The Nexus between Public Service and Research, Development and Innovation in South Africa: A public reform strategy

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Abstract

The paper explores the interconnectedness between public service and research, development and innovation (R, D&I) from a conceptual point of view. The ideology of public administration as what government can properly and successfully do and how it can execute its responsibilities with the utmost possible efficiency and effectiveness in the era of the 4th Industrial Revolution is interrogated. Attention is drawn to prospects of government investing in research, development and innovation as a mechanism to firstly, take evidence based policy decisions; secondly, provide relevant goods and services informed by empirical evidence, thirdly accelerate efficiency in service provision and lastly improve on monitoring and evaluation as far as the provision of public goods and services is concerned as well as improving the delivery of services in the future. The article is anchored on the Public Management Reform Theory which advocates for an improved public sector's administrative structures and operations. This theory promotes a better and modernised public service that delivers basic services in an effective and efficient manner. The theory points out to a paradigm shift from how the public sector is traditionally perceived into a future of the sector as a modernised sector that is market friendly, lean, decentralized and customer friendly. The methodology adopted includes a desktop research and document analysis. The researchers used primary and secondary scholarly literature from the public domain to substantiate arguments advanced in this article. Based on the preliminary literature review on the phenomenon, studies have shown that investment in research, development and innovation (R, D&I) leads to growth and development; hence governments such as the United States and China have created knowledge-based-economies by increasing rate of academic and public research advances within governments business. The outcomes of the preliminary literature posit that linkages amongst research, development and innovation in the public sector space are worth exploring to better the mandate of governments; this is evidently a global trend which differs from country to country. Moreover, evidence suggests that governments that have advocated for and adopted investment in R, D&I are doing well on their governmental mandates. The article contributes to the body of knowledge, by demonstrating how R, D& I can be mechanisms for public sector reform. Arguably, governments should be innovative in their attempt to reform the public service sector by ensuring meaningful synergies between public service and knowledge generating institutions.

Keywords: Public service, Research, development and innovation, public reform, 4IR.

Introduction and background

The father of public administration as he is referred to by the Americans, Woodrow Wilson (1887) has in his article entitled "*The Study of Administration*" unpacked what

public administration ought to be; he wrote that "it is the object of administrative study to discover, first, what government can properly and successfully do, and, secondly, how it can do these proper things with the utmost possible efficiency and at the least possible cost either of money or of energy" (Aderibigibe et al., 2014: 67). Basically, public administration is not only about delivering public goods and services but how these are delivered matters (Cloete, 1992; Donald, 2010). According Aderibigibe et al (2014), Wilson advocated for the following four key concepts of public administration, which are: Separation of politics and administration; comparative analysis of political and private organisations; improving efficiency with business-like practices and attitudes towards daily operations; and improving the effectiveness of public service through management and by training civil servants.

The evolution of public sector in South Africa has been observed over the years. In her paper Yvonne Muthien, the former Public Service Commissioner during President Mandela's tenure explains that the public sector has evolved from the apartheid government pre-1994 and has continuously moved to a post-apartheid discourse mirrored by the democratization and transformation of state machinery from 1994 to 2004 and then moving towards building a capable or developmental state from 2005. Currently, South Africa has not realised a model that is workable for public sector reform; hence, scholars have observed that South Africa's public sector needs a coherent public sector reform model because at the present moment it seems to be lacking (Chipkin & Lipietz, 2012; Muthien, 2013). Generally, there appears to be a consensus that research, development and innovation (R, D&I) systems have interactions and links in shaping and improving how the public sector renders public goods and services in an effective and efficient manner as well as shaping the socio-economic development landscape across the globe (Lundvall, 1992; Nadiri, 1993; Freeman, 2002; Lundvall, 2002; Lundvall, 2007; Patra, 2017; Tsvakirai, 2018). It has been documented that the most important resource for planning and development is knowledge and technological generation, dissemination and utilisation (Lundvall, 1992; Nadiri, 1993; Freeman, 2002; Lundvall, 2002; Lundvall, 2007; Patra, 2017; Tsvakirai, et.al, 2018). Lundvall (1992) and Lundvall (2007) argues that the long term effort to promoting socio-economic development is dependent on building R, D&I systems while simultaneously providing basic living conditions for the people. By digging deep into literature, this article seeks to demonstrate how R, D& I can be adopted as mechanisms for modernizing and reforming the public sector. This is more important given the increasing pressure for the public sector to be innovative in the provision of public goods and services. The article commences by providing a conceptual framework, this is followed by theoretical framework, the methodology adopted, the nexus of R, D &I and the public service, the performance of the South African public sector, R, D&I and the public sector in the era of the fourth industrial revolution, R, D& I as a public reform strategy, Recommendations for the South African government and Conclusion.

Conceptual framework

Public Administration

The definition of public administration as a practice and Public Administration as a

discipline has been a debate of lasting decades. Scholars have held different views; according to Aderibigibe et al. (2014: 65) public administration as a practice is "the implementation of government policy" and as a discipline it is an "academic discipline that studies this implementation and prepares civil servants for this work". In essence, public administration involves the translation of public policy into reality through managing different projects and programmes within the public sector (White, 1995; Aderibigibe et al., 2014). Aderibigibe (2014)'s definition is in par with notions expressed by scholars such as Hodgson (1969) and White (1995). Hodgson (1969) and White (1995) emphasise that public administration as a practice comprises of all the necessary operations which are purposefully geared at fulfilling the mandate of government and its agencies which is primarily to deliver goods and services through implementation of public policy.

Although scholars such as Donald (2010) and Kenneth (2010) hold a strong view that generally there is really no accepted definition of the concept "public administration". These aforementioned scholars are driving a point that the scope of public administration is highly debatable that it becomes easier to explain rather than to define it. Aderibigibe et al. (2014) explains the frustrations that comes with attempting to define the concept at hand. Furthermore, Aderibigibe et al. (2014) explains that public administration is both a field of study and a practice i.e. a discipline and an occupation or a profession so to speak. Disagreements to properly locate this discipline remains debatable as some scholars place public administration as a sub-field of political science and some place it as a subfield of administrative and management science (Donald, 2010; Kenneth, 2010 & Aderibigibe et al., 2014). Cloete (1992) explains that public administration encompasses activities, processes, and functions which aims at ensuring that public institutions deliver public goods and services. Furthermore, Cloete (1992) argues that public administration is a distinctive field of work performed subject to normative rules which demonstrate its distinctiveness. Based on these definitions from various scholars, public administration can be viewed as *firstly*, an integral view and part of government's comprehensive activities on their day to day functioning and implementation of public policy as public institutions and *secondly* as a "managerial view which appears narrower and possibly manageable" (Marume, 2016:19).

Research and Development

First and foremost, it is important to indicate that the concept of R&D was first defined in the 1960s during a conference in Frascati, Italy. It was during this 1963 conference in Italy that the Organisation for Economic Cooperation and Development (OECD) firstly defined R&D as a "creative work undertaken on a systematic basis in order to increase the stock of knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications" (Gyekye et al, 2012:916). Looking at the R&D concept retrospectively, Schumpeter (1934) was the first economist to look at the phenomenon of research and innovation as an enabler for economic growth development. Schumpeter (1934) defined the concept of innovation as "the introduction of new or improved products, production techniques, and organisation structures as well as discovery of new markets and the use of new input factors" (Gyekye et. al,

2012: 916). Notably, for innovation to take place there is a need for thorough research which eventually leads to novelty and innovation. Basically, innovation is an outcome of R&D and studies have proven this fact (Schumpeter, 1934; Rosenberg, 1982; Perrot et al., 2013). By implication the definitions by OECD and Schumpeter (1934) paved a way for R&D advocacy in different spheres of life such as socio-political and socio-economical. Over the years, R&D has been acknowledged as a tool for planning and long-term sustainable development, economic growth and socio-economic development (Schumpeter, 1934; Solow, 1957, Adams et al., 2001; Stratmann, 2005; Fourie, 2007; Gyekye et.al, 2012). Studies have converged on the view that the end-product of research and development if adopted can fuel innovations and breed commercialisation of products thus growing economies, creating employment, improving public service delivery and alleviating poverty (Gyekye et al, 2012). It has been noted that research (both basic and actioned research) is pivotal for the public sector to achieve planning and socio-economic development and growth as well as ensuring that public goods and services are properly delivered to the citizenry.

Innovation

According to scholars such as Fagerberg (2013) and Zulu (2017) the concepts of science, technology and innovation were not greatly associated with growth and development prior to the 1950s. It seemed the concepts were foreign to the theories of development and economies. However, scholars such as Schumpeter became a game changer and interrogated the role of innovation in socio-economic development (Fagerberg,2013; Zulu, 2017). According to Zulu (2017), Schumpeter identified the process of innovation into three stages namely; invention, innovation and diffusion. In that order, invention was defined as first demonstration of an idea, whereas innovation is referred to as the first commercial application of an invented product into the market space and diffusion as the spreading of the technology or process throughout the market (Zulu, 2017). Hence the Schumpeter's innovation theory came in to play (Śledzik, 2013.; Zulu, 2017). Schumpeter is considered as one of the economics think tanks of his time; his greatest contributions are on innovation and entrepreneurship (Śledzik, 2013; Zulu, 2017). In this theory Schumpeter describes development as a process of structural changes which are driven by innovation; similarly, he emphasises the significance of entrepreneurship and the role played by big firms in conducting extensive R&D and support technologies (Śledzik, 2013.; Zulu, 2017). In actual fact the diffusion of innovation posture is even supported by the diffusion of innovation theory (DOI) which was developed by EM Rogers in 1962, the theory is more inclined towards explaining how overtime an innovation or idea diffuses into a space (Rogers, 1962; Dearing & Cox, 2018). In essence, Rogers illustrates how long it is likely to take for a developed idea or innovation to start being utilized by the intended end users (Rogers, 1962; Dearing & Cox, 2018). According to Dearing and Cox (2018:183), diffusion "is a social process that occurs among people in response to learning about an innovation such as new evidence-based approach". The most critical aspect of this theory is on 'the adoption time' and reception of the innovation or idea. Moreover, this adoption should result in end-users doing things differently in comparison to how they are used to doing things; implying that in order for them

to acquire different results the end users will have to use a new and different approach than what they are used to. In the 1970s, the innovation theory's evolution was dominated by three approaches namely: induced innovation, evolutionary approaches and path-dependent models (Greenacres, Gross & Spiers, 2012; Zulu, 2017). These three approaches have seemingly been viewed as complimentary elements of general systems of theory of innovation (Dearing & Cox, 2018; Greenacres, Gross & Spiers, 2012; Śledzik, 2013; Zulu, 2017). The Organisation of Economic Cooperation and Development (OECD) developed innovation system frame in the 1980s which positioned the firms or entrepreneurs at the core of the innovation systems as the drivers of innovation economy; this was done through the innovation research led by OECD (Zulu, 2017). This innovation research became the genesis of the NSI systems in the 1980s onwards and has resulted in a wealth of literature on research, development and innovation (Greenacres et.al, 2012; Zulu, 2017).

Public Sector Reform

A public sector reform or public administration reform is defined as a "a conscious, well-considered change that is carried out in a public sector organisation for the purpose of improving its structures, operation or the quality of its workforce" (Gow, 2012 Jones & Roberts, 1999; Jones & Kettl, 2003).

According to the United Nations Development Programme Practice Note, public sector reform can be a very comprehensive process that includes changes in organisational structures, decentralisation, personnel management, public finances, results-based management, regulatory reforms as well as civil service statute. This reform process is usually motivated by an organization's will to do better at achieving its objectives effectively and boosting its productivity (efficiency); however, this process is more complex in a public sector than it is in a non-governmental organisation because in a public sector dimensions such as politics in an administrative space influence a lot of decisions (Gow,2012). Moreover, for some political and administrative actors a reform of this nature may be viewed as a setback whilst for others it may be viewed in a positive light as an opportunity for government to do better in improving the lives of the people by providing public services effectively and efficiently (Gow, 2012).

Theoretical framework

This paper is grounded on the Diffusion of Innovation Theory (DOI) which is inclined towards an explanation that new ideas, creations and innovation takes time to diffuse for the intended users and beneficiaries to start using it (Dearing & Cox, 2018; Rogers, 1962; Rogers, 2003). Dearing & Cox (2018:183) posits that diffusion "is a social process that occurs among people in response to learning about an innovation such as new evidence-based approach". It is within the context of this paper that DOI theory supports the argument that the idea of forming interconnectedness between the public service and R, D& I within the South African public sector is an idea that is seemingly taking time to diffuse in the public realm in comparison to the private sector. Although, the idea is taking time to diffuse, there is a greater likelihood that when institutions apply innovative ways to improve their performance efficiency and

effectiveness occurs. The public administration's focus into reforming the public sector will provide a space for public institutions to do away with compliance approach and adopt innovative ways that will yield positive results and ultimately create a result-based approach in the public sector (Mauri & Muccio, 2012). The R, D&I collaborations that could be forged between sectors will be aligned to the DOI theory of using new ideas, creations and innovations to reform and improve the public sector's operations.

Methodology

The article is guided by the remedial research approach with an aim of unpacking the interconnectedness between public service and R, D&I as a public reform strategy; this interrogation may assist government to arrive at remedial solutions pertaining to the existing socio-economic challenges. The article is conceptual and abstract in nature, desktop research and document analysis methods are used to interrogate and substantiate the thinking of public administration as what governments can properly and successfully do and how it can execute its responsibilities with the utmost possible efficiency and effectiveness using R, D &I in the era of the Fourth Industrial Revolution (4IR). Substantial primary and secondary literature from books, journals, internet sources and government reports in the public domain were utilised and these sources have assisted the researchers to present arguments advanced in this article.

The nexus between r, d &i and the public service in South Africa

South Africa like most African states are lagging behind when it comes to enhancing its R&D investment and funding systems; moreover, South Africa is not doing well in putting R&D as a key component for socio-economic development (Kahn, 2007). Over the years, South Africa has struggled to effectively and efficiently provide public goods and services, successfully achieve socio-economic development and grow its economy. These deficiencies result from its inability to capitalize on strengthening its research, development and innovation space (Schumpeter, 1934; Solow, 1957, Adams et al., 2001; Stratmann, 2005; Fourie, 2007; Gyekye et.al, 2012). One of the critical stance that the South African government should consider as Kahn (2007) has indicated is for the government to enhance the involvement of all key actors in the system of research, development and innovation with an aim of improving government's performance as far as provision of public goods and services is concerned. For example, South Africa can utilize R, D &I to increase productivity in delivering key services such as education and health.

South Africa has been conducting national R&D surveys dating back to 1966 (Engelbrecht, Featherstone, Matyila, du Toit, Fogwill and Alberts, 2018). Between 1966 and 2001 various institutions would conduct R&D surveys, some of those institutions included the Council for Scientific and Industrial Research (CSIR), Human Sciences Research Council (HSRC) and the Foundation for Research and Development (FRD) amongst others. However, from 2002 things changed when the Department of Science and Technology was tasked with the responsibility of commissioning the R&D survey for 2001/2002 with an aim of developing a baseline for future R&D surveys (Engelbrecht, et. al., 2018). Additionally, the Centre for Science, Technology and In-

novation Indicators (CeSTII) housed in HSRC was therefore tasked with the responsibility of conducting R&D surveys in South Africa, this assigned responsibility is dated as far back as 2002 (Engelbrecht, et. al., 2018). Gross Domestic Expenditure on R&D (GERD) is undertaken as an indicator to establish the extent of support for R&D in order to check how South Africa is progressing on investing and funding R&D (Mustapha, Blankley, Makelane & Molotja, 2015). It has been revealed that the main contributors of R&D funding and investment in South Africa is government and the business sector, the government sector is inclusive of the science councils in this regard (Walwyn & Cloete, 2016; CeSTII, 2021).

According to Kahn (2007), the 2004/5 R&D survey showed that South Africa's GERD is at 12.7 billion and it is comparable to countries such as Mexico, Norway, Poland and Turkey (Department of Science and Technology (DST), 2006). The GERD for 2004/05 was sitting at 0.87% when compared to the European Union, which is on an average of 1.93% (DST, 2006). When comparing these expenditures South Africa seems to be at a low research intensity. Interestingly, in South Africa provinces such as Gauteng seem to have their GERD higher than other provinces in the country (Kahn, 2007). In 2004/05, the gross geographic product ratio of Gauteng was recorded at 1.42% (Kahn, 2007, DST, 2006; CeSTII, 2021). This ratio was discovered to be at the same level with many R&D intensive regions in Europe. The reason for Gauteng's ratio to be at that level is attributed to the province being the economic hub of South Africa and Africa (Kahn, 2007). This is a clear indication that South Africa has the ability and capability to put more effort into enhancing the R&D investment and funding of the country by putting it as the key component of their economic strategy.

Interestingly, in their policy brief Mustapha, Blankley, Makelane and Molotja (2015) have highlighted that the South African government's contribution towards investing and funding R&D has been sluggish over the years, although a target of 1.5% R&D intensity ratio was set to be achieved by 2019 (NDP, 2011). Mustapha, et. al (2015) looked at the at the 2004/05 GERD ratio which was sitting at 0.87% and predicted that this 2019 set target seemed to be an ambitious target. Indeed, the 1.5% set target was an ambitious target because the CeSTII R&D survey report (2021) has recorded that GERD ratio for 2018/2019 was sitting at 0.75% (CeSTII, 2021). Below is a table which illustrates R&D expenditure per sector from the period 2009/10 to 2018/19 financial years.

Table 1: R&D expenditure as a percentage of GDP by sector (2009/10 to 2018/19)

Year	GERD/ GDP	Government	Science Councils	Higher Education	Business	Not-for-profit
	%	%	%	%	%	%
2009/10	0.84	0.04	0.14	0.20	0.44	0.01
2010/11	0.74	0.04	0.13	0.20	0.37	0.01
2011/12	0.73	0.04	0.12	0.22	0.35	0.01
2012/13	0.73	0.04	0.12	0.23	0.32	0.02
2013/14	0.72	0.05	0.12	0.21	0.33	0.02

2014/15	0.77	0.05	0.13	0.22	0.35	0.02
2015/16	0.80	0.05	0.14	0.24	0.34	0.02
2016/17	0.82	0.05	0.14	0.27	0.34	0.02
2017/18	0.83	0.05	0.14	0.28	0.34	0.03
2018/19	0.75	0.05	0.11	0.27	0.30	0.03

Table1: Source: CesTII R&D Survey 2018/2019 (2021)

Table 1 depicts South Africa's GERD from 2010 to 2019 financial years, the depictions suggests a decline in R&D funding and investment from almost all the sectors as indicated above. Infact, the R&D Survey report has recorded a decline of 0.08% from the 2017/18 financial year into the 2018/ 19 financial year (CeSTII, 2021). Conversely, the higher education sector seems to be growing although the 2018/2019 financial year has been recorded at 0.27% which is a decline compared to the growth recorded at 0.28 % in 2017/2018 (CeSTII, 2021). The point of higher education sector growing its contribution in the GERD has also been noted by Mustapha, et, al., (2015), these scholars have noted that this sector seems to be spending on production of knowledge capital in the past few years.

Table 2: Proportional government funded R&D by sector (2009/10 to 2018/19)

YEAR	GOVERNMENT	SCIENCE COUNCILS	HIGHER EDUCATION	BUSINESS	NOT-FOR-PROFIT
	%	%	%	%	%
2009/10	10.8	31.3	42.1	15.4	0.4
2010/11	11.0	32.5	46.8	9.2	0.5
2011/12	11.6	34.6	48.1	5.2	0.4
2012/13	11.7	31.1	49.8	6.3	1.1
2013/14	13.0	31.0	48.8	6.2	0.9
2014/15	13.3	33.6	46.8	5.4	1.0
2015/16	9.9	34.1	51.3	3.6	1.1
2016/17	9.3	30.9	56.1	2.8	0.9
2017/18	9.8	29.4	58.0	2.1	0.8
2018/19	10.9	26.6	60.1	1.2	1.2

Source: CesTII R&D Survey 2018/2019 (2021)

The table above shows the proportionality of research and development funding per sector from the financial year 2009/10 to 2018/19. The government's contribution seems to be declining from financial year 2014/15 government contributed about 13.3% which is the highest contribution from 2009/10; however, since then decline has been massive as depicted in the table above. These contributions per sector are may affect how South Africa address its socio-economic objectives such as health, education, social development and community services, energy supply, agriculture and more using R, D&I. Moreover, when there is a decline in funding of research and development activities it is mirrored in the quality of public goods and service that are delivered by government. The picture painted above should be of great concern for a country that is working towards a capable state.

Table 3: Benchmarking of R&D Expenditure as a Percentage of GDP (2006/07 to 2012/13)

	South Africa	*Brazil*	*Russia*	*India*	*China*	*Japan*	*South Korea*	*United Kingdom*	*United States*
2006	0.90	0.99	1.07	0.80	1.38	3.41	2.83	1.65	2.55
2007	0.88	1.08	1.12	0.79	1.38	3.46	3.00	1.68	2.63
2008	0.89	1.13	1.04	0.84	1.46	3.47	3.12	1.69	2.77
2009	0.84	1.12	1.24	0.82	1.68	3.36	3.29	1.74	2.82
2010	0.74	1.16	1.13	0.80	1.73	3.25	3.47	1.69	2.74
2011	0.73	1.14	1.09	0.82	1.79	3.38	3.74	1.69	2.76
2012	0.73	1.15	1.13	-	1.93	3.34	4.03	1.62	2.70
2013	0.73	-	1.13	-	2.01	3.47	4.15	1.66	2.74

Source: OECD "Main Science and Technology Indicators", Brazil and India data from UNESCO Institute of Statistics

Table 3 draws a picture of benchmarking South Africa's R&D expenditure with other countries. South Africa's R&D expenditure as a percentage of GDP by countries in the BRICS as well as other developed countries provides a very clear picture of how South Africa is investing in R&D in comparison to its counterparts across the globe especially those in BRICS and OECD. The painted picture is not a very satisfactory one as it puts South Africa at the lowest as far R&D investment and funding is concerned.

The South African public sector performance

The National Development Plan (NDP) Vision 2030 has highlighted that South Africa plans to greatly and intensely invest in R&D by 1.5% of GDP and this target was set to be achieved by 2019; however, it was not achieved (refer to table1) (CeSTII, 2021; Mustapha, et, al., 2015; NPC,2011). According to Mustapha et al (2015) had this target been achieved South Africa's R&D intensity would've been placed in line with the OECD average across the public sectors which was 2.34% in 2010. Basically, the R&D expenditure remains sluggish in South Africa particularly in the public sector and this trends affect public sector's performance (CeSTII, 2021). According to the South African Government's Twenty Year Review (1994-2014), strides in public goods and service delivery were made since the dawn of democracy; however, there are still some inconsistencies, challenges and unevenness in service delivery. There have been success stories such as the expansion in access to primary and secondary education, primary health care, water, shelter, electricity and more; however, there have been unsuccessful stories along the way such as poor quality of services being provided by government in access to education, health care, shelter, water and electricity just to name a few. Hence, other areas were marred with public protests and demonstrations over the years. It is very important to reflect on some of the service delivery challenges of the government in order to do better and reform the public with an aim of improving its performance going forward.

The Twenty Year Review Report has highlighted some of the challenges in the public sector that affect its mandate to deliver quality services in an effective and efficient

manner include the following:

1. **Human Resource**

The report has indicated that inadequately skilled and inexperienced civil servants in the public sector has resulted in the state's failure to deliver quality services as mandated. The deficit in relevant skills in technical areas such as infrastructure planning, health, engineering, finance, information technology tends to mar the public service and renders the process of reforming the public sector a futile exercise.

2. **Uneven public service performance**

South Africa is characterised by unevenness in the delivery of basic services such as education, health, water, electricity, shelter, social security amongst others especially in rural provinces. The quality of some of these basic services remain relatively poor and has resulted in service delivery protests in most parts of the country. These protests may suggest that the citizens are not satisfied with public sector's performance on providing services.

3. **Corruption and maladministration**

Financial mismanagement and corruption has also been highlighted as a challenge faced by the South African government and has been associated and linked to the failure for government to provide quality services. Moreover, the scourge and prevalence of corruption has made it difficult for the public service to adequately perform its mandate. Corruption practices such as allocation of contracts, rewarding of tenders, misuse of public resources has eroded the trust citizens have for the government.

4. **Policy implementation**

Government has policy documents and strategic plans to guide how public goods and service ought to be rendered; however, the implementation of such policies appears to be a challenge for the public sector, this also affects service delivery. Additionally, policy coherence is a challenge as critical dimensions of governance are not properly integrated and coordinated.

With all these above-mentioned challenges faced by the South Africa's public sector, it can be argued that R, D & I can be used as one of the vehicles to achieve an improved and reformed public sector (Fourie, 2007; Gyekye et.al, 2012; OECD, 2008; Slavin, 2008). R, D&I have the potential to drive evidence based planning and policymaking. For instance, research can provide the basis for policy decisions needed in the education sector such as:

1. Adoption of policy approaches such as the relevant curriculum to be implemented in line with the country's context and complexities; e.g. the outcome based education system which was adopted years back was criticized for having not taken into consideration the country's educational environment and its context thereof hence it did not yield expected results (The Presidency, 2014).
2. Setting up targets for national and provincial matric pass rates: the decision of this nature needs empirical evidence to guide government on baseline target setting and what strategies to employ in order to achieve the set targets. This also goes to other developmental areas such as service delivery decisions.

R, D & I and public service in the era of 4th industrial revolution

The Fourth Industrial Revolution (4IR) is an era which is charactised by technological innovations such as robotics, Artificial Intelligence (AI), the Internet of Things (IoT), cloud computing and more (Ndung'u &Signe, 2020). The 4IR presents invaluable opportunities for governments to drive socio-economic development and economic growth across the nations (Ayentimi & Burgess, 2019; Ndung'u &Signe, 2020; Shava & Hofisi, 2017). Within the context of a public service discourse, the combination of R, D&I and 4IR has a potential to tackle socio-economic challenges such as service delivery and economic growth if used effectively (Chan,2018). Additionally, R, D& I and 4IR have the capacity to provide an opportunity for the South African government to improve performance of the public sector in the following manner (Ayentimi & Burgess, 2019):

3. increase investment in sectors such education and training and health and capacitate upcoming researchers, scientist, technologists, teachers, health professionals, etc;
4. improve skills in key sectors by using technology; maximising production in key public and private sectors;
5. accelerate service delivery in various sectors such as education, health, housing and more;
6. assist the public service to restructure the economy and turnaround industries; and
7. ensure that programmes are effectively implemented.

All these mentioned opportunities brought by R, D, I and 4IR may influence the policy landscape of the South African government. As much as 4IR can present opportunities it can also have a downside and can present challenges; others scholars have highlighted consequences that may come with adoption of 4IR (Ayentimi & Burgess, 2019; Millington, 2017; Peters, 2017; World Economic Forum; 2017). Some of the highlighted consequences are related to the possibility of 4IR disrupting the labour markets as it is not labour intensive in comparison to the current modes of productions in industries. Also the extreme disruptions envisaged by these scholars relate to growing inequalities and unemployment because the work that is supposed to be performed by human will gradually be drifting towards the help of robotics and automation technologies (Ayentimi & Burgess, 2019; Millington, 2017; Peters, 2017; World Economic Forum; 2017).

The downsides presented by 4IR requires a research and development attention as well as policy discourse (Ayentimi & Burgess, 2019). According to Shava & Hofisi (2017) and the World Economic Forum (2017), elsewhere in big economies technologies ushered in by 4IR have already presented great improvements. However, in unique economies such as South Africa the opposite may occur if the governments do not create a conducive environment for its adaption guided by research in order to create a policy landscape suitable for developing economies' context. Notably, key drivers in the current big economies across the globe are associated with research, development, innovation and technologies such as robotics, artificial intelligence and more (Naudé, 2017; World Economic Forum, 2017). Thus, there has been improve-

ments and breakthrough in socio-economic developments in countries like Hungary which has improved living standards of ordinary citizens, increased productivity, improved work ethics and systems across all sectors public and private and industries (Ayentimi & Burgess, 2019; Naudé, 2017). These improvements associated with delivering proper services to improve people's standards of living and increase work ethics in public services are an evidence of what an improved public service ought to look like and can thus be used as a public reform strategy. Improvement of the public sector using R, D & I and 4IR can assist South Africa to accelerate infrastructure development and overcome infrastructure deficits, to shape their health care and education systems better by adopting electronic health (e-health), e-governance and digital education systems to maximize service delivery (Ayentimi & Burgess, 2019).

R, D & I as a public reform strategy

R, D& I can instigate a need for a public sector reform (Gow, 2012). Researchers may unearth the need for reform to take place influenced by new theoretical knowledge which may impact practice. Hence, the process may entail transfer of knowledge found in internal and external studies conducted about the phenomenon. For instance, researchers would generally develop models and methods which are based on theoretical knowledge and present such to the practitioners as a recipe for what a good reformed public administration ought to be (Cheung, 1997; Gow, 2012; Thomas, 1996). As alluded to in the Twenty Year Review Report in its current form South African government is marred with poor services such as health, education, water, sanitation, electricity and more as well as poor infrastructure development (The Presidency, 2014). A paradigm shift is needed in order for South Africa's public sector to reform. However, this will need commitment and investment in research, development and innovation as a tool for a successful public sector reform to be achieved (Schumpeter, 1934; Solow, 1957, Adams et al., 2001; Stratmann, 2005; Fourie, 2007; Gyekye et.al, 2012; OECD, 2008; Slavin, 2008). Additionally, R, D&I can be used to improve the performance of the public sector by ensuring that the public sector puts evidence based policy making at the centre of their operations and decision making (OECD, 2008; Slavin, 2008). Moreover, it should be used as a mechanism to *firstly*, take evidence based policy decisions; *secondly*, provide relevant goods and services informed by empirical evidence, *thirdly* accelerate efficiency in service provision and *lastly* improve on monitoring and evaluation of programmes (Adams & Engelmann, 1996; Moss, Jacob, Boulay, Horst & Poulos, 2006; Slavin, 2008). Thus, evidence based public reform should be adapted to protect the public sector space from adopting ineffective measures and strategies (Adams & Engelmann, 1996; Slavin, 2008). Moreover, evidence based public reform would create a progressive improvement in which researchers, developers and innovators are working to replace the traditional public space into a modernised and reformed public sector. From the intense literature review undertaken in this article, the authors have deduced that evidence-based public reform should be fashioned as follows:

1. That evidence based policy making prevails: this may include having evidence based programmes being implemented as a pilot and eventually as a full-scale programme e.g. robotics, digitilisation of education, e-health, digital record keep-

ing, e-governance, etc;
2. Government provide funding for research, development and innovation to support establishing evidence based programs and projects and ensuring that they are adopted accordingly;
3. Once the government sets out and fund sector specific programs and projects which are capable of improving and reforming the public sector then monitoring and evaluation will take place as both a passive and active monitoring. Passive monitoring and evaluation will rely more on technology and digitilisation, which is also a new aspect of reforming the public sector by making use of technological and innovative methods.

Recommendations

Based on the argument presented in this article the authors therefore submit the following recommendations for the South African government to consider in the pursuit of reforming and modernizing the public sector:

1. Invest in research, development and innovation: For more efficient public service delivery, government should concentrate on creating relevant knowledge through R, D&I (Gyekye, et al., 2012). This very crucial element must be interactive with policy, planning and development as well as monitoring and evaluation. Without or with little relevant and up to date information, the public sector cannot provide relevant services needed at the grassroots level.

2. Invest in M&E: Introduce and undertake systematic monitoring and evaluation mechanisms specifically for reform programs and projects by filtering and sorting the ones that are working better and the ones that are not doing well with an aim of improving government performance going forward with usage of technological advances (Nalubega & Uwizeyimana, 2019). More importantly, this process will require a neutral and external evaluator other than government officials assigned with projects on a daily basis.

3. Well-equipped civil service/servants: Invest in well-equipped civil servants by training and building their capacity to perform better in-line with the objectives and goals of a reformed public sector.

4. Rigorous policy landscape: Government should put rigorous policy measures to support public reform processes. Policy interventions extended in this regard should ensure that the policy landscape does the following:

- ensure policy coherence in order to extensively contribute to efficient public goods and service delivery;
- embrace research, development and innovation by injecting financial and human resources;
- promote R&D collaborations; and
- create a conducive environment for such collaborations to thrive when established (Slavin, 2008).

Conclusion

This article has unearthed an interconnection between R, D &I and public service. It is emphasised that for South African government to be able to effectively and ef-

ficiently deliver public goods and services to its citizenry and ensure that an enabling environment for socio-economic development is created research, development and innovation should be put at the centre of its developmental agenda. Furthermore, the article has presented evidence that for the South African public sector reform to be successful it needs government to make efforts of creating a policy landscape that support a paradigmatic shift into a reformed public sector. The article argues that government should promote the culture of relying on research, development and innovation for policy- making decisions as this will ensure that the public sector reform is evidence-based. Notably, a public reform process requires leadership will at both a political and administrative level; hence, one of the prerequisite for a successful public reform process is a committed and firm leadership that will support reform programmes and projects by mobilizing necessary resources.

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