

# The Fourth Industrial Revolution (4IR) and its Effects on Public Service Delivery in South Africa



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## Abstract

In recent decades, the Fourth Industrial Revolution (4IR) has added a new dimension to change and has been exponential in its development. It is important to understand its effects in various environments, particularly the opportunities and challenges it brings to public sector functioning, where there needs to be a greater drive towards innovative service delivery. This article explores 4IR within the context of public sector service delivery, focusing on South Africa as a developmental nation. It examines technological advancements of 4IR in line with some of the aims of local government, particularly in its mandate to be

more responsive and effective in its service delivery. It also establishes how 4IR platforms are being adopted for effective citizen engagement, which is an essential goal of service delivery within the sphere of local government. It examines some of the gaps that need to be addressed around the essential practicalities required to integrate 4IR effectively and explores the readiness of the general public sector environment to respond to the demands of 4IR. Key factors regarding what is needed to create a more enabling environment for local government service delivery and its prevalent developmental constraints are also discussed.

## Introduction

‘We must develop a comprehensive and globally shared view of how technology is affecting our lives and reshaping our economic, social, cultural, and human environments. There has never been a time of greater promise, or greater peril.’

—Professor Klaus Schwab

We are living in exponentially changing times where even the nature of change itself is changing. We are considered to be in a new age or revolution of change, and technological advancement is at its centre. Information and knowledge were once limited to libraries, books, and learning institutions; now, they are abundantly available, and almost any question can be addressed via internet search engines such as Google. This new industrial age of technological advancement can be perceived as a wonder, but can also appear overwhelming in its vastness and demands for rapid responsiveness. In recent times, the Covid-19 pandemic has also highlighted how critical technology is in supporting communities, and driving economic progress when standard practices are challenged. The effects of the pandemic have altered how workplaces operate, and have indicated how important it is to be responsive to technological integration in order to function, even on a basic economic level.

In many contexts, the agility factor required for creative and innovative responsiveness to this technological advancement is lacking. This is especially evident in many public sector environments, particularly in developing countries, who experience a critical shortage in resources, high levels of poverty and unemployment, a lack of education and skills, as well as limited access to technology within wider infrastructural and geographical contexts.

Within the public sector, key questions lie in how technology can be harnessed and integrated in visionary, proactive, and cost-effective ways. At the same time, one must also establish how to effectively keep pace with more immediate priority service demands and how to sustain critical developmental needs.

Advances in technology provide for opportunities to enhance institutional practices, systems, and

processes; at the same time, there is the need for highly adaptive methods for the effective and resourceful implementation of these technologies. Technology is, to a large extent, shaping how growth and advancement occurs within varied contexts. Thus, service delivery practices themselves are becoming more firmly lodged within the lens of technology. Technological advancement presents opportunities in creating greater access to information, enhanced communication and networks, wider community participation, more capacity for access to goods and services, and a greater opportunity for innovation. At the same time, it also needs to be articulated and integrated into existing service delivery platforms and mechanisms in agile ways. This needs to be done in such a way that technology does not quickly become superfluous, thereby compromising the very service it is meant to support. The alignment of technology and service provision needs to be carefully considered.

Whilst technology can enhance service delivery in its innovative platforms, it also presents many challenges in its implementation. This is especially evident in the public sector environment, with its intricate bureaucracy and its complex structures.

### 4IR: Overview, Challenges, and Opportunities

The Fourth Industrial Revolution (4IR) is more disruptive in its innovation edges in technological advancement than that of any previous technological revolutions.

The First Industrial Revolution (circa 1760–1840) was marked by the construction of railroads and mechanical production and changed societies in how work was undertaken. The Second Industrial Revolution was marked by mass production—eliminating certain jobs, whilst creating a lot of jobs in other arenas. The Third Industrial Revolution introduced the ‘electronic age’, which focused more on innovations of technological systems and the integration of varied networks and the ‘interoperability of ecosystems’ (Mbatha, 2019: 5).

According to Schwab (2016: 37), the 4IR is seeing great strides in developing technologies from ‘gene sequencing to nanotechnology, and from renewables to quantum computing.’ The amalgamation of these

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technologies is what causes the 4IR to differ from earlier revolutions. We can also learn from previous revolutions that progress in this new era will be proportionate to how society integrates it, and that there is a clear interaction between society and technology (Mbatha, 2019: 4).

Just as with the previous industrial revolutions, it is essential to conceptualise a platform for technological integration for an ‘inclusive society’ (Kaesar: 2018). This requires a radical review of political, economic, and social systems. Further, there is a need to consider all critical environments, both external and internal, to the public and private sectors. This is to ensure that standards are raised and that socio-economic challenges are addressed in different and more responsive ways, and that sustainability is ensured. There also needs to be a radical review in how training and education is undertaken, as skills needs will be vastly different in the future. This in itself needs to be revolutionary (Kaesar: 2018).

The 4IR will affect every country in the world and this raises some significant concerns. According to Schwab (2016: 40), these include:

- Addressing the question of how to harness the opportunity that the 4IR offers. Evidence has shown that the required levels of leadership to understand and leverage the changes in innovative ways are not adequate. This is borne out in reviews of how leaders across the world have responded to the necessity to rethink social,

political, and economic systems.

- Reviewing in what ways institutional frameworks are not currently geared for innovative reinvention, and to transition the changes necessary to accommodate such revolutionary innovations that will be brought on in 4IR.
- Reviewing the gaps in leadership and how to establish diversity in their ability to create more communal narratives essential for empowering vast and diverse communities and individuals.
- Understanding the disruptions that the radical changes of 4IR will bring and how it will affect organisations

Thus, it is essential that public sector institutions establish a set of common values and operating principles that inform policy to integrate changes. Such policy must not only create opportunity within technological advancement, but also create effective transitioning towards new systems to effectively sustain service delivery mandates.

### **Implementing 4IR Within the Public Sector Environment**

It is essential to review 4IR within the framework of the evolving Public Sector management paradigms. Over the past two decades, public sector management has come under significant scrutiny in its modes of operation, recognising that there needs to be an evolution beyond traditional administration towards more innovative ways of managing the public sector service delivery. In an era of globalisation, serious challenges have been posed on how the public sector can become more competitive, agile, and innovative in its delivery and citizen engagement mandates.

The Public Management Paradigm, moving beyond the Traditional Administration Paradigm, evolved in response to questions on how governments could become more responsive to its increasing discriminatory citizen demands. It also served to develop a more outcomes-based service delivery approach. However, the complexity of public administration and management have rendered the definitions of what this constitutes as somewhat vague. This is leading to thinking in public sector delivery that goes beyond the New Management Paradigm (NPM), and rather a review of its relationship to ‘public value’ (Bojang, 2021: 1–2).

The concept of government reinvention has been bandied about substantially in the past few decades. It has presented a significant debate, especially within the complexity of bureaucratic government structures and the multifaceted nature of the public sector. In addition, there are also ever-increasing demands for more innovative public service delivery with a more entrepreneurial and business-like ethos. This must be considered within a new era of democracy and what is required for greater citizen engagement (Bojang, 2021: 2).

Essentially, the NPM paradigm focused on several factors deemed pertinent to the public sector environment. This included greater levels of practical management, performance management, output-based management, competitiveness, adopting typical management styles utilised within the private sector, and more effective resource management (Hood in Bojang, 2021: 4). But in recent times, the concept of what constitutes a value chain needs to be considered within the wider ecosystem of public management and 'public value'. According to Bojang (2021: 5), where before the NPM paradigm sought to integrate typical private sector management practices into public sector management, evolving theorists of 'public value' identify and consider the differences that exist between private and public sector management. This emphasises the provision of service as a primary driver in the public sector environment. Political strategies also feature significantly in the implementation of the 'Public Value Paradigm' (PVP). The three primary ingredients to this paradigm include 'legitimacy and support, operational capacity and public value account' and centre on 'services, outcomes and trust' (Bojang, 2021: 6).

It is thus essential to consider 4IR applications and innovations within the context of these paradigms. The latter value paradigm points towards the need for a more transformative and integrated approach of e-Government platforms that can support the delivery of public value. It is also essential to formulate e-Governance policies that provide for effective integrative approaches across the complex and multifaceted disciplines with the public sector institutions. This links into Mbatha's proposition in 4IR thinking on a more inclusive citizen engagement in public sector decision-making and

essential functioning around technology, as well as the integration of all the various environments or 'ecosystems' within which the public sector operates (Mbatha, 2019: 4–5).

### **e-Government as a Driver of Public Sector Delivery and Value Outcomes in the Era of 4IR**

Within South Africa, a Presidential Commission on 4IR was established in 2019, recognising the significance and urgency in integrating 4IR into its public service strategy and goals. Within this, e-Government strategies must be considered as essential platforms to support public sector service delivery. e-Government is essentially a set of multifaceted public sector technological platforms used to create and support government structures. These structures also enable service delivery to be delivered in efficient, effective, and accessible ways (Bwalya, 2018: 5). In simpler terms, e-Government is the 'provision of routine government information and transactions using electronic means' (Marche and McNiven in Mawela, 2015: 20). Building on this, e-Governance concerns the ways in which 'decision and policy-making processes may be supported by Information and Communication Technologies (ICTs)' (Mawela, 2015: 20).

In further exploring the relationship between e-Government platforms and e-Governance, it is important to understand that e-Government platforms can become ineffective without agile governance. Evidence indicates that this is a concept that still requires more definition and can be wide in its scope. According to de Oliveira Luna et al. (2014: 134), agile governance can essentially be defined as:

'the ability of human societies to sense, adapt and respond rapidly and sustainably to changes in its environment, by means of the coordinated combination of agile and lean capabilities with governance capabilities, in order to deliver value faster, better and cheaper to their core business.'

Within literature theory and in defining e-Government, it is perceived that there is still a lack in 'knowledge integration across disciplines' and this is limiting perspectives on the integrated public sector functioning. It is thus essential to

explore e-Government by considering the nature of government in its essential democratic need of being 'socially inclusive'. It is also necessary to establish what is required to develop a 'systems architecture to ensure the efficient delivery of government services with transparency, reliability and accountability' (Khanra and Joseph in Malodia et al., 2021: 2).

There are a variety of e-Government platforms and these are advancing all the time in the accelerated era of 4IR, building on more simplistic e-Government platforms from the previous decades. 'Intelligence applications' have been especially acquired in countries that have a developmental imperative. Such applications include Big Data to better support information processing and accessibility as a basis of an 'analysis platform'. These are especially useful, for example, in establishing land usage and spatial patterns, determining infrastructural needs, and analysing critical data that inform socio-economic developmental needs (Bwalya and Mutula, 2014 in Bwalya, 2018: 240).

The advent of 4IR has accelerated e-Government platform development and, in addition to advances in 'Big Data' computing, the internet itself has advanced to better support processes that feed into value-based service delivery and decision-making systems. Thus this serves to go beyond the New Government Paradigm and integrate the proposed Public Value Paradigm. This also adds value to intricate and multifaceted necessities in decision-making across many and varied platforms (Bwalya, 2018: 248).

Other e-Government platforms include creating advances in establishing 'Smart Cities', where the capturing of and the access to information is more effectively enabled. This is harnessed around the various socio-economic and developmental goals that need to be understood and implemented (Bwalya, 2018: 250).

Other e-Government platforms include citizen engagement tools such as 'crowdsourcing', which is key in the participative and transparent tenets of governance in its democratic aims. Other new innovations expected to gain traction in the next while to support 'socio-economic value chains' include robotics, self-controlled technologies, 'grid computing' to advance access and better integrate

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infrastructural networks and related data, open data systems around public value, engagement and transparency processes, and research platforms (Bwalya, 2018: 251–259).

Digitisation and integration of varied e-Government platforms is thus essential to supporting the Public Value Paradigm within the goals of public sector service delivery.

Strides are being taken in South Africa to integrate innovation and technology into Public Sector service delivery strategies. For example, in August 2021, the Gauteng Provincial government launched a 4IR innovation strategy within the Gauteng Centre for Excellence. This will serve to build purposeful connections in supporting new businesses with digital infrastructural technologies. It will provide for transparent procurement platforms and also look at ways in which to advance competitiveness through the adoption of technologies. It will also support research goals around 4IR, especially in the area of service. It aims to identify the skills requirements for future digitalisation in work and social innovation. Finally, it will also explore 4IR governance issues and make recommendations for better governance via digital platforms. This is a direct response to the need to understand the implications of 4IR in public sector service delivery that were identified in the Industrial Revolution SA Digital Economy Summit, hosted by the Gauteng government. The strategy will serve to better support citizens in the spheres of youth development,

small and medium businesses, and also for employees within the department (Mailoane, 2021).

A further proactive measure has been taken on the part of the Province of KwaZulu Natal, where the office of the Premier has initiated a digital transformation strategy for 2020–2025. Its strategic priorities lie in digital skilling, information and knowledge management and information security, process automation, systems integration, and government digitisation. It is extending its strategies from cities to villages, adopting a top-down and bottom-up approach, and also takes cognisance of governance structures, monitoring and evaluation, and risk management within all departments (Province of KwaZulu Natal, 2020).

### **Questions to Be Considered in Implementing 4IR within the Public Sector Context in South Africa**

It is preferable to not focus on problems and complex layers that the 4IR presents, although these need to be carefully considered. Rather, it is essential to reframe questions that can lead to solutions for the integration of 4IR to advance service delivery. Some of the wider contextual questions that were posed in the earlier stages of 4IR are still prevalent currently and those that need to be debated include (Kemp in Balkaran, 2016: 6):

- How do we use current technology to help solve challenges?
- How do we shape 4IR and influence it towards service delivery strategies and in the favour of vision realisation?
- What are we doing to catch up and be part of this Fourth Industrial Revolution?
- How can we shift from questions focusing on minimising government failure rather to how government can leverage and maximise innovation?

According to Balkaran (2016: 3): ‘in order to create and shape technologies, government must be armed with the intelligence necessary to envision and enact bold policies.’ Since work is an essential tenet of human development it is also important to take on the vast socio-economic challenges in proactive ways, and governments can only achieve this effectively by transitioning towards ‘techno-

economic paradigms’ (Zhang et al. in Balkaran, 2016: 3).

South Africa is still in a ‘catch-up phase’ in adopting proactive strategies and policies to move into mainstream activities in 4IR. Whilst it may seek to leverage this to gain exposure in evolving global developments, realistically the focus in the more immediate future is on achieving competitiveness and the need for inclusive growth (Arnold, 2019).

One of the key drivers in technological integration is a national strategy for competitiveness. This requires significant reviews of what it means to be innovative and a need to drive towards efficiency, without compromising quality. It is about finding shrewd and innovative ways to create value because this is where perceptions of competitiveness are formed.

### **4IR in the Context of Sustainable Developmental Governance in Africa**

South Africa is a developing nation and has critical developmental challenges such as high levels of unemployment and poverty, which have escalated even more during the Covid-19 pandemic. Like many African countries, South Africa is also substantially dependent on developed economies. This has resulted in a majority of the population only engaging in a small proportion of economically-driven vocations (de Wet in Mamphiswana, 2020: 2). The question prevails as to how it can be responsive to the demands of 4IR within its developmental challenges. Although there is a skills shortage in meeting 4IR demands, from a global perspective, governments in developing countries are still being enticed to integrate 4IR (Shava and Hovisi in Mamphiswana, 2020: 3).

Perhaps a lesson can be learned from India, which has explored its rural challenges in 4IR integration, especially in the agricultural sector. India is facilitating citizen engagement and awareness programmes to better support rural inclusive growth more proactively (Lele and Goswami, 2017: 7–8) and has proven that digital platforms can provide for this via ‘smart physical systems’ and can be used to create more skilled jobs in rural areas, especially in the agriculture, energy, and infrastructure sectors (Lele and Goswami, 2017: 7–8). It is indicating that, through ‘pro-rural digital policies’, there needs to be a ‘bottom-up and

top-down' approach in order to successfully integrate 4IR opportunities (Mamphiswana, 2020: 3).

South African public service delivery has a strong citizen engagement imperative in its local government infrastructure. An advantage of 4IR is that it can speed up services and also create greater accessibility to services. This is advantageous in that it can better influence and form economies in the future and this in itself is opening up new opportunities (Mamphiswana, 2020: 3).

Once again, 'integration' is a key factor. 4IR is affecting all economic sectors and an 'interdisciplinary approach to teaching, research and innovation is now mandatory' (Xing and Marwala in Mamphiswana, 2020: 4).

A few key factors that present challenges for the integration of 4IR and that must be considered in such developmental strategies includes job scarcity. Digitalisation can compound this and make jobs that do exist redundant. Secondly, there is a large skills shortage within the workforce and this is exacerbated in the fast-growing population and limited absorption of the population into the more effective economic sectors. This also reinforces the recent strategy of the Gauteng Provincial Government to look at digital strategies that can better support the small and medium market sector and youth development. Africa is also suffering from 'deindustrialisation', which is limiting its competitive status globally. This, along with a lack of infrastructure, as well as bias and discrimination from developed economies, is creating challenges for effective 4IR transformation and integration (Mamphiswana, 2020: 8).

### South African Readiness for 4IR Integration

As mentioned, the 4IR revolution is critically hindered by existing developmental issues, especially in Africa. Within South Africa, the greatest challenge is the lack of 'adequate viable resources', not only in digital technologies and infrastructural support, but also in digital illiteracy. This is causing inequalities where digital solutions are implemented, as it is widening the skills divide by side-lining the illiterate (Olaitan et al., 2021: 2).

However, South Africa, in questioning whether developmental realities and frameworks are reviewed

and integrated, is also measuring its readiness for 4IR integration (Olaitan et al., 2021: 4). From this, it is evident that one of the greatest needs lies in the investment of skills upliftment and a 'telecommunications infrastructure' that supports transparency and openness in the 'socio-institutional component of the 4IR' (Olaitan et al., 2021: 3).

The frameworks under review have been integrated to monitor the country's capabilities for 4IR integration. This focuses on the structure of the 'drivers of production', the 'technological and social capabilities' and, thirdly, the country's 'digital capability' for greater competitive advantage (Olaitan et al., 2021: 5).

Within these readiness frameworks, it has been established that interventions such as Artificial Intelligence could stimulate 10% to 30% productivity in labour within the manufacturing sector in the next ten years. It is perceived that South Africa should transform more towards a knowledge-based economy on account of its rapid 'deindustrialisation' (Olaitan et al., 2021: 6).

The 'Viability' framework has revealed that the Covid-19 pandemic has escalated its already existing economic crisis. This means that it reduces the viability of South Africa in adopting new technologies and impacts 4IR readiness and responsiveness. This is further hindered in the lack of skills and literacy levels (Olaitan et al., 2021: 6).

Lastly, in the 'IT infrastructural' assessment framework, it has been established that South Africa still needs

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to expend much on digital platforms, even in simple 'universal broadband coverage', especially in local communities. This is also exacerbated by the Eskom infrastructural challenges that have led to continual load-shedding (Olaitan et al., 2021: 10).

Further factors that need to be considered are developing strategies that are 'context-specific', with the design of policies for innovation within the Sustainable Development Goals (SDGs) and a review of the capacity for innovation (Manda and Dhaou, 2019: 250).

### **Integrating 4IR Into the Local Government Context in South Africa**

South Africa has a strong drive towards citizen engagement, participation, and transparency in its local government structures. This is therefore an important conduit in driving 4IR advancement. It is a space in which to integrate e-Government platforms to eradicate some of the developmental challenges that prevail.

According to Mawela et al. (2017: 149), municipalities are important in accelerating e-Government programmes for all stakeholder engagement—including, amongst others, business, local communities, non-governmental organisations, and traditional leadership structures. It thus supports a cultural ethos and systematic governance process for local government goal achievement. It can allow for more accessible and engaging governance, supporting the Indian model of the bottom-up-top-down approach and the integration of the multiple environments in values-based ways.

A recent research project was undertaken to determine the effects of 4IR on local government, serving to inform a strategy for local government to support 4IR integration. It has reinforced various other research projects undertaken in that 4IR is adding to inequalities in a digital divide within developmental challenges. Whilst it also indicated that certain job roles would likely become more automated—such as accounting, administration, ballot-voting counting, and internal auditing—other roles are anticipated to grow. Such roles include the appointment of more specialists in digital transformation, developers and facilitators

of business, automation of processes, and digital security monitoring (LGSETA, 2020: 4).

It is anticipated that 4IR does create an opportunity for South Africa to better optimise socio-economic development. The primary area of significance within local government will lie in its strategy and policy formulation, its citizen engagement, and service delivery focus. Further, its organisational culture, human resources, risk and change management systems will also be important considerations for 4IR integration (LGSETA, 2020: 5). Local government is also key in supporting sustainable development goals on a very practical level and integrating e-Government is critical to achieving this.

Within its service delivery mandate, priority areas for the integration of transformative digital support systems mean a review of services such as water and electricity supply, waste management and those governance structures that require less resources, but can link up more effectively in integration (LGSETA, 2020: 83). The Integrated Development Plans (IDPs) of municipalities identified need to take cognisance of the broader strategies of the goals and objectives for 4IR integration (LGSETA, 2020: 84). To date, there is a lack of proactive integration of 4IR into IDPs, and digitalisation is still treated in isolation of other programmes, projects, and functions. The research recommendations point towards a policy-oriented focus to get municipalities to better encompass technological strategies in IDPs (LGSETA, 2020: 92). Some key priority areas that need to be more proactively addressed include the enhancement of 'revenue collection' systems and processes, Customer Relationship Management (CRM) systems, and communication technologies to expedite payment systems. Further, there is a need to improve customer-centre systems and expand fibre optics systems for more widespread and accessible communications systems (LGSETA, 2020: 85).

In line with this, the research recommendations highlight a need for local government to integrate and develop e-Government more specifically for greater service delivery efficacy and accountability. This is also needed to better business culture and practices. These need to move beyond the constraints of previous red-tape and inefficiencies. Processes such as licencing, obtaining digital data and records management

are already becoming more efficiently handled via digital platforms, although still need refinement. A greater integration of e-Government platforms at local government level will ensure a more proactive modernisation of governance, innovation, and citizen engagement. Greater stakeholder awareness and interaction must be implemented to better support effective 4IR integration (LGSETA, 2020: 91).

## Conclusion

4IR has brought about disruptive and rapid technological changes that are shaping functional services, offerings, and solutions. These exponential and multifaceted changes are forcing a more competitive agility in order not only to survive, but to remain on the innovative edge of change. These changes are not only technologically-centred, but also human-centred because they prompt serious reflections about how humans are engaging and responding to the world in which they live, urging us to find new ways to integrate the changes that have happened and will still happen over the next decades.

In line with this, the public sector must allow for greater innovation in technological integration to better support its service delivery and citizen engagement. It needs to build on legislation and regulations to maximise technological advancements in the various government functions and contexts.

South Africa is still playing catch-up with the rest of the world in integrating 4IR. Whilst the implications of the changes of 4IR are unprecedented and far-reaching, South Africa's focus in integrating 4IR needs to, over the next while, be primarily driven for competitiveness and inclusive growth. This is especially the case since it is a developing country with high levels of unemployment, limited skills levels, and a struggling economy—all of which have been further exacerbated by the Covid-19 pandemic.

South Africa has in place key frameworks to evaluate its readiness for 4IR integration. These frameworks point towards it not being ready from capability, social, and infrastructural perspectives. Within local government, there is great potential and opportunity to integrate 4IR more proactively. However, it has been established that municipalities are not adequately integrating broader 4IR strategies into their IDPs. This is a concern

in that digitalisation still remains isolated rather than integrated in essential local government strategies, functions, and disciplines. Since local government is a priority in 4IR transformation to support essential public service delivery, it needs to become more responsive in integrating these strategies. This is especially important when considering that governments are in a constant state of reinvention and going beyond the New Government Paradigm (NGP) towards a Value-based Paradigm that questions what value means in service delivery to citizens. Local government is especially important in addressing local economic development and is a key driver in eradicating developmental issues. Thus, it is essential to prioritise 4IR on a very practical level, looking at key programmes and projects where e-Government can better drive developmental mandates.

Delivering on 4IR strategies is not just about driving new technologies, but about creating an ethos, culture and environment to support new technologies. Agility and innovation are essential to this and transformative goals need to be carefully considered in bringing about technological change that aligns and supports broader strategic and developmental goals.

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## References

- Arnold, M.W. (2019). 'Business schools are SA's natural partner in the Fourth Industrial Revolution.' *Daily Maverick* [online]. Available at: <https://www.dailymaverick.co.za/article/2019-03-19-business-schools-are-sas-natural-partner-in-the-fourth-industrial-revolution/>
- Balkaran, S. (2016). 'The Fourth Industrial Revolution - its impact on the African Public Sector.' *Academia.edu* [online]. Available at: [https://www.academia.edu/22826511/THE\\_FOURTH\\_INDUSTRIAL\\_REVOLUTION\\_-\\_ITS\\_IMPACT\\_ON\\_THE\\_SOUTH\\_AFRICAN\\_PUBLIC\\_SECTOR](https://www.academia.edu/22826511/THE_FOURTH_INDUSTRIAL_REVOLUTION_-_ITS_IMPACT_ON_THE_SOUTH_AFRICAN_PUBLIC_SECTOR)
- Bojang, M.B.S. (2021). 'Beyond New Public Management Paradigm: The Public Value Paradigm and its implications for Public Sector Managers.' *ResearchGate* [online]. Available at: <https://www.researchgate.net/publication/348418310>
- Bwalya, K.J. (2018). *The e-Government Development Discourse: Analysing Contemporary and Future Growth Prospects in Developing and Emerging Economies*. Cape Town: AOSIS. <https://doi.org/10.4102/aosis.2018.BK71>
- De Oliveira Luna, Kruchten, and Moura. (2014). 'State of the Art of Agile Governance: A Systematic Review.' *ResearchGate* [online]. Available at: [www.researchgate.net/publication/268079328](http://www.researchgate.net/publication/268079328)
- DPSA. (2004). 'National e-Government Strategy and Roadmap.' Department of Telecommunications and Postal Services [online]. Available at: [https://www.dtps.gov.za/images/phocogallery/Popular\\_Topic\\_Pictures/nationalLe-Gov\\_Strategy.pdf](https://www.dtps.gov.za/images/phocogallery/Popular_Topic_Pictures/nationalLe-Gov_Strategy.pdf)
- Kaeser, J. (2018). 'The world is changing. Here's how companies must adapt.' *World Economic Forum* [online]. Available at: <https://www.weforum.org/agenda/2018/01/the-world-is-changing-here-s-how-companies-must-adapt?fbclid=IwAR0rM7nuVxd->

KGPDQmCaKizHRk\_yNT4Le01KQ6aE-3SRXUPcCEle\_SKd7Y7w

Khan, H.A. (2018). *Globalisation and the Challenges of Public Administration: Governance, Human Resources Management, Leadership, Ethics, e-Governance and Sustainability in the 21st Century*. Cham, Switzerland: Palgrave Macmillan.  
<https://doi.org/10.1007/978-3-319-69587-7>

LGSETA (Local Government Sector Education and Training Authority). (2020). 'Research on the 4th Industrial Revolution: Implications for Local Government in the Context of Skills Development.' City Insight [online]. Available at: [www.cityinsight.co.za](http://www.cityinsight.co.za)

Lele, U. and Goswami, S. (2017). 'The Fourth Industrial Revolution, Agricultural and Rural Innovation and Implications for Public Policy and Investments: A Case for India.' ResearchGate [online]. Available at: [www.researchgate.net/publication/319957420](http://www.researchgate.net/publication/319957420)  
<https://doi.org/10.1111/agec.12388>

Manda, M.O. and Dhaou, S.B. (2019). 'Responding to the Challenges and Opportunities in the 4th Industrial Revolution in Developing Countries.' ResearchGate [online]. Available at: [www.researchgate.net](http://www.researchgate.net)  
<https://doi.org/10.1145/3326365.3326398>

Mawela, T. (2015). 'Towards a transformational government framework for sub-Saharan Africa.' Pretoria: University of Pretoria. [online] Available at: <http://hdl.handle.net/2263/50692>

Mawela, T. Munganda Ochara, N. and Twinomurinzi, H. (2017). 'E-Government implementation: A Reflection of South African Municipalities.' SciELO [online]. Available at: <http://www.scielo.org.za/pdf/sacj/v29n1/09.pdf>  
<https://doi.org/10.18489/sacj.v29i1.444>

Mbatha, B. (2019). 'A Discussion on the Industrial Revolution in South Africa: Focus on Policy Formulation.' Academia.edu [online]. Available at: [www.academia.edu](http://www.academia.edu)

Mailane, L. (2021). 'Gauteng Introduces Innovation Centre, 4IR Strategy - 27 August 2021.' Gauteng Provincial Government [online]. Available at: [www.gauteng.gov.za](http://www.gauteng.gov.za)

Mamphiswana, R. (2020). *The Fourth Industrial Revolution: Prospects and Challenges for Africa*. Addis Ababa: Ethiopian Academy of Sciences.

Misuraca, G. (2007). *E-Governance in Africa: a Handbook on ICTs for Local Governance*.  
<https://doi.org/10.1145/1146598.1146659>

Ottawa: International Development Research Centre.

Moloi, D. (2018). 'Home Affairs Goes Digital.' SDR: Service Delivery Review, Vol. 11 No. 3 of 2018. Department of Public Service and Administration [online]. Available at: [http://www.dpsa.gov.za/dpsa2g/documents/service\\_delivery\\_review/SDR%20Vol%2011%20No%203%202018.pdf](http://www.dpsa.gov.za/dpsa2g/documents/service_delivery_review/SDR%20Vol%2011%20No%203%202018.pdf)

Moloi, D. (2018). 'Garbage in, cash out.' SDR: Service Delivery Review, Vol. 11 No. 3 of 2018. Department of Public Service and Administration [online]. Available at: [http://www.dpsa.gov.za/dpsa2g/documents/service\\_delivery\\_review/SDR%20Vol%2011%20No%203%202018.pdf](http://www.dpsa.gov.za/dpsa2g/documents/service_delivery_review/SDR%20Vol%2011%20No%203%202018.pdf)

Musgrave, A. (2018). 'SA's (finally) talkin' bout the fourth industrial revolution.' BL Financial Mail [online]. Available at: <https://www.businesslive.co.za/fm/features/2018-11-22-sas-finally-talkin-bout-the-fourth-industrial-revolution/>

Mtungwa, S. (2018). 'Free wi-fi connects city dwellers.' SDR: Service Delivery Review, Vol. 11 No. 3 of 2018. Department of Public Service and Administration [online]. Available at: [http://www.dpsa.gov.za/dpsa2g/documents/service\\_delivery\\_review/SDR%20Vol%2011%20No%203%202018.pdf](http://www.dpsa.gov.za/dpsa2g/documents/service_delivery_review/SDR%20Vol%2011%20No%203%202018.pdf)

Olaitan, O.O., Issah, M. and Wayi, N. (2021). 'A framework to test South Africa's readiness for the Fourth Industrial Revolution.' South African Journal of Information Management, 23(1): a1284. [online] Available at: <https://doi.org/10.4102/sajim.v23i1.1284>  
<https://doi.org/10.4102/sajim.v23i1.1284>

Province of KwaZulu-Natal. (2020). *Digital Transformation Strategy: 2020-2025*. Durban: Moses Kotane Institute.

Schwab, K. (2018). *Shaping the Future of the Fourth Industrial Revolution*. New York: Crown Publishing Group.

Schwab, K. (2016). *The Fourth Industrial Revolution*. New York: Crown Publishing Group.

Singh, S. and Travica, B. (2008). 'E-Government Systems in South Africa: An infoculture perspective.' Wiley Online Library [online]. Available at: <https://onlinelibrary.wiley.com/doi/full/10.1002/isd2.12030>

Vinod Kumar, T.M. (2017). *E-Democracy for Smart Cities*. Singapore: Springer.  
<https://doi.org/10.1007/978-981-10-4035-1>