



destea

department of
economic, small business development,
tourism and environmental affairs
FREE STATE PROVINCE

The state and impact of the Fourth Industrial Revolution on economic development



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I. LIST OF ACRONYMS

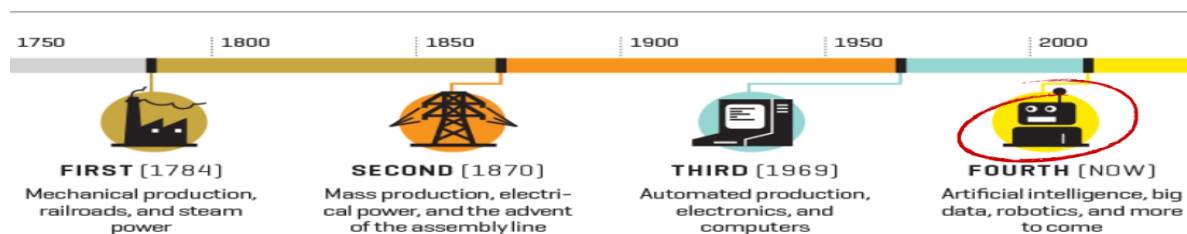
4IR	Fourth Industrial Revolution
4IRSA	4IR in South Africa
AI	Artificial Intelligence
Busa	Business Unity South Africa
CFO	Chief Financial Officer
Cosatu	Congress of South African Trade Union
CPUT	Cape Peninsula University of Technology
CSIR	Council for Scientific and Industrial Research
CUT	Central University of Technology
CUT	Central University of Technology
FNB	First National Bank
FPTI	Future Production Technologies Initiative
FSGDS	Free State Growth and Development Strategy
GPS	Global Positioning System
IFPTI	Instimbi Future Production Technologies Initiative
IoT	Internet of Things
LNG	Liquefied Natural Gas
MoU	Memorandum of Understanding
NAMPO	National Maze Producer Organization
NDP	National Development Plan
Nedlac	National Economic Development and Labour Council
Pacofs	Performing Arts Centre of the Free State
PEAC	Provincial Economic Advisory Committee
POS	Point of Sale
SA	South Africa

SADC	Southern African Development Community
SAUNN	Institute of Mining and Metallurgy
SIMM	Souther Institute of Mining and Metallurgy
SONA	State of the Nationa Address
STEM	Science, Technology, Engineering & Mathematics
UK	United Kingdom
Unisa	University of Soouth Africa
USA	United States of America
WTO	World Trade Organization

1. Section one: Introduction

The *first industrial revolution* is often described as the shift from human's reliance on animals, human effort and biomass as the primary sources of energy. This reliance was replaced by the use of fossil fuels and mechanical power. The *second industrial revolution* began towards the end of the 19th century and through the first two decades of the 20th century. The second industrial revolution was characterised by the distribution of electricity, both wireless and wired communication, the synthesis of ammonia and innovative forms of power generation. The *third industrial revolution* took place during the early 1950s and was characterised by the development of digital systems, communication and rapid advances in computing power which resulted in new ways of generation, processing and sharing information (World Economic Forum, 2016: Internet). The *fourth industrial revolution* (also known as *4IR*) was coined by Klaus Schwab, the founder and executive chairman of the World Economic Forum.¹ According to Schwab, the fourth industrial revolution can refer to a world where "individuals move between digital domains and offline reality with the use of connected technology to enable and manage their lives".² Figure 1 below briefly depicts the timeline of the industrial revolutions.

Figure 1: Industrial Revolution



Source: Rabana (2018: 4).

¹ Parliament of South Africa (https://www.parliament.gov.za/storage/app/media/EducationPubs/2019/january/14-02-2019/4th_Ind_Rev_FINAL_PAMPHLET_1.pdf).

² Xu, M., David, J.M & Kim, S. 2018. The Fourth Industrial Revolution: Opportunities and Challenges. (https://www.researchgate.net/publication/323638914_The_Fourth_Industrial_Revolution_Opportunities_and_Challenges).

2. Aim and Objective of the Study

The Department of Economic, Small business development, Tourism and Environmental Affairs (DESTEА) is tasked to be at the fore front in creating an enabling environment to produce a transformed economy. During the 2019 State of the Province Address, the Hon. Premier emphasised the importance of a Framework for Skills for a Changing world in order to prepare young people on how to respond to emerging technologies. In her 2020 State of the Province Address, the Premier announced that the FSPG will host the first Fourth Industrial Revolution Summit, which took place from the 28th to 29th November 2019 at the Central University. In terms of the SONA and Budget injunctions, DESTEА indicates in its National Development Plan (NDP) Five Year Implementation Plan 2019-2024 that in order to increase access to and uptake of ICT, the department is committed to do the following: to create an opportunity for 5 000 youth to undergo training in advanced ICT skills; support the growth of 5 digital start-ups to have collective revenue of R5m in 5 years; to support the development, testing and commercialization of locally produced ICT solutions; to urge the State Information Technology Agency to strengthen their support to young people on procurement opportunities (FS SOPA, 2019). Furthermore, to establish a Digital hub in partnership with MICT-SETA (DESTEА Budget Vote Speech, 2019). CUT In partnership with CEOs of Free State based ICT companies to build advanced critical skills of the youth in the digital economy (DESTEА NDP 5YR Implementation Plan, 2019).

Based on the discussing above, DESTEА felt it necessary to conduct a study on the impact of the Fourth Industrial Revolution (4IR) on economic development. Therefore, specific objectives in support of the above-mentioned are:

- 2.1 *Determine the state of the Fourth Industrial Revolution (4IR).*
- 2.2 *Determine the impact of the 4IR on South Africa's economic development; and*
- 2.3 *To determine the impact of the 4IR on the Free State priority sectors?*

In order to address the main objectives of this study, a certain research methodology will be utilised to address the objectives of this study.

3 Research Methodology

Qualitative research can be categorised into three groups namely; explanatory research, interpretive research and critical research studies.³ Explanatory method is utilised to conduct this research because the researchers seeks to identify the extent and nature of the cause-and effect of the Fourth Industrial Revolution. This study focuses on the analysis of the situation and will explain the patters of relationships between variables such as the priority sectors in South Africa and that of the Free State Province. Explanatory research approach is appropriate for this research because it seeks to identify the reasons behind the process and assess the impact of the Fourth Industrial revolution on the global and domestic community at large. This approach also allows for greater levels of internal validity due to its systematic selection of subjects. ⁴

4. Overview of the Fourth Industrial Revolution

“ The fourth industrial revolution requires a new leadership paradigm...Leaders no longer have the luxury of preparing for the Fourth Industrial Revolution” – Helena Laurent (Head of Shaping the Future of Advanced Manufacturing and Production, Member of the Executive Committee, World Economic Forum) (World Economic Forum, 2019:5).

The Fourth industrial revolution is building further on the third industrial revolution which relates to the digital revolution that has been present since the middle of the last century (Schwab, 2015; Xu, David & Kim, 2018). The fourth industrial revolution (4IR) is a mixture of technologies which is on the grey lines of physical, digital and biological spheres. According to Schwab (2015), what distinguishes 4IR from the previous revolutions is the velocity, scope and systems impact. There is no comparison between the previous revolutions and 4IR, it is evolving at an exponential rate and is transforming the whole system of production, management and governance

³ Research Methodology Chapter 2. (<https://repository.up.ac.za/bitstream/handle/2263/28709/02chapter2.pdf?sequence=3&isAllowed=y>).

⁴ Research Methodology (<https://research-methodology.net/causal-research/>).

respectively. There has been a breakthrough globally, with no limitations, it is connecting people from around the globe with mobile devices. These mobile devices have unprecedented processing power, storage capacity and an unlimited access to knowledge. The world has already witnessed the rapid emerging technological breakthroughs in artificial intelligence (AI), robotics, the Internet of Things (IoT), autonomous vehicles, 3-D printing, nanotechnology, biotechnology, materials science, energy storage and quantum computing. The impact of 4IR is already felt by everyone with the self-driving cars, drones, virtual assistants and software that translate or invest. However, the most prominent transformation has been with (AI). AI has been driven by exponential increases in computing power and the access to large amounts of data, to software being utilised to discover new drugs to algorithms which is used to predict cultural interest (Schwab, 2015). However, although much excitement has been spread regarding 4IR, it is vital to consider opportunities and challenges it presents.

4.1 Opportunities and Challenges

The fourth industrial revolution (4IR) has the potential to change the quality of life and raise the income levels of the global population. The previous revolutions had a positive impact on the global community, but the 4IR has proven thus far as having gained the reputation as being perceived as the most *revolutionary* when compared to previous revolutions. The biggest beneficiaries thus far has been consumers, who now have unlimited access to the digital world. The new technological advances have created a platform for consumers to access new products and services through a digital world which has resulted in their lives being improved. Emerging technologies will have an even greater impact on the supply-side with long-term benefits in efficiency and productivity. Therefore, businesses will have to keep up with technological developments. New technologies continue to decrease the costs of transportation, communication and logistics. Simultaneously, global supply chains will inevitably become more effective while trade cost will be a thing of the past and ultimately create a new open market that will stimulate economic growth. Economists Erik Brynjolfsson and Andrew McAfee, however have cautions that 4IR could lead to greater inequality that could distort the labour markets. It is becoming an emerging risk

that automation would substitute the labour force across the entire economy. In the long-term, on the one side of the coin; this could lead to the displacement of workers but on the flip side of the coin, it could yield safe and rewarding job opportunities. It is increasingly difficult to determine which scenario is likely to prevail, it could be one or the other or a combination of the former and the latter. Although, it is difficult to determine the full impact of the 4IR, one could anticipate that the job market will become increasingly segregated into “low-skill/low-pay and “high-skill/high-pay” segments which will further lead to rise in social tensions (Schwab, 2015). Therefore, it has become increasingly important to consider what the impact of 4IR will be on businesses and governments. Figure 2 on the below indicates the global technological distribution of the fourth industrial revolution and how half of the global community is not benefiting from the digital economy.

Figure 2: Globally Technological distribution

Half of the world's population is not benefiting from the digital economy



Source: Anil Mehta, World Bank Group, 2017

Source: Ngowi (2019: 5).

4.2 4IR's impact on businesses

The industrial revolution has always impacted the manner in which business is conducted, hence it's important to reflect on the main characteristics of the industrial revolutions.

Table 1 below indicates the main characteristics of the industrial revolutions

Period	Transition Period	Energy Resource	Main achievement	Main industries Developed	Transport Means
1760-1900	1860-1900	Coal	Steam Engine	Textile, Steel	Train
1900-1960	1940-1960	Oil Electricity	Internal Combustion	Textile, Steel	Train, Car
1960-2000	1980-2000	Nuclear Energy, Natural Gas	Computers, Robots	Auto, Chemistry	Car, Plane
2000-	2000-2010	Green Energies	Internet, 3D Printer, Genetic Engineering		

Source: Xu, David & Kim, (2018: 91).

The Fourth Industrial Revolution (hereafter referred to as 4IR) is indeed building on the Third Industrial Revolution. As previously discussed the 4IR represents both opportunities for businesses to grow. The reality is that artificial intelligence will result in significant economic disruptions (Xu, David & Kim, 2018). Globally, Chief Executive Officers and Senior Business Executives are convinced that the acceleration of innovation and the velocity of disruptions are too difficult to predict, hence the outcomes will be a constant surprise. It has become evident to even the most un-informed business minds that the technologies produced by the 4IR will have major impact on all types of businesses. From the perspective of the supplier, many industries have witnessed how new technologies have created alternative ways to serve existing needs and its disruption on the industries value chains. These disruptions also flow from agile, innovative competitors who can now outperform even the most well-established occupants due to access to global digital platforms. The global digital platform is a conducive environment for emerging entrepreneurs to

conduct research, development, marketing, sales and distributions. Therefore, these emerging entrepreneurs can quickly respond to feedback from consumers, improve the quality of their products/ services, speed and alter the prices of their products and services. Due to the nature of the global digital economy, one can anticipate changes within the employment landscape. According to the World Economic Forum (2016), it will be difficult to prepare for the future skills requirements and job content which will directly affect individuals, businesses and governments.

5. Employment trends 2015-2020

A positive outlook has been anticipated for the employment trends for the 2015-2020, while there may be significant growth in some areas, there is also a decline in others. With regards to computer and mathematical jobs, it has been anticipated that significant growth for data analysts and software developers can be expected. The growth of data analysis and software developers is not limited to Communication Technology Industry but will also overlap into other industries such as Financial Services, Investment, Media, Entertainment and Professional Services. A positive outlook is also anticipated for architecture and engineering roles especially in the, Information and Communication Technology (ICT) and mobility industries. However, the demand for engineering in its traditional basic core as well as Energy Industries are relatively low while a decline in the demand for manufacturing and production construction and extraction roles. These include chemical processing plant operators, mining and petroleum extraction workers, in which these industries will be facing difficult times in the coming years. Furthermore, the consumer industry will be reducing its manufacturing and production roles. This is in contrast to Mobility Industry that will grow in terms of transport and logistics since it continues to play an important role in globalisation while catering for the middle class in the emerging markets (World Economic Forum, 2016). Table 1 indicates the employment drivers of change per industry for the period of 2015-2020.

Table 2: Employment drivers of change by industry 2015-2020

Drivers of change (Industries)	Employment outlook
Basic and Infrastructure	0.16%
Consumer	1.72%
Energy	1.54%
Financial Services and Investors	1.54%
Healthcare	-0.37%
Information and Communication Technology	2.91%
Media, Entertainment and Information	2.31%
Mobility	1.61%
Professional Services	2.45%

Source: World Economic Forum (2016: 16).

Table 2 clearly indicates that the three major drivers for industries changing are; professional services, media, information and communication technology, entertainment and information. While, the least contributor to change in industry relates to healthcare, basic and infrastructure and energy and financial services and investors. According to the *2016 Future Job Report*, by the end of 2020 the jobs that will be critical relates to data analysts and sales representatives. Large firms around the world firmly believe that there will be a greater demand for data analysts in order to make sense of large data obtained through the technological disruptions

While, sales representatives on the other hand will be in high demand in all industries in order to articulate their respective products and services by businesses or government clients and consumers (World Economic Forum, 2016: 16). Another emerging employment trend according an article titled “*Upstart Banks*” by Business Day Technology Solutions and Innovations, make reference to digital banking being a hot topic globally. The United Kingdom (UK) has been closing hundreds of branches every year, despite the World Bank’s data indicating that there is approximately 50 per cent more branches per hundred thousand people now compared to a decade ago. Within some regions of the United States of America (USA) the number of new branches opening far out ways the total number of branches closing. According to the Chief Financial Officer (CFO), Petear Soldo from Digital Republic, banks that are scaling down are misled by the internet banking phenomenon and therefore attest that branches will remain customers’ preference.

Table 3: Drivers of change

Drivers of change	Rates as top trend	Expected timeframe	Definition
Evolving work environments and flexible working arrangements	44%	Impact felt already	New technologies already integrated such as remote working, co-working spaces and teleconferencing. Organizations consisting of smaller full-time employees, employees based in other countries and external consultants and contractors for specific needs.
Emergence of the middle class in emerging markets	23%	Impact felt already	It is projected that by 2030, Asia will account for 66% of the global middle-class and for 59% of middle-class consumption.
Climate change, natural resource constraints and the transition to a greener economy	23%	Impact felt already	Climate changes continue to be a major contributor towards innovation, as organizations seek for measures to mitigate or adjust to its effects. The global community continue to demand natural resources and raw materials. This high demand could lead to over-exploitation which could result in higher extraction cost and degradation of ecosystems.
Rising geopolitical volatility	21%	Impact felt already	The geopolitical landscape is constantly evolving and has direct impact on global trade and talent mobility, requiring industries such as oil, gas or aviation and tourism to react and adapt accordingly.

New consumer concerns about ethical and privacy	16%	2015-2017	During these years, the consumer's awareness and concerns around safety has become more prominent. They are ever increasingly concerned about the usage of the internet, security and their privacy online. While awareness has been noted pertaining to issues of carbon footprint, impact on the environment, good security, labour standards, animal welfare and company's ethical trade record.
Longevity and ageing societies	14%	2015-2017	It has been anticipated that over the next decade, advanced economies will be affected by an aging population. This is due to the fact that senior citizens will work beyond the age of 65 years old in order to secure themselves financially for their retirement years. The aftermath of this will lead to new opportunities (products and services) having to be created to accommodate the older society.
Young demographics in emerging markets	13%	Impact felt already	The world has experienced a fast increase in the population growth, this growth has especially been felt by the developing world. Therefore the developing world faces a demographic challenge more so than the advanced economies. These challenges relates to division of appropriate education and training systems to prepare the young population for the workplace. This has resulted in a higher number of college-educated young people which has impacted on the global distribution of talent.
Women's rising aspiration and economic power	12%	2015-2017	A significant increase in the participation of women have been noted in the attainment of education and therefore resulting in their increase in the labour force. Women are now not just consumers but they are also employees. In terms of a market, it has been predicted that women will account for US\$5 trillion additional consumer spending and approximately two thirds of global disposable income over the next decade.
Rapid urbanization	8%	Impact felt already	It has been predicted by observers that the world's urban population is expected to double between 2010 and 2050, from 2.6 billion to 5.2 billion. This rapid urbanization will be especially felt by marks such as sub-Sahara Africa and China which will result in new opportunities and challenges.

Source: World Economic Forum (2016: 5-6).

The world's industry leaders and observers are of the opinion that we are at a point of the fourth industrial revolution. Today, consumers are faced with smarter systems, homes, factories, farms grids and cities, which does confront dilemmas of all kinds

ranging from supply chain management to climate changes. Additional to the above-mention dilemmas is the socio-economic, geopolitical and demographic developments which has a direct and indirectly effect on each other. The consequences of the fourth industrial revolution is two-fold; it presents new opportunities but also new challenges. Figure 3 below demonstrates how the 4IR is already felt in industries and business models.

Figure 3: Timeline to impact industries, business models.



Source: *World Economic Forum (2016: 10)*.

According to the 2018, Job Skills Report, there is a noticeable shift in the skills demand which should be monitored by governments and businesses.

Table 4: Top Skills Demand 2018 verses 2020

2018	Trending in 2020	Declining in 2020
<ul style="list-style-type: none"> Analytical thinking and Innovation Problem solving skills Critical thinking and analysis Active learning & learning strategies Creativity, originality & Initiative Attention to detail & trustworthiness Emotional intelligence Reasoning, problem-solving and ideation Leadership & social Influence Coordination & time management 	<ul style="list-style-type: none"> Analytical thinking & Innovation Active learning & learning strategies Creativity, originality & Initiative Programming & technological design Critical thinking & analysis Complex problem solving skills Leadership & social Influence Emotional intelligence Reasoning, problem-solving and Ideation Systems analysis and evaluation 	<ul style="list-style-type: none"> Manual dexterity, endurance & precision Memory, verbal auditory & spatial abilities Financial & material resources managerial skills Technology installation & maintenance. Reading, writing, math and active listening skills Management of personnel Quality control & safety awareness Coordination & time management Visual, auditory & speech abilities Technological experience, control & monitoring

Source: World Economic Forum (2018: 12).

According to the *2018 Job Skills Report*, governments around the world have to consider the impact of new technologies on the labour markets. Therefore, education policies, skills development of persons of all ages need to consider the important role of both STEM (science, technology, engineering and mathematics) and non-cognitive soft skills. Intervention strategies need to be put in place at schools for learners, teachers training and vocational training that will speak to the realities of the fourth industrial revolution (4IR). While, the respective industries will have to consider the cost implication of these technologies. The competition for scarce skills is another factor which the industries should consider and the best option is therefore to invest in their current workforce by introducing them to new technologically reorganized high-skilled roles. Furthermore, Industries should make provision for a sufficient pool of

different skilled individuals in order to ensure that their companies position itself as learning organizations that will receive support from stakeholders for the upskilling and reskilling efforts. Employees will be forced to accept personal responsibility to ensure that they become lifelong learners who continuously invest in their career development. Hence, governments and employers (individually and collectively) should support the efforts by employees during their transitions and upskilling periods. For the period 2018-2020 receiving a universal basic income may be politically and economically unfeasible or undesirable, there is a need to provide universal lifelong learning fund for individuals (World Economic Forum, 2018: 23).

6. Section three: Impact of the Fourth Industrial Revolution on Industries

6.1 Impact of digital technologies on international trade

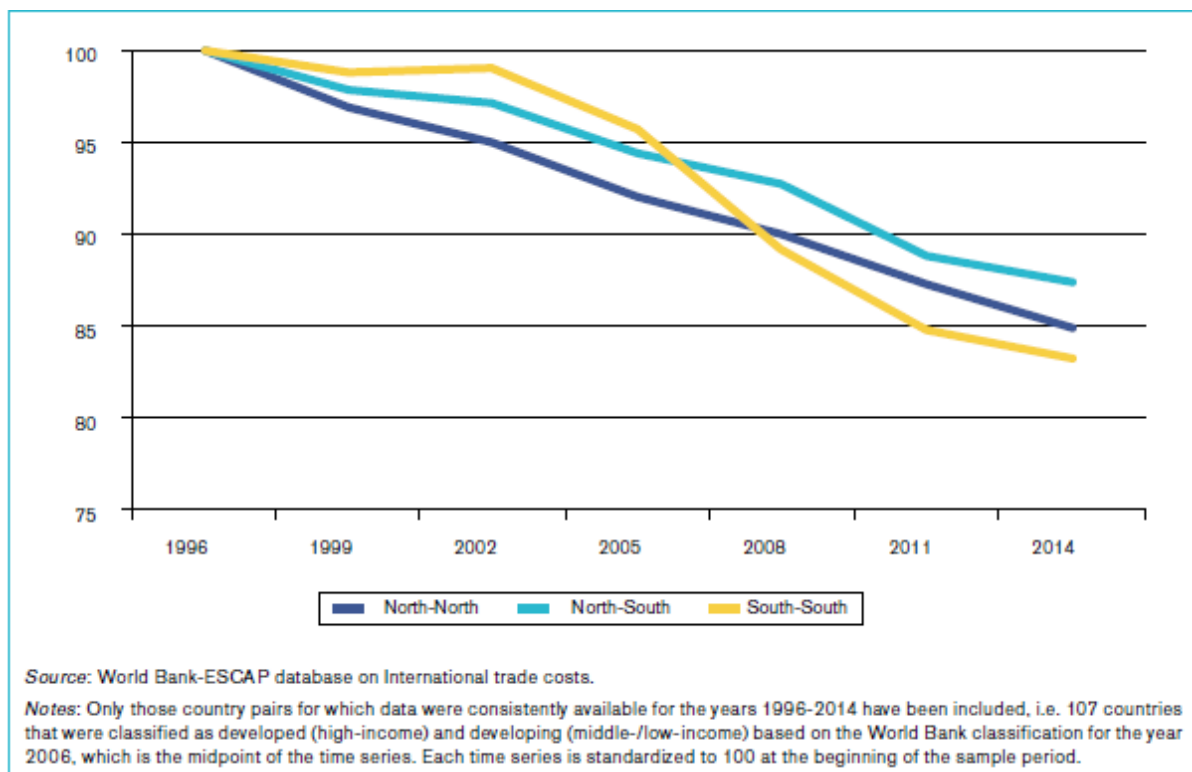
The international community has noticed that there has been a considerable decline in the international trade cost which has declined by 15 per cent between 1996 and 2014. The international community has anticipated that the emergence of new technologies will further reduce trade cost. According to the predictions by the World Trade Organisation using the WTO Global Trade Model; trade will increase yearly by 1.82 percentage points until 2030. The decrease in trade cost will result in cumulated growth of 31 to 34 percentage points over a 15 year period.

6.1.1 Lower trade costs: opportunity or an emerging challenge?

It is apparent that digital technology has transformed economic activity, this is especially the case when observing the purchasing habits on the internet. According to the *2018 World Trade Report*, digital technologies may have a direct impact on distance (geographical, linguistic or regulatory) and may further assist with searches for products, the introduction of mechanisms to confirm quality, reputations and even simplify cross-border transactions. Figure 4 on the proceeding page indicates the decrease in international trade between 1996 and 2014. The decline in the ratio (ratio between international and domestic trade), means that the world has truly become

more globalized. Simply put, international trade has grown significantly faster than domestic trade and challenges to international trade has declined around 15 per cent during 1996 and 2014.

Figure 4: Decrease in international trade cost from 1996-2014



Source: 2018 World Trade Report, (2018: 64).

The decline in international trade cost has been beneficial to all international role players. The decline in trade cost amongst developed countries (North-North) and between developed and developing countries (North-South) have been on the decrease during the period 1996 and 2014. However, the trade cost amongst developing countries (South-South) has been relatively slow in decline when compared to other parts of the world and has only experienced real movement during the mid-2000s.

- **The use of Artificial intelligence to reduce transport cost**

What has been the drive behind the decrease in trade costs? This report has already discussed how technological advances have had an important impact on transportation and logistics costs. The use of Global Positioning System (GPS) for navigation and route planning has become a norm. The emergence of innovative technologies such as artificial intelligence (AI) will take things to the next level since it currently includes autonomous driving capabilities and real time itinerary mapping. For example, an Indian company could change long-distance trucking across India by providing an alternative network based on AI and large data. The long-distance driving routine can be cut by almost half the time if a machine-learning algorithms system to predict when trucks will arrive, depart and even determine which petrol station is best to refuel. The older system which relied on one driver doing multiple stops, will now be utilising four drivers and ensure no stops for breaks, which automatically reduces long-distance time considerably.

- **The use of Cargo and shipment tracking to reduce logistics cost**

Cargo and shipment logistics are made more efficient through the use of vehicle telematics, robotization and artificial intelligence. The greatest benefit relates to tracking systems used in cargo and shipment because it increases operational efficiency. Through the use of tracking system, real-time adjustments can be made if necessary which also makes logistics systems more secure.

7. Section four: South African Perspective

7.1 The impact of fourth industrial revolution on South Africa's economic development

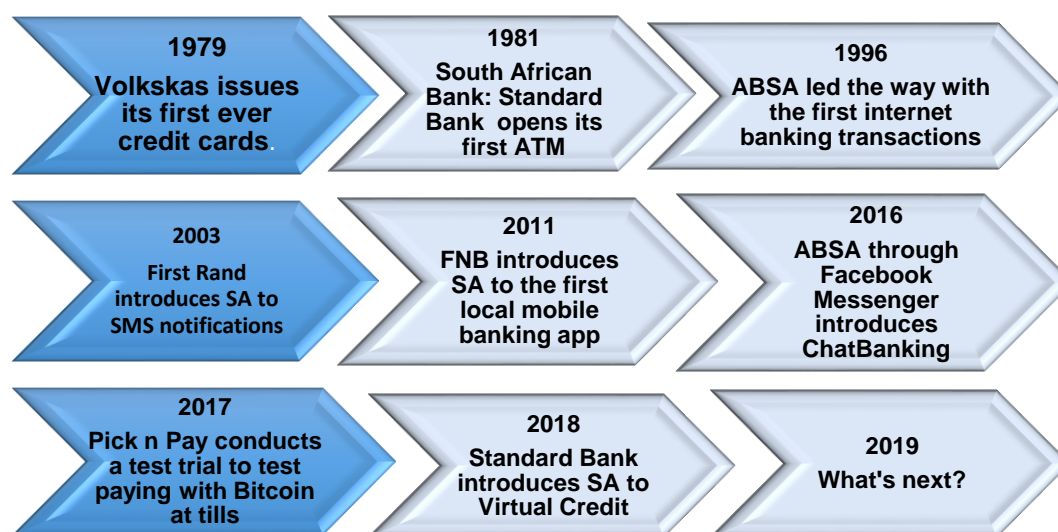
The first three sections of this report discussed in detail the international community's perception and reaction to the fourth industrial revolution (4IR). Section four of report will focus on how South African executives compared to that of the international community. Deloitte conducted a survey with C-level executives requesting their professional opinion on the 4IR and whether their respective organisations were ready

to embrace the revolution. Total of total n=1600 participants responded of which n=100 are from South Africa C-level executives (hereafter referred to as “executives”). Overall, the study found that South Africans are also quite optimistic about the impact of the 4IR, but the level of optimisms slightly differ from that of the international community. The respondents were asked several questions relating to the impact their respective organisations. Accordingly, 60% of international participants are of the opinion that their organisations are able to provide the best product or services. The South African executives’ response was similar with a 59% confidence in their organisation’s ability to provide best products/ services. However, when these executives were questioned on the whether their organisations could deliver strong financial results in the short and long term. South African executives indicated that they are not convinced that their organisations are fully equipped to deal with the changes which the 4IR is bringing. While the executives (33% of respondents) from around the world are confident that they will be able to be stewards for their organisations during the fourth industrial revolution, a mere 2% of South African executives also believe that they have the capabilities. South African executives’ main concern centres on the change in regulatory environment. These include aspects around the fourth industrial revolution such as tech-savvy customers and little concern is expressed towards emergence of new business or delivery models.

7.2 The Banking sector of South Africa

In section one, the report highlighted the trends of the banking sector in various countries. Most noticeably is the closure of bank branches in the United Kingdom (UK) and this was a result of the demand for digital support and making it easier for their customers. South Africa has not followed suite behind the ongoing international debate regarding the relevance or appropriateness of still having bank branches. Despite, South Africa’s lack of participation in the international debate, it’s important to first provide a glance of how the South African banking sector has revolutionised since the 1970s. Figure 5 on the proceeding page illustrates the technological trends in the South African banking sector.

Figure 5: Technological Trends SA Banking Sector



7.3 Payments revolutionised

Payments methods has also been revolutionised. Smartphone payments in South Africa has led to digital wallets and mobile banking apps which allows customers to store card details digitally and transact via their mobile phones. E-commerce and card-based payments has created a platform for customers to transact without merchant authentication of physical card or by streamlining electronic fund transfer payments. Recent developments like the mobile point of sale (POS) or point of purchase (POP) device has significantly reduced the cost and complexity of device management. E-commerce has also led to fast responses code resolutions such as Snapscan and Zapper which has eliminated the need for POS devices. These resent developments are supported by the next generation security measures which include location-based identification, biometrics and card tokenisation (protects consumers and increase confidence in digital platforms). Payment innovation has not had a significant disruption in South Africa because mobile money has not been prominent with the majority of domestic start-ups and international brands which led to operations being closed down. Crypto-currencies have the prospective to disrupt the international payment market by enabling users to securely allocate value with limited transaction costs without the need for intermediaries. Although South Africans have access to both international and domestic crypto-currency, it still remains a niche. The use of crypto-currency is not as popular in South Africa as yet and it requires digital access,

financial savvy, broad acceptance and trust in the digital infrastructure (Centre of Excellence in Financial Services, *n.d.*: 18).

7.4 Deposits, Lending and going Digital

The credit market has seen the emergence of alternative lending methods for consumers to access credit and secure funding from lending products outside the banking system. The peer-to-peer lending platforms and alternative scoring use unconventional data sources that has become popular. There are already a variety peer-to-peer lending platforms and novel methods of credit scoring are being utilized. There has been a shift in how South African banks operate in general. The South African banks have modernised by utilising mobile applications and internet banking. Until recently, Investec was the only bank in South Africa with a principally digital (branchless) offering but was recently joined by Discovery Bank and TYME in 2018 (Centre of Excellence in Financial Services, *n.d.*: 19).

South Africa's four traditional banks namely, Absa, First National Bank (FNB), Nedbank and Standard Bank have collectively closed 695 branches since the early part of the decade. The only bank in South Africa that has increased its number of branches by two thirds has been Capitec, from 507 in 2011 to 840 by the end of February 2019. Standard Bank made an announcement in early 2019 that the institution is scheduled to close down 104 branches throughout South Africa. It is anticipated that by June 2019, it would only have approximately 525 branches, less than the 726 it had in December 2013. Absa was the bank with the most branches in South Africa with 885 physical outlets which it reduced by 187 by December 2018 and only has 698 branches throughout the country. The table on the proceeding page indicate the highest number of branches of the top 5 Banks in South Africa and the number of physical branches they possessed by the December 2018.

Table 5: South Africa's top five branches peak vs recent numbers

BRANCHES	PEAK (HIGHEST NUMBERS)	UPDATED NUMBERS
ABSA	885 (2011)	698 ⁵
FNB	775 (2012)	628 ⁶
NEDBANK	764 (2014)	604 ¹
STANDARD BANK	726 (2013)	525 ⁷
CAPITEC BANK	507 (*not its peak)	840 ⁸

Source: *The Citizen* (2019).

What is the impact of Banks closing branches? The announcement by South African banks has led the community at large concerned about the job losses of thousands. Approximately 50 000 people were expected to participate in the national banking sector strike led by finance union South African Society of Bank Officials (Sasbo). However, the court ruled that strike would be unprotected which was the desired outcome for Business Unity South Africa (Busa). To date, Standard Bank has cut 1000 jobs by closing 104 branches countrywide. While Netbank, First National Bank (FNB) and ABSA joined this emerging trend of closing branches. According to Busa, the trade union federation Congress of South African Trade Unions's (Cosatu) section 77 notice sent to the National Economic Development Council (Nedlac) did not meet the requirements for a legal strike which was scheduled to take place, Friday 27th September 2019 (IOL Economy: 2019). Although a number of South Africans are concerned about the "major banks" closing branches across the country, the Fourth Industrial Revolution (4IR) also represents new opportunities for the unemployed. The 4IR is an unstoppable force and South African Banks need to be flexible and adapt accordingly. The financial sector is one of South Africa's key sectors and has become more digitalised. There are already three retail banks that are branchless and digital namely; Discovery, Tyme and Zero. The transition from traditional banking to more

⁵ Figure as of end-December 2018

⁶ Figure as of end-June 2018

⁷ Figure as of end-December 2018 less 104 announced closures

⁸ Figure as of end-February 2019 (The Citizen, 2019)

personalised banking allows consumers to manage their own banking experience (Daily Maverick, 2019).

7.5 Investment management

Investment management in South Africa and around the rest of the world has drastically changed. The traditional method of obtaining investment management has changed, robo-advisors are automating the human function of guiding investor's decisions. The latest automated investment have created a platform that provide access to a broad range of asset classes with lowered minimum investment requirements and automated portfolio management. There are multiple automated investment platforms in South Africa and individuals are now empowered to take managerial ownership over their asset trading. The retail trading platforms now makes provision for algorithmic trading capabilities while "copy trading" enables less experienced investors to automatically replicate the trade of experienced investors. Although this might be a new trading platform in South Africa, they have been common practices in foreign markets (Centre for Excellence in Financial Service, *n.d.*: 20).

7.6 Market provisioning

Artificial intelligence (AI) technology, capital markets trading and super data analysis provides institutional algorithmic traders with the opportunity to react in real-time, consider broader sets of data and refine their trading algorithms without human intervention. Algorithmic trading has become more popular in South Africa, traders are now utilising new data sources and AI such as machine learning that influence their trading strategies. Examples of these alternative stock exchange platforms that has emerged in South Africa are ZAR X and 4 Africa Exchange which involves low-cost fee structures, real-time settlement and automatically takes out a broker in the process (Centre for Excellence in Financial Service, *n.d.*: 20-21).

7.7 Regulatory response

The previous sections indicated how the fourth industrial revolution (4IR) has impacted the financial sector in South Africa. This section will briefly outline the challenges associated with the latest technological expansion. Although digital channels and real-

time responses have improved how the financial sector do business, it has also created opportunities for fraud and cybercrime. The fact that new data is readily available and centralised function of financial services has resulted in financial services intensifying data integrity and privacy risks. Therefore, it is imperative that regulators be informed on the issues and risks associated with digital innovation and find a balance between the positive and negative aspects. Lessons from the international community indicates that regulators have responded to this challenge along the spectrum of reactive to proactive. An example of *reactive approach* is where regulators do not prohibit their own developments and choose to rather amend regulations when necessary. According to the *Centre for Excellence in Financial Service report*, South Africa has generally taken the reactive approach. The *proactive approach* involves regulators working closely with innovators to understand the developments and regulatory obstacles to innovation and support start-ups in respond to these challenges. For example, regulatory sandboxes is often employed by fintech to test products under minimum regulatory obligations which in turn allow regulators to keep pace with technological innovation and observe its impacts on the market (Centre for Excellence in Financial Service, *n.d.*: 24-25).

7.8 Summary

The approach by the South African government and businesses need to be reconsidered. The current approach has been guided by the low levels of disruption that fintech innovation has caused to the fundamental activities and risks present in the financial system. However, observers have noted that South Africa is gradually changing from a reactive approach to a more proactive approach which has become increasingly important due to the three main reasons; (1) the current regulatory environment has the potential to stifle innovation and without the appropriate guidance, fintech will find the regulatory network problematic to navigate, (2) the ability to forecast innovation in financial services through proactive regulations is crucial for South Africa's development. This would allow South Africa to reach its national objectives and reserve its status as a world-class financial hub, and (3) utilising the proactive approach will enable regulators to identify, monitor and react to the merging risks and opportunities of technological innovation. It is important for South Africa to promote and support digital innovation; the fintech industry is currently small, however

it is growing at a rapid pace. South Africa should therefore structure its financial markets in such a way that digital innovations can have a greater impact on the financial markets (Centre for Excellence in Financial Service, *n.d.*: 25).

8. Section five: Free State Perspective

The Free State provincial government in partnership with the Central University of Technology (CUT) hosted the first ever Free State Fourth Industrial Revolution Summit from the 28th to 29th of November 2019 at the Performing Arts Centre of the Free State (Pacofs), Bloemfontein. The summit had a clear focus on 4IR technologies such as Artificial Intelligence, Block chain, Internet of Things, Big Data Analytics, Cloud Computing, Robotics and Automation, 3D printing and Sensor Networks. A key commitment between CUT and Free State Provincial Government was signing a Memorandum of Understanding (MoU) to build an Innovation Hub in 2020 for the people of the Free State. In attendance was the Minister of Communications, Telecommunications and Postal Services, Stella Ndabeni-Abrahams, who applauded the Free State for the move and also added that her department will ensure that the CUT offers online courses for digital skills in the near future. The 4IR summit also presented delegates with exhibitions on the latest technological developments. See images below.

Image 1: Robotics Free State 4IR Summit Exhibition



8.1 Water Management

The Electrical Engineering Department at CUT has managed to place the Free State province on the map with its innovative implementation strategy to utilise SMART Water Monitoring System Using the IoT. The development of a leakage management system, using the internet of things. It is reported that approximately 4 billion people worldwide face water scarcity monthly. Leakage of fresh drinking water is a major contributor scares water in the province, water leaks are only reported on average 4 to 8 hours after occurrence. Accordingly, depending on the size of the leakage it could lead to a loss of up to 50 000 litres of fresh water being wasted (Gericke and Kuriakose; 2019). Existing methods are often expensive or cannot determine the exact location nor the extent of the leak. Therefore is absolutely critical to identify such leaks timeously. The monitoring and control of water management systems can be achieved using Internet of Things. Existing leakage monitoring devices are expensive and limited in their capabilities. This technology driven approach is made possible through access and availability of the internet of things. Thus as a case study a 16km stretch of pipe in Reitz has been allocated with collaboration of the Mangaung Metro Municipality to conduct trial runs. Where two types of checks are deployed for 1) Major Leaks and 2) Minor leaks. With the use of the IoT the expectations of the water monitor, is to: 1) Monitor Water Pressure 2) as well as Communicate with adjacent neighbouring devices to automatically switch off the water vales connected to the main supply line.

8.2 Green energy

Figure 5: Tetra4 Virginia Plant



At the Free State 4IR summit the CEO of Renergen, Stefano Marani; was pleased to note at the Free State 4IR summit that this project is a milestone for South Africa, as Renergen is the first and only helium gas mine in the country, as well as the first commercial LNG liquefier and helium producer. Making the province the first commercial supplier of LNG product in South Africa. LNG is normally warmed to make natural gas to be used in heating and cooking as well as electricity generation and other industrial uses. LNG can also be kept as a liquid to be used as an alternative transportation fuel.

The Free State province, Virginia to be more specific has recently become a significant producer of helium gas with the initiation of the Tetra4 project. The project aims that by the year 2021 the Free State will be a prominent role player in the helium market because of the rich concentrate levels. This would make South Africa the eighth country to export helium. The Tetra4's Virginia Gas Project comprises exploration and production rights of 187 000 ha of gas fields across Welkom, Virginia and Theunissen, in the Free State. The source of the Virginia Gas Project's natural gas is primarily microbial. It originates from deep within the Witwatersrand Supergroup, via groundwater circulating through large faults and contacting bacteria deep within the earth's crust. This means the methane is a biogenic and a continuing renewable resource (<https://www.renergen.co.za>).

8.3 3D Printing

The Central University of Technology housing the Centre for Rapid Prototyping and Manufacturing (CRPM) established in 1997; has proven to be a leading institution in the Free State with regard to Additive Manufacturing (AM). Annually CRPM manufactures around 15 000 as part of the 500 projects that they have, servicing over 700 clients. The institution supports industries in new product development as well as moving from computer aided designs to prototyping. In 2016, the centre received the ISO 13485 certification for 3D printing of medical devices. This means that the products produced at the centre conform to the International Standards and accreditation. The medical applications are vast, the more notable advantages are: Reduced theatre time using 3D printed implants, usage of cutting/drill guides, pre-operative planning models can be elaborated on. Reduced theatre time has a ripple

effect on faster patient recovery time, 3D printing improves clinical efficacy with better fitting implants at a lower cost. Currently 95% of the medical devices in South Africa are imported which presents an opportunity for localisation, reduced cost and accessibility for more patients if localised (Booyesen, 2019).

8.4 Impact of 4IR on the agriculture sector

The Fourth Industrial Revolution (4IR) has already had an impact on various industry sectors that have embraced the technological movement. In the agriculture sector, consumers have not only welcomed the technological innovations but have indicated the need to move away from traditional methods of farming completely. This was evident during the 2019 annual NAMPO Agriculture Festival in Bothaville, Free State; several companies showcased their latest “smart” tools and monitoring systems for farming. One company namely, RS Components South Africa specialises in Internet of Things (IoT) showcased various products that will assist farmers to get closer to 4IR. According to Brian Andrew, Managing Director at RS Components South Africa, the highlight of the NAMPO 2019 was the smart products and services that were demonstrated by different companies.

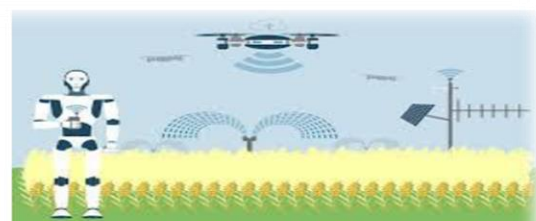
Image 2: Artificial Intelligence (AI) in Agriculture



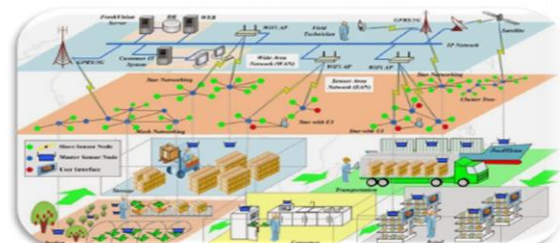
Using AI and IoT to help farmers



Use of AI in Agriculture



AI advances in Agriculture



AI in Agriculture value chain

Source: Ngowi (2019: 11).

The agriculture industry is one that is fast embracing 4IR due to the convenience it presents for farmers. Farmers can manage their yields wirelessly through connected devices and sensors that monitor various aspects that affect their produce and livestock simultaneously. Professor Louis Fourie from Cape Peninsula University of Technology (CPUT) shared the same sentiments and added that the IoT and related technologies such as Artificial Intelligence (AI) farm management systems, big data analysis and robotics have revolutionised the agricultural sector. It has been evident that the agriculture sector has been disrupted by technologies in the fields of biotechnology, nanotechnology, genetics and autonomous vehicles which have transformed the traditional farming methods. Farmers in South Africa now have other options available to them such as smart farming, precision farming which often include technologies such as geographic information systems, GPS, remote sensing technologies, AI, robotics, the IoT and big data (Polity, 2019: Internet).

Agriculture sector is one of the priority sectors that needs to be supported by the Free State Provincial Government (Free State Growth and Development Strategy, 2017). The Free State province is known for being part of South Africa's staple-food basket which largely focus on wheat, maize, cattle and sheep. However, it should be noted that there have been various products or crops that have arisen in the Free State namely; potatoes, groundnuts, sorghum, sunflowers and asparagus pertaining to crop, and flowers and cherries on the horticultural side as well as game framing on the livestock side (Centre for Development Support, 2004: 22). The table below indicate for the period 2018 and 2008, the agriculture sector had the lowest average annual growth of 3.43%. In 2018, the Free State experienced a negative growth in all the industries with an annual growth rate of -0.14% since 2017. However, it should be noted that during the period of 2008 to 2018, the agriculture sector had its highest positive growth in 2017 with an average growth rate of 30.5% (HIS Markit Regional eXplorer, 2019: 23).

Table 6: Gross Value Added (GVA) by Broad Economic Sector of the Free State, 2008, 2013 and 2018 (R Billions, 2010 Constant Prices)

FS SECTORS	2008	2013	2018	Average Annual growth
Agriculture	6.8	6.5	4.8	-3.43%
Mining	19.2	19.3	19.1	-0.03%
Manufacturing	14.9	15.0	15.7	0.50%
Electricity	4.5	4.6	4.4	-0.15%
Construction	3.6	4.1	4.1	1.36%
Trade	22.6	25.5	26.4	1.58%
Transport	11.6	12.2	13.0	1.15%
Finance	20.4	21.8	23.1	1.25%
Community services	29.7	33.7	35.8	1.89%
Total Industries	133.4	142.6	146.6	0.95%

Source: IHS Markit Regional eXplorer version 1750

Despite the fact that the agricultural sector remains an economic driving force in South Africa, there is a need for the industry to adopt new technology on a larger scale. This would require various stakeholder such as the farming sector, national and provincial government, businesses and higher educational institutions to work together (Polity, 2019: Internet). Therefore, it is imperative for the Free State government to address the forces that have resulted in the reduction of employment and the value-added of conventional farming in the Free State. In 2014, the Free State Provincial Economic Advisory Committee (PEAC) indicated that there is a need for the Free State to organise a new range of growth niches and to stimulate a number of the platteland places (Centre for Development Support, 2004: 3). Lessons can be drawn from other provinces such as the Western Cape where the Department of Agriculture introduced Sentinel -2 earth observation technology. The Sentinel -2 is considered a ground-breaking platform with 10-20 spatial resolution and a five-day revisit frequency. According to MEC for Agriculture and Economic Development, Ms Beverley Schafer, the Sentinel -2 is a free-access platform where ground breaking satellite imaging technology can be accessed and used to develop agriculture, respond to natural disasters due to climate change. This tool is available for all farmers in the Western Cape in effort of the Provincial government to contribute towards sustainable farming and the development of a food-secure province through technological innovation (Western Cape Government, 2019). Although these new technology innovations are

already affecting all sectors, tangible and visible planning is required in South Africa to address unemployment and poverty. There is a need for both national and provincial government to develop a solid foundation for 4IR to flourish which could lead to a prosperous economy (Zollner, 2019).

8.5 The impact of 4IR on Manufacturing and Mining

In the previous sector, this report indicated that the Fourth Industrial Revolution (4IR) has an impact on all sectors across-the-border. The Minister of Trade and Industry, Dr Rob Davies launched the new Intsimbi Future Production Technologies Initiative (IFPTI) in Cape Town at the NTIP's Centre of Excellence. The IFPTI was developed in line with the principles of the new production technologies for the 4IR. According to Minister Davies, this launch is based on the South African government's effort to build capacity in order to respond to the impact and opportunities of the 4IR. This launch was based on the pilot project National Tooling Initiative programme in order to make it a fully-fledged 4IR programme which includes capacity building in terms of training in robotics, mechatronics and industrial maintenance. Accordingly, the Intsimibi model is a success story for the South African government in terms of expanding South Africa's position as an Advanced Manufacturing sector that responds the 4IR that has drastically transformed the global Manufacturing industry (the dti, 2019).

There are a variety of companies that have been testing autonomous vehicles for many years and these include Telsa, Uber and Google's sister company Waymo (that have tested with 16 million kilometres on public roads with zero fatalities. South African company, Mobility Centre for Africa has been in the process of launching Africa's first autonomous vehicle pilot programme. These recent developments and many other automotive technological advancements will have a huge impact on global and domestic economy (Daily Maverick, 2019). The South African mining industry remains one of the key sectors that drives the economy. In the Free State, the Free State Growth and Development Strategy (FSGDS) reiterates that mining is a key priority sector that needs to be supported by the Free State Provincial Government. At the start of 2019, Baletsema Mining Services and the University of South Africa (Unisa), the Southern Institute of Mining and Metallurgy (SAIMM), the Council for Science and Industrial Research (SCIR), the Institute for Security Studies and the University of

Witwatersrand (Wits) collaborated with 4IR in South Africa (4IRSA) and many other institutions have hosted colloquiums and seminars to unpack the Fourth Industrial Revolution (4IR). This is a clear indication that is officially part of the South African National Agenda.

8.6 4IR and Tourism sector

Globally, tourism is regarded as one of the fastest growing sectors, continuously exhibiting high levels of growth irrespective of the ever changing economic and geopolitical factors in its operating environment. The South African tourism sector shares this same growth trajectory as the country continuously leads the Southern African Development Community (SADC) on this front. The tremendous growth, development and transformation opportunities garnered by the tourism sector have been highlighted by President Cyril Ramaphosa in his 2018 State on the Nation Address as well as in the 2018 Budget speech (National Treasury Department, 2019; State of the Nation Address, 2018).

The tourism sector is one that continues to evolve with technology, the admin of travel has been simplified and very much customisable. The global community is able to so as a Fully Independent Traveller (FIT) through ITC and the Sharing economy. With the use of Mobiles one can search for real time travel information. The local based visitor information centres, coupled with the sharing of experiences through social network sharing. And finally convenience and access to goods through the sharing economy.

Image 3: Online Platform for FIT



Adopted from: (Prof Yoon, n.d)

8.7 4IR and Transport sector

Without technological change, the traditional, car-dominated cities of the 20th century would not survive rapid urbanization and the increasingly stringent air pollution regulations. Some solutions are more costly than others to implement, include for instance integrated intra and inter-urban transport and logistics systems, reducing the need for private vehicles. Real-time transport and traffic management and monitoring systems. Cleaner vehicles and low-carbon mobility solutions that allow people to walk and bike more freely. Platforms to better utilise existing and new forms of shared and ambient mobility, e.g. bikes, buses, and autonomous vehicles. Mixed-use neighbourhoods and better use of home services improving access to goods and services exploiting fourth industrial revolution technologies could transform not only the daily commute, but also delivery logistics, inclusion and productivity.

Autonomous vehicles providing on-demand mobility services are one, option although much debated. Deploying AI and sensors also offer options, these are based on the IoT, for predictive and real-time traffic flow and pollution management, advanced materials for low-carbon and clean fuel options, drones for deliveries and virtual reality (VR) for remote meetings.

Transport infrastructure is an integral part of the transport system of any city or state. In connection with the development of society and intensification of international relations due to the globalization processes, the importance of transport as a factor for economic and social development has enhanced. Various aspects of the activities related to the development of transport infrastructure have increasingly become the objects of scientific researches. Transportation as an economic factor is a measure of economic activity and at the same time transportation is a reflection of economic activity. So, the questions about transport infrastructure performance measurement and relationship between transport infrastructure and economic growth are the subjects for discussions in both academic and non-academic circles.

8.8 Workforce Education/ Training

In his 2019, State of the Nation Address (SONA), President Cyril Ramaphosa announced that South Africa is planning on implementing a Framework for Skills for a Changing World. The aim of this framework is to ensure that all South African children will be able to respond to emerging technologies such as robotics and artificial intelligence. At provincial level, the Free State Premier, Ms Sisi Ntombela announced during her 2019 State of the Province Address that “*we will extend our current programme of using technology to teach our learners in more schools to better prepare them for the 4th Industrial Revolution*” (Office of the Premier, 2019: 7-8). The Fourth Industrial Revolution (4IR) presents a prospect for South Africa to advance their economic prospects through innovative technology to drive growth. The recent retrenchments by large companies such as Standard Bank and MultiChoice speaks to the digitisation – how new technology is impacting on the labour market. This may be a disruption in the current status quo but it presents new opportunities for employment and entrepreneurship. However, the question remains, *is South Africa ready to exploit these opportunities that are emerging at such a rapid speed?*

8.8.1 Evaluation of South Africa’s education system

According to the World Economic Forum, 65% of children entering primary school today will end up working in completely new jobs that do not exist yet. This suggests that the current industrial revolution necessitates higher education levels and cognitive skills. It is widely believed that the 4IR can enhance economic growth, create job opportunities due to innovation, advance safety and security and promote improved education and skills transfer. Therefore, it is imperative for South Africa to change the current school curriculum to ensure that the *next generation* is adequately responsive to technological innovation.

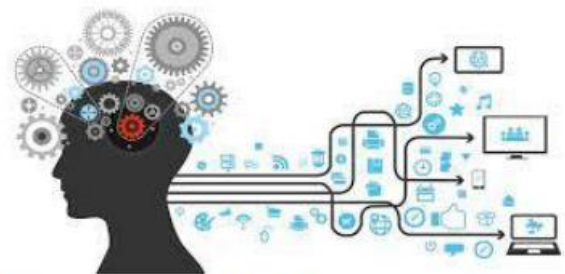
However, a critical evaluation of the South African education system indicates that the country need to address the following challenges;

- The current school curriculum does not adequately prepare learners with the appropriate skills or education for the Fourth Industrial Revolution (4IR).
- Computer science skills is found to be at the heart of 4IR, however there is a limited amount of primary and high school learners that have access to computers. It is reported that some learners obtain their Grade 12 qualifications without having accessed a computer during their school career.
- In South Africa, access to internet remains a national dilemma and for those learners who can access the internet find that it is an expensive exercise.
- The current South African curriculum does not have coding as part of the curriculum despite it being crucial to technical skills for future jobs.
- The teachers in South Africa (both primary and high school) levels are not obtaining the necessary training and development to capacitate them with 4IR (Bizcommunity, 2019: internet).

Figure 5: Use of Artificial Intelligence (AI) in Education



Teacher and AI Collaboration



AI and personalized learning experience



AI and accessibility to all students



Tutoring and support outside classroom

Source: Ngowi (2019: 14).

The assurance by the President of South Africa and the Free State Premier comes at an appropriate time, as it affirms the beliefs by SA executives. South African executives have confidence that the current education system will ill prepared workers for the fourth industrial revolution as opposed to their international counterparts. According to the study by Deloitte, a majority (73%) of South African executives' believe that technologies will replace human workers in the near future. This is not a very optimistic view. Furthermore, 100 South African executive respondents from the Deloitte study firmly believe that the workforce is trending towards contractual or temporary employees as opposed to full time/ permanent employees (Deloitte, 6). Curro (a private education group) has already surpassed South Africa by introducing tech-focused schooling models that focus on coding and knowledge in robotics. The fact that private education groups are ahead of South Africa, could increase the inequality gap of the rich and the poor in terms of education and training. This could potentially lead to further marginalisation of disadvantaged communities (Daily Maverick, 2019).

8.9 The Free State Fourth Industrial Revolution Summit

The Free State Provincial Government in collaboration with the Central University of Technology (CUT) hosted the first ever Free State Fourth Industrial Revolution with the following deliverables;

- Enhance the awareness and impact of the Fourth Industrial Revolution technologies in stimulating economic growth in the Province;
- Exhibiting 4IR-related technologies and investment opportunities in the Free State.
- Establish an interactive platform to promote innovation and entrepreneurship with special focus on youth in the Free State.



The Free State Fourth Industrial Revolution summit was a success and the following agreements were signed:

- The FSPG will donate R5 million to CUT to establish an innovation hub at CUT.
- MyFinB Holdings Pte Ltd (MFB), RRS Trade and Investment Group (RRS) and CUT Innovation Services (CUTis).

The outcomes of their 4IR Summit is not limited to the above-mentioned agreements. The Premier of the Free State convened a special session with the private sector to encourage them to establish a close working relationship with CUT in order to develop skills and 4IR-related technologies. Additionally, telecommunications companies such as MTN, Cell C and Huawei has expressed interest to partner with CUT. While Microsoft indicated that they already have a working relationship with the institution. In terms of overall economic development of the Free State Province, CUT has been requested to develop a methodology for 4IR skills forecasting and programmes and qualifications that address the needs identified within the Free State Growth and Development Strategy.⁹

⁹ Central University of Technology. 2019. Free State Provincial Fourth Industrial Revolution (4IR) Summit Report. Free State: Bloemfontein.

9. Findings and Recommendations

The first objective of this study is to **determine the state of the Fourth Industrial Revolution**. This study has found that digital technology has transformed economic activity, looking at the purchasing habits of online shoppers on the internet. Digital technologies may have a direct impact on distance (geographical, linguistic or regulatory) and may further assist with searches for products, the introduction of mechanisms to confirm quality, reputations and even simplify cross-border transactions. According to the *2016 Future Jobs Report*, by the end of 2020 the jobs that will be defined as critical will relate to data analysis and sales representatives. Large firms around the world firmly believe that there will be a greater demand for data analysts in order to make sense of large data obtained through the technological disruptions (World Economic Forum, 2016: 16).

The second objective of this report is to determine the impact of the 4IR on South Africa's economic development. In order for South Africa to gain a competitive edge on the international arena, the country will have to start reshaping its high school curriculum and reskilling its workforce. It is recommended that the South African Department of Basic Education address the following challenges related to 4IR;

- The curriculum needs to adequately prepare learners with the appropriate skills or education for the Fourth Industrial Revolution (4IR).
- Computer science skills are very important, from primary and high school learners need to have access to computers. It is reported that some learners obtain their Grade 12 qualifications without having accessed a computer during their school career.
- In South African access to internet remains a national dilemma and for those learners need to be able to access the internet at affordable rates.
- Coding as part of the curriculum could be advantages and crucial to technical skills for future jobs.

There are a quite a number of positive changes presented by the 4IR across the globe that is making it easier and faster to complete complex and cumbersome tasks. South Africa is already taking advantage of some of these technologies at different levels respectively. But for the Free State and South Africa to reposition itself globally, there is a real need for infrastructure development and the skills and education need to be the primary focus. It is important to realise that the fourth industrial revolution is not just about gadgets, but also about the infrastructure which is the backbone on which smart devices run. For the Fourth Industrial Revolution, to be harnessed it starts with infrastructure development. All technological innovation is grounded on supporting infrastructure coupled with skilling and creating opportunities in the Fourth Industrial Revolution, the government should bring youths into the fold skilling them to become innovators of smart tech solutions that can transform economic sectors and improve service delivery

The final objective of this study is to determine the impact of the Fourth Industrial Revolution in the Free State. The Free State province has been taking advantage of the different aspects of 4IR technological advancement, which comes in many shapes and forms. Organisations in the province have displayed an ability to take advantage of a number of the 4IR building blocks, from: the wide usage of The Internet of Things (IoT) in agricultural and water management practices, the additive manufacturing and 3D printing applications, Renergen alternative energy, artificial intelligence and big data to mention a few. However, this report has determined that the Fourth Industrial Revolution has had no significant impact in the Free State. The Free State Government's relationship with CUT and its commitment to establish an innovation hub, is an indication that the province is heading the right direction. However, in terms of actual usage of 4IR-related technologies in the priority sectors of the Free State is none-existent. Therefore, this research report concludes that 4IR is at its developmental stage or infant stage in the Free State province.

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