

Measurement of innovation in South Africa: An analysis of survey metrics and recommendations

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The National System of Innovation (NSI) is an important construct in South Africa's policy discourse as illustrated in key national planning initiatives, such as the National Development Plan. The country's capacity to innovate is linked to the prospects for industrial development leading to social and economic growth. Proper measurement of innovation activity is therefore crucial for policymaking. In this study, a constructive analytical critique of the innovation surveys that are conducted in South Africa is presented, the case for broadening current perspectives of innovation in the national policy discourse is reinforced, the significance of a broad perspective of innovation is demonstrated and new metrics for use in the measurement of the performance of the NSI are proposed. Current NSI survey instruments lack definition of non-technological innovation. They emphasise inputs rather than outputs, lack regional and sectoral analyses, give limited attention to innovation diffusion and are susceptible to respondent interpretation. Furthermore, there are gaps regarding the wider conditions of innovation and system linkages and learning. In order to obtain a comprehensive assessment of innovation in South Africa, there is a need to sharpen the metrics for measuring non-technological innovation and to define, account for and accurately measure the 'hidden' innovations that drive the realisation of value in management, the arts, public service and society in general. The new proposed indicators, which are mostly focused on innovation outputs, can be used as a basis for plugging the gaps identified in the existing surveys.

Introduction

Various empirical studies conducted across the world in the past half-century suggest a high correlation between innovation, on one hand, and industrial competitiveness and economic growth, on the other.^{1,2} Through economic growth and its direct social impacts, innovation can be linked to improved quality of life as measured, for instance, by the Human Development Index.³ For this reason, innovation has become an important part of public policy in many countries, including South Africa.³ For the purpose of this discussion, innovation is:

*a process of generating, acquiring and applying knowledge for economically and socially beneficial purposes and takes place through efficient unfolding of various learning processes, rather than being determined by the mastery of science and technological knowledge.*⁴

In this broad sense, innovation can be regarded as the deployment of new value to society through the exercise of human ingenuity in any sphere of activity.

It is commonly accepted that innovation processes germinate and develop within what is referred to as innovation systems.⁵ These include private and public organisations and other actors that connect in various ways to bring together the technical, commercial and financial competencies and inputs required for innovation. It is on these systems that government innovation policies focus.⁶ Comprehensive country reviews on science, technology and innovation demonstrate that innovation is an important policy construct in South Africa.^{7,8}

The National Development Plan is the latest government programme of action to recognise the role of innovation in economic development.⁹ This plan, apart from pre-existing theoretical and practical justifications, provides a new impetus for a review of the National System of Innovation (NSI) indicators.

The purpose of this paper is to (1) present a constructive analytical critique of the innovation surveys that are conducted in South Africa; (2) reinforce the case for broadening current perspectives of innovation in the national policy discourse; (3) demonstrate the implications of a broad perspective of innovation; and accordingly, (4) propose new metrics for use in the measurement of the performance of the NSI.

This report is based on a qualitative study, conducted using an adaptation of the Delphi method, which was carried out in the following sequence:

1. Meeting of an expert panel to define the problem and map out the process and parameters
2. Analysing the national research and development (R&D) and innovation surveys that are currently carried out in South Africa
3. Critically assessing the metrics, methodologies and outcomes of the current national surveys that pertain to innovation
4. Proposing, based on the above analysis, a broader framework and appropriate metrics for conducting innovation surveys
5. Consolidating inputs from the expert panel

The expert panel provided inputs on an iterative basis, throughout the above stages, after which the final narrative was consolidated.

Measurement of performance of the National System of Innovation

Given the importance that is attached to innovation for a country's economic development, efforts are made in many countries to measure it. The results are used to inform government policy and funding for innovation. South Africa's National Advisory Council on Innovation (NACI) expresses the rationale for regular innovation surveys as follows:

Sound measurement of innovation is crucial in policy formulation and implementation, to monitoring spending in this regard, assessing the contribution of innovation to achieving social and economic objectives. Reporting on the measurement of innovation serves to legitimise public intervention by enhancing public accountability.¹⁰

Two major surveys are currently used to measure the performance of South Africa's NSI. These are the research and development (R&D) survey and the innovation survey. Both of these surveys are conducted by the Centre for Science, Technology and Innovation Indicators of the Human Sciences Research Council and commissioned by the Department of Science and Technology (DST).

DST is the national government department that is currently responsible for innovation policy in South Africa. R&D surveys have been conducted on an annual basis since the establishment of DST in 2002. The innovation survey is a more recent endeavour with its second report, which spans the period 2005–2008, only published in 2008.

The key indicators used in conducting the R&D and innovation surveys^{11,12} are shown in Table 1. The analysis and recommendations made in this report take into account the metrics, methodologies and outcomes of the two surveys mentioned above.

Gaps and shortcomings in current NSI surveys

Poor definition of non-technological innovation

The key indicators in the R&D survey have a clear focus on research and experimental development, which are some of the important input processes towards innovation. The R&D survey provides useful data both on the input and output metrics.

However, an analysis of the key indicators used in the innovation survey raises a concern that they lack clarity and focus. Under organisational innovation, the survey looked into the following dimensions:

- knowledge management systems to better use or exchange information
- major changes to the organisation of work
- external relations with other firms or public institutions¹²

The above indicators provide ample room for confusion because they don't make explicit the innovative aspects of the organisational change that result in value addition. Many organisational changes that are in line with the above may not be innovative at all. For instance, changes in the organisation of work bear no innovation import if they don't deliver value to the clients or the organisation. Furthermore, the organisational indicators outlined above may eschew other forms of non-technological innovations. These are outlined in detail elsewhere in this report.

Emphasis on inputs rather than outputs

The current surveys tend to focus on the inputs rather than the outputs of innovation. The R&D survey and the innovation survey provide fairly comprehensive sets of input factors, such as the level of public resources invested in innovation promotion. However, there are, by comparison, much fewer measures that address the social and economic outputs of innovation. A consequence of this imbalance is the inability of the surveys to provide definitive indications as to whether the investments that are being committed to innovation promotion are yielding the desired results.

Lack of regional and sectoral analysis

By definition, national surveys are meant to provide a country perspective on innovation. However, if the purpose is to provide a meaningful basis for economic and industrial policy, there is a need to provide a provincial or regional analysis in order to take account of local innovation and production systems. If, for an example, a particular trend emerges dominantly in the Western Cape, that result should not conceal the attributes of a Limpopo-based industrial sector which may be experiencing a diametrically opposite phenomenon owing to variant regional dynamics. A regional analysis is important for policy making in South Africa as there are strong geographical differences and inequalities. This level of analysis would enable better understanding of 'specific knowledge spill-overs that occur around certain firms, industries or institutions unique to that space'.¹³ The results of the surveys should be reported in a way that would enable provincial and local governments to derive policy implications for their respective regional economies. Furthermore, a geographical analysis of innovation is crucial to achieve a better understanding of innovation at the national level.¹⁴

Table 1: Key research and development (R&D) and innovation indicators used in current National System of Innovation surveys

R&D survey indicators	Innovation survey indicators
<ul style="list-style-type: none"> • Gross domestic expenditure on R&D (GERD) • Gross domestic product (GDP) at market prices • GERD as a percentage of GDP • Civil GERD as a percentage of GDP • Total R&D personnel (FTE) • Total researchers (FTE) • Total researchers per 1000 total employment (FTE) • Total R&D personnel per 1000 total employment (FTE) • Total researchers (headcount) • Female researchers as a percentage of total researchers 	<ul style="list-style-type: none"> • Rate of innovation • Characteristics of enterprises covered by the survey • Types of innovations • Product (goods or services) innovation • Process innovation • Innovation activities and expenditures • Financial support for innovation activities • Sources of information and cooperation for innovation activities • Cooperation partners for innovation activities • Effects of innovation • Factors hampering innovation activities • Intellectual property rights

FTE, full-time equivalent

Similarly, the survey data should provide a sectoral analysis that is based on the different industrial sectors of the economy. This level of analysis is useful for bringing out into the open trends and anomalies that may otherwise be concealed in aggregate figures.

The sectoral analysis would provide the key basis for a more nuanced, fact-based industrial policy. Sectoral innovation¹⁵ is an important conceptual framework for innovation activity that provides a multidimensional, integrated and dynamic view. The descriptions of methodologies in the reports of the surveys conducted by the Centre for Science, Technology and Innovation Indicators provide some provincial and sectoral data but these are not reflected in the published innovation survey reports. For this reason, the innovation survey data cannot be readily accessed by policy makers to inform plans and programmes in specific regions and sectors.

Limited attention to innovation diffusion

Like all other countries, South Africa's social and economic development depends on both local and imported innovations. The impact of those innovations is dependent on the extent of their diffusion across society and industry. Knowledge outputs such as patents that emanate from firms and research institutions might indicate the performance of the individual institutions. However, it is only through implementation that impact can be realised. A more realistic measure of the impact of those outputs on the economy is the extent to which they are dispersed in the relevant industrial and social sectors.

In view of this, it is necessary to measure the extent of diffusion of innovations within the NSI. The current surveys tend to concentrate on measuring technological development through the indicators that look at the different types of innovation outputs within an enterprise. These measures should be supplemented with indicators that provide an estimate of the extent of diffusion of the acquired or produced innovations.

A critical point that needs to be taken cognisance of is the strategic positioning of the country's innovation agenda. South Africa's capacity to be the prime mover at the cutting edge of innovation is limited to only a few areas of knowledge. In most cases, the country is well equipped to focus on attracting and adapting global knowledge to address local needs and conditions. Measures in this regard should then track the level of diffusion of the innovations through various entrepreneurial activities in the economy. The key issue therefore is to strike the right balance between using or attracting existing knowledge and innovations, adapting them to local contexts, on one hand, and pursuing focused research, including on frontier technology when appropriate, on the other.⁶

Respondent interpretation

Both the R&D and innovation surveys are based on the Organisation for Economic Cooperation and Development's framework and methodology.¹⁶ On the methodological aspect of the survey, it is standard procedure that questionnaires are mailed to the respondents. Proper attention is given to providing the necessary information in the instructions and telephonic support, if required.

The questionnaires also provide definitions of the various indicators that are being measured. However, in spite of all these efforts, the questions still leave too much room for the respondents to answer some key questions based on their own misconceptions. For example, when reporting, there may be variances among respondents as to the meaning of 'significant improvements' in relation to products or services.

The wider conditions for innovation

Each institution and organisation within the NSI does not exist in isolation. All the components are embedded in a broader social and economic environment that is subject to both local and international influences. An organisation's capacity to innovate is not only dependent on its internal competencies and circumstances, it is also dependent on the dynamic influences of the factors in the broader environment. Both the R&D and innovation surveys address the outputs and outcomes that were obtained within individual firms and institutions. They do not provide data about the broader conditions for innovation in the country. Government policy

has to concern itself with the aggregate social and economic factors that allow or limit innovation. It is essential to formulate evidence-based advice on the general environment in which innovation occurs.

With respect to the wider conditions of innovation, relevant data are available in various forms and reports that are produced by different public institutions such as Statistics SA, the Department of Trade and Industry (dti), the South African Revenue Service (SARS) and the South African Reserve Bank, among others. There is no need to proliferate indicators by instituting additional metrics when useful data are already available. In-depth analysis of relevant existing data, taking into account the R&D and innovation survey reports, should provide advice on the broader conditions of innovation.

Linkages and learning

The NSI is a nationwide network of diverse policies, institutions and organisations that work together in various ways to promote innovation. In essence, the NSI is more about the connections and linkages between its elements than it is about the individual entities.¹⁷ In order to measure the strength of the NSI and the time-series progression of its innovation capacity, it is necessary to focus on the linkages.

The target basis of measurement in current surveys is the individual organisation. The various data sets are then pooled into aggregates, according to the various metrics, to provide an aggregate national picture. It is not always possible to develop an accurate measure of innovation for a system in this way. A dynamic system, such as the NSI, is never a sum of its parts.¹⁷ There is a need to develop indicators that measure the quantity, quality and efficiency of the linkages and networks between the various elements of the NSI. This will contribute towards making better sense of the NSI as a dynamic whole.

An aspect that is closely linked to the discussion of networks and linkages is that of learning. The specific focus here is on technological learning. Marcelle¹⁸ provides a detailed description of how the technological capability building (TCB) approach can be applied at firm level in order to promote organisational learning and capability building. The TCB incorporates the various technical and non-technical components that are essential for sustained learning. The TCB approach can be adapted, using appropriate indicators, to measure the rate at which the NSI is progressing with respect to innovation.

Measurement of non-technological innovation

Traditionally, surveys of South Africa's NSI tended to focus on science and technology based innovation. The consequence of this was the exclusion of other forms of innovation that could also be contributing significantly to the country's economic and social development. The Organisation for Economic Cooperation and Development¹⁹ reports that in many countries there are firms that introduce new products and services without performing any R&D. It is reasonable to expect that the same holds true for South Africa. The recent efforts to broaden the definition of innovation in the innovation survey are therefore appropriate.

A study of the economic sectors in Table 2 suggests that the sectors that are major contributors to R&D, such as agriculture, mining and manufacturing, are relatively small.²⁰ These sectors also add up to a small percentage of South Africa's total productive economy. Sectors such as finance, real estate, business and government services are the more dominant components of the country's gross domestic product. The latter sectors do not innovate through R&D or in the manner that is anticipated by the existing innovation indicators.

South Africa's economy is replete with examples of innovations that do not follow the traditional R&D-based pathway. The innovations that led to the emergence of Capitec as a force in South Africa's banking sector may not have been captured by the current surveys. The introduction of new methods of registering for and paying out social services to the recipients that have been introduced by the South African Social Services Agency, is another example of an innovation that might fall through the cracks and left unaccounted for by the current innovation surveys. The same could be said of the methods that have been implemented by the South African Revenue Service (SARS) to optimise the recovery of taxes.

During the development of the cellular telephone industry, Vodacom introduced several non-technological innovations, some of which were world leaders.²¹ In the biodiversity sector, various innovations are being implemented to protect species from environmental and fabricated threats. It is possible that the current surveys fail to capture these innovations owing to the metrics definitions.

Table 2: South Africa's economic sectors

Seasonally adjusted and annualised quarterly value added (Q4 2011)		
Industry	Value added (ZAR billion, 2005 prices)	% Contribution to total GDP
Agriculture, forestry and fishing	40.528	2
Construction	58.599	3
Electricity, gas and water	34.734	2
Finance, real estate and business services	404.974	21
General government services	262.627	14
Manufacturing	289.294	15
Mining and quarrying	96.817	5
Personal services	104.676	5
Taxes less subsidies on products	205.653	11
Transport, storage and communication	174.621	9
Wholesale and retail trade, hotels and restaurants	239.367	13
GDP at market prices	1 911.890	100

In order to provide a more comprehensive analysis of the level of innovation within South Africa's NSI, it is recommended that surveys should expand their range of indicators to include other aspects of innovation. These aspects include organisational innovation, soft innovation²² and social innovation.

Organisational innovation

Although organisational innovation is included in the current surveys, there has not been a comprehensive analysis of its nature and contribution to South Africa's NSI. Under the current definition, any organisational restructuring process, including downsizing, could pass as organisational innovation. Case studies that reflect success stories of novel approaches would form a useful supplement to the reports in order to recognise and promote this type of innovation.

Soft innovation

Soft innovation²² is the type of innovation that takes place across all sectors of the economy. The arts and other creative industries, such as film and television, are driven by soft or 'artistic' innovation. These industries are major contributors to the country's formal and informal economy. Within the traditional R&D-based sectors, such as industrial manufacturing, soft innovation adds a lot of value in the form of product design, packaging and other aesthetic value additions. Soft innovation is likely to be missed by the current innovation metrics because it does not always constitute a new or significantly improved product. Yet, according to studies conducted in the United Kingdom,²² this type of innovation may add significant economic value to products and services. In this regard, a proper analysis of the contribution of the Design Institute, and similar initiatives, needs to be conducted.

The work conducted by the National Endowment for Science, Technology and the Arts (NESTA)²² with respect to soft innovation makes the following important points: Soft innovation is a concept that reflects aesthetic

changes; soft innovation and technological innovation are interrelated; only soft innovations with high market share are considered significant; non-traditional metrics are needed to measure soft innovation; there are high rates of soft innovation in the creative industries; soft innovation is significant outside the creative industries too; missing soft innovation gives a biased account of total innovation activity; intellectual property rights are an important area for policy; sub-optimal levels of soft innovation may justify government intervention; the commercial benefits of soft innovation may be high; government policy must embrace all innovation activities, not just technological or scientific.

The above findings concerning the role of soft innovation in the context of overall innovation activity within the economy hold true for South Africa's NSI.

Social innovation

In addition to the types of innovation discussed above, there is a further more encompassing form of innovation referred to in this report as social innovation. Social innovation is a value-adding outcome that emanates from a variety of ways that involve interactions between people. The above innovation types tend to focus on products and services. However, a deep analysis of South Africa's economic activity suggests that value can be created through the quality of human-to-human contact. While the nature of social innovation is difficult to define and measure, its social and economic impact is undoubted. It should therefore be reflected in the key metrics that are used to measure innovation activity within the NSI.

Figure 1 illustrates a comprehensive perspective of innovation that includes the types that are discussed in this report. It emphasises that the different types of innovation are not discreet but overlap and often complement one another in value creation.

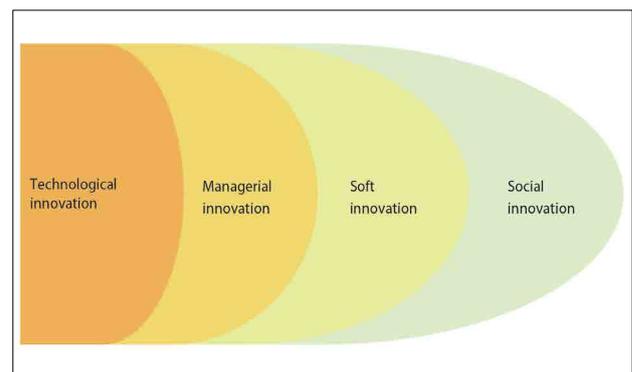


Figure 1: An illustration of the overlapping types of innovation.

In order to account for the full spectrum of the types of innovation that are active in the NSI, it is recommended that consideration be given to the following:

- All the above types of innovation must form a component of indicators of innovation within the NSI, in the longer term.
- Further work needs to be done in order to formulate rigorous definitions of soft and social innovation to build on the proposals presented in this work.
- There is a need to develop consensus around the meaning and application of social innovation in the South African context.
- Studies should be conducted to explore the dynamics of the interplay, if there is any, between technological and non-technological innovation.
- Appropriate indicators should be identified and used to measure the baseline and subsequent development trends for all types of innovation.
- The NSI indicators should adopt flexible and appropriate ways to report on innovation, including using non-quantitative reports, as necessary.

Proposed new indicators

A key message is that current surveys of the NSI do not cover the full spectrum of innovation activities that are important for South Africa's social and economic well-being. The above discussion outlines the various forms of innovation that have been missed by the R&D-based surveys that are currently in place. This report proposes a broader view of innovation that encompasses knowledge domains beyond science, engineering and technology. Furthermore, there is a need to focus more strongly on the innovation metrics on the demand-side of the economy, i.e. those that measure the actual uptake of knowledge-intensive factors, rather than merely measuring supply.

Four principles guide the approach adopted by this report in formulating its proposals:

- *Parsimony* – For practical reasons, it is absolutely important to limit the number of indicators. By their very nature, indicators are, at best, proxies that are used to draw credible conclusions about the behaviour of the NSI. For this reason, as few indicators as possible are selected to explain as much as possible about the NSI.
- *Complementarity* – The aim of this work is not to introduce a new regime of metrics of innovation. Instead, it is to identify gaps in the existing surveys and propose ways to fill them. The proposed indicators are meant to complement the R&D and innovation surveys. Similarly, the use of other appropriate national and international surveys that collect data that are applicable to innovation measurement are recommended.
- *Optimisation* – There are strong indications that where relevant data are available (see examples in Table 3), they are not always subjected to sufficient analysis in order to provide better understanding of innovation activities in the country. This report therefore calls for more diligence in the analysis of innovation-relevant data from all credible sources.
- *Output focus* – The new indicators that are proposed below aim to shift the focus of measurement towards innovation outputs. Input measurements are important to inform policy, for example, with regard to investment decisions. However, as discussed above, a healthy balance needs to be struck between input and output indicators.

Some of the indicators that are proposed below are drawn from a pilot study that was commissioned by the Cooperation Framework on Innovation Systems between Finland and South Africa (Cofisa)²³ while others are new conceptions that emerged from this study.

The proposed new indicators are organised around the five themes that are at the centre of innovation activity. These are:

- knowledge demand indicators
- knowledge mobilisation indicators
- knowledge application indicators
- knowledge flow indicators
- social impact indicators

Knowledge demand indicators

The focus here is on the actual knowledge that drives the economy. The indicators that are chosen address directly the attractors of skills in business and knowledge centres. These are the knowledge and technology intensity of manufactured goods, and the contribution of knowledge to the manufacturing trade balance.

Knowledge and technology intensity of manufactured goods

'Exports of knowledge intensive goods' is a meaningful indicator of the innovation capacity of a country. Such goods form an important component of the economy in that they provide local needs, thus substituting imports, and are able to compete successfully in the global market.

To measure the level of knowledge and technology input in the export products, international guidelines are used. The data are collected by SARS and reported by the dti. For further details, see Cofisa²³.

Contribution to the manufacturing trade balance

The sectoral trade balance indicates the structural strengths and weaknesses of the different sectors of an economy. It is measured relative to the performance of total manufacturing trade. A sectoral analysis of the trade balance is an incisive measure in that it can focus on priority industries. Their respective performances can be measured relative to overall manufacturing data, to indicate comparative performance, irrespective of whether aggregate manufacturing is growing or falling. The data are collected by SARS and reported by the dti.²³

Knowledge mobilisation indicators

Since the 1996 White Paper on Science and Technology, there has been a recognition that the growth of innovation in South Africa will depend on the continuous improvement of skills and education levels in the country. These indicators address not just the education levels in society but also the skills that are accessible for deployment in the economy. The key indicator here is participation in lifelong learning.

Participation in lifelong learning

The South African government recognises the importance of lifelong learning as a means towards social and economic development. This is evidenced by the provisions for work-based learning in the Skills Development Act and various other supporting institutions and instruments, such as the Sector Education and Training Authorities (SETAs) and the Skills Development Levy. Many employees use the tertiary education institutions to further their skills. Participation in lifelong learning is a good indicator of a knowledge economy that demands and promotes continuous knowledge and skills acquisition.

The annual General Household Survey that is conducted by Statistics South Africa can supply the baseline data required for individuals 20 years old and above. Employer-based reports, such as the skills development plans, as well as the reports of SETAs and other training authorities, can provide annual data that can be used to establish a baseline and thereafter track trends.

Knowledge application indicators

Current indicators tend to focus on the supply side of knowledge outputs. The indicators that are proposed under this heading complement this by looking at the knowledge outputs that are actually absorbed into the economy. These include the licensing of patents, and entrepreneurship

Licensing of patents

Patent output is used in current surveys as a proxy for knowledge intensity. It is proposed here that the licensing of patents and other intellectual property for industrial application is perhaps the more appropriate indicator. This is because it indicates the intellectual property that is actually engaged productively in the economy. This is in stark contrast to patents that are filed and never put to practical use.

Current R&D and innovation surveys can be used to collect data on patenting licensing. The patents involved here are those that are developed exclusively or jointly by South Africans. The data can be compared to the licensing information that can be supplied by the relevant patent offices.

Entrepreneurship (company registrations)

Enterprise creation is an important indicator of economic activity. A vibrant and growing knowledge economy will be reflected in the registration of new business ventures. Alternatively, the company de-registrations can, on aggregate, hint at a reduction of economic activity.

It is proposed that the registration of new companies with the Companies and Intellectual Property Commission, as a percentage of registered companies, can be used as an indicator of entrepreneurship and knowledge intensity. The data can be obtained from this commission.

This may require further development of registration categories in order to adequately inform innovation activity.

Knowledge flow indicators

The strength of the NSI is dependent on the extent to which knowledge flows and is converted into practical use within the networks of institutions and organisations. The diffusion of knowledge and innovation enables the widening of impacts to society. The indicator that provides an alternative approach to measure this aspect is innovation networks.

Innovation networks

The strength of an innovation system is dependent on the quality, quantity and efficiency of the flow of key information within the elements that make up the NSI. A disconnected system has a poor chance of developing. However, a vibrant and well-connected system, wherein all the components interdependently share and cooperate, is likely to result in an aggregate systemic increase in innovation intensity.

This indicator is an important missing link in the current surveys. Appropriate measures need to indicate the rate of change of connectivity within all the key players in the NSI. This could be done by determining the number and extent of partnerships, cooperative projects or joint ventures with other entities in the NSI. The degree of communication and networking could be measured through determining the number and sizes of knowledge-sharing networks an organisation is participating in. A higher weight should be given to partnerships and networks that involve different types of institutions. Regional innovation forums could be tasked with documenting local activity and providing indications of participation. This data could be obtained by adding the necessary questions in the current innovation survey.

Social impact indicators

An important argument made in this report is the need to extend the measurement of innovation activity to include areas of activity beyond the traditional R&D sectors. This category could also accommodate measures of innovation activity in the public sector,²⁴ as they are developed. In addition, there is a need to determine, with better accuracy, the social impact of innovation. The social impact indicators discussed are social cohesion, social impact innovations and innovations in the public sector.

Social cohesion

Social cohesion, particularly in a South African context, is difficult to define or measure. However, it is reasonable to accept that, depending on how it is used, an increase in innovation, and the benefits that accrue as a result, will manifest in social cohesion. This could be in the form of a more inclusive society, with low rates of income inequality, poverty and other social maladies and divides. Social cohesion, therefore, can be regarded as both an instrument and a goal for innovation policy.

Social impact of innovations

The ultimate measure of innovation impact is the rate of social development that accrues to society. Some innovations may provide direct social impact even when they may not be commercial successes, such as those that pertain to improved public service delivery. The innovations that have an economic impact may result in social benefits through improved wealth. Measures of social impact, such as the Human Development Index, may serve as an indicator of the knowledge intensity of the country. This indicator is currently being used although the focus is mostly on the ranking attained by the country, for instance in the indexes of the World Bank and the Institute for Management Development (IMD). While the

Table 3: Summary of proposed new innovation indicators

Category	Proposed indicator	Input/output	Primary/secondary	Data source
Knowledge demand	Knowledge and technology intensity of manufactured goods	Output	Primary	The dti; SARS
	Contribution to the manufacturing trade balance	Output	Primary	The dti; SARS
	Foreign student population in higher education	Output	Secondary	Higher Education Management Information System (HEMIS)
	Employment of tertiary level graduates	Output	Secondary	Stats SA
Knowledge mobilisation	Participation in lifelong learning	Input	Primary	Stats SA; SETAs; company HR data
	Education system resources	Input	Secondary	Education Management Information System (EMIS)
	Access to ICTs	Input	Secondary	Stats SA
Knowledge application	Licensing of patents	Output	Primary	Innovation surveys
	Entrepreneurship	Output	Primary	CIPC
	Economic impact of innovations	Output	Secondary	The dti; SARS; Stats SA
Knowledge flows	Foreign direct investment networks	Input	Secondary	SARS; Stats SA
	Innovation networks	Input and output	Primary	Adapted Innovation Survey
	International flows of human resources	Output	Secondary	DHA; company HR data
Social impact	Social cohesion	Input and output	Primary	Stats SA; other existing sources
	Social impact of innovations	Output	Primary	World Bank; IMD
	Innovation in the public sector	Input and output	Secondary	CPSI; Innovation Survey

comparisons may provide useful insights, the focus should be more on how and why the total score changes over time. This data should be complemented by identifying the quality and quantity of the innovations that impacted society. Broader social surveys among communities and individuals should elicit this data.

Innovation in the public sector

Government plays an important role in society in creating enabling policy environments for social and economic development as well as in rendering essential services. Government departments, other public institutions at national, provincial and local levels, have to adapt to increasing demands and strive to attain higher levels of efficiency. The public service should be encouraged to innovate in order to meet these challenges. The measurement of overall innovation activity in the country should take into account innovation in the public sector.

The key indicators of public sector innovation should include various innovation activities, as defined elsewhere in this report, as well as their contribution towards service delivery. The current innovation survey can be adapted, taking into account the proposals made here, in order to measure public sector innovation. This work could be done in association with the Centre for Public Service Innovation (CPSI) in order to provide a comprehensive view of innovation and its impact in the country.

Primary versus secondary indicators

In keeping with the need to keep the number of indicators to the minimum, the proposed indicators are divided into primary and secondary indicators (Table 3). The primary indicators will provide key data that will fill the gaps that exist in the current R&D and innovation surveys, as discussed in this report. The secondary indicators are regarded as important metrics to provide supporting data for a more comprehensive understanding of innovation activity in the country. It is recommended that a further process should unfold to refine this distinction.

The primary indicators that are proposed for immediate adoption are:

- knowledge and technology intensity of manufactured goods
- contribution to the manufacturing trade balance
- participation in lifelong learning
- licensing of patents
- entrepreneurship
- innovation networks
- social cohesion
- social impact of innovation

Conclusion

The R&D and innovation surveys that are currently conducted in South Africa provide necessary and important information about the growth and development of elements of the NSI. The data that they produce could be optimised through more rigorous analysis. Regional and sectoral analyses would provide important nuances that carry useful import for public policy at national, provincial and local government levels. The international benchmarks that are applied in the metrics and methodologies that are followed to conduct the studies permit useful comparisons to be made to continuously stretch development targets.

However, in order to get a comprehensive assessment of innovation in South Africa, there is a need to sharpen the metrics for measuring non-technological (e.g. the social impact indicators) innovation. The practice of innovation in the South African economy takes place well beyond the confines of science and technology, which have dominated the innovation policy discourse since the advent of the NSI. There is a need to define, account for and accurately measure the 'hidden' innovations that drive the realisation of value in management, the arts, public service and society in general.

The current innovation indicators need to be supplemented in keeping with the broader view of innovation presented here. The new proposed indicators, which are mostly focused on innovation outputs, can be used as a basis for plugging the gaps in existing surveys.

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