

Sparking Innovation: Strategies to Boost South African Entrepreneurship in Industry 4.0

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Abstract: The objective of this research is to appraise the level of entrepreneurial activity in South Africa and to identify the challenges to implementation of the fourth industrial revolution (4IR) that obstruct the leveraging of 4IR technologies to boost entrepreneurial activity in the country. A conceptual exploratory literature review approach was applied. This study's results show that a high unemployment rate, the quality of entrepreneurial support initiatives, physical infrastructure, enterprise funds and increased economic freedom are enablers of entrepreneurial activity in South Africa. High data costs, poor digital technological preparedness, an unreliable energy supply, data protection and cyber security risks, among other factors, were identified as obstacles to 4IR implementation. We, therefore, recommend a 4IR fund, mandatory data price laws, proactive policing, further public-private partnerships, enhancement of whistle-blower protection laws, among others, as solutions to buoy entrepreneurial activity through application of 4IR technologies. These results signal the need to ensure a synchronized effort by all relevant spheres of government to address the 4IR implementation challenges and enhance entrepreneurial activity for South Africa's economy.

Keywords: Entrepreneurial Activity; Determinants; Entrepreneurship; Fourth Industrial Revolution (4IR); 4IR Implementation Challenges; South Africa

Introduction

Entrepreneurial activity “is the enterprising human action in pursuit of the generation of value, through creation or expansion of economic activity, by identifying and exploiting new products, processes or markets”, (Ahmad and Seymour 2014, p. 15). This may be interpreted as an economy and its people's innovative or entrepreneurial endeavours to create value through various business ventures. The totality of all these entrepreneurial efforts to the country, as per the Global Entrepreneurship Monitor (GEM 2022) report, culminates in entrepreneurial activity which is a critical engine for society's prosperity and health, and also an important driver of a country's economic growth. According to the same report, overall entrepreneurship activity is indispensable for societal advancement through modernization, which in turn, enables the utilisation of emerging opportunities for further production and employment creation.

Moreover, the Organisation for Economic Co-operation and Development (OECD 2019) refers to the importance of a country's overall entrepreneurial activity, noting that the most prevalent businesses and job creation emanate from entrepreneurial activities. In addition, Ssekitoleko and du Plessis (2021), and Meyer and de Jongh (2018) consider entrepreneurial activity in South Africa to be a major factor in enhancing the general buying power, along with helping in the dissemination of knowledge to both individuals and business entities. The most commonly used measure of a country's entrepreneurship activity is the Total Early-Stage Entrepreneurship Activity (TEA), the percentage of the adult population of the age group 18–64 that are launching or managing a new business (Meyer and de Jongh 2018). South Africa's TEA grew from 6.5% in 2001 to 17.5% in 2021, indicating that the level of entrepreneurial activity in the country had more than doubled in the last two decades (GEM 2022) only to plummet to 8% in 2022, according to the GEM (2023). This recent poor performance has been explained by Bowmaker-Falconer and Meyer (2022) and Swartz et al. (2019) by the fact that as a country, South Africa is still far from achieving a level of overall entrepreneurial activity that becomes a critical enhancer of economic development and ensures employment creation and social solidarity. It is, therefore, unsurprising that the same depressed performance of the economy has continued for over a decade now, coupled with an unprecedented level of inequality in the population.

South Africa's entrepreneurial activity still undershoots, according to Bowmaker Falconer and Meyer (2022), when compared with that of similar profile economies (Level C economies of less than USD 20,000 GDP per capita that posted 19.6% TEA). This relatively poor performance is considered against the backdrop of the fourth industrial revolution (4IR) that is currently sweeping across the world. The World Economic Forum (WEF 2018) relates 4IR to the recent rapid advancements in the Information and Communications Technology (ICT) space. These rapid developments in ICT due to 4IR are suggested by both Thaba-Nkadimene (2020) and Xing (2018) to be a suitable basis to further the overall entrepreneurship levels in an economy. Abdullahi et al. (2020), Bowmaker-Falconer and Meyer (2022) and GEM (2022, 2020) add that there are abundant entrepreneurial opportunities arising from ICT advancements. On this account, this research strives to ascertain ways through which South Africa's entrepreneurial activity can be grown further through the opportunities created by 4IR in order to reap further economic growth and development. This then will combat the triple challenge of poverty, unemployment and inequality that continues to strain South Africa's economy.

Theoretical Foundation of the Study

In assessing South Africa's entrepreneurial activity amid the fourth industrial revolution era, this study is underpinned by the following relevant theoretical perspectives.

Romer's Endogenous Growth Theory

Romer's endogenous growth theory is viewed by this research to be cognisant of the importance of advancements in technology to enhancing entrepreneurial activity. It is underscored by Apostol et al. (2022) and Zhao (2019) that innovative technologies bring state-of-the-art products and services onto the market as a culmination of various entrepreneurial activities. Ssekitoleko and Mbukanma (2022) further elucidate that, consistent with Romer's endogenous theory, an unexpected result from advancements in technology in one economic sector by a particular business entity leads to other entrepreneurial ventures in other sectors also experiencing improvements. This has been demonstrated in South Africa and other parts of the world by private entrepreneurial companies such as Uber, who first introduced 4IR technologies in their ride-hailing services (special taxis), technologies which were then extended into other sectors such as fast food and freight.

Knowledge Spillover Theory of Entrepreneurship

The knowledge spillover theory of entrepreneurship advanced by Audretsch (1995) contends that, contrary to the views of orthodox scholars and policy framers, advancements in technology are propelled not only by giant contemporary business entities, but also by the enterprising activities of small firms. Acs et al. (2013) further explain that the introduction of a new entrepreneurial endeavour can be a reaction to the now recognised opportunities from newly occasioned know-how that has not been profitably utilised by the big contemporary firms. Thus, this is the knowledge spillover effect on entrepreneurial activity in the country in which other business enterprises take advantage of the technological innovations and business opportunities resulting from skills and capacities initiated by other firms. The knowledge spillover theory of entrepreneurship is relevant to the South African context, especially concerning the application of digital technologies. This occurs through the transfer of important skills and innovations in technology from technological discoveries, particularly by employee entrepreneurs of the enormous firms when these employees later decide to start their own business ventures.

It can be seen from Figure 1 below that there are enablers to elevation of entrepreneurial activity in South Africa. As reviewed in the above theories, technological innovations help catapult entrepreneurial activity to new levels, with improvements in both product and service offerings. This is the expected result of the application of 4IR technologies, and yet their application to buoy the level of entrepreneurial activity in South Africa is confronted with a number of challenges.

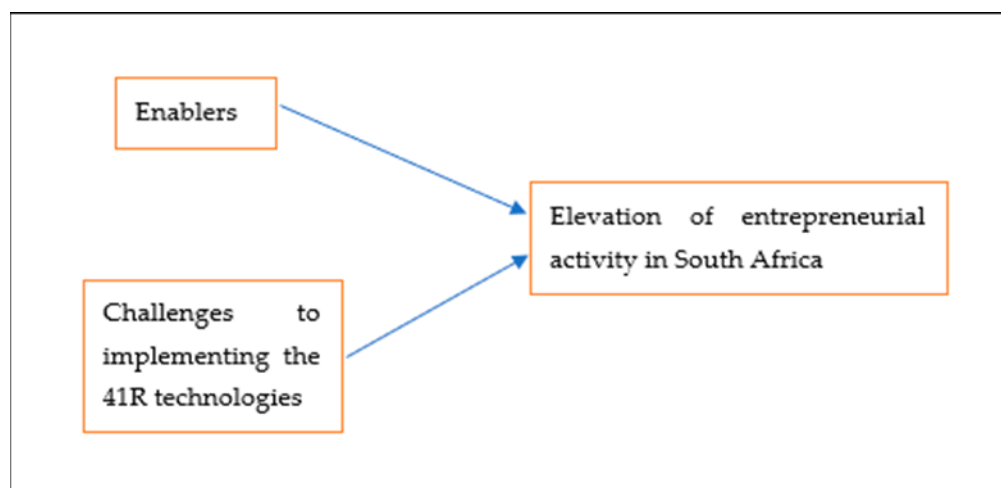


Figure 1. Conceptual framework guiding this study. Source: the Authors.

Methodology

This is a conceptual type of study based on the literature and focuses on elevating South Africa's entrepreneurial activity in the era of 4IR. A review of the literature was performed using the following search terms: "entrepreneurial activity+4IR+South Africa", "enablers or determinants+entrepreneurial activity+South Africa", and "challenges+4IR+entrepreneurial activity+South Africa". This search was performed using the Google Scholar search engine database since it is considered by Martín-Martín et al. (2021) and Gusenbauer (2019) as the most complete, and the primary search engine that the majority of academics resort to when conducting a literature review (Delgado López-Cózar et al. 2019). The online articles and documents relevant to South Africa returned by the search with the above key words were then evaluated by reading their abstracts and summaries to establish relevance. Also, we only considered articles published from the year 2017 to the present, as 2017 was the year that the term 4IR was globally popularised by Schwab (2017).

This review of the literature aimed to achieve an up-to-date analysis of entrepreneurial activity in South Africa, especially in the era of 4IR. This led to discovery of key recent reports, particularly by the GEM Consortium. Again, the review intended to find links to implementation challenges facing 4IR technologies that hinder entrepreneurial activity as well as the enabling factors of South Africa's entrepreneurial activity.

Results and Discussion

The results comprise the enablers of entrepreneurial activity and challenges to the implementation of 4IR and are discussed in the following section.

Enabling Factors of Entrepreneurial Activity to South Africa

It is important for a country's entrepreneurial activity to be afforded an enabling ecosystem in which economic players can participate freely. This then allows for inter-sectoral trading among entrepreneurs, which in turn, promotes all-inclusive economic growth in the country. The factors that promote South Africa's entrepreneurial activity are also seen to be mostly centred on its entrepreneurial ecosystem, and they are presented below.

Availability of Quality Entrepreneurial Support Initiatives

On a macro level, a nation's government is charged with ensuring an appealing entrepreneurial ecosystem in which businesses can emerge and flourish because entrepreneurial activities are vital to an economy. This is supported by Stam and Van de Ven (2021) who argue that it is important to have in place effective programmes that local businesses are aware of to nurture and grow entrepreneurial ventures at the local community, district and national levels. The GEM (2023) report discloses that the South African government has rolled out supportive and wide-ranging entrepreneurial schemes,

specifically with the recently ratified National Integrated Small Enterprise Development agenda, which is intended to buoy small business entities in the country.

Physical Infrastructure

A country's physical infrastructure is one of the key pillars that supports the smooth running of an economy and aids in achieving economic development (Ssekitoleko and Mbukanma 2022). This is because critical physical infrastructure, such as well-developed and maintained road networks and expressways and cell phone towers, among others, easily facilitates the extension and growth of business operations further into the country, which in turn increases overall economic activity in the country. The GEM (2023) report rates South Africa's physical infrastructure to be near appropriate, with a score of 4.9 out of 10. This score implies that there exists a relatively supportive entrepreneurial ecosystem, so business-minded people in the country will find it easier to conduct entrepreneurial work due to improvements in the physical infrastructure.

Ample and Accessible Enterprise Funds

The amount of and levels of access to business financing in South Africa is reported by the GEM (2023) report to have improved, with the country now positioned sixth out of 13 Level C economies. Additionally, government policy support to stimulate entrepreneurial activity is evidenced by the concerted effort to make more money available to local small businesses. These undertakings include the shortened times required to fulfil finance requests and the introduction of the Small Business Innovation Fund (meant to provide a miscellany of monetary contracts among business parties with both loans and allowances aimed at reducing the costs of borrowing for businesses) (GEM (2020)). The above government support should also be considered alongside South Africa's robust banking sector, which was assessed by the World Economic Forum's (WEF 2019) global competitiveness report, placing the country tenth out of 141 participant economies with regard to the proportion of domestic credit provided to the private sector. Therefore, entrepreneurs in South Africa stand to benefit from the overall widespread and accessible funding, and this is expected to promote business activity and grow the economy further.

Improved Level of Economic Freedom

Khyareh and Zamani (2022) examine the relationship between a country's economic freedom level and overall entrepreneurial activity, arguing that it is less challenging for would-be entrepreneurs to embark on business ventures if there is a certain level of economic freedom that enables hassle-free operation of business. It is important to recognise South Africa's recent gains concerning ease of entry (market dynamics), which are chronicled in the GEM (2023) report. These are now inching nearer to adequate thresholds that are expected to encourage the development of further entrepreneurial activity in the country.

Unemployment Rate

In addition to a country's entrepreneurial environment, studies such as Dvouletý and Orel (2019) establish that a country's unemployment rate has an influential effect on the level of entrepreneurial activity. This may be interpreted that, *ceteris paribus*, as more people lose salaried jobs and with the prospect of staring poverty in the face, the more they tend towards self-employment and engage in entrepreneurial activity, which is a survivalist and necessity-propelled type of entrepreneurial activity. According to Statistics South Africa (Stats SA 2023), South Africa's unemployment rate stands at 32.7%, a figure still considered very high internationally, with over a quarter of the country's population deemed unemployed. South Africa's high unemployment rate is, therefore, considered a boosting factor to the country's entrepreneurship levels, in agreement with Loukil's (2019) push postulation that links the level of unemployment and the entrepreneurial activity in an economy.

Implementation Challenges of Industry 4.0 on Entrepreneurial Activity in South Africa

The Fourth Industrial Revolution (4IR), or industry 4.0, is predicted to advance entrepreneurial activity by improving the overall contribution of businesses to the South African economy and at rapid speed. However, in tapping into the 4IR potential and boosting the level of entrepreneurial activity, South Africa finds itself at a low state of preparedness compared with highly industrialised countries of the west. We discuss below obstacles to the implementation of 4IR digital technologies, which are to the detriment of entrepreneurial activity in the country.

High Data Costs

The relatively excessive costs of data in South Africa, when contrasted with those of other African countries (Mtotywa et al. 2022), pose one of the main obstacles to advancing entrepreneurship levels. This is a critical market dynamic that needs attention because numerous entrepreneurial openings are in the digital economy (Bowmaker-Falconer and Meyer 2022; GEM 2022). Bayode et al. (2019) also agree that even though South Africa has arguably the most connected wireless network facilities on the African continent, a majority of its people do not have access to the network and the mobile internet costs are inhibitory.

Inadequate Worker Expertise

There is a shortage of workers with the requisite skills for particular fields involving the supervision of digital jobs (Oyebanjo and Tengeh 2021). It is explained by Xu et al. (2018) that 4IR could possibly distort job markets and, hence, worsen the levels of inequality among people. It should be remembered that in South Africa, it is a minority who contribute most to the national economy, as evidenced by the Department of Communications and Digital Technologies South Africa (DCDTSA 2020) and the World Bank (2022). The digital technologies of 4IR carry with them automated processes, which will inescapably eliminate the jobs of basic workers by substituting them with computerised machines (Xu et al. 2018). That said, the disruptions in the local labour market due to 4IR are again expected to create a gaping hole that can be filled by people with the new and relevant skills needed for entrepreneurial activity to grow further in the country.

Data Protection Inefficiencies and Cyber Security Risks

In South Africa, the proliferation of 4IR technologies has increased cyber security and data protection concerns, particularly the activities of systems infringement and publicising of privileged information, all of which impinge industry competitiveness (Oyebanjo and Tengeh 2021). Indeed, it is highlighted by DCDTSA (2020), Olaitan et al. (2021) and Signé (2023) that there is uncertainty concerning guaranteed protection of public information. Accordingly, the Global Connectivity Report (GCR 2022) points to a lack of working laws that balance government access to public information and the fight against financial crimes and international terrorism.

The security risks in the country are illustrated by Allen (2019), who estimates that there are over 550 internet attacks occurring in South Africa every second. This, therefore, means that online attacks on both individuals and institutions such as banks are expected to increase with the 4IR in full motion. Additionally, it is also reported by Halder and Jaishankar (2021) that countries typified by generally weak laws regarding corruption suffer from higher rates of data protection breaches, and this indicates inadequate safeguards for user information. It means that in South Africa, with its poor rating on the Corruption Perception Index (CPI 2022), scoring 43 out of 100 (still deemed very corrupt), prospective entrepreneurs hesitate to invest in digital technologies due to the risks of online attacks and data insecurity.

Insufficient Funds to Invest in Digital Infrastructure

Oyebanjo and Tengeh (2021) highlight the shortage of financial support at state, provincial and local government levels, which is required for infrastructural development in South Africa. This relates to the alarm about fiscal deficits that casts gloom over the calibre of the entrepreneurial environment that exists in the country, with inadequate basic services. However, the analysis of Serumaga-Zake and van der Poll (2021) specifically points to a lack of adequate financial resources for South African small businesses to purchase the requisite digital technologies for their sustainability. Bayode et al. (2019) emphasise that the sector entities' reluctance to invest the monetary rewards from investment in 4IR technologies represents another facet of the lack of wherewithal by small business entities in South Africa to adopt digital technologies. These authors advise that small local entrepreneurs need to invest significantly in new technologies as well as change their modus operandi, thereby ousting the older technologies and models, if they are to leverage the upcoming 4IR innovations.

Poor Digital Technological Readiness

South Africa is grappling with poor infrastructural development, especially the low level of digital technological preparedness, according to Olaitan et al. (2021). Debrah et al. (2018) interprets this as a consequence of restricted public investment and a generally low acceptance of technology usage, characteristic of sub-Saharan Africa. However, Mtotywa et al. (2022) make specific reference to South Africa about the lacklustre reception level of digital technology, which is a major barrier to the adoption of 4IR technologies. This is exemplified by Olaitan et al. (2021) who report that South

Africa has, for several reasons, not fully taken up 5G mobile digital technology, and yet this technology is vital for all-round internet connection. On the entrepreneurial front, Oyeбанjo and Tengeh (2021) intimate an inflexibility among the majority of businesses to incorporate 4IR technologies in their business operations, which may be attributed to various factors. Indeed, the GEM (2022) report also reveals muted expectations, with just 52% of adults engaged in entrepreneurial activity in South Africa having the intention to utilise digital technologies in their ventures, the lowest rating among similar economies. Therefore, this lamentable state of digital technological preparedness at both business and country level in South Africa, for various reasons, stands to jeopardise the infusion of the 4IR technologies into entrepreneurial ventures in the economy.

Undependable Power Supply

An unstable energy supply to the country's economy threatens the much-talked about 4IR gains (Bayode et al. 2019; Olaitan et al. 2021), predominantly due to the damaging costs of loadshedding by power utility Eskom. It is imperative to maintain a constant power supply for the country as the basis for 4IR technologies such as the Internet of Things (IoT), which involves the efficient and the automated transmission of information via everconnected automatic and digital computers (Kayembe and Nel 2019). Such technologies will be a vital force in the greater industrialisation of the country. Additionally, blockchain technology, another key feature of 4IR expected to foster entrepreneurial activity in the country, requires an uninterrupted energy supply. This kind of technology is thought to be a deciding factor in the confidence of contracting partners, for it enables lasting trade in the digital world (European Commission (EU 2022)). A lack of consistent energy supply also increases the general operational costs to businesses, which in turn, increases the costs of the produced goods and services. Consequently, this reduces the general sales levels in the country, thereby making operating of businesses less worthwhile.

Untimely Decline in Industrialisation

An overall mistimed reduction in industrial activity in South Africa poses another obstacle for 4IR to transform the country's entrepreneurial activity and economy. Jegede (2021) and Olaitan et al. (2021) provide a negative assessment of South Africa's performance on the manufacturing share of GDP in the year 2020, with a declaration that the country has been on a downward spiral from the start of the year 1990. Ever-advancing industrialisation in the country is mandatory, with Gavaza (2019) emphasising the need for robust and intricate manufacturing infrastructure akin to that of countries such as Japan and China, among others, which typically relies on low-skilled and low-paid workers.

Prevalence of High Crime

High crime rates are identified by Mtotywa et al. (2022) as an encumbrance to the implementation of 4IR technologies in South Africa. The country is riddled with high crime, including the theft of copper and fibre optic cables, which deals a heavy blow to the installed infrastructure by cutting the required connectivity for 4IR implementation. Also, there is common knowledge across the country about the ever-higher incidence of burglaries at both homes and in business areas, especially targeting equipment such as portable computers, cell phones and plasma televisions. The South African Police Service's (SAPS 2023) third quarter crime statistics reveal that burglary in business zones is up by 13%, which manifests the high risks to the equipment installed to enable the functioning of 4IR elements, risks which jeopardise the operations of business ventures in the country.

Recommendations

South Africa's entrepreneurial activity levels stand to benefit already from the prevalent enabling factors that have been discussed in Section 4.1 above. However, these enablers seem insufficient on their own to spur the level of entrepreneurial activity in the country. Addressing the challenges faced in implementing 4IR technologies discussed in Section 4.2 above could stimulate entrepreneurial activity to match and better the standards of similar profile economies (Level C economies). This is because the implementation of 4IR technologies, as advanced by Abdullahi et al. (2020), Bowmaker-Falconer and Meyer (2022) and Thaba Nkadimene (2020), among others, catalyzes entrepreneurial activity in an economy. This research, therefore, makes the following recommendations in a bid to tackle the obstacles to the implementation of 4IR technologies and buoy South Africa's entrepreneurial activity.

These form part of the entrepreneurial activity enhancement model that is illustrated in Figure 2 below.

Mandatory Laws on Data Prices and ICASA Stance on Oligopolistic Telecoms

The issue of low access to mobile internet due to high data costs can be averted through enactment of unequivocal and efficient laws by The Competition Commission of South Africa to prevent prices of data constantly increasing and maintain affordable rates for all. Chinembiri (2020) declares the existing laws on data prices in South Africa to be ineffective. Again, another relevant government body is the Independent Communications Authority South Africa (ICASA), whose mandate is to supervise telecommunications and broadcasting entities for the good of the country. ICASA ought to license additional players and allow them to participate in the local telecommunications market. This would enhance competition among the increased number of telecommunications companies, and thus, achieve a lowering of data prices. The oligopolistic nature of South Africa's telecommunications market is demonstrated by Sutherland (2021), with the market containing two major companies and another less powerful trio.

Strategic Human Resource Management Plan

A human resource strategy is recommended to address several challenges faced in implementing 4IR, which would in turn, boost South Africa's entrepreneurial activity. Firstly, as a measure to combat loadshedding in the country, there is need for a strategy to hire and retain experienced and competent staff at the state-run power utility Eskom. Owing to a number of reasons, the utility has been plagued particularly by a high turnover rate of experienced engineers, with replacements having poorer skill profiles or none at all. Thus, ensuring that the right skills are always present at Eskom will ensure the efficiency and maintenance of all power facilities, and thus, minimise the occurrences of loadshedding.

Secondly, a wide-ranging government-backed 4IR skills training initiative needs to be swiftly implemented in order for the country to catch up with the relevant new and fast-approaching technologies. This has to entail reskilling and upskilling of all people in the working age group in South Africa, equipping them with 4IR-compliant competencies in all sectors, together with a re-adaptation of the generally prevailing skills to 4IR. It should be mentioned that currently, the South African government, through the Department of Higher Education, Science and Innovation, has a plan to train citizens in a number of sectors and institutions, targeting a few hundred people (Parliamentary Monitoring Group, (PMG 2022)). This implies that many people in South Africa will continue to lack the necessary expertise in 4IR that is critical to enhancing entrepreneurial activity. Also according to PMG (2022), the skills readiness strategies introduced by government, such as the 28 4IR qualifications in the media sector, will need to secure approval from the South African Qualification Authority (SAQA) prior to implementation. This would entail an increased pace of the approval process for such qualifications in order to keep up with the rate of evolution of the 4IR technologies and thus boost entrepreneurial activity. This proposed government support for extensive and rapid upskilling of people in 4IR would also address the challenge of technology readiness, which is discussed in Section 4.2.5 above, by increasing the technology acceptance and usage rates of 4IR in both private and public sectors.

Thirdly, a strategic human resource plan ought to include government recruitment for and training in online security skills. This would increase the capacity to identify, lessen and combat the online security threats that are growing in the country.

Strategic Risk Management of Data Protection

This research recommends stricter enforcement of the Protection of Personal Information (POPI) Act, which only came into full effect in South Africa two years ago. This should be administered with an emphasis on information technology asset placement so as to fight unapproved access. For business entities, the strategies on data protection need to include software protections that encrypt data to increase the difficulty of criminal and malicious access.

Apportioning a South African 4IR Fund

There is need to allocate money for support of 4IR technology developments, particularly developments from the private sector. The South Africa Department of Innovation and Science established the Centre for Fourth Industrial Revolution (C4IR). C4IR has a mandate to co-ordinate with stakeholders to introduce management and regulatory mechanisms that guide policies for all relevant stakeholders in pursuing economic opportunities. An additional significant fund should be established for entrepreneurial activities that make use of the latest 4IR technologies. This fund would supplement that of the African Development Bank (2021) and stimulate the pace at which South Africa takes up 4IR to boost entrepreneurial activity.

Alternative Energy Sources and Enhanced Whistle-Blower Protection

South Africa's overreliance on the power utility Eskom is also the cause of the lack of constant electricity supply, which is a barrier to the potential gains from the adoption of 4IR technologies. It is, therefore, advised that to ensure a more consistent power supply, the country seek and fund other sources of electricity, such as wind, biomass and solar, to supplement the coal-based electricity, which according to Akinbami et al. (2021), accounts for more than 85% of the country's energy.

Moreover, the fight against state capture at Eskom should be intensified to ultimately rid the entity of flaws in tendering and procurement processes or deal with tunneling activities, all of which rob the value-creation meant to keep the utility operating efficiently. To ensure a completely corruption-free Eskom, there needs to be further enhancement of whistle-blower protection in the country. Granted, whistle-blowers in South Africa have existing laws to resort to, inter alia, the Protected Disclosures Act, Witness Protection Act, Criminal Procedure Act, Prevention and Combatting of Corrupt Activities Act. However, there is a lack of synergy in some of the stipulations of these laws, with some parts being a mere replica of the laws from the West, with no practical applicability for South Africa. A redrafting of the prevalent whistle-blower protection laws is necessary to include safeguards against possible threats and the fear suffered by whistle-blowers, to install measures for physical protection, to offer safety guarantees to witnesses who testify, and to provide measures for contractual terms with givers of evidence on cases being investigated. These measures need to be implemented as per the Commission of Inquiry into State Capture (2022). Dentlinger (2023) contends that the Commission's recommendations have not yet been fully included in the existing laws, to the dissatisfaction of the chief justice Judge Raymond Zondo.

These recommendations in the framework would help ensure an uninterrupted and dependable energy supply, which is required for 4IR technologies to gain momentum and catapult the overall entrepreneurial activity in the country to greater heights.

More Public-Private Partnerships for Industrialisation

In order to assuage the constant decline in South Africa's industrialisation, this study advocates for an increase in public-private partnerships (PPPs), with the government, strategically targeting specific private partners that will enhance digital manufacturing in the country. The government on its own is incapable of achieving high levels of digital manufacturing and automation in entrepreneurial activities, which are desirable for streamlined, smart industrial operations in the entire economy. Nel-Sanders (2023) outlines the advantages of PPPs, which include their low cost, minimization of risk, and effectiveness. According to Business Media Mags (2023), South Africa's C4IR is currently only in a partnership with the global technology manufacturer, Siemens. This partnership merely aims to test digital technological industrialisation for mass production, online security, drinks, water and food for South Africa. There is a need to recruit more private partners, speed up the trial processes and catch up with the rapid pace of 4IR technologies, all in an effort to arrest the decline in industrialisation. This would then enable complex industrialisation, thereby providing more opportunities for further entrepreneurial activities in the country.

Proactive Policing

Proactive policing will help confront the high crime rate in the country that disrupts 4IR implementation. Specifically, the application of a location-based approach that targets known areas characterised by significant activity in crime should be given priority. This would allow the swift

collection of evidence at these individual locations and identify locations requiring a higher security presence. In this way, burglaries in both business and residential zones, as well as the theft of critical infrastructure that facilitates the required connectivity for 4IR, will be tackled. Therefore, with the implementation of area-specific proactive policing throughout the country, entrepreneurial activities will find it easier to utilise 4IR technologies due to the enhanced security oversight on 4IR-enabling infrastructure.

Conclusions

This research set out to determine approaches to improve South Africa's underperformance in entrepreneurial activity amid the fourth industrial revolution with its digital technologies. It also aimed to identify the challenges to 4IR implementation in a bid to help reinvigorate entrepreneurship activity in the country. This was achieved using a conceptual exploratory literature review approach. Our study revealed the enablers to entrepreneurial activity in South Africa as follows: availability of enterprise funds, improved economic freedom, availability of entrepreneurial support, physical infrastructure, and the current high unemployment rate. Furthermore, this study identified the following challenges to the implementation of 4IR technologies: high data costs, poor digital technology readiness, unreliable energy supply, data protection and cyber security alarms, and high crime rates. This study recommends a framework to augment entrepreneurial activity in South Africa via solutions to 4IR implementation challenges. We propose the establishment of a South African 4IR fund to finance investment in the latest technologies, proactive policing to fight crime, mandatory laws on data prices, more public-private partnerships for further industrialisation, enhancement of whistle-blower protection laws, alternative energy sources, a strategic human resource plan for 4IR-complaint skills, among others. This research results are limited to the literature that was identified. This study used only the Google Scholar search engine and thus, the results of other studies may vary when other literature sources and search engines are incorporated. Therefore, future research could utilise more literature sources to verify the findings of this study.

This paper's value is that it gives an up-to-date overview of the literature pertaining the enhancement of South Africa's entrepreneurial activity through 4IR technological innovations. These latest technologies have the ability to merge both physical and digital spaces and hence generate a variety of entrepreneurial activities. This is coupled with their ability to increase the overall entrepreneurial activity and thus help to alleviate various social and economic challenges in South Africa.

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