

The contract between science and society: A South African case study

Michael Kahn*

Centre for Research on Evaluation, Science and Technology, DST/NRF Centre of Excellence in Scientometrics and Science Policy, Stellenbosch University, Private Bag X1, Matieland 7602, South Africa

*Corresponding author. Email: mj Kahn@sun.ac.za

Abstract

The anchor concept of this article is the implicit or explicit social contract for science, and its interaction with research and innovation policy in a given system of innovation. This is a topic that has received considerable interest over recent years as innovation, often conflated with the term ‘science’ has become a buzzword in both the North and South. In order to interrogate the evolution of the social contract for science under conditions of politico-economic change, this contribution examines the case of South Africa in the transition from apartheid to a more inclusive constitutional democracy. The changing social contract is examined through an ideographic methodology conducted through structured interviews with insiders who shaped or implemented research and innovation policy from the 1990s going forward. This contribution extends the analysis of science policy; the process of formulating new policy; and its adoption, modification, and implementation.

Key words: science policy; social contract; innovation system; linear model; Big Science.

1. Introduction

The anchor concept of this article is the implicit or explicit social contract for science, and its interaction with research and innovation policy in a given system of innovation. This is a topic that has received considerable interest over recent years (see e.g. Gibbons 1999; Elzinga 2012). Innovation, often conflated with the term ‘science’, has become a buzzword in the industrialized ‘North’ (OECD 2015) and developing ‘South’ (African Union 2014).

After the Second World War, newly independent countries of the South inherited public research organizations (PROs) or producer-funded research organizations in health, agriculture, and mining. For some, the PRO firmament included industrial research and development organizations. In Africa, the Lagos Plan (OAU 1980) set out a bold role for government to use science and technology in building the fabric of the newly independent states. In the main, however, this did not come to pass as nationalism; neo-colonialism and cold war rivalries collided. The PROs and public universities could have formed the backbone of emergent systems of research and innovation, but through to the 1990s many of these vital organizations in Africa saw their budgets shrink, so that in some cases PROs were forced to resort to survivalist consulting and the sales of lines of artifacts. In other cases, structural adjustment saw higher education, and by implication research, given lower priority than primary education. Whatever the social contract for science might have been was frayed in the making.

In the final quarter of the twentieth century, many countries of the South—Brazil, Chile, India, Indonesia, and South Africa—underwent disruptions to their politico-economic fabric, and

adopted or intensified neo-liberalism. *Inter alia* the emphasis on ‘value for money’ impacted negatively on state funding for research and innovation. Then, in the first decade of the twenty-first century, deepening globalization and the commodity super cycle brought about something of a sea change, with many of these economies attaining high growth rates. Faced with increasing priorities for well-being, environmental sustainability, and durable economic growth, one might anticipate the research and innovation ecosystem to evolve, with new mechanisms for agenda setting, prioritization, and incentives. This evolution might be a consequence of changes in the social contract between science and society.

The object of study is the contract between science and society before, during, and after major politico-economic disruption, specifically the ending of apartheid in South Africa. This contribution extends the work of Kahn (2013) that used secondary sources to characterize the changing social contract for science across that disruption. It was argued that the social contract of the apartheid years and that of the present system bore significant continuities as well as some differences. That contribution drew on published documents as well as science, technology and innovation (STI) indicators.

This contribution seeks to verify the prior analysis by means of an empirical study employing constructivist methodology. This entailed structured interviews with insiders who shaped or implemented research and innovation policy from the 1990s going forward. Where personal interviews were impossible, an email questionnaire was disseminated. The constructivist methodology extends the “4th Generation Evaluation” approach of Guba and

Lincoln (1989). The author has prior experience of research and innovation policy both as insider and outsider, and is currently a wholly independent adviser.

This work extends the analysis of science policy; the process of formulating new policy; and its adoption, modification, and implementation. As such the work fills a gap in the understanding of the changes that the end of apartheid brought about in the governance, funding, and orientation of scientific research and the wider national system of innovation in South Africa. It extends the underdeveloped literature on the social contract in the South, as well as shedding light on policy formulation in times of rapid political change. Making the assumptions of the social contract explicit provides an analytic lens that might be applied in to understand and shape research and innovation policy in other developing countries.

The article is organized as follows. After this introduction, a two-part literature review is presented. The first part covers the idea of the social contract for science, and the second examines the case of South Africa. Next, are the research questions and methodology that is based on naturalistic inquiry. This forms the structure of the following section that presents the results of the interviews, organized according to the Guba and Lincoln approach, as a set of ‘claims, issues and concerns’. The final section provides concluding remarks and suggestions for future research.

The author has prior experience of South Africa’s research and innovation policy as insider and outsider, and is currently an independent adviser.

2. Literature review

The literature review has two parts. The first examines how the idea of a social contract for science has informed earlier research and innovation policy debates. The second investigates the social contract for science in South African science policy and practice.

2.1 The idea of a social contract for science

The notion of a social contract for science has been a central feature of debates around the funding and independence of science for the best part of a century. A useful starting point is Bernal (1939) who followed a Marxist approach to examine the social responsiveness of science. His later wartime work on operations research informed planning of the future welfare state of the UK. In the USA, Bush (1945) also drew on wartime experience, in his case to promote government investment in basic science as the font for industrial and economic growth, providing the genesis of what some term the ‘linear model’ of innovation. Bernal and Bush provide examples of instrumentalist approaches.

Next came Polanyi (1967: 54), who argued that ‘scientists, freely making their own choice of problems and pursuing them in the light of their own personal judgment are in fact cooperating as members of a closely-knit organisation,’ contributing to the debates between socialists and those calling for the ‘Open Society’. In his notion of the *Republic of Science*, coordination did not require top-down action, but came about through the spontaneous mutual adjustment necessary for the free exchange of information. The *Republic of Science* envisaged the free exchange of ideas—in effect knowledge for knowledge sake.

Then came the work of Singer et al. (1970), whose input to UNESCO policy for science and development gave rise to what became known as the *Sussex Manifesto*. This proposed radical changes in the institutional approach to science and its funding in both South

and North. The objective was to build capability, halt external brain drain, and restrict what was termed ‘internal brain drain’, the latter being the situation where scientists in the South worked on problems of interest to the North, with little direct impact on the South. The deficit meant that the South was unable to capitalize on the social role of science as a modernizing force (ibid: 8). Here too, the call for socially responsive science.

The *Sussex Manifesto* came from the Left, but also drew on the work of the OECD Committee for Science and Technology Policy (CSTP) in which Chris Freeman and Geoffrey Oldham, both later to be closely associated with the Sussex University Science Policy Research Unit (SPRU) participated. Soon thereafter came Lord Rothschild’s ‘customer-contractor’ principle that set out to ensure the accountability of publicly-funded science, noting that ‘However distinguished, intelligent and practical scientists may be, they cannot be so well-qualified to decide what the needs of the nation are, and their priorities, as those responsible for ensuring that those needs are met’ (HM Government 1971). Politicians, not scientists would decide.

Recent highly-cited papers on the social contract include Sarewitz (1996), Gibbons (1999), Lubchenco (1998), Jasanoff (2003), and Martin (2003), with others such as Rosenberg and Nelson (1995) treating the matter indirectly. Of these contributions, the idea of *Mode 2* knowledge production associated with Gibbons, founder of the Manchester University Institute for Policy Research in Engineering, Science and Technology (PREST), and consultant to OECD, has had a major influence on thinking about the social contract. In a best-selling book Gibbons had suggested that blue sky discipline-based science, *Mode 1* had given way to a new paradigm of socially- distributed, transdisciplinary, funder-driven, and application-oriented science, *Mode 2* (Gibbons et al. 1994; Nowotny et al. 2001). Nowotny et al. (2003) also refer to the societal distribution of the many, heterogeneous sites of knowledge production. Their analysis seeded a conflict between policy makers and civil servants on one side and researchers on the other. The former found a convenient fit between *Mode 2* and the precepts of *New Public Management* (Hood 1995) that was then in vogue; the latter reacted to the ‘imposition’ of *Mode 2* as an assault upon their academic freedom. The *Mode 2* viewpoint understands the science project to be socially embedded, and open to robust, transparent assessment, by peers and public alike. The practice of science had thereby to be re-thought.

The ideas embodied in *Mode 2* show a strong resonance with those springing from the innovation systems approach that began to emerge at various sites from the 1980s (see e.g. Lundvall 1985, Kline and Rosenberg 1986; Freeman 1987), eventually, and unsurprisingly receiving endorsement through OECD (1997). In this process, the formulation and emphasis of the innovation systems approach varied considerably. The prior association of the advocates of the innovation systems approach with the OECD Committee on Science and Technology Policy ensured a degree of commonality. Though lacking a prescriptive edge, the innovation systems approach gained traction as a way of understanding the complex, nonlinear, multi-actor interactions of the innovation process (Godin 2006).

In the USA, a number of influential voices joined the debate. Lubchenco (1998) called the community of scientists to account, urging a commitment to work on pressing societal problems in exchange for public funding. Guston (2000) followed with the riposte that the old contract of self-regulation and linear model thinking should be retired. A new science policy entailing ‘collaborative

assurance' was emerging to deal with the old problem of delegation, namely how the patrons of science could receive assurance that scientists were delivering. This harks back to the Rothschild principal-agent problem where the principal faces the dual issues of possible adverse selection and moral hazard. For Guston, the implications of the 1980 Bayh-Dole Act that provided personal financial incentives to scientist/inventors decisively broke the apparently disinterested stance that the linear model and previous social contract were predicated upon. Self-regulation and the linear model were now being replaced by the monitoring and incentive schemes that principal-agent theory demanded. Guston's 'new' science policy involves the use of monitoring and evaluation to gain the confidence of decision makers that scientific results are based on evidence, and not on ideology.

These swirling currents of thought fed into the World Conference on Science, whose *Bangalore Declaration* called for a multidisciplinary enterprise of science that would 'show a human face' with attention to 'inequalities, poverty, social injustice, inadequate health care and education and environmental degradation' (UNESCO 1999: 2). This amounted to a restatement of an inclusive agenda of science for development, redolent of the earlier *Sussex Manifesto*.

Next followed the 2002 World Summit on Sustainable Development hosted in Johannesburg, South Africa. In the run-up to the Summit (UNESCO 2002), South African policy analysts declared the need for a new social contract between science and society, for capacity-building to close the knowledge and technology divides, for increased interdisciplinary exchanges (a la *Mode 2*), and increased dialogue between scientists and policy makers. Yet the eventual *Johannesburg Declaration* and its associated Plan of Implementation made no mention of an explicit contract between science and society. Textual analysis of the *Johannesburg Declaration* identifies two main strands. The first strand was the exhortation to 'use modern technology to bring about development and make sure that there is technology transfer, human resource development, education and training to banish underdevelopment forever' (ibid: 3). The second was advocacy for the expert role of scientists and technologists—'Scientists must put the issues of biodiversity into understandable language for politicians to act on' (ibid: 92). As of September 2002, the world science community seemed to have reverted to the precepts of the *Republic of Science*: we know, and advise through our expert channels.

Elzinga (2012) identifies three different periods for science policy since the Second World War: legitimization; professionalization; and accountability, the latter coinciding with the rise of New Public Management. He explains the continuing role of policy in accounting for, and defending the funding of science for its expected public benefit within a given social, political, economic, and ideological context. His analysis thereby stands somewhat apart from those referred to above, where contextual dimensions and drivers are rarely mentioned.

The later debates miss the significance of two related drivers. First, the 2008 financial crisis that highlighted excess inequality and accountability, and secondly, the crisis of environmental sustainability and climate change. Both crises challenge the practice of research and innovation, and demand a reappraisal of the social contract. Krishna (2014) sees the emergence of a 'business as usual' social contract for science that mimics the market dominance of globalization, in tension with pressure to adopt and implement the Sustainable Development Goals with their more inclusive contract.

The emergence of a social contract that is fit for the Anthropocene era is the most pressing concern.

2.2 The case of South Africa

The first part of this review considers policy formulation for the state to be, and then by the subsequent democratic state.

The pre-1994 innovation system was of modest size, and attuned to the needs of the day, with a robust set of 'science councils', a set of PROs that were both generalist, for example, the CSIR and sector-specific, for example, the Agricultural Research Council. CSIR was, and is *primus inter pares*, being the largest such PRO on the African continent, with expertise ranging from missile technology, to environmental management, medical products, and policy research. According to Kaplan and De Wet (1994: ii) the national system of innovation (NSI) was notable for 'the separation of S&T in a highly fragmented system; user payments for benefits; and a very limited stakeholder representation'. With the installment of democratic governance, responsibility for science policy was vested in the Department of Arts, Culture, Science and Technology (DACST).

Post-1994 S&T policy drew on the work of the African National Congress Interim Science and Technology Group (ANC 1990, 1992), the stakeholder-based Science and Technology Initiative, and an externally-funded OECD style policy review (IDRC 1993). In a support study for the Science and Technology Initiative, Kaplan and De Wet (1994: iii) proposed that 'the role of government is to facilitate and not command' (ibid: iii). A future government Ministry would be supported by two statutory bodies: an expert National S&T Board and a stakeholder based National S&T Forum. IDRC (1993), as a reaction to perceived controls under apartheid, emphasized the importance of strengthening the Republic of Science.

These three processes set the scene for the construction of a Green Paper discussion document that was then followed by a White Paper (DACST 1996). Both of these processes enjoyed support from Canada's International Development Research Centre with a continuity of technical assistance in the person of Jim Mullin, a previous chairman of the OECD CSTP. The White Paper served as the touchstone for subsequent research and innovation policy development and analysis, having set out an agenda of change, starting with the premise that the innovation systems approach would ably serve the transformation agenda through policy that was socially responsive, enabling international competitiveness.

The nature of the social contract was implicit in the catholic definition that: 'a national system of innovation can be thought of as a set of functioning institutions, organisations and policies which interact constructively in the pursuit of a common set of social and economic goals and objectives' (ibid: 20). Most significantly, however, the White Paper promoted a science push model of development, stressing the importance of basic and applied research rather than technology development. The various recommendations of the White Paper took time to gain traction, with some recommendations still in early implementation stage fifteen years later.

Through the years of the Mandela Presidency, research and innovation policy formulation processes were consultative, as in the Green and White Papers, and the later Foresight Study. Thereafter, as the multifaceted DACST was split into the Department of Arts and Culture, and the Department of Science and Technology (DST), research and innovation policy formulation became internal to DST.

The new Department immediately launched the second major policy statement, the *National R&D Strategy* (DST 2002). This was based on a linear model heuristic, rather than the nonlinear

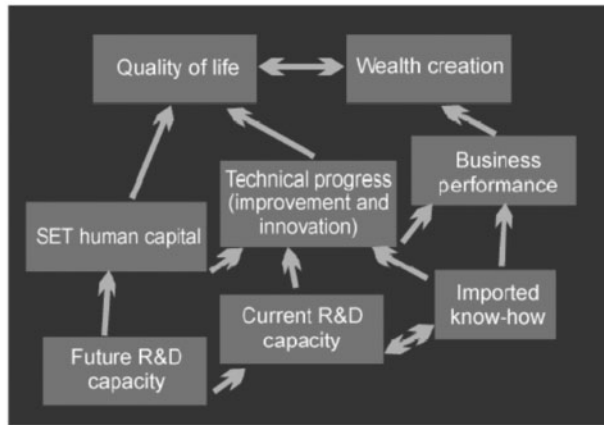


Figure 1. From capacity to outcomes—how R&D impacts economic growth & quality of life. *Source:* DST (2002).

innovation systems approach. The heuristic took the form of an elegant schematic (Fig. 1) that explained the contribution of R&D to socioeconomic change (DST 2002).

This heuristic is avowedly supply-side driven, placing R&D at the core of the NIS. Much as was stated in the White Paper definition of innovation, the logic is that R&D is the main driver of innovation. Accordingly, the R&D strategy represents a shift from the innovation systems approach of the White Paper to that of a research-led system. Anecdotal evidence is that CSIR assisted in developing the schematic using the ThinkTools™ application for which it held a licence. The heuristic is in keeping with CSIR's purpose as laid down in its founding Act, namely 'through directed and particularly multi-disciplinary research and technological innovation, to foster, in the national interest and in fields which in its opinion should receive preference, industrial and scientific development'.

Broadly speaking the *R&D Strategy* proposed five technology missions to fill the gap left by the downscaling of military R&D. These missions might be understood as giving expression to a new social contract, especially that expressed in the goal of Poverty Reduction with its focus on demonstration and diffusion of technologies to impact quality of life and enhance delivery (ibid: 42). The missions were to address what was termed the 'market principle' (presumably addressing research market failure) that was to be complemented by 'excellence' to grow the human resource base. It was argued that excellence might best be achieved by focusing on geographic advantage (skies, seas, flora etc.) and existing knowledge advantages in fields such as fluorine technology, encryption, deep mining, microsatellite engineering, infectious disease, and indigenous technology. So, on the one hand the public goods, on the other, excellence.

The third policy statement was the *Ten-Year Plan for Innovation 2008-2018* (DST 2008). That document reads more as vision statement than plan, being short on detail, indicative budgets, and mechanisms for implementation. In its own words, the *Plan* re-articulated the technology missions of the *R&D Strategy*. Moreover, it too follows with the linear model heuristic of the *R&D Strategy*. The *Ten-Year Plan for Innovation* did not signal a change in thinking concerning the social contract.

However, understood through semiotics, its influence has been far-ranging. Its precepts and targets have been adopted by other departments in the government Economic Cluster as well as in the

National Development Plan (Presidency 2012). It is in this latter document that the tensions around the social contract for science are exhibited most clearly. On one side is the statement that 'The best solution is for the state to play an active role both in funding and in guiding the type of research and development that the private and public sectors conduct' (ibid: 131) and on the other that 'The freedom of scientists to investigate and of entrepreneurs to innovate is critical' (ibid: 331). On the one hand *dirigisme*, and on the other *laissez faire*.

The 2009 General Election marked the first occasion that a Minister of Science and Technology was appointed from the ranks of the ruling party. The new Minister immediately appointed a committee to review the S&T landscape and charged its members (predominantly academics) to advise on the fitness of the innovation system to take the country forward. The most salient findings of the Review were the limited extent of buy-in of the innovation systems approach, the lack of mechanisms for agenda setting and prioritization, and inadequate policy learning. In particular, '... the state's investment in innovation has historically focused on 'big science', rather than sufficiently supporting the technological requirements of the business economy and social development priorities. Demand-pull approaches ... should be given as much attention as science supply-push approaches' (DST 2012: 10). The Review argued that: '... the most pressing matters concern the need for strengthened and coordinated governance at the highest level ... dramatically improved resourcing to critical mass directed at a limited number of priority areas' (ibid: 68) and concluded that 'the achievement of convergence, whether strongly-directed or indirectly encouraged ... is the greatest imperative for the NSI, and also the most challenging to achieve' (ibid: 84).

Turning now to the academic literature, a good starting point is the historical overview commissioned for the centenary of the Royal Society of South Africa (Brown 1977). Being an edited compilation it lacks an organizing philosophy, save for the assumption that scientific activity was exercised for the good of mankind, and that South Africa was possessed of unique geographic advantage. Perhaps the strongest statement of an underlying approach to public science was that of Meiring Naude and Brown (1977: 79) that 'Research cannot be dictated and organized from above; it must grow from within the organization.' This statement is the more remarkable since at that juncture Meiring-Naude, head of CSIR over 1952–71, was the scientific adviser to the hard-line Prime Minister, whose government was developing nuclear, chemical, and biological weapons. The Royal Society of South Africa *oeuvre* was essentially apolitical, and silent on the role of science in supporting the apartheid government, the exception being (Schaffer 1977: 372)—'only a minority group has been able to play a significant part' in the country's scientific development.

Thereafter, Saul Dubow is arguably the leading writer on the historiography of South African science. He offers a long perspective from colonial times through to the early 2000s describing the modernizing role of science in dominion nationalism that was expressed as 'South Africanism'. He notes that a key message of 'South Africanism' was the unique geographic advantage of the country whose earth, flora, fauna, skies, oceans, and first peoples offered a natural laboratory. Local scientists (mainly white males) studied these, taking for granted '... the superior attributes of western civilization, rationalism, and progress. Implicitly or explicitly, intellectual achievements were publicly celebrated in order to construct and defend an ethnically inclusive but racially exclusive white nation-state.

One may note that the southern geographic advantage is a strong feature of the *R&D Strategy*. Scientists played a strong role in maintaining and promoting minority rule and regional hegemony (Dubow 2006: 158) and it was hardly surprising that ideologists in the new South Africa were now reacting against this historical legacy' (idem: 277). Dubow, while expressing concerns that today's Africanism could turn inward, as Afrikanerdom had done six decades before, concluded with the opinion that 'the dominion of knowledge remains relatively open, globally oriented, and free for contestation' (ibid: 278).

Given the pivotal role that CSIR played in the NSI, reference must be made to Basson (1996) who provided a review marking the institution's fiftieth anniversary. This reveals CSIR's role as an incubator of technologies especially with military application, and as a nursery that spun out research divisions. CSIR was an effective agent for 'technology transfer' by way of adaptive development and organizational capacity-building.

By the mid-1980s, CSIR research productivity had stalled, and consultants were called in to re-engineer the organization, resulting in the shift from 'a university without students' to strategic business units. This reflects the inbuilt independence that CSIR enjoyed (and according to a key interview for this study) and continues to enjoy. The restructuring occurred as the 1990–4 political settlement took form and the 'transformed' CSIR was thus positioned to have a strong influence on science and technology policy in the new dispensation. Fact is that as co-chair of the Science and Technology Initiative, CSIR played a direct role in the discussions that shaped S&T policy for the government-in-waiting. It is reasonable to expect that some of its ideas would then shape the dialogue that later involved staff who moved between CSIR, DACST, and DST by way of a 'revolving door'. This cemented knowledge exchange between CSIR and DST that is today located in Building 57 on the CSIR Campus outside Pretoria.

Policy critique in the literature ranges from rationalist perspectives to Marxist structuralism. Kahn and Reddy (2001) cover the apartheid years and early stages of the democratic era noting the bifurcated system of the sanctions years: considerable effort went toward meeting the expressed needs of the apartheid government, which in return made resources available to foster the illusion of 'normal' science. They point to the danger of shifting too much attention to applied research that in their view would lead to a long-term decline of inventive capacity. A later contribution of Kahn (2006) suggested that apartheid acted as a constructed crisis that drove innovation for self-sufficiency. The imperatives of poverty and inclusion could in turn function as new constructed crises to shape research and innovation policy. In this context, Marais and Pienaar (2010) claim that post 1994, upstream R&D, as for example space science, is being favored relative to innovation for development, and that stronger control of PROs is being exerted. Without offering supporting evidence, they aver that 'the radical political change of 1994 impacted extensively on the STI system' (ibid: 105).

Mouton (2003), and then Sooryamoorthy (2010) consider the changing nature of science policy over three periods: colonial times to the advent of National Party rule in 1948, Nationalist party rule to 1994, and full democracy thereafter. Mouton refers to the first period as one during which amateur science became formally institutionalized, with the second dominated by massive spending on defense R&D, isolation of the country, and '... how scientists uncritically served the interest of the apartheid government ... for relevant and strategic research over the past three decades' (ibid:

244). To characterize the third period, Mouton sought for change in emphasis by locating the various financial instruments on two orthogonal axes—directed and competitive funding, and claims to detect a shift toward strategic research. He notes continuation of the historic autonomy of higher education, alongside stronger use of financial instruments to push public science toward more strategic goals and suggests that researchers were able to adapt to the new state imperatives by repackaging their activities. This suggests that high levels of autonomy that Mouton conflates with 'excellence', continued to prevail across the system even as the hand of the state was exercised in its demands for 'accountability', a proxy term for meeting the goals of government.

Sooryamoorthy (2010: 374) argues that 'Apartheid in more ways than one commanded the science and scientific system of the country' at least through to the late 1980s when a host of reforms gave greater autonomy to researchers. In his account, the (real or imagined) isolation of the apartheid years had a negative impact on international collaboration even while individual scientists and learned societies made it their business to work with, and admit whom they pleased. His narrative is somewhat inconsistent but it does point to a mix of state directed activities alongside a zone of independence. In his view isolation failed, and was unable to hold the country back, so that 'It steadily progressed along the scientific track' (ibid: 379).

Maharajh (2011) studied the political economy of the country over the period of a century: eighty years from the Union of 1910 to the crisis facing the successor Republic in 1980, followed by another eight much shorter periods to 2010. His Marxist analysis, arguably hinging on the base-superstructure construct, claims that an untransformed capitalist mode of production must need to reflect in an untransformed mode of scientific production. He argues that the science system of the democratic order, despite adoption of the innovation systems approach would display significant continuities with past practice, thus failing to meet the development objectives of the new government. Maharajh thereby echoes the findings of OECD (2007), a standard OECD Innovation Policy Review, premised upon a quite different philosophy, social democratic at best, and neo-liberal at worst, according to one's prejudice. OECD (2007) praised the resilience of the innovation system under transition, but warned that social exclusion and skills deficits posed threats to long-term stability. By implication, there was a widening gap in the social contract.

Pouris (2012) offers an uncritical appraisal of the impact of the Ten-Year Plan and associated interventions.

Kahn (2013) proposed the construct that science research policy reflects the underlying social contract for science, and argued that the social contract shifted from a mix of 'own' science and 'science for apartheid' to a new mix that promotes 'own' science and 'Big' science. Various policy instruments foster these two dimensions—the journal subsidy system, the academic rating system, the South African Research Chairs Initiative, and the Centres of Excellence and Centres of Competence programmes. 'Own' science was evidenced in the ability of the local Republic of Science to respond to the HIV pandemic.

'Big' science is demonstrated in projects such as the defunct Pebble Bed Modular Reactor and Joule electric car, and the international South African Large Telescope and the to be Square Kilometre Array radio telescope. The astronomy projects are examples of exploitation of geographic advantage; the former two represent failed attempts to capitalize on prior knowledge advantage. Neither survived the market principle.

Further evidence of the shift toward ‘own’ science is the increased proportion of expenditure on basic research, and funding for university research. Even so, the sentinel indicator of the ratio of Gross expenditure on Research and Development to GDP remains well below the 1.5 per cent targeted in the *Ten-Year Innovation Plan*.

With the exception of Kahn (2013), the literature makes no explicit reference to a social contract. However, the idea that the science system exhibited a duality is deeply embedded in the textual evidence. There is wide agreement that scientists enjoyed considerable freedom of action in their pursuit of excellence while others were engaged in supporting the cause of minority hegemony. Excellence exhibits a special form of path dependence, and is closely allied with exploitation of the southern geographic advantage, a theme that has been used to support the science endeavor for more than a century.

3. Methodology

The working hypothesis of the article is that the nature of the social contract for science will evidence in the choices of policy makers and the voice of organized science.

For South Africa, past and present, Kahn (2013) argued that documentary evidence and STI indicators suggested a social contract that combined the freedom to pursue own science alongside a strong component of state-directed science. The system ‘walked on two legs’. This amounts to continuity despite the (positive) disruption of abandoning apartheid and the opening up of the economy to all residents and the outside world. [The Two Legs metaphor is inspired by China’s historic ‘two legs’ approach that sought to balance basic and applied research.]

In order to test the Two Legs hypothesis, the constructivist evaluation methodology of Guba and Lincoln (1989) was adapted as a tool to analyze qualitative data. A short questionnaire of open-ended items was developed, and where possible was administered in a one-hour face-to-face interview.

Respondents were identified on the basis of their prior or present role in the formulation and implementation of science policy. Without exception those approached agreed to participate. The research was conducted over August to November 2015 and a total of thirteen persons were interviewed directly, with two respondents completing by email with telephonic follow-up.

The discipline background of the respondents was predominantly in the natural sciences and engineering (thirteen), with two from the social sciences and humanities, though some combined both disciplines. The system experience of the respondents was considerable, with eight having experience at the level of Deputy-Director General or higher, three having served as Deans or Deputy Vice Chancellors, two with experience as heads of PROs, and the remaining two being a senior academic and policy analyst.

The schedule posed five questions:

1. How would you characterize science policy pre-1994? Was there a social contract—implicit or explicit?
2. What were your expectations of science policy post 1994?
3. What is the nature of contemporary science policy; is there evidence of a social contract?
4. Who benefits/loses from current science policy and what are the reasons for such a benefit/exclusion?
5. What changes might be needed in science policy?

These questions arose from the structured analysis of Kahn (2013). At this point it is appropriate for the author to declare an interest, being both insider and outsider to the research and innovation system, having been involved in science policy formulation, implementation, monitoring, and evaluation over a quarter century, as activist, official, adviser, academic, and independent consultant. The author therefore took pains to avoid putting forth an opinion that could bias the conversation. The research project was entirely self-funded.

The responses to each question were transcribed during the interview. Per the method of Guba and Lincoln that tests emerging claims, issues, and concerns, the principal investigator is free to probe further, taking as much care as possible to avoid the introduction of personal bias. A claim is a positive statement; a concern is negative; whilst an issue is unresolved.

As the interviews unfolded, the principal investigator may feed in for discussion the views of prior respondents for testing. This iterative method allows the investigator to identify matters where there is convergence and that may thus be taken as representative of the relatively limited number of respondents. The analysis of the interview schedules thus follows a process of naturalistic inquiry—identification of common themes; testing the theme; fine-tuning the emergent theme; submitting the refined theme to a new respondent; and iterating toward saturation. The results are presented item by item, with claims appearing first, then the concerns, and finally the unresolved issues. Author comment is provided in square brackets.

4. Results

The working hypothesis of the article is that the nature of the social contract for science will evidence in the choices of policy makers and the voice of organized science.

4.1 The character of pre-1994 science policy and the social contract

The strongest level of agreement among the respondents was the Two Legs nature of the pre-1994 social contract. Comment was along the lines that the social contract of the time ‘promoted research and innovation that supported the strategic goals of the apartheid government’. There ‘was a high degree of coordination, but sufficient autonomy to pursue one’s own research agenda’. A minority view was that it was less a case of Two Legs, rather the pull of the ‘apartheid developmental state’ as ‘a pre-liberal modernizing agenda’ that drew science into its slipstream according to top-down directed research thrusts attained via state funding decisions.

Two respondents rejected the qualifier ‘social’, expressing the concern that this implied a commitment to the greater good. One of these rejected the entire idea of a contract since in their view scientists in both the East and West were constrained to withhold ‘truths’ and were denied the full fruits of the intellectual capital they created. Not only was there no ‘own science’ pre-1994, but Gibbons’ (1999) suggestion that there was a ‘stable, underlying agreement between its practitioners and society’ was rejected as baseless. Science was, and remains ‘a tool of the state’.

4.2 Expectations post 1994

A respondent provided the key insight regarding the future of the PROs, in the advice to Nelson Mandela, of Kenyan academic Prof Thomas Odhiambo, a member of the IDRC Review, to ‘keep your science system intact’. It was claimed that President Mandela heeded this advice, and he confirms as much in his foreword to IDRC

(1993: viii). The initial fear of retribution toward the PROs was rapidly dispelled to the extent that ‘scientists were surprised at our protection, investment and support’.

The expectations of respondents regarding the post-1994 dispensation were uniformly optimistic, with little reference made to the principles of the White Paper or any pre-1994 policy documents. The creation of the hybrid, standalone Ministry was viewed as a positive achievement, albeit seen by some as a ‘Cinderella’ organization that was under the sway of the opposition parties of the then Government of National Unity. There was unanimity that the new policies set out to promote inclusion, ‘to be open to all’, with ‘inclusive decision-making, evidence-based decision-making and coherence’. One respondent described the period as something of a golden age for the Rainbow Nation—described as the ‘rational policy window driven by technocrats before narrowly based interest groups congealed’. There was wide expectation that ‘all sectors would be mobilized’ and that a far-reaching size and shape exercise similar to that for the higher education sector would lead to significant change of the PROs as part of the stated agenda of ‘science for development’.

What then were the outcomes? One outcome was the emphasis on Big Science. This was mentioned by a number of respondents, with one highly influential respondent explaining that the new leadership sensed the opportunity that the Reconstruction and Development Program offered through its focus on infrastructure development. The new Department, capitalizing on public excitement at the impact of comet Shoemaker-Levy 9 shown live on TV via a link from the Hartebeespoort Radio Astronomy Observatory, duly motivated for its own infrastructure project, the South African Large Telescope (SALT), marking the onset of the Big Science basic research agenda. As a respondent argued: ‘focussing on applied science does not guarantee innovation – working on poverty and food security holds one to the old colonial agenda of exporting commodities for the benefit of the North’—hence go for basic research. For another respondent, it was clear that radio astronomy offered no developmental return, but its adoption was consistent with the ethos of the Mbeki years (1994–2008) ‘the man who could dream of the African Renaissance would also dream that Africa could do Big Science’. The hard questions posed by institutional restructuring were left alone as ‘it was easier to start new things like SALT’.

Furthermore, a strong theme was that while general ‘science policy was excellent, integration into industrial policy was not’.

One might note that but one respondent mentioned the HIV/AIDS pandemic and the irrational response of government, a response that began as early as 1997 when the ‘Virodene’ scandal engulfed the Mandela Cabinet. For that respondent, the HIV debacle amounted to the single largest failure of science policy.

These responses not only confirm, but also explain the implicit post-1994 social contract with its Two Legs—continuity of ‘own science’ and the onset of Big Science.

4.3 The current nature of science policy and the social contract

This question elicited a mixed response, with a division between those who felt there an actual social contract and those that did not. Even those who averred that a contract existed used terms such as ‘vague, patchy, sub optimal and weak’ to describe it. As one respondent averred, there was ‘something for everyone’, with an overall lack of critical mass, Big Science excepted.

A number of respondents claimed that there was an ongoing tension between science for science’ sake (for which read ‘own science’)

and science for development, with a senior figure in the PRO sector claiming that nothing had changed—science was free rather than directed. This stands in contradiction with a senior policy analyst view that nothing had changed—the system remained directed at state behest as, for example, Big Science.

Perhaps the most insightful comment came from a researcher/academic/public servant who noted that ‘the two legs have converged. Big Science and excellence are one and the same thing’, going on to express the concern that in effect, ‘alignment with national goals is coincidental rather than deliberate’. These insights are further confirmed through an observation that ‘science was not mentioned in the Reconstruction and Development Programme’. [This is not entirely correct since science was accorded six paragraphs in that policy statement, but these were very general and motivational, and made no specific recommendation save to establish a Ministers’ Council on Science and Technology. That body did come into being under the chairperson of Deputy President Mbeki but was terminated in 1999 when he assumed the Presidency.]

The re-emergence of techno-nationalism coupled with Africanism was also noted as a feature of the period 2004–9 when the leader of the Azanian Peoples Organization assumed to the Ministry. [This was expressed in the Department shifting into activist mode—seeking to revive human vaccine production, supporting knowledge intensive SMEs, and providing significant funds for beneficiation of platinum, fluorspar, and titanium. The activist mode gained momentum when CSIR was shifted from reporting to the Department of Trade and Industry to the Department of Science and Technology. It grew apace with the publication of the former Department’s Industrial Policy Action Plan with its scattergun approach of something for everyone. The Department of Science and Technology duly seized the gap with CSIR as its vanguard.]

4.4 Who benefits and loses, and why?

This item elicited little in respect of benefits per se, possible benefits being outweighed by many concerns with respect to loss and losers.

It was widely argued that the main beneficiaries of the new policy dispensation were academic researchers who among other mechanisms enjoyed the support of the journal subsidy scheme, the National Research Foundation rating system, the South African Research Chairs Initiative and the Centres of Excellence programme. Essentially those positioned to lobby had benefited and were able to improve their own positions substantially. The PROs had enjoyed some benefit but not as much as the universities with the result that in order to balance their books they had been pushed into short-term contract and consultancy work.

The negative concerns included poor South African performance on innovation scoreboards, the perceived absence of an inclusive innovation agenda, a generally dysfunctional education system (pockets of excellence notwithstanding), lack of coherence at the topmost level of government, all coupled with uncritical adoption of foreign science policy instruments. In effect ‘society was the loser’, the more so as there had been system capture—‘we thought we were building the engine room of a developmental state, but instead have a state driven by interest groups for which science offers no obvious benefit’. This allowed interest groups *within* the science community to advance their narrow causes. Worse still was a lack of direction so that a widely valued initiative such as the Technological Human Resources for Innovation Program was terminated despite receiving a positive summative evaluation. ‘This suggests the lack of a social contract.’

4.5 What might change and how?

This item was designed as open-ended, and it certainly achieved that objective, with a very wide range of suggestions coming forward. There was convergence that the most promising way to strengthen delivery and alignment would be through the implementation of the science and innovation rich National Development Plan. [The Plan pivots on the building of a competent, capable state and the deepening of social capital, both of which are supported by the respondents.] One may note, however, that little in the way of Plan implementation has occurred five years down the line. A second convergence among respondents was the need for mechanisms to specify demand, to foster cooperation, and to promote policy learning.

Support for the social was counterbalanced by equally strong advocacy that ‘elitism must be maintained for excellence’. For a number of respondents this was why the astronomy and palaeontology thrusts were so important and deserving of support. The thrusts provided ‘focus’ and ‘utilize the southern geographic advantage’. As one respondent argued to justify Big Science, ‘even if we are spread too thin there will always be a benefit’.

5. Synthesis and directions for future research

This article has reported on the testing of the working hypothesis that the idea of a contract between science and society is a useful tool for exploring the nature of science policy. The voices present among the interviewees essentially confirm the Two Legs hypothesis. In the apartheid era the Legs were ‘own science’ and ‘science for warfare’, while in the present dispensation the Legs are ‘own science’ and state-driven ‘Big Science’, both of which center on basic research. The intent to promote science for social development, what might be termed ‘welfare science’, has gained little traction. These developments are captured in the schematic (Fig. 2) below.

This quadrant schematic places *dirigisme* and *laissez faire* on the horizontal axis; the vertical axis is time based, commencing at the bottom with the 1910 Union of South Africa, after which came the Christian National Socialism of the post-1948 apartheid government. The year 1994 saw the onset of constitutional democracy that is now under contestation as an assertive African Nationalism has taken form. The four quadrants summarize the dominant nature of the polity and economy seen from the perspective of *dirigisme* or *laissez faire*. The main aspect of the science–society contract is placed in each quadrant. Own science, the essence of Polanyi’s Republic survives, and indeed prospers. It serves itself and society at large when it is called so to do, as in rising to the challenge of infectious disease.

This naturalistic inquiry provides support for the claim that there was a dual agenda before 1994. Post-1994 was period of good intent and lofty goals that in the mix of financial realities and competing interest groups saw the continuation, if not strengthening of the ‘own science’ agenda, with Big Science capturing the space vacated by military-oriented R&D. This capture, by official scientists was as much opportunistic as a consequence of the long belief in the exceptionalism bestowed by the southern geographic advantage. The comment that ‘the two legs have merged’ thereby gains credence.

What comes through from the primary research is that the nature of the social contract is a useful analytical device. Its nature is consistent with cross-government fragmentation and scattergun attempts to placate constituency groups. So, for example, the selection of Research Chairs and the focus of the Centres of Excellence is

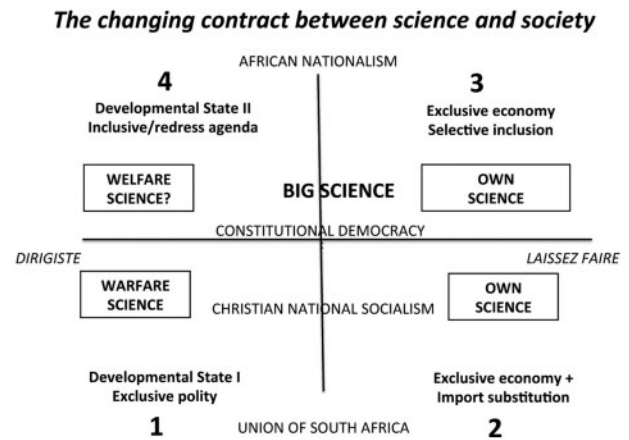


Figure 2. The changing contract between science and society.

a mix of top-down and bottom-up choice, with the latter in the ascendant. To repeat, there is something for everyone.

At the same time, one must address the question of the social benefit of the above science activity. It might be averred that addressing social deficit is hardly a matter for basic research. Ensuring the provision of potable water, primary health care, acceptable education, and environmentally-appropriate housing do not entail rocket science. Failure in these domains is more a poverty of politics than a poverty of technology.

This negative criticism misses the point that the local Republic of Science has prospered and pays its social dues. How so? The most obvious was its response to the HIV pandemic, where despite the active denialism of government, the Republic [somewhat quietly] got on with the task of understanding the aetiology of the disease, seeking robust interventions, and thereby serving the community.

The second ‘service’ activity is the ongoing provision of sound advice to government, both on request, and self-initiated on issues as varied as energy mix, environmental impact, and the dissemination of genetically modified organisms, and food security and safety. These interventions speak eloquently to responsible research and innovation. These activities have allowed the research and innovation system to maintain its world standing. In certain fields such as infectious disease and mathematics, her scientific production is above the world average in terms of intensity and impact.

In parallel, as part of its commitment to, and in recognition of its leadership role on the African continent, South Africa has by design or default seen its approach to science policy being exported, first into the Southern African Development Community, and then into the African Union via the New Partnership for Africa’s Development. What indeed does it mean for policy to be exported beyond the context, if not contract within which it has developed? South Africa’s export to Africa is not science for development but has taken on the form of Big Science, through drawing in the science communities of far-flung nations to allow for long-baseline radio astronomy as a pre-cursor to the Square Kilometre Array. Big Science is seductive, much as rock stars and athletic prowess serve as distractions from the stress of everyday life. Exactly how and when Big Science can pay an innovation dividend is as much an unknown as the unknowns that Big Science seeks to provide answers to.

Big Science has found a resonance in many African countries, a situation that is encouraged both by the associated prestige, and the fact that basic research predominates across most of the continent’s innovation systems. It is for this reason that foregrounding the implied

social contract is a useful, and perhaps delicate task for the policy formulator and analyst. Whose interests are served by the emphasis on basic research? Does this emphasis imply an ongoing disconnect between research activity, and industry and community need?

Making the assumptions of the social contract explicit provides a lens that might be applied in developing economies as they seek to shape appropriate research and innovation policy. This is especially needed where resources are constrained, as in many African countries.

Joining the Big Science bandwagon brings the benefit of 'feel good' through the possibility of working with the community active in frontier science. How such activity would address the needs of emergent industry or social disparities is yet to be explained. One fears that a trickle-down mechanism is implicitly at play. Explicating the implied social contract might just force this issue into the open.

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