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The Fourth Industrial Revolution (4IR) readiness in South Africa's public sector: Pathways to achieving SDGs

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Abstract

The attainment of Sustainable Development Goals (SDGs) through fostering comprehensive, sustainable and equitable progress remains a significant global endeavor for all nations. South Africa encounters formidable challenges in achieving SDGs, encompassing elevated levels of poverty and inequality, unemployment, and insufficient access to quality education and healthcare. With the emergence of Fourth Industrial Revolution (4IR) which brought about digital technologies that are affecting all sectors of life, delivering services has presented numerous challenges as well. The article evaluates the readiness and preparedness of public sector institutions to utilise digital technologies to enhance and accelerate service delivery to all citizens. The study adopted a qualitative research methodology and data was collected from secondary sources such as journal articles, reports, dissertations, theses and official documents from Google Scholar, ResearchGate, Scopus, JSTOR, and Google. The study has revealed that public sector institutions in South Africa are ready for 4IR to some extent, however preparedness has not been fully considered. Thus, it is for this reason that this study aimed to prove extensively that readiness and preparedness should be used concomitantly. The findings reveal the relevance of the psychology of people and how their preparedness can hinder the significance of 4IR for effective service delivery. The paper concludes by arguing that 4IR readiness and preparedness by public sector institutions are fundamental to addressing service delivery challenges, economic disparities and thus promoting SDGs and creating an inclusive and sustainable future for all.

Keywords: Fourth Industrial Revolution (4IR); Sdgs; Digital Technologies; Public Sector Institutions

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1. Introduction

The achievement of Sustainable Development Goals (SDGs) by promoting comprehensive, sustainable, and equitable progress is a critical global effort for all countries, and South Africa is not without an exception. South Africa is currently confronted with service delivery crises as witnessed through ongoing service delivery protests by dissatisfied communities (Khoza, 2023), which requires multiple approaches to be tackled successfully. In this context, Fourth Industrial Revolution (4IR) technologies and conceptual frameworks could become beneficial in identifying feasible solutions. The use of 4IR technology and innovations can facilitate the nation's progress in overcoming obstacles such as poverty (SDG 1: End poverty in all its forms everywhere), inequality (SDG 10: Reduce inequality within and among countries), and unemployment (SDG 8: Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all) (Mbiza and Sinha, 2023). However, the emergence of the 4IR in modern world affairs presents both opportunities and challenges. The 4IR has been spreading across countries, and many African countries have started to feel the impact in some sectors of the economy (Olaitan et al., 2021). In Africa, there have been efforts to adopt digital technologies that come with 4IR technologies to improve service delivery processes while significantly achieving Sustainable Development Goals (SDGs). The president of the Republic of South Africa in his speech in 2019, endorsed the 4IR as one of the means through which the government is going to adopt to solve social problems.

> *Given what we know today about the potential beneficial impacts of the Fourth Industrial Revolution, we must embrace this historic confluence of human insights and engagement, artificial intelligence and technology, to rise to the challenges of poverty, unemployment and inequality".* (Ramaphosa, 2019)

Mbiza and Sinha (2023) assert that while the adoption of technology innovation may be crucial for expediting the advancements required to enhance South Africa's future; automation and artificial intelligence (AI) technologies have indisputably resulted in job displacement and heightened economic inequality. Moreover, the implementation of these technologies has also sparked concerns relating to the lack technology infrastructure, the lack of resources by citizens, and the lack of capacity by public sector institutions in South Africa which continue to widen the technology gap leading to extreme social inequality. As such, this paper argues that for South Africa to fully leverage 4IR as a pathway to accelerate service delivery and achieve SDGs, it is imperative that public sector institutions are ready and prepared for this revolution. Therefore, the aim of this paper is to assess 4IR readiness and preparedness by South Africa's public sector to improve service delivery while significantly achieving SDGs. This means the paper evaluates whether public sector institutions are ready to integrate 4IR technologies to address service delivery inefficiencies and deliver quality services to the people through the use of 4IR technologies and whether people are informed about digital technologies to request and receive those services and ultimately drive progress toward SDGs. The research question that the paper seeks to answer is to what extent are South African public sector institutions ready and prepared to adopt digital technologies to improve service provision to the citizens, thus attaining SDGs, and to what extent are citizens aware of such technologies.

To achieve the aim and answer the research question, the paper is divided into five sections. The first section provides a conceptualisation of terms that are central to the study. The second section provides the

research methodology adopted in the study. The third section provides the literature review entailing the background and context of 4IR; the role and effects of digital technologies in service delivery; and thus, examining the extent to which South African citizens are enlightened in terms of digital technologies that come with 4IR and how to use such technologies to request and receive services from the government. This means that the section seeks to assess whether South African public institutions have recognised the roles and advantages of digital technologies in improving the provision of services to the people. The fourth section provides the findings and discussions of the study with the aim to assess and understand 4IR readiness and preparedness by public sector institutions in South Africa to improve service provision and ultimately achieve SDGs. Then, the fifth section provides concluding remarks and research implications.

2. Conceptualisation of key terms

This section defines concepts that are central to this paper.

2.1. Fourth Industrial Revolution (4IR)

Since the start of the 4IR, scholars and advocates of the 4IR have contributed to the corpus of research to define 4IR sometimes referred to as industry 4.0. McGinnis (2023) describes 4IR as the blending of the digital, physical and biological world, including the fusion of advancement in artificial intelligence, robotics, genetic engineering, quantum computing, 3D printing, internet of things (IoT) and other technologies. While Schwab (2016) defines "4IR as a revolutionary change that is mostly described by the global use of diverse technologies which is characterised by more ubiquitous use of the mobile internet, much more powerful, smaller and cheaper sensors and the use of AI and machine learning". According to Min et al. (2019), "the Fourth Industrial Revolution is an era of technological advances premised on information and communication". Nhede et al. (2022) denote 4IR as the emergence of cyber-physical systems entailing completely new proficiencies for people and machines, signifying completely new methods of how technology is entrenched within societies. Fundamentally, 4IR signals the innovation and digital transformation of the whole system, though not only for production but for administration and management as well.

According to Nel and Masilela (2020), innovation is a prerequisite for adapting to the 4IR. Therefore, it is impossible to define 4IR without taking into consideration the description of innovation. As such innovation is defined by Nel and Masilela (2020) as the execution of a novel or a significantly enhanced product (either good or service), or a process, a new marketing communication, or a new business organisational approach in its practice, or external relations. Innovation within the era of the 4IR has become a significant and an exceptionally important element. Additionally, innovation is well recognised in many fields (professional and academic), as well as public sector institutions and private sector businesses as a crucial driver of the creation of new products and services, economic growth and development, rigorous market expansion and penetration, improved efficiency in an organisation, and the creation and provision of public services to citizens of a country (Nel and Masilela, 2020). Moreover, innovation is defined by Shava and Vyas-Doorgapersad (2022) "as a dynamic process through which problems and challenges are defined, new creative ideas are developed, and new solutions are selected and implemented". It is thus, imperative to note that innovation encompasses the integration of digital technology in the creation or adoption of value-enhancing novelty, whether a product, process or a service as stated by Shava and Vyas-Doorgapersad (2022).

2.2. Public sector institutions

In order to derive the meaning of public sector institutions, the paper first defines the term institutions, then the definition of the public sector. A prevalently accepted definition of the concept of "institutions" is provided by Joshi and Carter (2015) as the formal and informal regulations that orchestrate social, economic, and political relations. Hogson (2006) denotes that the latter refers to established and predominant systems that structure social interactions. The term institutions is/are often referred to or confused with "organisations". In essence, public institutions are basically all offices, agencies and all other entities that constitute local, provincial, and federal governments. These organisations are funded by taxes to operate in the service of citizens. In defining the public sector, scholars are increasingly challenged to reach a consensus on the term. On one hand, the World Bank Group (2018) refers to the public sector as comprising "upstream core ministries and central agencies, downstream bodies (including sector ministries, regulators, State-Owned Enterprises and corporate bodies), and non-executive state institutions (including judiciaries, legislatures and Supreme Audit Institutions)". On the other hand, Pitzer and Dupuis (2006) define the public sector as a portion of the economy which consists of all organisations that are owned and controlled by the government. This in essence incorporates everything from schools, roads, and bridges. The common definition of the public sector involves ownership and control by the government instead of a mere function, and thus includes for instance activities such as exercising public authority or public policy implementation.

Joshi and Carter (2015) describe public sector institutions as legislative frameworks, policies, formal and informal norms as well as codes of conduct that generate the incentives that drive governments' decision-making, public sector employees' behaviour, allocation of resources and eventually the exercise of power within the state bureaucracy. The primary purpose of the public sector is to render services that are well-thought as essential to the society's wellbeing. As such, these services are provided for free or at a subsidised rate. The significant role of these public sector institutions is to ensure the smooth running of the society and promote economic growth and stability (Pitzer and Dupuis, 2006). As such, the paper draws from the definition of public sector institutions as all public entities as well as parastatals within the public service.

2.3. Service delivery

Service is defined by Crous (2002) as the duty or work performance by an official, or the power to control and utilise resources as an act of assisting others, or a system or an institution providing the public with something necessary or useful. The act of delivery is described as creating or conducting, handing over, taking goods to the intended recipient or executing outcomes as expected or as promised. Crous (2002) adopts the two definitions, to come up with a combined definition of service delivery as the "government's provision of a product or service to the society that was promised or which the community is expectant of". The concept 'service delivery' has for quite a number of times been utilised in a variety of contexts to describe the relationship between the government and its citizens in the process of service provision to citizens. With that being said, the quality and sustainability of the services are the main determining factor as to whether the government of the day is effectively and efficiently providing the required services to its citizens. These services for example include social, economic and infrastructural services (Mphako, 2013). Additionally, Mphako (2013) contends that there is a correlation between the quality-of-service delivery and the way in which public institution's governance is conducted. For the purpose of this paper, "service delivery is the public

sector's provision of goods and services to address societal needs". This study considers it as a measure of public sector efficiency and responsiveness within the context of 4IR. 4IR presents transformational technologies such as big data analytics, blockchain, virtual reality and artificial intelligence which can be efficient and effective to improve service delivery in South Africa. However, in order for South Africa to benefit from this transformation in their service delivery endeavours, public sector institutions are ought to be ready and prepared. As such, the paper asserts that the provision of efficient and sustainable services is crucial in achieving the SDGs by guaranteeing that vital services are accessible to all communities, especially those who are most vulnerable.

2.4. Sustainable Development Goals

The Sustainable Development Goals (SDGs), also referred to as the Global Goals, are a comprehensive and an inclusive initiative aimed at eradicating poverty, safeguarding the environment by 2030, and promoting peace and prosperity for all individuals (United Nations Development Programme, 2024). The SDGs are a collection of 17 interrelated global goals created by the United Nations in 2015. Their objective is to tackle the most urgent global issues by 2030, with the aim of fostering economic well-being while safeguarding the environment (Nkhabu, 2021). SDGs encompass a wide array of concerns, such as poverty, malnutrition, healthcare, education, gender parity, access to clean water and sanitation (Statistics South Africa, 2023). More concerns include renewable and accessible energy, fair employment, industrial growth, mitigating inequalities, creating sustainable urban areas, promoting responsible consumption, addressing climate change, preserving marine ecosystems, conserving terrestrial ecosystems, fostering peace, ensuring justice, establishing robust institutions, and fostering partnerships (Statistics South Africa, 2023). All these issues are critical service delivery challenges which necessitate robust strategies and enhanced capacity by public sector institutions to address them.

3. Methodology and approach

The study employed a qualitative research methodology and involved a comprehensive review, analysis, and evaluation of secondary data sources related to the subject under investigation from university databases (such as thesis and dissertations), as well as academic databases such as Google Scholar, ResearchGate, Scopus, JSTOR, and Google. The study drew heavily on secondary sources to obtain the pertinent and necessary information needed to achieve the article's objectives and suggest a solution to the central issue. This was achieved by examining readily accessible relevant literature and concentrating specifically on public sector, 4IR, service delivery and SDGs. The study comprised comprehensive document analysis from various reports on 4IR, service delivery, public institutions and SDGs, from South Africa and other countries in similar contexts, such as government gazettes, news bulletins and policy briefs. As such, these reports were pursued to understand the level of 4IR advancement and adoption in public institutions and the various strategies currently utilised which aided the researcher to arrive at an in-depth conclusion. All sources were chosen according to the fundamental principles of source evaluation: authenticity, credibility, representativeness, and significance (Lubinga et al., 2023). The selection of these sources was critical in ensuring that only the most pertinent and high-quality studies were considered for analysis and review to enhance the reliability and

credibility of information. Recent articles were selected to ensure that the information reflects the latest trends and advancements as the key themes of this paper are 4IR and SDGs which are rapidly evolving trends and thus new sources were critical for accuracy.

4. Literature review

4.1. Background and context of 4IR

The term industrial revolution (IR) is a significant historical process in local, regional, national, and continental and internal contexts (Mohajan, 2019). Industrial revolution as a concept refers to a time when advancements in technology led to profound and dramatic changes in the socioeconomic circumstances of individuals and nations (Olaitan et al., 2021). While the 4IR (also known as the 4IR or Industry 4.0) is designed to transform society in ways never previously possible, it expands on the foundation of the first three industrial revolutions (McGinnis, 2023). The First Industrial Revolution was sparked by the invention of steam locomotive power, which transformed textile industries in England and other developed countries between 1760 and 1840 (Olaitan et al., 2021). During this period, railways served as the primary mode of transportation and coal served as the primary source of energy. In terms of capital invested, output value, and employment, textile and steel were the two most important industries (Xu et al., 2018). The advent of electricity, mass production, and the division of labour contributed to the Second Industrial Revolution (2IR), which took place between the end of the 19th and the beginning of the 20th century. This led to a period of tremendous industrialisation where mass production was powered by oil and electricity (Xu et al., 2018).

This was later followed by the Third Industrial Revolution (3IR) which occurred in the early 1950s and signalled the development of electronics as well as information technology to automate production. With this wave, a wealth-based informational system progressively emerged across the globe. During this time, due to major innovations in fields like mobile telecommunications, millions of individuals all over the world had access to digital capabilities (Nhede et al., 2022). Currently the world is experiencing the early stages of the 4IR coined by Klaus Schwab which has been said to have been originally mentioned in the 1940s (Olaitan et al., 2021). This revolution often referred to as 'industry 4.0' is the use of technology as well as a combination of cutting-edge production methods and intelligent systems to integrate digital, biological, physical world and organisations. Although each industrial revolution is frequently seen as a distinct event, when taken as a whole, they can be better viewed as a chain of interconnected activities that built on breakthroughs made during the preceding revolution and gave rise to more sophisticated forms of production (Xu et al., 2018).

The 4IR was first popularised by the World Economic Forum (WEF) in 2015 to describe globally impending transformations to business, education, and labour models brought by the development of cyber-physical networks (Markowitz, 2019). These technologies driving 4IR include among other things artificial intelligence (AI), big data, blockchain, cloud computing, Internet of Things (IoT), 3D printing, synthetic biology and advanced materials. The 4IR is a notion that is extensively debated amongst business executives, scholars and researchers. Critics have described 4IR as a rapidly approaching challenge, a wide-ranging pattern of visible change in distance, and an impending thunderstorm. However, proponents advocate that people's lives can be enhanced by the opportunities brought by 4IR technologies. According to Sithomola (2021), "almost all sectors of society around the world agree that 4IR is an unavoidable force driving a wide range of products and

services that are quickly becoming an essential and incredibly useful component of nearly every aspect of modern life". This is also apparent in South Africa's context. The 4IR according to Schwab (2016) is developing exponentially rather than at a linear pace, when compared to earlier revolutions.

Digital technologies are largely adopted in developed countries and countries such as Canada, Australia and Switzerland are pioneering the way. As such, the adoption and usage of 4IR technologies in developed countries have reached an advanced stage and it now spreading in developing countries. Toure (2021) argues that Africa was largely left out in the first, second and third industrial revolutions. However, Morsy (2020) corroborates that the 4IR represents a unique opportunity for African countries to leapfrog over development hurdles with the help of technology. On that note, Olaitan et al. (2021), and Mangwanya and Uwizeyimana (2021) assert that the adoption of cutting-edge technologies under 4IR will lead to an increase in production and service provision, particularly for those goods and services that are necessary for contemporary society in developing countries. As a strategy to improve service delivery, South Africa took advantage of the 4IR technologies to try and solve the historical challenge of service provision.

As much as the adoption of 4IR proposes opportunities to the world at large, it also presents challenges and South Africa is no exception. 4IR has the potential to be one of history's most revolutionary and disruptive transformations (Jarbandhan, 2017). Xu et al. (2018) argue that growing trends in artificial intelligence for example point to major economic disruptions in the years to come. Hence, it is without a doubt that although the potential of 4IR is realised, it will adversely put a lot of pressure on public authorities in South Africa as they will be required to re-evaluate and alter the manner in which public sector institution's function. In support of this, Abubakar and Shrestha (2020) note that public sector institutions are now constantly forced to adapt their methods of operation to new realities and innovation by integrating 4IR technologies in their processes and systems. As a result, these modifications constitute challenges for decision making, policymaking and operations for the latter. For example, Nhede (2018) cited in (de Vries et al., 2018) states that digitalisation has tremendously challenged decision making processes of the public sector.

Recent studies reveal that South Africa's public sector encounters distinct obstacles in using 4IR technology to attain Sustainable Development Goals. Ongoing socio-economic disparities, resource limitations, and deficiencies in technology infrastructure impede the successful implementation of 4IR solutions (Mbiza and Sinha, 2023). According to Alexander (2022), a key challenge in South Africa is insufficient infrastructure mostly in remote areas. As a result, inadequacies in infrastructure provision impede the development and expansion of 4IR systems for the public sector, making it difficult for the government to successfully render quality and sustainable services to citizens. Moreover, this further hinders citizens to fully participate in 4IR and current e-government initiatives. A study by Khoza (2023) found that local government in South Africa does not have sufficient funds to invest or procure 4IR technology. The study also revealed that public officials in local government lack digital skills and expertise fundamental for 4IR and as a result these municipalities therefore have to depend on outsourcing skilled consultants from the private sector which in turn creates a financial burden on them due to costs related to remunerating these consultants. Shava and Hofisi (2017) argued that the while 4IR improves productivity, the dilemma especially in the public service is that there will be a large number of workers with little or no job to do as 4IR introduces technical advancements in robotics and artificial intelligence that necessitate a reduction of human labour by both public and private sector institutions. This was evident for example, when Covid 19 hit, most municipalities in South Africa had to retrench and layoff some of the employees due to cutting down of operations that required a physical setting

(Department of Planning Monitoring and Evaluation, 2020). Thus, this paper contents that to fully embrace 4IR technologies and reap its potential requires readiness and preparedness for such a revolution. Therefore, it is imperative that the public sector in South Africa address these issues to be able to capitalise on the advances of 4IR to further its development objectives (Mbiza and Sinha, 2023).

4.2. The role and effects of digital technologies in service delivery

In this 4IR era, the emergence of digital technology is revolutionising the realm of contemporary service provision according to Olaitan et al. (2021), propelling progress and effectiveness, augmenting and nurturing openness. These technological breakthroughs are fundamentally changing the way services are rendered and perceived, resulting in enhanced outcomes across different sectors. Layton-Matthews and Landsberg (2022) contend that the Covid-19 pandemic has highlighted the pivotal role of technology in supporting communities and promoting economic progress, especially in situations where conventional approaches are disrupted. The pandemic has profoundly altered the operations of workplaces, emphasising the critical necessity for technological integration to ensure efficient functioning, even at a fundamental economic level. In addition to improving service delivery, insights gained from the World Economic Forum in 2016, demonstrate the potential impact of digital technology on expediting socio-economic progress. Therefore, by leveraging advanced technologies to drive innovation, productivity, and sustainable growth, governments need to capture 4IR opportunities with both hands. Moreover, 4IR has the capacity to propel countries that are ready and prepared for the digital age into unparalleled economic success. Schwab (2016) asserts that emerging technologies have the potential to significantly influence various aspects of society, including the economy, business operations, market dynamics, the labour force, and individuals' livelihoods. In highlighting the potential benefits of digital technologies, technological progress offers prospects for more information accessibility, improved communication and networking, broader community engagement, expanded access to goods and services, and higher potential for creativity (Layton-Mathews and Landsberg, 2022). For example, currently, there is a 24/7 prevailing culture, mostly attributed to the connectivity facilitated by information and communication technologies (ICTs), which allow for instant access to information and communication, primarily aimed at enhancing the overall well-being of individuals (Khoza, 2023). The study conducted by Shava and Vyas-Doorgapersad (2022) argues that digital innovations have the potential to drive economic development and prosperity. However, the limited acceptance and technical capabilities of countries using modern ICT devices hinder their ability to bring about significant change. Based on this premise, this has become the foundation of the study to assess technological adoption and capacity strength by public sector institutions.

4.3. The role of the government to enlighten citizens about 4IR

Technologies are expanding beyond the computing capabilities linked with the digital revolution, the physical world is transforming through new production methods and robotics; human capacity is enhanced mentally, physically, and experientially (World Economic Forum, 2018). Furthermore, the environment is pervading to enable greater interconnectedness, supervision, and the efficient use of resources. When highlighting both the opportunities and challenges of the 4IR with regard to the major changes that are underway, Schwab (2016) emphasises the narrative to empower a diverse set of individuals and communities to be consistent, common, and positive. Therefore, the government, as responsible and accountable to its citizens, has a significant role

in enlightening society about the transformative potential of the 4IR. Mawela et al. (2017) stress the importance of implementing supplementary mechanisms to promote dialogue and citizen engagement. Mathebula (2021) is of the view that information and communication technology infrastructure such as broadband connectivity enables effective communication between governments and citizens, integration between people, machines and systems. For example, metropolitan municipalities such as the City of Cape Town and the City of Tshwane by now have made major progress with regard to expanding their ICT infrastructure and making sure that there is access to the citizens through their smart city initiatives. Shava and Vyas-Doorgapersad (2022) are of the view that in order to ensure seamless use of digital advancements, it is imperative for local authorities to establish a facilitative platform that allows citizens to provide input on their needs. Thus, this two-way relationship is crucial for improving service delivery by leveraging digital technologies. This encounter will enhance the relationship between the public sector institutions and the people they serve by fostering trust, engagement and collaboration. One of the popular mechanisms is e-governance. Bannister and Connolly (2012) define e-governance as a combination of "the use of information and communication technologies (ICTs) to support public services, government administration, democratic processes, and relationships among citizens, civil society, the private sector, and the state." While Layton-Matthews and Landsberg (2022) refer to e-government as to a collection of complex digital platforms in the public sector that are utilised to establish and maintain government systems. These platforms also enable service delivery to be delivered in a manner that is efficient, effective, and accessible. In the South African context, it is worth noting that creating an enabling environment and enlightening citizens in terms of digital technologies that come with 4IR necessitates capacitating citizens on the digital know-how on the use of such technologies to request and receive services from the government. Therefore, this places a huge role on the government to ensure that citizens are equipped with the necessary technology and other resources, thus bridging the digital divide (Khoza, 2023).

5. Findings and discussions

5.1. Barriers underpinning successful adoption to 4ir

Markowitz (2019) noted that 4IR has the potential to bring about significant advantages in terms of enhanced productivity to African nations, however, it also poses numerous hazards, notably in relation to the rise of automation. As such, the paper argues that although technology has the potential for the realisation of SDGs and the improvement of service delivery through its creative platforms, it also poses numerous problems during its adoption. This is particularly apparent in the public sector setting, characterised by its complicated bureaucracy and complex institutions.

5.1.1. Inequality (digital divide)

In most social studies, inequality remains one of the most common barriers to successful adoption of digital technologies. According to Shwab (2016), the 4IR will create great benefits and major challenges in equal measure. Schwab (2016) denotes that a concern in particular relates to exacerbated inequality. This refers specifically to the increasing rate of inequality as well as developing concerns about unfairness which in turn

presents such a significant challenge (Shwab, 2016). Markowitz (2019) argues that this exacerbated inequality is not only a societal concern but also a key economic concern. The disparity in access to affordable digital technologies and digital literacy, based on income levels and geographical locations, is intensifying inequality. The digital divide is caused by limited access to resources, lack of digital connectivity, inadequate technological infrastructure, and insufficient skills and knowledge to use new technology. As a result, the gap between individuals with access to digital technology and those without is widening, restricting access to public services and economic opportunities (Ragolane and Khoza, 2024).

South Africa exhibits a paradoxical nature, as it confronts challenges such as poverty, unemployment, and a notable deficit of proficient people (World Economic Forum, 2018). Perhaps the most extensively debated factor contributing to inequality is the prospect of 4IR to increase unemployment. Every industrial revolution entails both job creation and the elimination of jobs. Regrettably, there is evidence suggesting that emerging industries are generating comparatively fewer employment opportunities than in previous eras. Davis (2016) argues that the rising inequality not only affects productivity, mental well-being, and trust but also gives rise to security issues for both individuals and nations. This can be attributed to shifts in employment (as well as job categories in risk) and the skills that are necessary during the era.

In the case of South Africa, a society with more pronounced income and educational inequalities, the After Access Survey 2017 shows that despite the hype around smartphones connecting the poor, the digital divide between the poor and the rich is significant. Furthermore, the data shows that while the digital gap between men and women is diminishing, inequality still persists (Gillwald et al., 2018). Data costs remain prohibitive for the majority of individuals in South Africa, where 47% of the population lacks Internet access. The absence of internet-enabled devices and digital literacy, both correlated with poverty, constitute the primary obstacles to online access. According to Faloye and Ajayib (2021), the digital divide in South Africa dates back to the apartheid era where educational systems were skewed, where resources, income and opportunities were not equally distributed. This gave rise to the gap between the have and the have not. For South Africa to exploit the full potential of 4IR, the country needs to carefully take into consideration ethical, social, and economic implications, ensuring that 4IR benefits are broadly shared, and risks are managed effectively (Department of Communications and Digital Technologies, 2024).

From the above-mentioned aspects, it is worth noting that the provision of fair and just service delivery contributes to the achievement of SDG 10 (Reduced Inequality) by guaranteeing that underprivileged communities receive essential services, thus bridging gaps in access and opportunity. Ultimately, to promote inclusive growth and development, governments and organisations should prioritise the establishment of efficient service delivery systems. It is crucial for them to match their policies with the sustainable development goals in order to build resilient and sustainable societies.

5.1.2. Lack of Infrastructure (especially rural areas)

Information and communication technology (ICT) infrastructure is one of the most important components in ensuring sound communication systems for the purpose of adopting 4IR. However, Mathebula (2021) and Khoza (2023) argue that South Africa is lagging behind in terms of ICT infrastructure which can embrace and facilitate the 4IR. South Africa is also hurdled by the geographical access barriers where disadvantaged communities and rural businesses do not have WIFI or broadband access, computers as well as

centres/facilities from which technology or internet can be accessed further extending the gap between rural and urban areas. Respondents in the study conducted by Sikhakhane and Lubbe (2005) alluded that in Emkhindini Reserve (KwaZulu Natal Midlands) people are lagging behind in the use of the internet and while one of the objectives of the South African government has been to empower communities; yet this goal remains unfulfilled. On the contrary technology infrastructure should be viewed as an indispensable structure for government operations in the 21st century (Khoza, 2023). Efficient service provision is also a fundamental aspect of SDG 11 (Sustainable Cities and Communities), which promotes inclusive and sustainable urban development, necessitating strong infrastructure and services (United Nations Development Programme, 2024).

5.1.3. Poor adaptation and use of 4IR technologies

Comprehending the 4IR is crucial due to the extensive impact that technological advancements have on the training and development of human resources, which in turn affects service delivery. Consequently, public officials require the necessary literacy and skills to effectively utilise social and digital channels for engaging with the public to accommodate this new digital change. Digital literacy remains one of the constraints that hinder the successful adoption and use of digital technologies. A significant number of people, particularly in less developed areas, do not possess the necessary abilities to efficiently navigate and make use of digital technology. This creates a digital divide that worsens pre-existing disparities. Furthermore, this may cause slow or poor adoption of such technology, thereby impeding economic growth and social development. In the public sector milieu, one of the challenges faced by public sector institution managers is the lack of knowledge on the use of modern equipment. The study conducted by Khoza (2023) found that digital literacy is a common barrier in municipalities especially among public officials and servants. According to Gower (2018), Science, Engineering, and Technology represent only 29% of total enrolments in most Higher Education Institutions in South Africa. This is much lower than in other BRICS countries such as India (42.6%) and Brazil (33.9%). Notably, education and skills remain fundamental aspects needed for this 4IR era. Thus, this recall for new strategies in which digital literacy and skills can be transferred among public officials and citizens to enable 4IR adoption.

Nhede et al. (2022) suggest the following inputs in terms of ensuring seamless adoption of 4IR. Firstly, the digital environment requires the public service to fully embrace the digital transformation. Secondly, the public service must prioritise the training of its employees to ensure them obtain the essential skills and competencies needed to properly adapt to 4IR. Finally, when employees are not fully capacitated with digital technologies, it hinders their ability with machines and as a result, it might lead to loss of jobs (Nhede et al., 2022). Thus, possessing the requisite skills and knowledge would enhance employees' dedication and enthusiasm to utilise and embrace new and streamlined technologies, while alleviating their concerns about being replaced by those who have already acquired the relevant abilities. According to Roger’s diffusion of innovation theory, followers often highly regard the opinions of the leaders, hence Cenderello and Bertrand (2022) posit the rate at which adoption occurs is also impacted by a country's political determination, strategic guidance, and philosophical commitment to providing digital services. This means that the government has an overarching role in educating its employees and coming with comprehensive strategies such as fear appeals to motivate and lead them to adapt to the new technologies.

5.1.4. Psychological constraints

While some theorists have discussed the above-mentioned barriers extensively in the literature, the paper contends that the psychological preparedness of citizens as recipients of services and public officials as service providers have not been dealt with in the literature. However, while public sector employees have been seen as critical human capacity for 4IR innovation, the psychological preparedness of public sector employees is considered to be one of the most important things that ought to be dealt with. As a result, in this section, the paper discusses the relevance of the psychology of people and how their preparedness can hinder the relevance of 4IR in the South African public sector institution for effective service delivery. The readiness and preparedness of public sector institutions for the 4IR is greatly influenced by psychological restrictions. According to Al-Maskari et al. (2022), readiness as a psychological concept is defined as "the cognitive precursor to the behaviours of either resistance to, or support for, a change effort". Meaning that aspects such as resistance, support, change and acceptance efforts should be sought in the diffusion and adoption of digital technologies even in the context of South African public sector institutions. A study by Nalubenga and Uwizeyimana (2024) on "Artificial intelligence technologies usage for improved service delivery in Uganda" revealed that African governments have not fully participated in the three previous industrial revolutions. This could perhaps be attributed to as a root cause for low levels of readiness or preparedness for public sector institutions in South Africa. 4IR on the one hand came as a rapid technological advancement which forced African governments who were left behind to be committed and join the movement and utilise digital technologies to enhance public service delivery and sustain the quality of life of citizens. However, on the other hand, such emergence did not prepare anyone psychologically and physically for the change. Resistance to change is one of the primary barriers to psychological readiness for 4IR, which arises from a fear of the unfamiliar and an unwillingness to relinquish conventional approaches.

Nhede (2018) contends that human capital occupies a central part of the life of an organisation. In the public sector, human capital is essential for public service delivery. In their pursuit to produce and deliver services, officials may feel overwhelmed and anxious due to the rapid rate of technical developments and the intricate nature of inventions in the 4IR. Consequently, this may cause mental strain on them, due to having to continuously adapt and keep up with the advancements. The adoption and implementation of 4IR may have disastrous psychological effects given that all facets of human existence will be digitised, eliminating the necessity for physical interaction, hence undermining social relationships and adversely affecting the social capital (Shave and Hofisi, 2017). A 2017 PricewaterhouseCoopers survey involving 10,029 individuals from China, Germany, India, the UK, and the USA revealed that 37% of respondents expressed concern regarding automation jeopardising employment, whilst 60% believed that a limited number of individuals would get stable, long-term work in the future. Moreover, 74% expressed a willingness to acquire new skills or undergo retraining to maintain employability in the future, while 73% believed that technology could not replace the human intellect (Gower, 2018). However, research has shown that approximately 5.1 million job losses between 2015–2020 which resulted due to disruptive labour market changes caused by the introduction of new technologies (Jarbandhan, 2020).

Public officials who have fixed mindsets may doubt their abilities and technological intelligence, which may further impede their preparedness. Psychologically, this may also constrain their willingness to engage and embrace innovation necessary for 4IR readiness and preparedness (Khoza, 2023). A Gallup study encompassing 142 countries revealed that merely 13% of the global workforce is 'engaged', indicating

psychological commitment to their employment. A majority of the workforce (63%) is deemed disengaged, attributing this to a deficiency in motivation (Jarbandhan, 2020). In the same vein, Markowitz (2019) points out that technological advances cause security threats due to the prediction they are also expected to result in a decrease in employment chances in conventional industries. This has psychological effects on employees who might fear losing their jobs and threaten the mental capacity of those who have to deal with the loss. These psychological constraints remain the pressing issues that necessitate governments to effectively act on them to ensure a successful transition in the 4IR.

6. Public sector institutions readiness and preparedness for 4IR

Although the adoption and the use of 4IR technologies and processes have promised the advantages and the potential to solve service delivery problems, the question of readiness and preparedness remains. It can be said that some countries have reaped the benefits of 4IR, and research has shown that public sector institutions in South Africa are to a certain extent ready for 4IR, however, it is still unknown if preparedness was considered. Thus, it is for this reason that this section aims to prove extensively that readiness and preparedness should be used concomitantly. At country level, especially for developing countries and their use of technology, readiness may not necessarily mean preparedness because preparedness in this context refers to the ability of governments, public organisations, communities, and individuals to anticipate and respond effectively to the impact of 4IR, whereas readiness means the willingness to fully embrace the impact of 4IR. Thus, this article argues that public institutions in South Africa may be regarded as ready for 4IR, however this does not mean they are prepared. According to World Economic Forum (2018), readiness is the capacity to take advantage of future production possibilities, minimise risk and challenges, and demonstrate resilience and agility in responding to unforeseen future shocks. As a result, this paper accepts the view by World Economic Forum (2018) that indeed the public sector ought to assess their institutional infrastructure in which public sector institutions in South Africa are capacitated to capitalise on 4IR opportunities, mitigate risks and challenges associated with adopting 4IR as a driver to achieve service delivery and promote SDGs, as well as be resilient to future shocks and the unknown about the future.

6.1. Capitalising on 4IR opportunities

A study conducted by Olaitan et al. (2021) provided a theoretical framework to test South Africa's readiness for 4IR. In their study, they questioned readiness in terms of two dimensions Task-technology fit dimension and viability dimension. Three elements that make up the task-technology dimension include task, technology and fit. The task elements refer to the country or organisation's task requirements. Whereas the technology element refers to available technology features such as communication support, processes architecture as well as information processing. The third element fit, measures the degree to which the new emerging technologies meet the task requirement of the government (Olaitan et al., 2021). As such, this refers to the available resources in a country that impact how quickly emerging technologies develop in South Africa. The second dimension is viability which consists of three factors namely economic, organisational and IT-infrastructural ones. In this case, the economic aspect refers to both the country's financial stability and the economic viability of adopting and implementing the new 4IR technologies (Olaitan et al., 2021). The country's comprehensive

information, communication, and technological infrastructure is evaluated by the IT infrastructure. A nation with advanced technological capabilities would be in favour of the 4IR.

According to the research that is currently accessible, South Africa's IT infrastructure is deemed to be inadequate. Khoza (2023) found that local governments in South Africa do not have sufficient infrastructure to employ ICTs in their process nor have the financial capacity to procure such technologies. African Development Bank Group (2019) argue that readiness propels governments to mobilise the finance to capitalise on the 4IR opportunity. Nel and Masilela (2020) alluded that public sector institutions must be proactive rather than reactive when solving service delivery challenges, requiring them to have information and data assets for sound and informed decision making. Moreover, public sector institutions have the responsibility to strengthen their internal infrastructure resources and re-engineer departmental capabilities to aid them in finding creative, practical and sustainable solutions.

Oliatan et al. (2021) explain the organisation factor as referring to the overall of the country to adopt and utilise 4IR technologies. Based on this, it would be impossible to refer to the overall readiness of public sector institutions without considering the human capital. Shivdasani (2019) corroborated this by considering that an exceptionally proficient population will possess the ability to utilise 4IR innovations. However, South Africa cannot be categorised as having a highly skilled workforce as there is still a high level of illiteracy in the country. To this end, South Africa lacks the necessary capabilities to support the desired level of technological innovation.

6.2. Mitigate risks and challenges associated with adopting 4IR

Mangwanya and Uwizeyimana (2021) argue that the emergence of the 4IR necessitates change and demands the ability to modify and conform to new technological notions. Therefore, while implementing 4IR technology in a public sector institution, it is crucial to ensure that both staff and service recipients are well trained and equipped for this transformative change. Mangwanya and Uwizeyimana (2021) argue that prior to implementing any organisational change, it is crucial to establish the perception that a change is necessary and communicate to all individuals that they must be prepared for it. During the transitional phase, organisations and governments encounter difficulties in adapting to the changing circumstances. Consequently, employees require education, effective communication, support, and sufficient time to adapt (Mangwanya and Uwizeyimana, 2021). The South African government should disseminate information regarding the significance of the 4IR and the ways in which emerging technology might enhance the efficiency of public sector institutions in delivering services. As a result, public sector institutions can adopt Technology Readiness (TR) which is a term that assesses an individual's willingness to accept and use new technology in the course of their regular activities. This will enable them to determine individuals' willingness to embrace digital technologies and monitor the pace and progress of adoption.

6.3. Being resilient to future shocks and the unknown about the future

According to Layton-Matthews and Landsberg (2022), in many contexts, the absence of the agility component necessary for creative and imaginative adaptation to this technological advancement is evident which may affect resilience. This is especially evident in many public sector environments, particularly in developing countries. South African public sector institutions encounter substantial obstacles in developing resilience

towards the 4IR in order to attain efficient service delivery and SDGs. Although there are attempts to incorporate 4IR technologies into government processes, the rate of implementation is frequently hindered by universal challenges. A major hurdle is the ability as well as readiness of public sector entities to adopt and execute new technology due to 4IR entering the market as a shock to many. This then propels the government to be more resilient and prepare for future shocks. A perfect example of this is how the government responded to the Covid-19 pandemic.

7. Conclusion

In conclusion, the study has explored 4IR readiness and preparedness by public sector institutions to improve service delivery and achieve SDGs and suggests what the public sector institutions in South Africa should do to enhance their readiness and preparedness to fully embrace digitalisation of the work environment and improve service delivery. 4IR emergence has promised advantages, opportunities and cutting-edge technologies to accelerate growth and development for nations. However, 4IR has also proven to introduce disruptive and rapid technical advancements that are influencing the development of functional services, offers, and solutions. These rapid and complex changes necessitate a higher level of competitiveness and adaptability in order to not only survive but also, to maintain a leading position in innovation. These changes are both technologically and human-focused, as they encourage deep contemplation on how humans interact with and react to their environment. Therefore, compelling us to discover innovative methods of incorporating the changes that have occurred and changes that will continue to occur in the coming decades. 4IR readiness and preparedness by public sector institutions in South Africa have proven to be lacking due to systematic and psychological concerns. Thus, it is essential that the two components are coupled when grasping the leapfrog opportunity offered by the 4IR to improve service delivery and ultimately achieve SDGs.

8. Research Implications

The findings of this research recommend the following:

- The digital divide remains one of the significant challenges that hinder the successful integration of 4IR especially in developing countries. The South African government needs to address the growing issue of the digital divide. This can be achieved through bridging the divide between the have and the have not, skilled and unskilled as well as the rich and the poor. For example, investing in infrastructural development especially in remote areas. Moreover, public sector institutions need to come up with extensive policies that foster inclusivity ensuring that no one is left behind. The achievement of sustainable development necessitates that one is left behind in this digital transformation. This will in turn lead to the attainment of SDG goal 11: sustainable cities and communities.
- Capacitating public officials and servants with the relevant skills and education needed for 4IR remains fundamental to improve literacy and education. Training and development according to Rykleif and Tengeh (2022), is in fact a psychological research procedure sought to improve the well-being of employees and the efficiency of an organisation. As such training and development programmes will reinforce the existing knowledge and skills sets of public officials thus enabling them to become relevant in the digital era. Capacity building and civic education is also important for communities.

Equipping communities with digital skills will enable them to be able to request and receive services including e-services. As a result, technology literacy can bridge the gap between readiness, preparedness and the pace adoption of digital technologies. As Stephen Hawking once said, "intelligence is the ability to adapt to change" (Marwala, 2019). Thus, digital skills must be at the core of 4IR development. This will ultimately, motivate and encourage officials to readily accept 4IR technologies. Hence, it is worth noting that this will promote SDG 2 ensuring inclusive and equitable quality and education and promote lifelong learning.

- The government should design change policies that outline the need for change and extensively explain the reasons for change as well as why such a change is necessary. This will thus, psychologically prepare both public sector officials and citizens. Successful transformation for 4IR necessitates that both the officially and citizens are mentally invested. It is imperative that when designing such policies, they are in line with the legislative and regulatory framework that regulates 4IR and ICTs in South Africa.
- The fear of the unknown and uncertainty have led to a majority of innovations that come with 4IR being vilified and not embraced. Over and above, this does not only delay the objectives of the SDGs but diminishes the state of institutions in government. This fear in the public sector can be salvaged in two-fold: (1) Increasing awareness and understanding of 4IR technologies through targeted educational programs and workshops can help demystify these innovations as well as offering training and resources, public sector employees and stakeholders can gain a clearer understanding of how these technologies work, their benefits, and their potential risks. This knowledge can reduce apprehension and foster a more positive attitude towards embracing new technologies. (2) Introducing 4IR innovations through incremental steps and pilot projects allows for gradual integration and adaptation. Moreover, starting with small-scale implementations and demonstrating their effectiveness, the public sector can build confidence and showcase tangible benefits. Successful pilot projects can serve as proof of concept, helping to mitigate concerns and encourage broader adoption of these innovations. Consequently, the SDGs objectives would not be farfetched, and public institutions would then deliver services that satisfy the people who are on the receiving end.
- 4IR readiness and preparedness by public sector institutions implies having the necessary resources, technological infrastructure, finance, skills and training, as well as a fixed mindset to fully embrace digital technologies in order to deliver services effectively, efficiently and economically. Therefore, the two concepts should be concomitantly in order to realise SDGs in South Africa. While South Africa has in place key frameworks to evaluate its readiness for 4IR integration, preparedness frameworks should also be pursued.
- The introduction of 4IR and AI in developing countries as compared to Western countries has been slow due resource constraints and dealing with the technology has presented numerous challenges. Thus, it is worth noting that constraints such as budget (affordability), security measures, facilities as well as skills and expertise may further hinder 4IR adoption especially in settings with limited resources. These barriers therefore require extensive measures to enable successful 4IR adoption.

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Conflicts of interest

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