

Technological Readiness Challenges for The Fourth Industrial Revolution (4ir): A Case Study of the Setsoto Local Municipality

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Abstract

The main aim of this article is to assess the Setsoto Local Municipality's readiness to adopt emerging technologies associated with the Fourth Industrial Revolution (4IR). Although both local government officials and citizens require a level of e-readiness (e-literacy and e-skills), a skills deficit and a lack of cluster implementation of 4IR-related technologies have resulted in a mismatch between critical technological vacancies and the delivery of municipal e-services. Additionally, in most instances, municipalities are poorly equipped to provide these services to their local populace. Thus, this study analyses various factors that affect the Setsoto Local Municipality's readiness to adopt 4IR-related technologies in rendering e-services. To address this issue, the study employed a qualitative interpretivist research paradigm to explore the lived experiences of officials in the Setsoto Local Municipality. Thirty-five (n=35) semi-structured interviews were conducted with the management and administrative employees of the municipality. The most significant finding of this article is that the adoption of 4IR technologies is hindered by interrelated financial, staffing, information, and communication technology infrastructure constraints that impact the e-readiness capacity of officials. This article recommends that scholars follow a holistic approach when assessing the readiness of local government to adopt and deliver e-services using 4IR mechanisms to the local community.

Keywords: E-Services, Fourth Industrial Revolution (4IR), Information and Communication Technology, Setsoto Local Municipality

Introduction

Information communication technologies (ICT) associated with the 4IR continue to (re)shape how governments render services and goods to their populace. Therefore, the readiness of public officials to adopt or adapt to the latest frontier ICT technologies in local government is crucial for delivering effective and efficient services, especially in developing countries. In a global survey, Deloitte (2018:3) found that government and business leaders lack knowledge on how to strategically align the benefits brought about by 4IR mechanisms within their internal systems and processes. Similarly, a recent study conducted by the United Nations (2023) revealed that most developing countries (e.g., Latin America, the Caribbean and sub-Saharan Africa) are ill-prepared or the least ready to take advantage of frontier ICT technologies. As a result, the “readiness index” of these countries is negatively affected by skills, ICT deployments, research and development (R&D), and lacklustre industry performance, as well as limited access to finance. Mholongo and Thomas (2024, p.2) added that South Africa’s “readiness is often questioned, since municipalities are currently in a catch-up phase in adopting and/or adapting to frontier ICT.

Considering the above, the local government in South Africa is often characterised as “closer to the people”. It should thus be technologically ready to address the plight of the citizenry. For example, frontier ICT technologies not only provide “new” opportunities for democratic participation, but also improve efficient public service delivery (Jakoet-Salie 2020, p. 19). However, in the 2021/22 *Consolidated General Report on the Local Government Audit Outcomes*, the Auditor-General of South Africa (AGSA) highlighted an ICT challenge facing Free State municipalities, which include, but are not limited to, the weakness of ICT in most municipalities where municipalities show no commitment towards implementing strategies that aim to alleviate the information technology environment. Against this background, this article aims to explore the technological readiness of officials in the Setsoto Local Municipality to adopt 4IR-related technologies in rendering e-services to the local populace. For this reason, this article provides a fresh perspective on how technological readiness for 4IR-related technologies can be improved in Setsoto Local Municipality.

This article is structured as follows: The first section conceptualises the Fourth Industrial Revolution (4IR) from an evolutionary perspective, followed by the theoretical framework underpinning this study. A second major component elucidates and contextualises the technological challenges that confront local government in South Africa. The fourth section discusses the research methodology employed to address the study's aim. The fifth section discusses the results that emanate from the unit of analysis. Finally, recommendations are proposed, and conclusions are drawn in determining the Setsoto Local Municipality’s readiness to adopt 4IR-related technologies.

The Evolution of the Industrial Revolution

History shows that the First Industrial Revolution, Second Industrial Revolution, and Third Industrial Revolution preceded the Fourth Industrial Revolution (4IR). The First Industrial Revolution (1760-1900) mainly made use of water and steam power for production (Ndung’u & Signé, 2020, p. 61), while the Second Industrial Revolution (1900-1960) led to the growth of new industries, which included transportation using oil, electricity in production and lightning (De

Vos, 2017; Ndung'u & Signé, 2020). According to Marnewick and Marnewick (2020:3), both the first and second revolutions had a significant impact on productivity. The Third Industrial Revolution, the *Information Society (1960-2000)*, transitioned from analogue devices to digital or computer technology. This revolution was mainly characterised by the use of ICT, including the internet, to automate production (De Vos, 2017). This article focuses on the Fourth Industrial Revolution (2000-present), a progressive revolution characterised by strong internet connectivity equipped with cheaper, smaller, and stronger sensors. These sensors mainly include artificial and machine learning (Lee *et al.*, 2018, p. 2). However, despite extensive knowledge about the historical developments of the Industrial Revolution, it is also imperative to understand the theoretical framework underpinning the 4IR in local government.

According to Adel (2022, p. 1), the 4IR has made a significant difference in bringing emerging technologies to play a role in organisations, but it has limitations. Adel introduces Industry 5.0 as a revolution that integrates humans and machines to work together, ultimately improving efficiency. Similarly, Momenta (2022:4) asserts that the core principles of Industry 5.0 are that the industry is human-centric, sustainable, and resilient. By drawing on the concept of Industry 5.0, it is important to assess the readiness and adoption of 4IR mechanisms in creating a resilient municipality that can easily adapt to emerging technologies such as Industry 4.0.

Throughout this article, Industry 4.0 will be used interchangeably with the 4IR, whereby the 4IR is used to refer to the digital transformation of production that is monitored by automated systems that are able to make decentralised decisions to transform lives through access to knowledge and digital connectivity as a mechanism of providing service delivery to improve the lives of local communities. Table 1 will be frequently referenced in this article, as it provides a thorough description of the 4IR mechanisms that local governments can utilise to adopt the 4IR and promote service delivery.

Table 1: The ten most influential 4IR technology mechanisms (Adopted from PWC, 2017:18)

Technology	Description
1. Advanced materials	A set of nanotechnologies and other science technologies that can produce materials with significantly improved or completely new functionality.
2. Cloud technology (Big data)	This technology mechanism enables the delivery of computer applications and services using the IoT to reduce storage and computer power needs. Big data is enabled by cloud technology, which allows predictive relationships to form.
3. Autonomous vehicles	Robots enable these vehicles to operate and navigate with little or no human control (e.g., autonomous cars drive without human interference and operate autonomously).
4. Synthetic biology	An interdisciplinary branch of biology applying engineering principles to biological systems.
5. Virtual and Augmented Reality	Computer-generated simulation of a three-image overlay to the physical world (AR) or a complete environment (VR).
6. Artificial Intelligence (AI)	AI includes software algorithms that can perform tasks that normally require human intelligence (e.g., decision-making and visual perception).
7. Advanced Robotics	Electro-mechanical machines or virtual agents that automate, augment, or assist human activities, autonomously or according to set instructions.
8. Blockchain	Mainly a distributed electronic ledger that uses software algorithms to record and confirm transactions with reliability and anonymity.

9. 3D printing	Additive manufacturing techniques used to create three-dimensional objects by 'printing' successive layers of materials.
10. Internet of Things (IoT)	The network of objects embedded with sensors, software, network connectivity and computer capability that can collect and exchange data over the internet and enable smart solutions to complex problems.

Table 1 provides an overview of the most influential 4IR technology mechanisms utilised by nearly all individuals across organisations, industries, and countries. In addition to the overview provided in Table 1, it is also necessary to explain the theoretical framework of the 4IR that informs this study.

Theoretical Framework

As illustrated in Figure 1, several studies emphasised the importance of integrating theories and models in technology adoption (Ali *et al.*, 2018; Ahmad *et al.*, 2019; Simões *et al.*, 2020; Ali *et al.*, 2020). However, there is still insufficient research on integrating theories and models to adopt new technology in organisations and governments, particularly in the local sphere of government. Subsequently, this research integrated the TOE framework, STI, and TRAM (as shown in Figure 1) as a new approach and strategy for adopting emerging technologies brought about by the 4IR in local government. According to Ali *et al.* (2018:1160), most research studies do not include socio-technical, organisational, and environmental factors in ensuring that emerging technologies are readily accepted, which are just as important as the technological factors. Therefore, this research study included the Socio-Technical Innovation theory in assessing the organisational readiness of local government in adopting the 4IR.

The proposed conceptual research model offers a fresh perspective on the adoption of the 4IR in local government, providing guidelines on how certain digital challenges can be addressed by local governments in adopting emerging technologies, such as the IoT and AI. Ali *et al.* (2018:1160) add that these theories and models play a unique role in analysing the various aspects of adopting emerging technologies. Therefore, the proposed conceptual research model will enable the research study to be more intentional and analyse past research regarding IT studies, while new experiences and lessons are learned from the above-mentioned theories and models. Additionally, merging two well-known theoretical models (TOE and TRAM) with a more recent theory (STI) is justified because the attributes of these theoretical models address the development of an inclusive understanding of emerging technologies and their easy incorporation into organisations (Ali *et al.*, 2018, p. 1160).

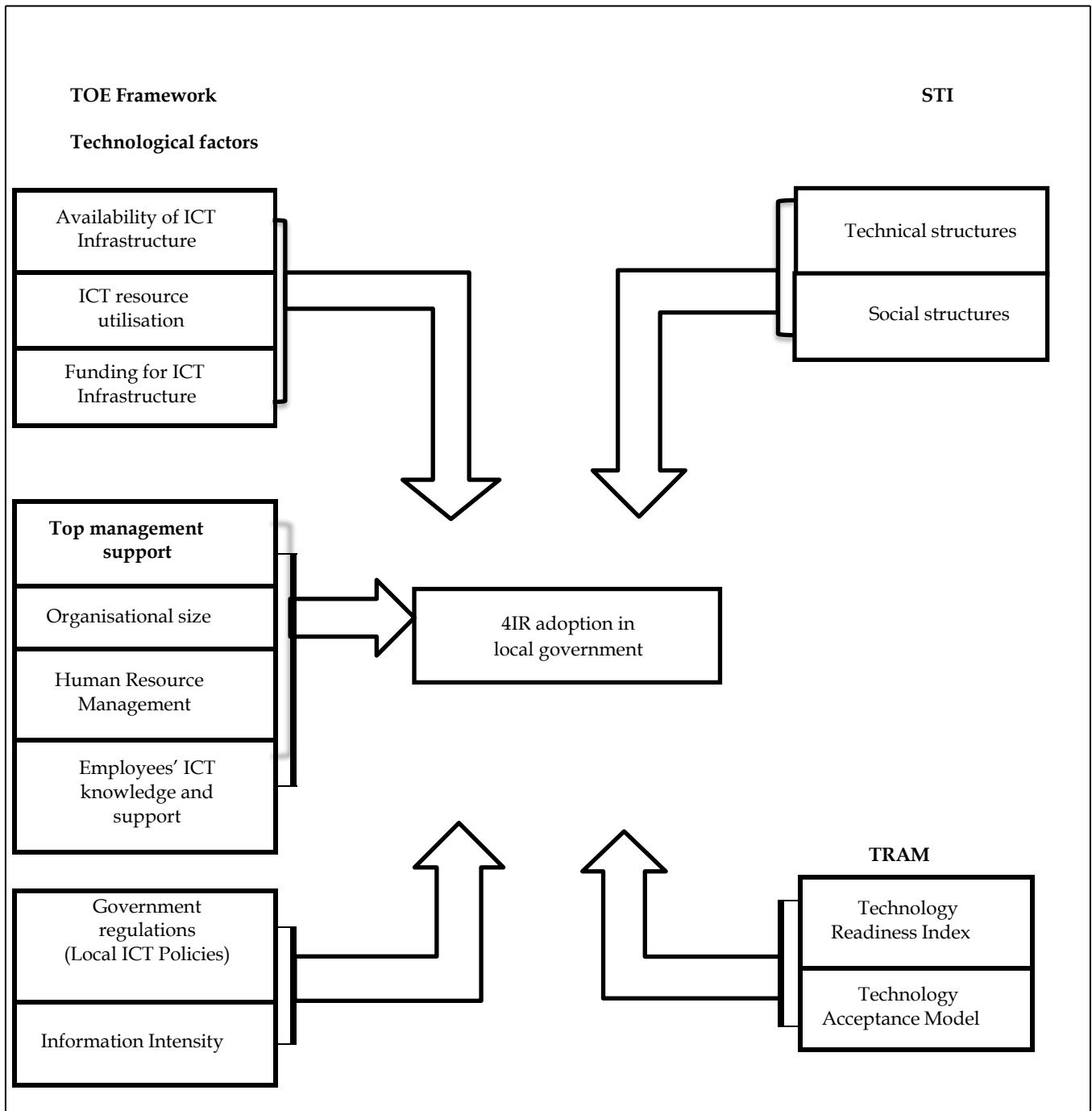


Figure 1: Conceptual Research Model (Adopted from: Ali *et al.*, 2020)

Contextualising ICT Challenges in South African Local Government

Numerous studies have attempted to explain the challenges faced by local governments in implementing information and communication technology (ICT) in South Africa (e.g., Business Connexion, 2016; Pederson, 2016). However, in 2022, the State of South African Cities published an article discussing key challenges and issues local government faced. The key challenges included (i) disjuncture between constitutional and political arrangements, (ii) inadequate collection of municipal rates and taxes, (iii) a lack of local government responsiveness to community needs, and (iv) a lack of continuity and maintenance of infrastructure (State of South

African Cities, 2022:267). For Mabizela and Zwane (2023), service delivery and the overall performance of municipalities also remain a challenge. Consequently, Mabizela and Zwane (2023:) assert that the absence of a monitoring and evaluation system contributes to the lack of effective service delivery, as it hinders the availability of proper systems and tools to assist management in improving how tasks are undertaken to achieve the strategic goals of local government. More recent local government challenges have been summarised by the National Council of Provinces (2019, p. 13), highlighting the key challenges facing the local sphere of government, namely (i) a lack of accountability and good governance, (ii) capacity of finance/budget units in local government, (iii) lack of community participation, (iv) inability to use Municipal Infrastructure Grants (MIG), (v) inappropriate intervention, and (vi) over-employment with resultant staff more than the establishments of municipalities.

Therefore, the challenges reported by the State of South African Cities are similar to those identified by the National Council of Provinces during the 2019 Provincial Week, which was themed 'Building Sustainable, Responsive and People-Centred Municipalities'. Similarly, Mabizela and Zwane (2023) recommend that the public sector actively explore strategies focused on strengthening monitoring and evaluation practices by implementing key principles and approaches that will improve the overall performance of municipalities. Against this background, it is essential to understand why challenges prevent municipalities, such as the Setsoto Local Municipality, from adopting 4IR mechanisms.

Specific Challenges Currently Faced by Local Government in Adopting 4IR Mechanisms

This section outlines a non-exhaustive list of challenges that local government in South Africa face in adopting 4IR mechanisms to promote and improve service delivery. This is particularly necessary, given the sluggish and suboptimal pace at which frontier ICTs are introduced in local government (Netshirando, Munyoka, and Kadyamatimba, 2024, p.2).

Digital Divide

According to Seifert (2017, p.6), the concept of the “digital divide” is explained differently throughout technological research studies. For Yelisha and Yang (2020:1), the digital divide is a technological gap in the access and the utilisation of emerging technologies between individuals, households, businesses, and geographic areas. However, the e-Governance Academy (2007) describes the digital divide as a barrier to digital transformation because the lack of internet access prevents people from benefiting from online services. Seifert (2017) confirms this statement by explaining that the technological gap occurs when a relatively small number of people have access to the benefits offered by emerging technologies. Seifert (2017) notes that the digital divide is two-fold, representing individuals who have significant digital access to emerging technologies, while others have limited or no access to the same emerging technologies. The challenge of the digital divide thereby raises concerns of digital inequality. By drawing on the concept of digital inequality, Gillwald (2019) has shown that digital inequality stems from the digital divide issue and primarily prevents people from fully benefiting from the advantages that emerging technologies bring, resulting in societal inequality.

For this reason, new technologies play a vital role in creating simplicity when using digital devices. However, a technological gap has also been created, exacerbating digital inequality in access to innovative digital services and tools across various demographics. This challenge connects to the level of technology acceptance by individuals and organisations. These technological gaps are evident in the frequent power disruptions in local government areas (Morapela, 2017). The response to this challenge leads to decreased access to new digital services due to the inconsistent electricity supply in local government areas.

Furthermore, the issue of digital inequality remains a persistent challenge that appears to intensify alongside digital transformation. According to Statistics South Africa (2019, p. 44), a relatively high number of young people have access to electricity, while access to basic services, such as municipal waste removal, is low. Ideally, the 4IR should be able to form a link to ensure a balance between minimising digital inequality and providing access to quality public services to all.

The Ownership and Maintenance of ICT Infrastructure and Services

The ownership and maintenance of ICT infrastructure and services is two-fold. Firstly, the availability of ICT in local government is an important component of ownership and maintenance of ICT infrastructure; however, Ndung'u and Signé (2020, p. 66) state that Africa is challenged by infrastructure parameters. Specifically, in South Africa, the infrastructure parameters include the lack of electricity and broadband penetration, which includes internet density. Firstly, the lack of electricity in local government areas appears problematic as the efficient use of natural resources and alternative energy sources is paramount in ensuring that the 4IR flourishes. Therefore, an uninterrupted supply of energy is one of the important tools for a functioning digital transformation in local government. In contrast to this is the issue of load shedding interruptions in local government areas, which have led to increased costs for ICT enterprises for providing internet with no electricity (Masibi, 2015, p. 30). One criticism prevalent in much of the literature on infrastructure is the lack of a fully functioning energy system, which, if not addressed, will continue to have a detrimental effect on the way the 4IR will survive in local government.

Lastly, the use of ICT in local government may determine the extent to which ICT equipment is maintained to keep up with the latest innovations. The South African Local Government Association (SALGA) (2012:14) created a *Municipal Guide to Successful ICT Governance to raise the status and level of ICT in municipalities, promoting effective and efficient administration and service delivery*. Presumably, the municipal guide gives a general overview of how municipalities use ICT in local government. Based on the guidelines, municipalities are expected to develop and maintain ICT governance frameworks, which outline factors such as the municipality's IT organisational system. It is almost certain that SALGA's municipal guide does not keep up with the pace of change and innovation. The possible root problem is that, although the document was revised three times in 2012, SALGA appears not to have updated the document to accommodate the emerging technological issues brought about by the 4IR and provided guidelines for how municipalities can respond to these challenges.

According to Kwon and Park (2017, p. 12586), IT governance is a collective concept encompassing the authority and responsibility of internal entities in IT decision-making, organisational system and process decision-making, communication methods, system and coordination, and control

decision-making. In simple terms, IT governance should form part of a municipality's internal technological structure as it is part of the municipal IT infrastructure-related activities and efforts. Based on the above, an agile local government must collaborate through intergovernmental relations and public-private partnerships to successfully incorporate clear IT governance guidelines that will focus on increasing access to innovation, technology, and knowledge sharing. Aasi (2018, p. 23) maintains that IT governance can influence organisational culture and structure, which can be either constructive or destructive. Thus, there is a strong possibility of a relationship between the IT governance of a municipality and its human resource management system being formed, which may be required to be utilised effectively to provide a constructive organisation, should the relationship exist.

Human Resource Management

Puhovichova and Jankelova (2020, p. 139) define human resource management as a logically thought-out strategy aimed at ensuring a balance between the basic needs of employees and effective employee performance management in organisations. One may suppose that the constant pace of change brought by the 4IR will require human resource management in local government to become more inclusive and innovative. Puhovichova and Jankelova (2020, p.139) further draw attention to the concept of Smart Human Resources 4.0 (Smart HR 4.0). Smart HR 4.0 is a new term within the 4IR that features innovations used to effectively manage both current and future employees. The involvement of Smart HR 4.0 in local government will likely provide employees with a different perspective on delivering public services to communities using the 4IR. However, some challenges prevent concepts such as Smart HR 4.0 from prevailing in local government.

Sourcing adequate digital skills and capabilities can be identified as a digital competency constraint, hindering the introduction and integration of emerging technologies within organisations (Manda & Dhaou, 2019, p. 247). These challenges include skills mismatches and skills redundancy due to the constantly changing nature of jobs. Some authors (Shava & Hofisi, 2017; Govender & Reddy, 2019) argue that more job losses will occur in administrative and white-collar categories, whereas 2.1 million jobs are expected to be created in fields such as computer science, mathematics, architecture, and engineering. Nzimakwe (2021:8) adds that local government often neglects to utilise the benefits of emerging technologies to maximise the delivery of basic services to communities. Together, these authors (Shava & Hofisi, 2017; Govender & Reddy, 2019; Nzimakwe, 2021) provide important insight into the need for digital skills and capabilities in local government to successfully adapt to the digital transformation of the 4IR. On the other hand, their insight highlights the shortage of skills in local government, which may gradually increase due to the demand for new technological skills required to perform work optimally.

Commenting on the shortage of skills in local government, SALGA states as follows:

“The huge ICT skills shortage in South Africa also has a negative impact on the public sector, specifically local governments. Unfortunately, the reality is that staff are made up of under-qualified professionals with watered-down skills that are not geared for real-life ICT crises and challenges. This negatively affects the optimal running of ICT departments and delivery of government ICT projects” (SALGA, 2012, p. 15).

In the statement above, SALGA reiterates that skills mismatches and redundancy have led to local government, in some instances, neglecting to fill critical ICT vacancies with qualified individuals. This challenge has placed the delivery of municipal services and the fulfilment of ICT projects at a disadvantage, as a limited number of individuals possess the necessary ICT skills and competencies. Equally important, Voss and Rego (2019, p. 30) assert that the public sector often lacks IT specialists, such as software developers, computer network and systems engineers, and information systems technicians, to perform technical responsibilities that promote and advance information technology.

The Finance and Investment of Emerging Technologies in Local Government

According to Chen et al. (2021:1), adopting emerging technologies may require organisations to invest large sums of money without any guarantee of profit. Local governments are currently facing various financial challenges, including limited financial resources and cash flow issues. Evidence of this is the lack of accountability from municipalities, which has led to some municipalities facing serious consequences of financial health and service delivery challenges (Parliament of South Africa, 2019:11). To support these findings, the Auditor-General (2018:43) discovered that there are three reasons why the Setsoto Local Municipality suffers from poor financial management. Firstly, the municipality had a salary bill of R200,4 million, which exceeded their cash collected from consumers of R159 million by R41,4 million (Auditor-General, 2018, p. 43). Secondly, the municipality's financial health continued to deteriorate, as the R159 million collected only represented 25% of the R630.8 million collectables from consumers (Auditor-General, 2018, p. 43). Consequently, this led to the municipality failing to maintain its assets. Thus, the municipality only spent R3,5 million on the maintenance of infrastructure assets, which is only 0,12% of its net book value of R3 million (Auditor-General, 2018, p. 43). This resulted in a maintenance shortfall of nearly R240 million. As a result, the Setsoto Local Municipality encountered the biggest shortfall of any local municipality in the Free State Province.

Lastly, the municipality experienced extensive water (42%) and electricity (11%) losses of R24,3 million due to leakages, burst pipes, line losses, tampering and theft. The root cause of these challenges was the municipality's inability to finance and maintain the infrastructure. Perhaps the most serious disadvantage of this revelation is that the Setsoto Local Municipality will take years to recover from the financial loss and regain the financial strength necessary to continue funding daily operations. Difficulties arise, however, when local governments are expected to adopt and diffuse emerging technologies brought about by the 4IR. Accordingly, one may question the extent to which the Setsoto Local Municipality is prepared to fund the 4IR, given its apparent inability to fund and maintain its current infrastructure assets.

Voss and Rego (2019, p.52) argue that investment in infrastructure will require increased time in workers' IT training and development, equipping employers and employees with digital skills, and encouraging the workforce to obtain new qualifications. For this reason, substantial investment is required at the local sphere of government to fund the adoption and maintenance of the 4IR. In addition, the WEF (2018, p. 23) asserts that large capital investments will be required to upgrade and connect technology platforms, adequately train and develop employees with digital skills, adopt technologies, and transform production systems to incorporate 4IR mechanisms. Additionally, for local governments to become investment destinations, they would need to implement measures to address potential investment obstacles.

ICT Legislation and Policy in Local Government

The effectiveness of local government in adopting 4IR mechanisms will depend on the rules, regulations, and legislation that drive technological development and transformation in this sphere of government. According to the WEF (2018, p. 5), rules and policies must ensure that human labour and creativity are augmented rather than replaced. This step may be facilitated through legislation that formulates strategies aimed at preserving citizen democratic participation while integrating the influencing role of emerging technologies in promoting service delivery.

Gillwald et al. (2018) identified three central policies that shape technological development in South Africa, both at the government and industry levels: the 2012 National Development Plan (NDP), the 2013 National Broadband Policy (SA Connect), and the 2016 National Integrated ICT Policy White Paper. Gillwald et al. further report a failure in policy and regulatory areas, which has limited South Africa's readiness for 4IR adoption. On the contrary, the Department of Telecommunications and Postal Services (2016) maintains that its primary objective is to foster a people-centred, development-oriented, and inclusive digital society, where equality, accessibility, transparency, and accountability are prioritised. On the other hand, Gillwald et al. (2018:9) argue:

"Intergovernmental communication is poor. There is no sharing of data and information between national departments and between national and provincial governments, and at local government, it is arguably worse" (Gillwald et al., 2018, p. 9).

The above statement implies that there is a lack of agility, adaptability, and information sharing among the spheres of government, whereby local government, as the sphere closest to the people, receives little or no information and updates on matters concerning ICT development. Difficulties will arise, however, when local government attempts to implement 4IR mechanisms without coordination and communication, in terms of ICT-related matters, with other spheres of government.

The South African Local Government Association (SALGA) has created a municipal ICT guideline, where information sharing plays a key role. The aim is to share information on ICT governance and related topics, where valuable information and ideas will be exchanged. Arguably, local government appears not to have legitimate ICT policies and legislation in place to foster the adoption of the 4IR. SALGA's efforts appear to rely heavily on providing guidelines for ICT governance, rather than solid policies and projects that will drive the 4IR in local government. Evidence of this is the lack of ICT policy documentation in the Setsoto Local Municipality that indicates how the 4IR will be supported and implemented to achieve gradual digital transformation.

The Department of Communication and Digital Technologies indicates that, over the medium term, it aims to integrate and improve policies to align them with the provisions of the 2016 National Integrated ICT Policy White Paper, while taking into consideration the developments brought about by the 4IR. The purpose of this document is to implement the three central policies identified by Gillwald et al. (2018, p.9). The national and provincial governments are making an effort to incorporate the 4IR into their policies and legislation. However, there is limited support from these spheres of government to address the 4IR at the local government level. Municipalities

have few or no sufficient policy guidelines to incorporate this revolution into their policy framework and service delivery provision.

Research Methodology

The study employed a qualitative case study research approach to evaluate the Setsoto Local Municipality’s ability to adapt to the 4th Industrial Revolution (4IR). Thus, this study employed a case study research design to gather in-depth information on the phenomenon under investigation. Consequently, the principal researcher collected data through semi-structured interviews with a purposively selected sample. The study’s population consisted of all employees in the Setsoto Local Municipality who could provide information relevant to the research aim.

The sample of this study included thirty-five (35) participants consisting of six (6) administrative employees from the Office of the Municipal Manager, six (6) administrative employees from the Department of Treasury, six (6) administrative employees from the Department of Engineering, six (6) administrative employees from the Department of Development Planning and Social Security and six (6) administrative employees from the Department of Corporate Services. Lastly, five (5) managers or specialists directly responsible for the management of ICT were interviewed.

This study followed a thematic analysis approach guided by Braun and Clarke’s (2006:81; 2017:297) six-step framework. Thematic analysis is a method for systematically identifying, organising, and offering insight into patterns of meaning (themes) across a dataset. The Braun and Clarke (2006) approach was applied to generate themes and subthemes from the transcribed data collected through semi-structured interviews with participants. Subsequently, one overarching theme and three subthemes emerged from the empirical data (see Table 2).

Table 2: Study’s overarching theme and subthemes

Overarching Theme	Subthemes
Specific technological challenges currently experienced in the Setsoto Local Municipality	1. Financial and investment constraints
	2. Shortage of ICT capacity
	3. Lack of Information and Communications Technology (ICT) infrastructure maintenance

This study considered the following ethical considerations. The principal researcher obtained written informed consent from all participants, as well as approval from the gatekeeper, to ensure adherence to ethical standards and research integrity. Key ethical principles observed included informed consent, voluntary participation, and confidentiality. In addition, ethical clearance was obtained from the University of the Free State prior to the commencement of the study, ethical clearance number UFS-HSD2022/1902/23.

Results and Discussion

The following section outlines the overarching theme and three subthemes derived from the empirical data analysis.

Specific Technological Challenges Currently Experienced in the Setsoto Local Municipality

The research study aimed to outline the ICT-related challenges currently experienced by the Setsoto Local Municipality in adopting 4IR mechanisms. Strong evidence of municipal ICT challenges was found when some participants highlighted that the municipality currently uses traditional communication methods without including 4IR mechanisms. Traditional methods of communication include, but are not limited to, the use of excess paper on a day-to-day basis within the municipality.

Moreover, the issue of load shedding has been brought to attention, as it plays a crucial role in disrupting the technological infrastructure; for example, the level of network connectivity in the municipality, despite having backup systems in place.

Subthemes

- ***Financial and Investment Constraints***

The location and resources accessible to the Setsoto Local Municipality have disadvantaged the municipality due to access to infrastructure, such as the lack of fibre installation in the towns. In the same vein, there was a sense amongst the participants that the Setsoto Local Municipality is not a revenue-generating entity, where the municipality primarily relies on grants as a source of funding. One may infer that the TOE framework is useful in explaining the interconnectedness of the financial technological readiness of Setsoto Local Municipality as it relates to acquiring ICT infrastructure and resources for staff development (see figure 1). The resultant response to this challenge is the municipality's failure to adequately finance 4IR mechanisms. One participant stated:

"We've got vacant positions, but they are not yet filled. We only have two ICT technicians in the municipality, but we need all these other vacant positions to be filled because we need to save and segregate our duties accordingly" [sic].

The comment made by the participant supports the notion that the Setsoto Local Municipality is in a precarious financial position, as previously referenced in relation to the Auditor-General's findings, leading to the next challenge, which explicitly outlines the lack of ICT capacity within the Setsoto Local Municipality.

- ***Shortage of ICT Capacity***

The South African Local Government Association (2012:15) expressed concern over this aspect, stating the ICT skills shortage in South Africa negatively impacted inter alia local government and that it was a "reality that staff was made up of under-qualified professionals with watered-down skills not geared for the real-life ICT challenges and crises". For this reason, the TOE framework is useful for assessing the strategic intent of top management in tandem with the Human Resource Management Directorate in the Sesotho Local Municipality to conduct technology-related skills audits and a training needs analysis. The latter is useful in determining ICT skill shortages and gaps in the Sesotho Municipality (see figure 1). This challenge seems to persist, as Mohale (2024:1) cites the lack of ICT infrastructure as a key challenge for municipalities in South Africa to engage in e-government. The shortage of ICT capacity in the Setsoto Local Municipality is two-fold. Firstly, one participant who responded to this question indicated that the municipality has only two Information Technology (IT) technicians in its IT department. The

technicians primarily handle all technology-related matters within the municipality. Commenting on this issue, one participant acknowledged as follows:

“Our ICT unit does not have enough personnel, but it has people who have the capacity and interest to ensure that we move with the changing world as well” [sic].

The evidence presented thus far suggests that adequate ICT capacity is necessary to fill vacant IT positions with skilled personnel and should not be overlooked. Lastly, during the semi-structured interview, participants indicated a lack of ICT literacy in the municipality. Commenting on this issue, a participant indicated the following:

“There are other employees or personnel who have been here for a very long time. I normally classify them as those who were born before technology. Unfortunately, there’s nothing that we can do. We can’t just get rid of them. They can’t be at the same level of those that were born or have been exposed to technology, but they are they are coping well, and they are almost at the exit stage of the institution. So, for now we would assume that although it is not at the satisfactory level, but yes, they are there” [sic].

According to the extract, the ICT skills deficit and gap in the municipality cannot be easily resolved, as various generations, among other factors, need to be considered during the transition. In this case, the TRAM model will be useful in dissecting multigenerational perceptions on the usefulness of technology. By compiling a technological readiness index on staff traits and attitudes towards technology acceptance, a differentiated approach will be useful in training and developing staff in the Sesotho Municipality. However, this challenge cannot be disregarded as recommendations, not limited to, have been provided by some of the participants, stating as follows:

“It is important that employees do not see the 4IR as a threat but rather see it as an opportunity to learn new technology and enhance their ICT skills by studying and obtaining certificates before the 4IR is introduced” [sic].

Taken together, these results suggest an association between the level of available municipal finances and the extent to which municipality employees are exposed to emerging technologies.

- ***Lack of Information and Communications Technology (ICT) Infrastructure Maintenance***

A recurrent theme in the interviews was a sense amongst the participants that the Setsoto Local Municipality struggles with overall infrastructure management. Indicators such as infrastructure mismanagement and inadequate ICT infrastructure were among the themes identified by the participants. Commenting on the mismanagement of ICT infrastructure, one participant stated:

“We have structures and plans in place; the problem is the management of it. So, it’s just managing of those plans, meaning implementation of it. That’s where the problem is. They require funding, they require proper management, they require people with skills and knowledge” [sic].

The verbatim quote coincides with the TOE framework, especially in highlighting the need to synchronised macro, meso and micro dimensions of information and communication technology in municipalities. Thus, external technology funding and budgeting for infrastructure are directly linked to top management's ability to support, upskill and reskill employees' ICT knowledge. Therefore, the mismanagement of infrastructure and negligence threaten the 4IR from flourishing as it will require extensive management and maintenance. Moreover, a common view amongst participants was that the municipality had inadequate ICT equipment. Inadequate ICT equipment includes, but is not limited to, the following:

"Network challenges, the network is slow and often not stable. This challenge is also affected by the issue of load shedding. Equipment includes printing machines; the main issue with this is that we use one machine to scan documents within the department" [sic].

Moreover,

"One of the major challenges is that it is not accessible to all municipal employees. There'll be some of our officers that do not have access to IT or even network infrastructure to enable them to send emails and things, but even our communication, we have areas within our municipality where you cannot, your network for telephone systems is not adequate" [sic].

It appears that the municipality employees face challenges in terms of ICT accessibility, as it does not reach all employees. In addition to the lack of ICT accessibility, the issue of budgetary constraints to fund ICT equipment was also identified by one of the participants interviewed. For example, utilising old infrastructure equipment, such as laptops. This challenge raises the question that was posed during the semi-structured interview regarding the Setsoto Local Municipality's ability to replace old infrastructure with new and updated infrastructure.

Therefore, the infrastructural challenges currently faced by Setsoto Local Municipality are limiting the municipality from adopting 4IR mechanisms, which are aligned with the specific challenges highlighted in the theoretical framework. Apart from the mentioned challenges, it appears that there is an organisational culture of promoting traditional ways of doing things, as opposed to promoting an agile and digital inclusive environment where sufficient digital capabilities, digital strategies, organisational culture, and talent development drive the digital transformation of the 4IR (Chen *et al.*, 2021, p. 4).

Recommendations

This section aims to provide recommendations for addressing the challenges that administrative employees and the management of the Setsoto Local Municipality face in adopting 4IR mechanisms to promote and improve service delivery. Having considered the potential influence that the adoption of 4IR can have on the Setsoto Local Municipality, the researcher proposes the following recommendations:

Getting the Basics Right

It is recommended that the Setsoto Local Municipality ensure that the key performance areas and predetermined objectives set are aligned with the Back-to-Basics principles. To support this, the Cooperative Governance and Traditional Affairs (2016:18) clearly stipulates that local government has been the primary site for delivering services in South Africa since 1994. Simply put, the Setsoto Local Municipality should be at the forefront of ensuring that services are rendered effectively and efficiently while adopting emerging technologies, because it is situated at ground level with access to the local community. Furthermore, this research study has enhanced our understanding of the challenges the Setsoto Local Municipality currently faces in adopting the 4IR. This evidence thereby highlights the need for the municipality to align its objectives with the Back-to-Basics principles, which encompass promoting good governance through transparency, accountability, and regular community engagement. Putting the people first involves the administrative employees and the management of the municipality, understanding that the services delivered to the local community are ultimately for the greater good of serving the community.

Accordingly, it is essential that the Setsoto Local Municipality creates conditions for decent living by providing, but not limited to, basic quality water, sanitation, electricity, waste removal, and the maintenance thereof. This action will build a sustainable, responsive, and people-inclusive municipality. Adopting sound financial management is imperative in maintaining and building long-term relationships with the local community, affected stakeholders, and investors. This can be achieved by aligning the recommendations proposed by the Auditor-General, reducing wasteful expenditure (e.g., excessive paper usage), and taking decisive action against fraud and corruption.

The Adoption of a Comprehensive 4IR Policy and Legislation in Local Government

The Setsoto Local Municipality needs to adopt and implement a comprehensive 4IR policy that details the stages of 4IR integration within the municipality. The results of this research study support the idea that the municipality's administrative employees and management are still uncertain about how the 4IR will be introduced and integrated into the municipality. This requires re-evaluating the overall Information and Communications Technology (ICT) policy to ensure it adapts to emerging technologies. Additional stages that the municipality could consider include steps detailing the role that 4IR mechanisms will play in promoting service delivery, while ensuring that the rules and policies augment human labour and creativity rather than replacing it with 4IR. This recommendation aligns with the theoretical framework, which emphasises the need for local ICT policies to enhance e-governance and digital services within the municipality.

The Advancement of Investment Prospects of Emerging Technologies in Local Government

It is recommended that the municipality establish realistic investment priorities to ensure the adoption of 4IR mechanisms within the municipality. However, Chen et al. (2021:1) remind us that digital transformation involves an investment of large amounts of money without any guarantee of return. Thus, the municipality needs to initiate collaborative partnerships with

various stakeholders at the forefront of adopting 4IR mechanisms and incorporate these initiatives into their current and future 4IR policy plans. For instance, collaborative partnerships with the Centre for the Fourth Industrial Revolution (C4IR South Africa) (Council for Scientific and Industrial Research [CSIR], 2023) acting in collaboration with the Department of Science and Innovation can provide the Setsoto Local Municipality with insights and best practices in technology governance and enable the municipality to test and refine various enablers for the adoption of 4IR emerging technologies. Among the focus areas of C4IR is to transition the government to a data-driven digital economy, improving its competitiveness and becoming a relevant global player while accelerating the digitalisation of government (CSIR, 2023). Therefore, the Setsoto Local Municipality, acting as an agent for change, will possibly foster sustainable partnerships with various stakeholders.

Sourcing of Adequate and Valuable Digital Skills and Capabilities

This research study extends our knowledge of the inadequate digital knowledge, skills, and capabilities currently experienced in the Setsoto Local Municipality. Therefore, the municipality needs to cultivate a culture of continued learning by incorporating short-term and long-term educational courses, among others, that address digital competency. This solution will ultimately foster a learning environment filled with a competent workforce equipped with digital knowledge and skills. Additionally, the municipality must fill critical ICT vacancies with qualified individuals. The vacancies include, but are not limited to, software developers, computer network and systems engineers and information systems technicians. This research study has demonstrated that the Setsoto Local Municipality faces a shortage of ICT personnel to drive digital transformation within the municipality. Therefore, Chen et al. (2021:4) state that applying digital technologies, such as the Internet of Things (IoT), alone is insufficient to drive digital transformation. Instead, the authors propose an organisation characterised by sufficient digital capabilities, effective digital strategies, an organisational culture that fosters talent development, and a commitment to ensuring successful digital inclusion and transformation of the 4IR.

Conclusion

This article aimed to assess the Setsoto Local Municipality's readiness to adopt technologies associated with the Fourth Industrial Revolution (4IR). Therefore, it was evident that the challenges limiting the municipality's adoption of 4IR mechanisms are aligned with the specific challenges highlighted in the theoretical framework of this article. Apart from the mentioned challenges, it appears that there was an organisational culture that promoted traditional ways of doing things, rather than fostering an agile and digital-inclusive environment where sufficient digital capabilities, strategies, organisational culture, and talent development drive the digital transformation of the 4IR within the Setsoto Local Municipality.

In conclusion, to ensure that the Setsoto Local Municipality is at the forefront of rendering services and ensuring that the service is delivered effectively and efficiently to the local community while adapting to emerging technologies, the municipality needs to put the needs of the people first to achieve the promotion of good governance through transparency, accountability, and regular engagements with communities. Therefore, recognising the significant role emerging technologies, brought by the 4IR, play in local government means that the Setsoto Local Municipality needs to source adequate digital skills and knowledge to bridge

the digital skills gap currently experienced in the Setsoto Local Municipality. The integration of emerging technologies within the systems and processes of the Setsoto Local Municipality is a major concern to the community, and this remains a topic that requires further study, as it is a new research area with no similar studies existing, especially in the Setsoto Local Municipality. As a result, the contribution of this study is two-fold. First, it makes a rare empirical contribution to understanding how the Setsoto Local Municipality can enhance its readiness to adopt 4IR-related technologies for e-governance and digital service delivery. Second, this study contributes to the growing discourse on how local government in South Africa can catch up in adopting frontier ICT.

Declarations

This study received ethical clearance from the UFS General and Human Research Ethics Committee (GHREC), protocol number UFS-HSD2022/1902/23.

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