in national contexts.

What do SGCs and researchers need in order to fulfil multiple mandates?

The issues briefly addressed above warrant further discussions and deeper thought. But we suggest that the issues have some immediate

and practical upshots for SGCs. As outlined above, there are dual needs to embed research in society and to build and retain a political space and economic recourse to secure a degree of independence, authority and the ability to foster knowledge that is truly relevant (Chataway et al. 2017a). We have made the argument that making progress in navigating this terrain is best not viewed as a straight trade-off in power between academics and non-academics, but as a more complicated acknowledgement for engagement underpinned by a variety of 'capitals' in relation to SGCs and academics, which underpin effective interaction. Power struggles within the Republic of Science may be as important in this regard as power relations between academic and non-academic actors.

National-level SGCs need the space and resources to foster research that engages local communities in multiple ways which embed science, research and innovation in the realities of local contexts (AAS 2018), while, at the same time, retaining autonomy to ensure scientific rigour, excellence and relevance in research practice (Russell 2015) and policy directions (Daniels 2017). This need is clearly articulated by SGCs and researchers in the study carried out by Tijssen and Kraemer-Mbula (2018) and similar findings in Chataway et al. (2017a and 2019).

Thus, a primary role of SGCs will remain in organising peer and expert reviews of research. Establishing operational autonomy to oversee the peer and expert reviews of research is widely seen as important in ensuring quality and rigour. In this, the legacy of Republic of Science thinking remains. Nevertheless, demands for broader indicators of excellence, so that the value of researcher, in relation to wide-ranging goals of fostering development of the research environment and in relation to the need for science and research to address societal challenges, also needs to be respected at national level.

The take-away from this first part of the chapter is that across contexts and different organisational and institutional set-ups (Cruz-Castro and Sanz-Menéndez 2018), SGCs are involved in a dual and ongoing process to establish in varying degrees their own operational and strategic autonomy on the one hand, and on the other hand, to embed themselves in broader policy processes and societal processes and narratives. This duality, and the multiple mandates that Kruss

and colleagues (Kruss et al. 2016a) have written about, is reflected in the way in which SGCs support and evaluate research.

To be effective, SGCs require vision, alliances (social capital), economic resources (economic capital) and political support (political capital). The African Union (AU), the AU Development Agency (AUDA) (formerly NEPAD, New Partnership for Africa's Development) and initiatives such as the SGCI are working in a range of ways to support SGCs as they navigate this difficult terrain and forge new ways of working. One clear implication is that national science and research funders, such as the government, need to find ways to articulate their needs in relation to international funding. This is a crucial area and one that warrants more attention and further policy analysis and research (AAS 2018).

In many respects this conundrum is not new. However, changes in the framing of science and research policies and accompanying funding mean that researchers and the SGCs that fund them are looking for new ways to construct that balance. Since the 1990s, innovation systems have heavily influenced science policy and done much to highlight the wide variety of institutions, organisations and intermediaries necessary to relate research to science. There are now growing demands that policy bodies and funders pay more attention to the direction of research so that it contributes in broader ways to social and environmental goals and economic well-being, as well as more conventional industrial connections (Stirling, 2007, 2014; Schot and Steinmueller, 2018).

One way to achieve this goal of ensuring that science and research address societal challenges could be through the inclusion of those traditionally considered to be 'non-scientists', for example, civil society groups and the private sector, in the formulation and implementation of relevant science and research projects. A broader group is also essential to achieving national innovation and development agendas (Daniels et al. 2017). Although the involvement of other groups in innovation, development and policy processes raises additional capacity, coordination, management and various other challenges for SGCs, this approach provides one avenue to addressing the complaints raised around the (mis)alignment of science and research to societal

challenges in SSA. In line with our previous argument, however, this combination of academic and non-academic perspectives needs to be based on genuine engagement and attempts to co-construct agendas.

This has led to SGCs in many countries, including Colombia, Finland, Sweden, Norway, Japan and South Africa amongst others, making decisions to better align their funding to a range of local social and environmental policies, as well as industrial and growth goals. In some cases, Sweden for example, funding for innovation-related research is now explicitly linked to the Sustainable Development Goals (SDGs), while Colombia has recently produced a post-conflict ST&I strategy, a Green Paper that focuses on the SDGs and Transformative Change, underpinned by innovation policy (Chataway et al. 2017b; Schot et al. 2017). In the UK, the impact component of the Research Excellence Framework (REF) requires academics to develop case studies showing how their research contributes to non-academic goals. Although this approach is not linked to predefined social goals, it institutionalises a demand for all research departments (although not every academic) to relate their work to addressing societal challenges more broadly. There may be lessons for SGCs in SSA to draw from the UK's REF approach.

The need to broaden our frames of reference for engagement between researchers and society is echoed in many quarters, including from those working within innovation systems schools of thought that have previously focused on economic growth and links between industry and university (Fagerberg 2018). Lundvall (2007) highlights the fact that innovation systems approaches have been more useful for explaining the evolution of innovation systems than system building because of the largely unplanned and spontaneous nature of system evolution. Lundvall's argument stresses the reality of difficult living conditions in low-income countries which constrain people's ability and willingness to engage in work-based learning and participate in formal innovation processes. Against this backdrop, an obvious policy strategy is to target the wider context of the innovation system in such a way as to reduce these difficulties by, for example, enhancing stability, basic living conditions and access to basic services. This needs to be done in tandem with more conventional efforts to enhance scientific and technological capabilities, as well as institutional and

organisational capabilities. SGCs in SSA can potentially play important roles in forging links across policy domains.

The following section considers some new approaches being implemented by SGCs in fostering new ways of connecting science and research to addressing societal goals, and connecting researchers to the broader society.

Navigating Republics and embedding excellence

One way in which research funders and researchers have sought to fund research relevant to local contexts is to fund 'applied science'. In the political economy study that the SPRU/ACTS team carried out, applied science emerges as a priority for all SGCs in case study countries (Chataway et al. 2017a). What was less clear is what was meant by applied science and how applied research was differentiated from basic science. This lack of clarity was compounded by the fact that public sector funding for applied work did not seem to be related to networks including private sector or civil society actors. As far as our evidence allowed us to judge, there seemed to be very few instances of applied funding. This begs the question, 'applied to what?'.

More broadly, questions about the usefulness and legitimacy of the distinction between applied and basic science have been raised by science policy analysts for some time (Calvert 2006; Narayanamurti and Odumosu 2016). Calvert (2006) for example suggests that the categories are used in fairly random ways as devices to generate support for particular initiatives. Narayanamurti and Odumosu (2016) on the other hand, writing in the context of the United States of America, argue that separating science into the two broad categories of 'basic' and 'applied' is a false distinction, and that this distinction limits science/research and hinders policy.

For SGCs, it could be useful to view the underlying need to support relevant research from a process and capabilities standpoint. Rather than providing support to a category of research labelled as applied, SGCs need to support a range of capabilities that will enhance capacities to generate and diffuse socially relevant science and research. Capabilities are also essential if SGCs are going to get

better at conceptualising science, research and innovation in ways that ensure embeddedness or relevance, and shape key policy directions in Africa (AOSTI 2013; Daniels 2017).

To be effective, these capability-building efforts need to be related to research supported by stakeholder engagement exercises. This perspective highlights the importance of achieving relevance by means of different stakeholders being able to engage in a process around collective development of science and research agendas, broad-based consultations during research, and potentially carrying out research jointly; that is, involving multiple stakeholders in an inter- or transdisciplinary manner. This generates different sorts of 'capital' in Bourdieu's terms (Russell 2015) and capabilities relating to identified objectives (Chataway et al. 2017b; Schot and Steinmueller 2018).

Whilst many would argue that it is critical for SGCs themselves to retain control over the review process and with regard to final decisions about how and what to fund, we stress the need for participation and broader stakeholder engagement. A variety of studies point to the value of having engagement in formulating and carrying out research based on the following criteria (Russell 2015):

- Normative (from a power and justice point of view, to encourage participation offers a chance for non-academics to engage with an area that they are funding through taxes);
- Instrumental (it is more likely that research will have societal relevance if it is based on the engagement of different actors); and
- Epistemological (the ability to create knowledge communities which are able to develop new pathways, and approaches to relate science and society are enhanced by new communities and ebb and flow in social capital).

So, an approach that recognises the importance of a range of different capacities and capabilities in order to achieve goals is necessary. This approach highlights the importance of funding not only discrete research projects, but also funding networking and engagement activities designed to facilitate conversations between researchers, government ministries, civil society actors, a range of private sector

bodies and civil society stakeholders. Responsive mode calls may not require these forms of engagement, but funding mechanisms that are designed to encourage research relevant to more immediate aims are likely to benefit from efforts to increase engagement. Engagement exercises can be in relation to particular challenges or broad issues and extend SGCs' remits beyond only academically valued research or boundaried public–private partnerships (PPPs) to a broader remit of supporting research and engagement activities (Palmberg and Schwaag Sherper 2017). This broader remit could improve the prospects of research that better contributes to addressing societal challenges and perhaps underpins broader approaches to thinking about excellence.

Engagement exercises and research based on stakeholder engagement can be used as part of inter- and transdisciplinary exercises in numerous ways. The following are a few examples:

- Exploration of ways to 'ground', contextualise and sense-make scientific research. For example, positive results from clinical trials to assess the effectiveness of antiretroviral drugs (ARVs) in preventing as well as treating HIV/Aids was received in radically different ways according to ability and desire to integrate new treatment options into existing treatment pathways and policies. An engagement exercise around the results helped clarify the implications of clinical trial results and define options for policy-makers and health systems decision-makers (Morgan Jones et al. 2014). This is just one example, but there are numerous others which might be proposed if SGCs design funding calls constructed to enable researchers to explore how best to make use of recent scientific developments. This type of approach is one way of aligning local research agendas with developments at the 'global frontier'. It does not of course overcome the issue of how local research spending can be skewed by international research funding patterns.
- Calls based on research partnerships and the co-creation of research are increasingly common. For example, (1) partnerships for vaccine development in relation to capacity building in health and innovation (Hanlin 2008); or (2) joint research chair

initiatives, in which the IDRC has ample experience and has collaborated with various actors in developing countries. In these examples, the partnerships, collaborations or research chair initiatives help to build capacity, focus on research which is relevant to the countries involved and foster development. These initiatives, which sometimes take the format of PPPs, are often thought of as useful ways across many contexts to link research and development (Hanlin 2008; see also Oyelaran-Oyeyinka et al. (2018) for a summary). However, evaluations often underscore the need for national public sector partners, including research partners, to have adequate resources, capabilities and capacities (Marjanovic et al. 2015; Eurodad 2018) and to be able to deploy their various 'capitals' with operational autonomy. Although there is not any clear evidence that PPPs always lead to good outcomes, the examples above highlight where good capacity-building outcomes have been achieved within specific contexts, resulting in strengthening of health systems.

In a number of contexts the SDGs have inspired or are being used to structure new approaches to science funding and support in national contexts. For example, drawing heavily on the work of the Transformative Innovation Policy Consortium (TIPC) (Chataway et al. 2017b; Schot et al. 2017), Colombia is proposing to restructure its science funding around transformative innovation (El Libro Verde 2018). Whether or not these initiatives prove successful will need to be monitored and evaluated, but they represent powerful examples of experiments in funding research, which drive science in particular directions based on assessment of social, environmental and economic needs.

The desire of academics to work on these types of embedded research approaches may well depend on the way their work is evaluated (Kruss et al. 2016b) and the impact that engaging in interdisciplinary and transdisciplinary work has on academic careers. This takes us back to questions about indicators and metrics and research evaluation, and directly to how different versions of excellence are valued (Wilsdon et al. 2005, 2015).

Concluding thoughts: New approaches for embedded excellence

This paper has looked at different dimensions of the debate over scientific autonomy and discussed the need for funding and supporting research, which both reflects a respect for scientific excellence and embeddedness (or relevance, quality). In achieving this excellence versus quality objective, there is the need to extend the definition of excellence in ways that embed research in social, political, economic and policy contexts. This notion of embeddedness therefore constitutes the key argument and contribution that this chapter seeks to make.

In developing this notion of embeddedness, we have discussed some of the 'capitals', capabilities and capacities needed to support the process of embedding excellence at the national level. This includes new national and international understandings of the ways in which different sorts of research agendas can create support and synergies with each other. In addition, we point out that realising the desired level of embeddedness will require the aligning and realigning of national and international science and research agendas and funding, across different sectors and systems of critical development importance.

Furthermore, we have argued that the process of embedding excellence requires expanding the criteria for assessing quality and for science and research to have direct relevance to pressing national-level social, economic and environmental and policy issues. In order to achieve this objective, SGCs will have to do a number of things, which includes: (a) take greater ownership of their science and research agendas; (b) exercise higher levels of autonomy in their activities and decision-making; and (c) design and implement science and research projects, and funding schemes, in ways that encourage the involvement of non-academic actors. In doing this, SGCs also have to accumulate and deploy their various sources of strength and capital to make sure that research is seen to be trustworthy (i.e. maintaining scientific rigour and excellence), while remaining relevant to societal goals and needs.

We have outlined some of the thinking which underpins the notion of embedded excellence as an alternative to the notion of excellence based on traditional indicators and metrics, such as publications, or the distinction between applied and basic research. In the later part of the chapter, we developed ideas on how SGCs, and research councils in general, can more strategically orient themselves in the context of the above critiques and apply some of the practical suggestions in the chapter. Finally, we provided some practical suggestions in which the concept of embedded excellence might guide the work of SGCs in SSA, but also science councils elsewhere.

Notes

1 For more on SGCs, see Chataway et al. (2017a) *Case Studies of the Political Economy of Science Granting Councils in SSA*. Available at: https://sgciafrica.org/en-za/resources/Resources/PoliticalEconomy.pdf and Chataway et al. (2019)
2 For the missions see: https://sgciafrica.org
3 This chapter builds on a study undertaken for SGCI on the Political Economy of SGCs in SSA (see Chataway et al. 2017, 2019).
4 Other chapters in this volume look in detail at the perverse consequences of journal impact factors; therefore we do not focus on those arguments here.
5 Ideas about science policy and David Goodhart's book *The Road to Somewhere* can be found here: http://tipconsortium.net/science-and-innovation-policy-as-though-somewhere-mattered/
6 Daniel Sarewitz (2017) Saving science: Science isn't self-correcting, it's self-destructing. To save the enterprise, scientists must come out of the lab and into the real world. *The New Atlantis*. https://www.thenewatlantis.com/publications/saving-science
7 In Caroline Wagner's terms as laid out in *The New Invisible College*, the calls for link and sink strategies whereby national level investment accompanies strategies aimed at international integration.
8 Regional funders are e.g. Alliance for Accelerating Excellence in Science in Africa (AESA), while international funders include the likes of the UK's Wellcome Trust and DFID, the Gates Foundation and World Bank (for more on this, see e.g. Chataway et al. 2018).

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