



DEVELOPING AN ECONOMICALLY  
ACTIVE CITIZEN DURING THE TIME  
OF **THE FOURTH INDUSTRIAL  
REVOLUTION**

R E S E A R C H  
R E P O R T



**KAGISO**  
TRUST  
Overcoming poverty



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# CONTENTS

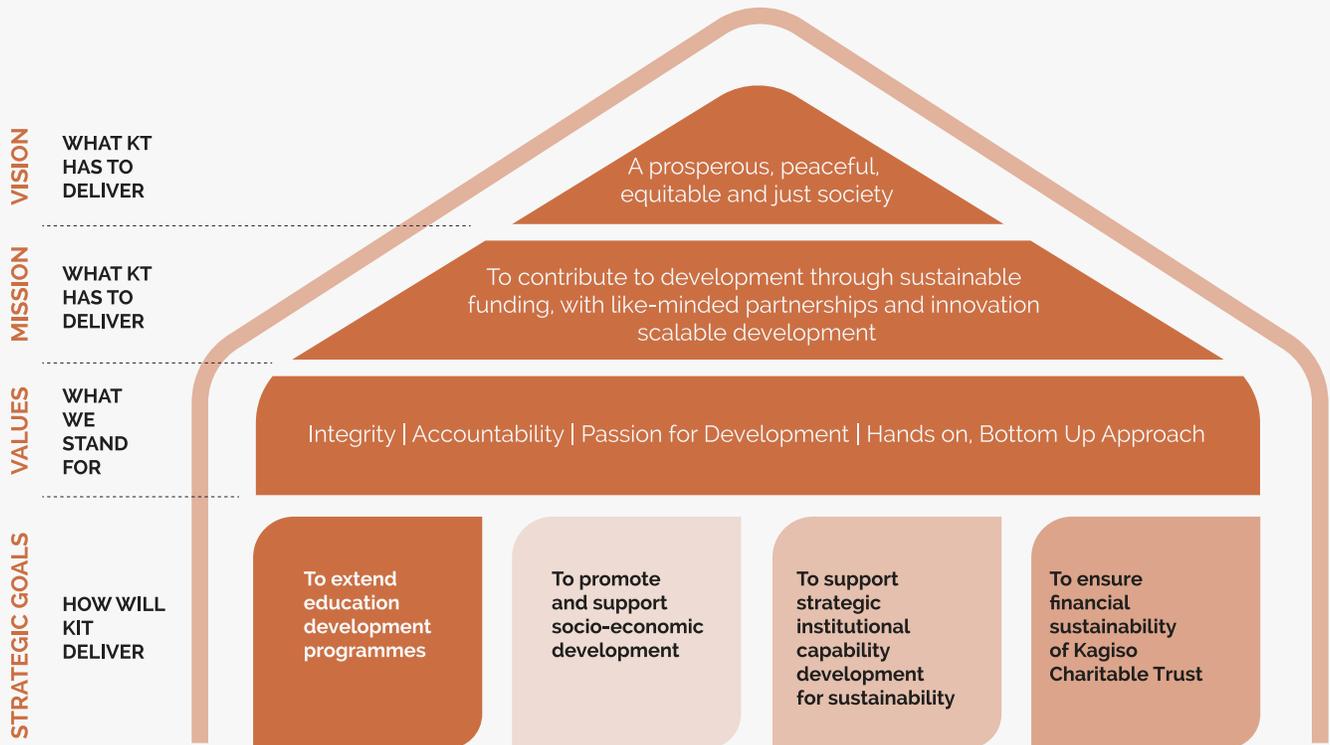
<b>Chapter 01</b>	<b>08</b>	<b>Chapter 03</b>	<b>43</b>
<b>Introduction and Methodology</b>		<b>Strengthening Institutional Capacity Effectiveness</b>	
11. Introduction		3.1. Strengthening Institutional Capacity Effectiveness	
12. Methodology		3.2. Conclusion	
<b>Chapter 02</b>	<b>17</b>	<b>Chapter 04</b>	<b>50</b>
<b>Factors that Influence the Development of an Economically Active Citizen</b>		<b>Changed Mindset to Leverage Opportunities</b>	
2.1. Overall Knowledge		4.1. Changed Mindset to Leverage Opportunities	
2.2. Embracing Technology and Digitisation		4.2. Conclusion	
2.3. Responsive Education System		<b>Chapter 05</b>	<b>56</b>
2.4. Re-Defined Work Structure		<b>Conclusions and Implications</b>	
2.5. Skills Development for Emerging Jobs		5.1. Proposed Conceptual Model	
2.6. Reducing Driving Socio-economic Barriers		5.2. Implication for Stakeholders	
2.7. Conclusion		5.3. Conclusion	
		<b>REFERENCES</b>	<b>64</b>
		<b>ACKNOWLEDGEMENTS</b>	<b>59</b>



# ABOUT KAGISO TRUST



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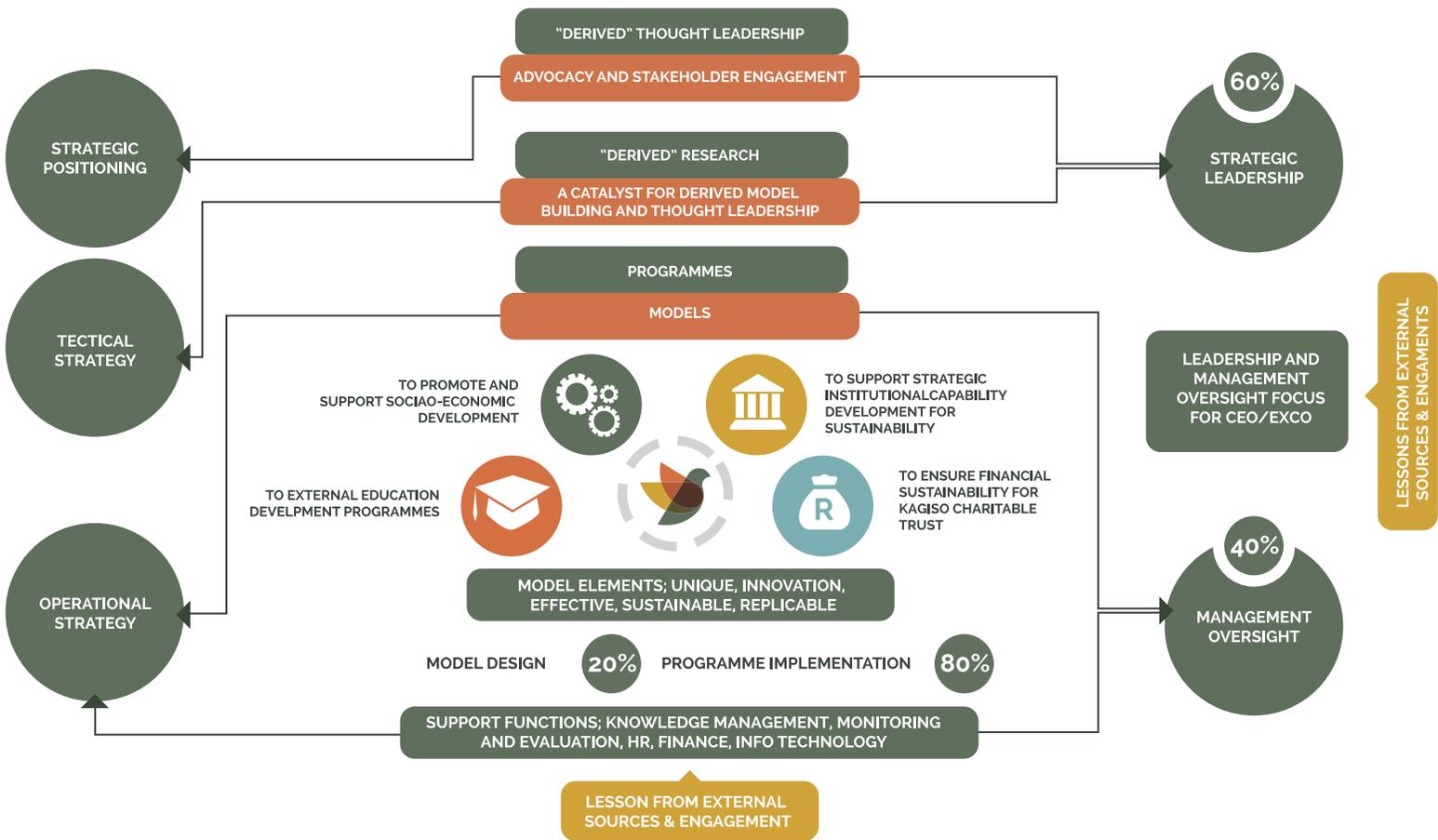


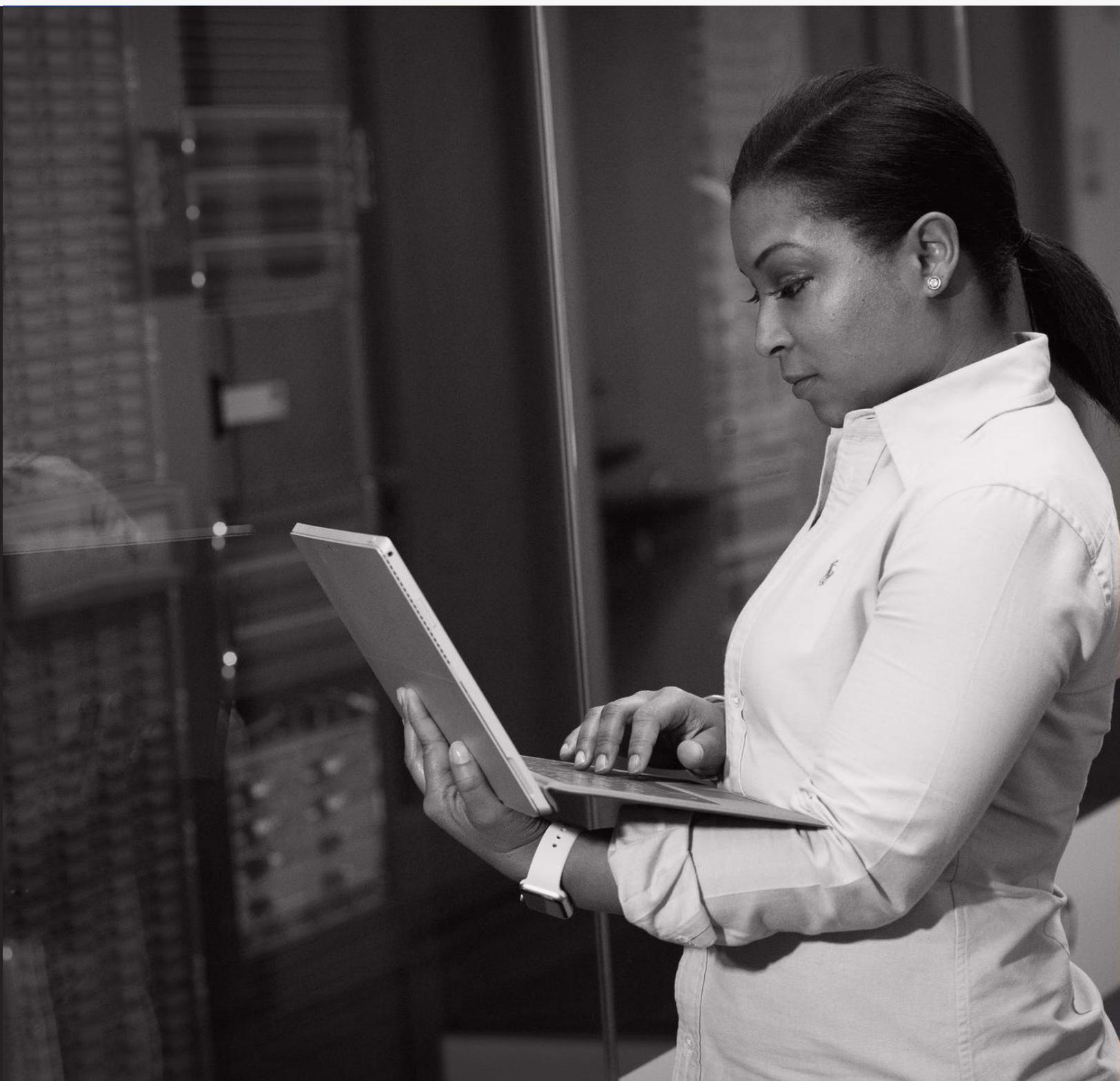
*Kagiso Trust has a clear strategic architecture to guide its growth over the next 30 years*

Kagiso trust (KT) was established as an anti-apartheid organisation in 1985, using empowerment as a tool to fight the oppressive regime. With the advent of democracy in 1994, the Trustees decided to take the Trust in a different direction; after all, although the regime was abolished, its after-effects lingered and are characterised by inadequate social institutions. KT aimed to address these inequalities by helping to bolster development in communities. KT aimed to address these inequalities by helping to bolster development in communities.

Kagiso Trust sets itself apart from the other organisations through its ability to relate to ordinary people; the very people, in fact, who it aims to assist. Led by the values of integrity, accountability, a passion for development, and a belief in a hands-on, bottom-up approach, KT has proved itself as an effective facilitator of sustainable development.

KT's commitment to a society built on liberty, justice, and freedom from poverty, remains as strong as ever.





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# EXECUTIVE SUMMARY

Governments, private organisations, academia and other societal stakeholders have started to notice the advent of the Fourth Industrial Revolution and its impact, and have started to create platforms, pilot studies and implementation plans to seize the opportunities associated with it. In this study, research was conducted to investigate the critical factors that were influencing the development of an economically active citizen during the time of the Fourth Industrial Revolution in South Africa.

The empirical data was collected in multiple stages from diverse stakeholders - public entities, the private sector, funders, academia, entrepreneurs and connectors of change who play a pivotal role on the effective participation in the Fourth Industrial Revolution. This was collected from panel discussions as unstructured focus groups (seven experts), survey questionnaires (1123 respondents), structured interviews (105 respondents) and semi-structured in-depth interviews (32 experts).

The depth of the data allowed for both data and methodological triangulation, and thus ensured both rigour and credibility of the research study.

## CRITICAL FACTORS TO DEVELOP AN ECONOMICALLY ACTIVE CITIZEN

There were six core and two enabling factors that were identified to influence the development of an economically active citizen during the time of the Fourth Industrial Revolution. The core factors identified were knowledge about the Fourth Industrial Revolution, embracing technology and digitisation, a responsive education system, re-defined work structure, skills development for emerging jobs and reducing socio-economic barriers.

These are complemented by strengthening institutional effectiveness and a paradigm shift to leverage opportunities. The findings revealed that the education system must be responsive and allow the fusion of several skills and multi-disciplinary knowledge. These are critical to harness the South African citizens so that they are able to effectively participate in the Fourth Industrial Revolution. The approach to achieve this is through re-alignment of the Sector Education and Training Authorities (SETAs) as they are already well positioned to manage and create learnerships, skills-based programmes, among others, for all the occupations in South Africa. In addition,

there is a need to strengthen the recognition of prior learning (RPL) and to promote accredited skills development through fast-tracking programmes. These are short-term measures.

Medium and long-term, there is a need to restructure early childhood development (ECD) to leverage the window of opportunity for stimulus, strengthen the basic education curriculum by making Science, Technology, Mathematics and Innovation (STEMI), and entrepreneurship education mandatory and to revise the curriculum to be cross-disciplinary. Further, there is an urgent need for the Universities of Technology and Technical and Vocational Education and Training institutions (TVETs) to focus on skills, engineering and all the other related subjects that are critical for the Fourth Industrial Revolution success.

This responsive education system will work effectively if it is enabled through the implementation of a fully fledged technology-based education, educators are amply capacitated, there is an education value chain co-ordinator and the strengthening of mentorship.

A responsive education system will create skills for emerging jobs which will allow the citizens to have a choice of either being employed formally or being self-employed as entrepreneurs.

Critically, there is a need to develop the citizens' knowledge about the Fourth Industrial Revolution as findings revealed that current knowledge is low with only 5% of respondents who scored themselves 9 out of 10 in understanding what the Fourth Industrial Revolution is about and a quarter of the respondents scored themselves 7 out of 10 on knowledge (acceptable levels) about the Fourth Industrial Revolution. The citizens have a chance to embrace technology and digitisation, provided they are equipped with the requisite knowledge. During the interviews, it was also evident that there was a Fourth Industrial Revolution knowledge bias in favour of citizens with higher socio-economic status. Hence, there is a need to reduce the socio-economic barriers, such as the high cost of data to access internet in order to allow citizens to access information and utilise it for their prospects as economically active citizens.

Complementing the above, is a paradigm-shift needed to leverage opportunities and to strengthen the institutional effectiveness by ensuring that there is political will and leadership, enabling and responsive policies, collaboration, capacitated officials, and the promotion of good governance and the curbing of corruption.

## IMPLICATIONS OF THE FINDINGS

The Fourth Industrial Revolution has the potential to facilitate the problem solving for both economic and social imperatives, especially in a country such as South Africa, which has high levels of unemployment and poverty.

Furthermore, the Fourth Industrial Revolution has a potential to leapfrog and ensure that the infrastructure backlog and other remnants of the previous revolutions are not always the constant stumbling blocks for development and future progress. This is important for South Africa's National Development 2030 vision.

All the different stakeholders have a role to play to ensure that all sectors of society, including the marginalised, are included and are allowed to participate in the Fourth Industrial Revolution.

This can be done through awareness campaigns, thought leadership and advocacy, collaboration and public-private partnerships, especially for the infrastructure development required for the Fourth Industrial Revolution imperatives. The study confirmed that developing an economically active citizen during the time of the Fourth Industrial Revolution is a multiple and complex task and the guidelines offer an opportunity to assist stakeholders to find a way forward on how they can contribute towards this revolution. The Fourth Industrial Revolution is here and it is imperative that South Africans and the rest of Africa leverage this opportunity to improve efficiencies and decrease dependency as followers.

## ACKNOWLEDGEMENTS

We wish to express our gratitude to the following contributors and partners:

All the almost 1300 respondents from government, the private sector, academia, entrepreneurs and connectors of change who contributed to this study, without whom this project and the report would not have been possible

The data collected for both qualitative and quantitative phase of the study throughout the targeted districts of South Africa. Isaac Manqele, Gugu Gumbi, Thobelani Mhinana, Trust Tivane, Sinazo Manyisane, Lwazi Mahali, Nolufefe Mgozolwala, Nhlakanipho Ncube, Nkosinathi Manqele, Lorato Tshetlho, Nomcebo Nxumalo,

Vuyiswa Chondo, Sibusisiwe Mtotywa, Larona Tekana Noxolo Manentsa, Kano Mashinini Obakeng Ditsele, Maletete Nkadameng.

Finally, we would like to thank Kagiso Trust Staff who were responsive, assisted, sponsored and supported this project under the leadership of the CEO, Mrs Mankodi Moetsi and Head of Programme and Strategy, Ms Modjadji Seabi. We would also like to thank the research support staff of the Business and Social Research Institute, especially Smilo Manqele, Luzuko Jama, Dimpo Sipuka and Kgomotso Molalathoko.



# 01

## INTRODUCTION AND METHODOLOGY

The Fourth Industrial Revolution is characterised by the underlying digital logic and transformation that changes everything in our lives. The industrial revolutions are periods of technology, innovation and production paradigm changes. It involves data analysis as capabilities, digitisation of value chains, digitisation of products and services and digital innovation. The UN Secretary-General, António Gutierres, asserts that the Fourth Industrial Revolution will have a dramatic impact in our societies, on our way of life, and also within the labour markets.

The same view is also advanced by several scholars who explained the importance of the Fourth Industrial Revolution in our daily lives, workplace and society at large (Schwab, 2016; Lele & Goswami, 2017; Liao, 2017). As such, governments, private organisations, academia and other societal stakeholders have started to notice the advent of the Fourth Industrial Revolution and its impact and are creating platforms, pilot studies and implementation plans to seize the opportunities that are being offered by this revolution (Kagermann, Wahlster & Helbig, 2013; Kuruczleki et al., 2016; Jones & Pimdee, 2017).

South Africa has also started to engage with the Fourth Industrial Revolution in order to understand what it means for the country and the continent of Africa, and what ought to be done to ensure that the country and its citizens becomes Kagiso Trust is contributing to the recognition on the criticality of the Fourth Industrial Revolution for citizens, especially the marginalised, and has thus commissioned this research. This is done with an intention to aid the understanding of what is required for an economically active citizen during this time of the Fourth Industrial Revolution. active respondents in the Fourth Industrial Revolution.

Kagiso Trust is contributing to the recognition on the criticality of the Fourth Industrial Revolution for citizens, especially the marginalised, and has thus commissioned this research. This is done with an intention to aid the understanding of what is required for an economically active citizen during this time of the Fourth Industrial Revolution.

As such, the research was focused on answering the main research question which was:

What are the critical factors to advance an economically active citizen during the time of the Fourth Industrial Revolution?

This report provides findings, insights, as well as improvement proposals from research conducted within the different areas and from the different stakeholders.

These stakeholders are government, the private sector, academia, entrepreneurs and connectors of change in South Africa. In this report, the conceptual model was developed and is presented. The report ends by advancing the implications for the stakeholders.

## THE ADVENT OF THE FOURTH INDUSTRIAL REVOLUTION

The Fourth Industrial Revolution follows previous revolutions (Schwab 2016; Baldassari & Roux 2017; Naude 2017).

During the First Industrial Revolution, there was the development of steam engines, machines and tools, the emergence of production capabilities, as well as urbanisation. During that revolution, water was heated to get steam. This resulted in the advent of the steam engine.

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The steam was used to power everything from agriculture to textile manufacturing. The lasting feature of the first industrial revolution was urbanisation, with huge migrations from rural areas to urban areas. This change was positive, but it came with problems, such as overcrowding, which resulted in health issues (Galvin, 2003). This phenomenon remains in place across the world today, and in particular, in Africa with on-going urbanisation (Naude, 2017). South Africa is no different, as it is also characterised by high levels of urbanisation. In South Africa, urbanisation is so high such that by 2017, 65.8% of the country's population was living in urban areas (Statistics South Africa, 2018). Unfortunately, this positive development has also had a negative ripple effect that is characterised by poor service delivery, including water, sanitation, and electricity provision, as well as refuse removal, due to inadequate capacity to deliver these services (Van Baleen, Schutte & Von Leipzig, 2015).

This was followed by the Second Industrial Revolution, which was associated with science, mass production and electricity. This revolution was distinguished by the development of capital-intensive production, growth and productivity (Jensen 1993). This revolution accelerated things, with several key inventions, such as petrol and diesel engines, aeroplanes and chemical fertilisers. The Second Industrial Revolution also saw the development and use of electricity as a source of power. This revolutionised manufacturing and other sectors. Countries benefited from it, allowing for a very high increase in the labour force and the development of industries and wealth. South African industries also developed, and today, the country has the second largest economy in Africa behind Nigeria. It has an abundance of natural resources, especially precious metals, such as platinum, gold, and others. The challenge is that, together with the manufacturing sector, the mining industry is struggling, and it is shedding jobs due to very high operational costs (Fisher & Schnittger, 2012). Furthermore, society has shown an increase in inequality. This inequality is exacerbated in countries like South Africa as it also had apartheid, where the state power was structured to promote the culture, language and economic interests of minority groups (Kallaway, 2002).

This led to a legacy of economic divisions and gross inequality among South African citizens (Salisbury, 2016).

This was followed by the Third Industrial Revolution which was the digital revolution and the information age (Blinder, 2006). This revolution saw the world moving from analogue, electronic and mechanical devices to digital technology. Electronics and information technology began to automate production, especially manufacturing sector production and also to take supply chains global. This era saw the development of the computer industry and internet networks which resulted in drastic changes, with global communication reaching unprecedented heights. The technological transformation started to change both the economic and social life of the citizens (Dosi, 2012). This included employment generation, goods and services demands and the accumulation of wealth. The same was found in South Africa which is regarded as a gateway to business in Africa, with favourable market accessibility to the global markets. This is made easier in South Africa with its world-class general infrastructure and advanced financial and banking services.

Then comes the Fourth Industrial Revolution, which is also referred as Industry 4.0 or 4IR. The Fourth Industrial Revolution is shown to stimulate critical advances in science and technology, using the Internet of Things (IoT), artificial intelligence (AI) and other supporting technologies to develop customised products for customers, optimised production chains and improved efficiencies (Liao et al. 2018).

The Fourth Industrial Revolution, like other previous revolutions, has brought with it socio-economic benefits and challenges in society and the countries must adapt and transform with these changes (Morrar, Arman & Mousa, 2017).

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## CONVERSATIONS ABOUT THE FOURTH INDUSTRIAL REVOLUTION IN SOUTH AFRICA

The conversations about the Fourth Industrial Revolution have started in South Africa and are gaining traction, especially in the past 12 months. Table 1 presents some of the published efforts on the Fourth Industrial Revolution at different stage (preparation and conceptualisation, research, piloting and fully implemented) from the five key stakeholders, which are government, public organisations, the private sector and funders, academia, entrepreneurs and connectors of change. Although the list is not fully exhaustive as several stakeholders are working on their own and have not publicised their work; what is evident is that South Africa is still in the infancy stage getting ready to prepare itself to leverage the realities of the Fourth Industrial Revolution.

## GOVERNMENT AND OTHER PUBLIC SECTOR INITIATIVES

The legislature and government departments in South Africa have started preparations, conceptualising and some instances, piloting activitive related to the Fourth Industrial revolution.

Parliament has started the conversation about the Fourth Industrial Revolution and hosted their inaugural Round Table Discussion on 31 May 2018

**'SOUTH AFRICA MUST TAKE ITS REIGHTFUL PLACE AS ACTIVE AS ACTIVE PLAYER IN THE 4TH INDUSTRIAL REVELUTION**



This was a good start of the journey; in her remarks, the Speaker of the National Assembly, Ms Baleka Mbete, admitted that “the 4th industrial revolution would certainly alter the way we live, work and relate to each other”. But of concern to her is that there is no single policy framework and plan which articulate our national blueprint in this regard.

There are other multiple initiatives that government departments have taken to start to prepare South Africa for the Fourth Industrial Revolution.

In May, the Department of Basic Education (DBE) presented a Three-Stream Model they are planning to implement in the South African Curriculum that, amongst other changes, gears up the education system to deal with the technological challenges of the Fourth Industrial Revolution.

ENTITY	AREA	FOCUS	STAGE
<b>GOVERNMENT</b>	Parliament: National Assembly	Readiness and preparation for policy framework for 4IR	Preparation & Conceptualisation
	Department of Higher Education & Training	Set-up of multi-sectoral task team	Preparation & Conceptualisation
	Department of Basic Education	Preparation of learners to operate in 4th IR will transform societies and governments	Preparation & Conceptualisation
	SITA	#NDP2030 HACKATHON: Solution to South African Imperatives	Research
	CSIR	CAM SMART SYSTEMS	Research
	National Development Plan Youth Ambassador Masterclass	The Fourth Industrial Revolution as a Disruptor and Opportunity	Preparation & Conceptualisation
<b>ACADEMIC</b>	University of JHB	4IR effects on University graduates	Research
	University of Cape Town, Development Policy Research Unit	Impact of Automation on jobs	Research
	UNISA	Industry 4.0 round table and workshop	Preparation & Conceptualisation
	Stellenbosch University	Impact of the Fourth Industrial Revolution in	Research
<b>PRIVATE SECTOR</b>	Kumba Iron Ore	Farming in the Western Cape	Piloting & Implementation
	MTN	Optimising surveying process and improving safety	Implementation
	World Economic Forum	Leverage internet of things to solve problems	Research
<b>CONNECTORS OF CHANGE</b>	Silicon Cape	Readiness for future production assessment Aims to support development growth	Preparation & Conceptualisation
	AT Kearney associate	Caring out studies for WEF	Research
	Kagiso Trust and UJH	#EducationConversations. Education during the time of the Fourth Industrial Revolution	Research
	Afrika Tikkuns Childhood development	Childs growth and intellectual	Research
	Black IT Forum	Conference: Africa Championing 4IR	Preparation & Conceptualisation
	SAIMC	Collaboration between industry, government and academia: 4IR	Preparation & Conceptualisation
<b>ENTREPRENEUR</b>	Siemens, CSIR and CNBC Africa	Critical time for small business	Pilot

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This Three-Stream Model is planned to have three pathways – academic, technical vocational and technical occupational. The Department of Basic Education reported that they have started with the implementation of the emerging disruptive technologies in the Eastern Cape, Gauteng and Free State (Parliament Monitoring Group, 2018). Other work piloted by the Department of Basic Education includes the Teacher Assessment Resource for Monitoring and Improving Instructions (TARMII) in two provincial education departments as online platforms for learners and teachers in assessments. The Gauteng Department launched two schools in nuclear technology as part of 25 schools project in April 2018 and signed agreement with Samsung (Samsung Engineering Academy) for several schools to be able to assemble, fix Samsung products, such as mobile phones, washing machines, refrigerators, air-conditioners and others, by the time they finish Grade 12.

There are other initiatives that are on-going, with the hosting of workshops and seminars, such as the National Development Plan Youth Ambassador Masterclass to evaluate the Fourth Industrial Revolution as a disruptor and opportunity enabler. The Department of Trade and Industry in 2017 established a new Chief Directorate, The Future Industrial Production & Technologies (FIP&T) unit to examine the likely impact and to build capacity around government to confront the challenges of the digital industrial revolution that comes with the Fourth Industrial Revolution (Department of Trade and Industry, 2018).

Additionally, government agencies, such as SITA and CSIR, are focusing on some of the practical solutions, for example, #NDP2030 HACKATHON: Solution to South African Imperatives, where society is encouraged to come with solutions that will solve problems and advance the NDP 2030 Vision.

## PRIVATE SECTOR INITIATIVES

Some of the pertinent research includes the one conducted by the University of Cape Town (UCT) to predict the risk of jobs losses due to automation and that from Stellenbosch which focuses on the impact of the Fourth Industrial Revolution on farming. A few projects are either in pilot stages or in full implementation. These include work from Kumba Iron Ore for optimising the mine surveying process and improving safety,

solutions from the IoT as presented in MTN conferences. These include humanoid robots with neuromorphic chips that mimic humans' neurological brain process.

Other efforts include big data and artificial intelligence that have been implanted in companies such as Eskom, to improve responsiveness and efficiencies in the call centre and highly automated factories, such as VW in Uitenhage, near Port Elizabeth.

## ACADEMIA INITIATIVES

Academia has also engaged in the Fourth Industrial Revolution, noticeably at tertiary level are initiatives from the University of Johannesburg, University of Cape Town, University of South Africa and Wits University. Some of the initiatives at the University of Johannesburg is understanding the Fourth Industrial Revolution effects on University graduates and re-inventing the African libraries, focusing on the Fourth Industrial Revolution and the Library Practices in South Africa. Some of the initiatives at Wits University include Tshimologong Digital Innovation Precinct, in partnership with Johannesburg Centre for Software Engineering (JCSE), Link Centre, City of Johannesburg and others. Tshimologong is an e-skills, software innovation and digital knowledge hub. There is also participation in the development of smart cities, notably Gauteng City Region Observatory (GCRO) with the mandate to help inform the decisions to make urban life better for all. This initiative is a partnership between Wits University, University of Johannesburg, Gauteng Provincial Government and Local Governments (Wits, 2018).

## ENTREPRENEURS INITIATIVES

There are on-going discussions of the role and criticality of the small business to the Fourth Industrial Revolution. Some of the these discussion were collaborative efforts by Siemens, CSIR and CNBC Africa.

## CONNECTORS OF CHANGE

Engagements in the education space have commenced, such as #EducationConversation, a collaboration between Kagiso Trust and the University of Johannesburg.

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Some of the efforts have been embarked upon by organisations such as Africa Teen Geeks teaching school learners coding and, in some places, in collaboration with University of South Africa (UNISA), who made available their laboratory for this training.

All these demonstrate that the conversations and initiatives about the Fourth Industrial Revolution have commenced in South Africa; the questions is how well focused are they, what are the main priorities and whether there is enough collaboration to optimise the resources.

## THE FOURTH INDUSTRIAL REVOLUTION TECHNOLOGIES' USAGE IN SOUTH AFRICA AND THE REST OF AFRICA

There are technologies of the Fourth Industrial Revolution which have been effectively used in Africa to save lives and improve societal well-being. Notably in Rwanda and Tanzania was the employment of unmanned aerial vehicles (UAVs), known as drones, to deliver medication in remote areas of the countries (Hotz, 2017). In Zanzibar, drones are used to map out the habitats of the mosquitoes that carry the malaria parasite, and this initiative has resulted in malaria prevalence levels decreasing from 40% to less than 1% (World Economic Forum, 2018).

The drones are also used in the mining and agricultural sectors. Kumba Iron Ore, in the Northern Cape, South Africa, is using drones to optimise the surveying process to increase coverage and improve reach, including in small constricted areas (Mining Weekly, 2018). The major spin-off of this is improved safety for this type of operation in the mine.

These drones have also seen an increase in the inspection of hazardous areas, such as cell towers and wind turbines.

PricewaterhouseCooper (PwC) argues that drones have revolutionised the agricultural sector, focusing on soil and field analysis, planting, crop spraying, crop monitoring, irrigation and health assessment (PwC, 2016).

There are the technologies of the Fourth Industrial Revolution that are in use in Africa. Included in these technologies is the use of artificial intelligence and machine learning, which is often used to profile customers and position customer preferences using loyalty programmes (Martechtoday, 2018). The data for this is available as there is a substantial increase in the uptake of loyalty programmes and the survey shows that 79% of the consumers in South Africa use loyalty programmes, representing an increase of 8% between 2016 to 2017 (Truth, 2017). The main drivers of the uptake are the benefits that comes with it which are an effective way of saving costs for the customers.

David Meads (2018) believes that the Fourth Industrial Revolution will impact the economy and has a potential to drive Africa forward, with the hope that the delivery period will be shortened and improved (Meads, 2018). Mawasha (2017) is hopeful that this would enable innovation within the economy and propel new business models.

To this end, government is preparing themselves for the major change that the Fourth Industrial Revolution (4IR) is about to bring to the table. How much time government is taking to prepare its citizens is an important question because a sense of urgency is required as the Fourth Industrial Revolution shall not wait for anyone.

## METHODOLOGY

This study on the factors and influences of an economically active citizen during the time of the Fourth Industrial Revolution obtained an ethics clearance from the University of Johannesburg, South Africa (Ref number: 2018-057). The methodology applied in this research is presented, focusing on the research design, sample of the study, data collection methods, data analysis and quality considerations.

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The study was conducted employing an integrated mixed method, as it afforded a rigorous and integrated analysis of qualitative textual evidence and quantitative numeric data. Given the noted strengths and weaknesses of the qualitative and quantitative approaches, the use of an integrated methodology for the concurrent use of both methods in a manner that offers the descriptive richness of text narratives and the precision in measurement afforded by quantitative approaches was deemed appropriate. A qualitative research method, which involved a focus group from experts from multiple sectors (government, academia, the private sector and entrepreneurs) was purposively selected (Leedy & Ormrod, 2015) to explore and describe the experience, while a survey from citizens across South Africa investigated the magnitude of the societal impact (Fetters, Curry & Creswell, 2013).

The qualitative data was collected using unstructured interviews within a round table setting as a focus group (Leedy & Ormrod, 2015) and in-depth interviews. The in-depth semi-structured interviews were conducted either face-to-face, telephonically or through Skype. The experts provided their experience and perspectives about the influence of the Fourth Industrial Revolution with emphasis on socio-economic opportunities and threats, improvements in education systems, institutional capacity, and approaches in shaping the Fourth Industrial Revolution, policy dilemmas and collaborative structures. There were also close questions focusing on solutions to improve education systems, and entrepreneurial skills, competencies and job profiling.

The quantitative data was collected both on-line, using an electronic platform link, and manually, by 20 field data collectors from 20 of the 44 districts in South Africa in all nine provinces. The research instrument contained Likert-type statements where respondents were required to state the degree of agreement or disagreement with a statement on the societal impact of the Fourth Industrial Revolution. In addition, a 'do-not-know' option was included as the Fourth Industrial Revolution is still new terrain.

The qualitative text-based collected data was analysed with Atlas.ti 8.0 using Braun and Clarke (2006)'s six stage thematic analysis.

The quantitative numeric data was analysed using IBM Statistical Package for Social Sciences (SPSS) version 25.

The quality of the study was ensured with the pilot study to ensure internal validity. In addition, the sampling and response bias was minimised by the multistage sampling approach, with reliability where applicable analysed with Cronbach Alpha coefficient. The credibility and the rigour of the qualitative data was ensured with relevance of the sample, adequacy of the sample (Guetterman, 2015), saturation, member checks and evidence-based reporting, including contradictions (Shenton, 2004).

Overall, then, the quality was ensured through the use of data and the methodological triangulation.

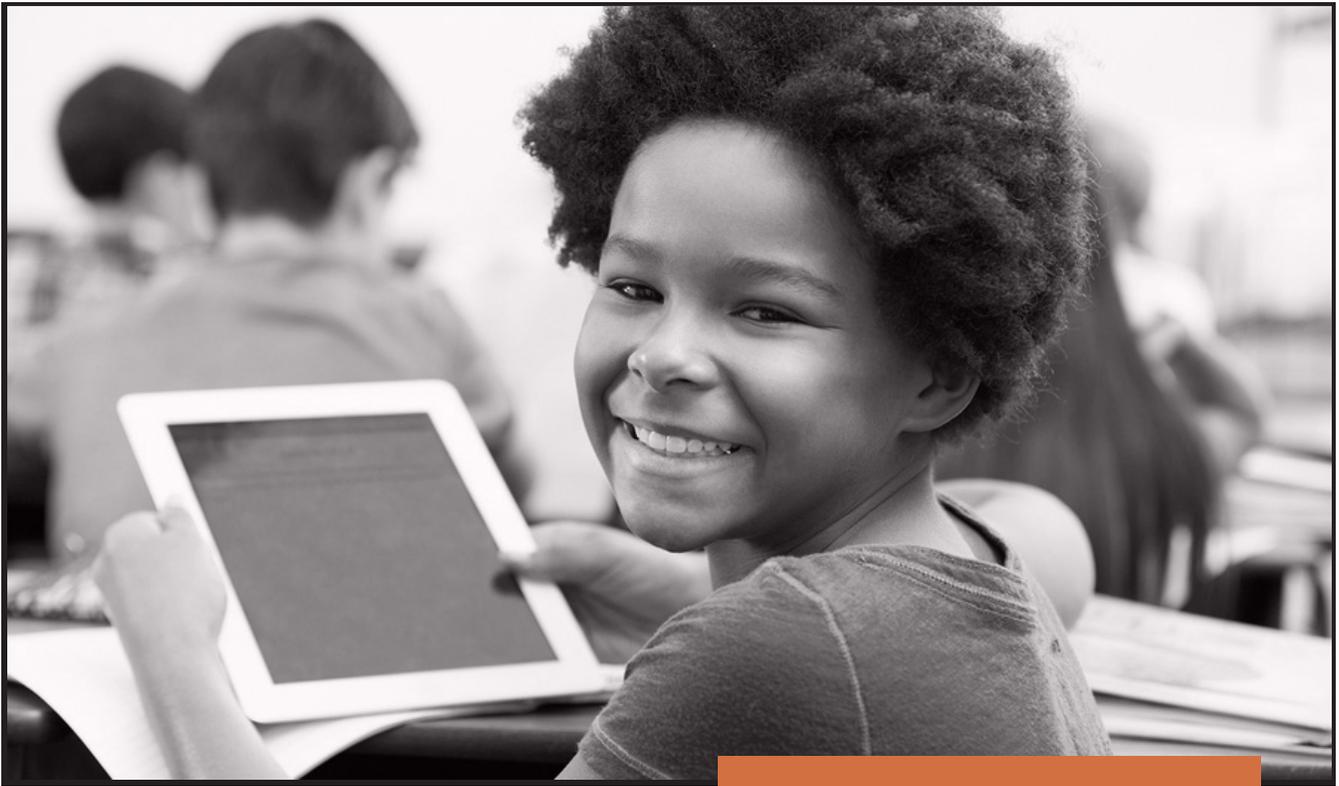
## PROFILE OF THE RESPONDENTS

There were four groups of respondents in this study; this includes those who were involved in the round table discussions, the survey questionnaire for knowledge and societal impact, the survey questionnaire for the skills and competencies and semi-structured in-depth analysis. There was good representation across all stakeholders.

## PUBLIC SECTOR

During the round-table and semi-structured interviews, there were respondents from the Departments of Basic Education, Telecommunications and Postal Services, Trade and Industry, Science and Technology, Small Business and Local government. There was a total of 11 respondents for in-depth interviews, 20 respondents from the closed questionnaires on innovations, skills and capabilities and 203 for the survey questionnaire.





## PRIVATE SECTOR

The private sector had respondents in all four phases of the research, with two in the round-table discussions, eighteen in innovations, skills and capabilities, fourteen with in-depth interviews and 220 in the survey questionnaire.

## ACADEMIA

Academia was also represented in all four phases, with a good proportion in the survey questionnaire with 220 respondents and 34 in innovative solutions, skills and competencies.

## ENTREPRENEURS

In the study, a total of 160 respondents were Entrepreneurs, mainly township entrepreneurs for evaluating the knowledge assessment, with further 18 for innovation, skills and capabilities and the in-depth interview phases.

## CONNECTORS OF CHANGE

The connectors of change's voice was also represented in all phases of the research. This was the least represented group of all the stakeholder entities with 64 respondents in the survey questionnaire.

Overall, there was a total of seven panelists in round-table discussions, 1123 respondents in the survey questionnaire, 105 in the closed questionnaire and 33 semi-structured in-depth interviews. Within the survey questionnaire, there was also a group of unemployed citizens who were also part of this phase of the study.



# 02

# FACTORS THAT INFLUENCE THE DEVELOPMENT OF AN ECONOMICALLY ACTIVE CITIZEN

Central to the research was to understand the critical factors that would play a pivotal role in efforts to advance an economically active citizen during the time of the Fourth Industrial Revolution. These factors are important for decision making and to the subsequent success of the efforts and agenda of the stakeholders.

There were eight factors that were identified during the research, which were: knowledge of the fourth industrial revolution, embracing technology and digitisation, responsive education system, re-defining work, work structure, skills development for emerging work, reducing socio-economic barriers, strengthening institutional effectiveness and changing mindsets for leverage (Figure 1).



**Figure 1** Critical factors that influence the development of an economically active citizen during the time of the fourth industrial revolution.

## KNOWLEDGE ABOUT THE FOURTH INDUSTRIAL REVOLUTION

Knowledge means understanding, awareness of a body of ideas gained either by learning or experience (Agbedia 2013). Knowledge about the Fourth Industrial Revolution is both important and relevant, as most knowledge is, which is to help all of us understand the issues, how they affect us, analyse and develop possible solutions (Scaratti, Galuppo, Gorli, Gozzoli, & Ripamonti 2017).

Knowledge makes for sensitivity and consciousness (Agbedia 2013). With knowledge, there is a migration of the developed knowledge to impactful knowledge which is then actionable, as the incumbent of that knowledge takes action to deal with that knowledge's realities (Sannino, Engestom, & Lemos 2016). Knowledge, attitude and practice (KAP) can be assumed as a chain of action, one influencing the other (Agbedia 2013). Increased knowledge may then be a catalyst and motivator for engaging with the Fourth Industrial Revolution, to prepare the citizens, including business, to leverage opportunities that are brought by this revolution.

These include expected increased productivity, new learning, increased markets and increased reach for products and services (Bloem et al. 2014; Schwab 2016) and to mitigate associated threats, such as job losses (Shank 2016; Mesnard 2016).

### OVERALL KNOWLEDGE

The quantitative survey from 1123 respondents found that the overall knowledge about the Fourth Industrial Revolution was problematic; the results are presented in Table 2. Only 1% of the respondents were highly knowledgeable about the Fourth Industrial Revolution, with only 5% who ranked themselves at a score of 9 out of 10 in understanding the Fourth Industrial Revolution. A quarter of the respondents rated themselves 7 out of 10 on knowledge about the Fourth Industrial Revolution, while 50% of the respondents rated themselves 5 out of 10 in so far as knowledge and understanding of the Fourth Industrial Revolution is concerned.

**Table 2** The score distribution of self-knowledge assessment about the Fourth Industrial Revolution

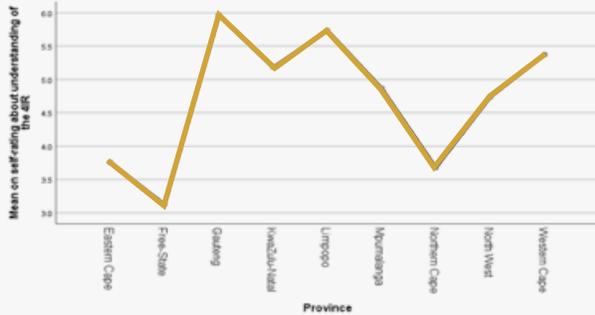
Mean	5.01
Median	5.00
Std. Deviation	2.496
25th	3.00
50th	5.00
75th	7.00

### DIFFERENCES IN KNOWLEDGE BASED ON SOCIO-DEMOGRAPHIC FACTORS

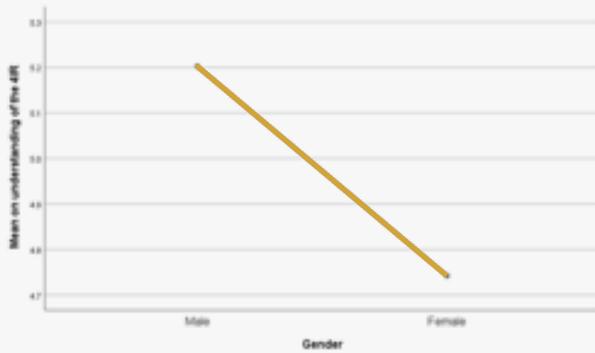
A further analysis was done to ascertain if there were differences in the knowledge about the Fourth Industrial Revolution between the socio-demographic groups based on province, gender and age. Respondents from Gauteng, Limpopo and Western Cape had the highest knowledge, while the Free State, Northern Cape and Eastern Cape had the least knowledge about the Fourth Industrial Revolution (Figure 2).

The results between males and females show that there was a significant difference in the knowledge scores with males having higher knowledge scores (M = 5.20, SD = 2.547) than females (M = 4.74, SD = 2.412). However, this difference was small (Figure 3).

**Figure 2** Difference between the level of knowledge of the Fourth Industrial Revolution per province

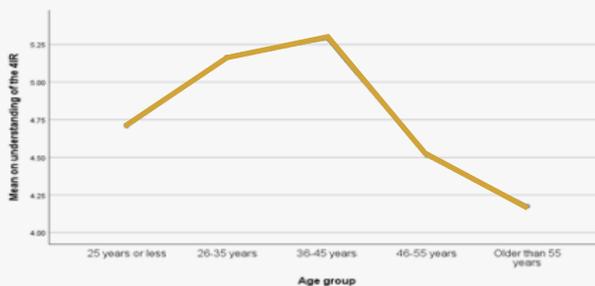


**Figure 3** Difference between the level of knowledge of the Fourth Industrial Revolution per gender



The respondents who were 25 years and younger had less knowledge than those who were aged 36-45 years. In addition, the knowledge of respondents who were older than 55 years was lower than those who were aged 36-45 years and those aged 26-35 years (Figure 4). Overall, citizens between the ages of 36-45 years were the most knowledgeable about the Fourth Industrial Revolution.

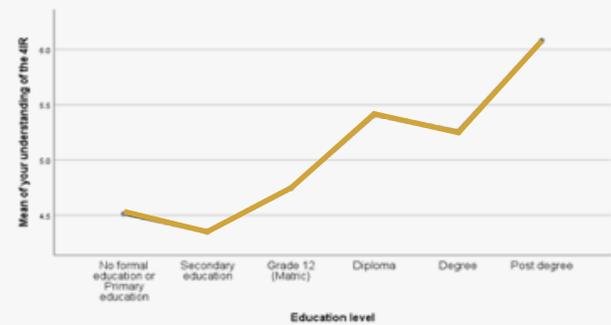
**Figure 4** Differences between the level of knowledge of the Fourth Industrial Revolution per age group



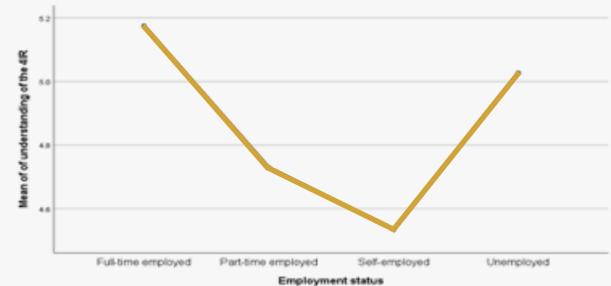
analysis was conducted to ascertain if there were differences in the knowledge about the Fourth Industrial Revolution with regard to the occupational entity, educational level, employment status, household income, accessibility of data.

The educated respondents had higher knowledge about the Fourth Industrial Revolution. Respondents with the highest knowledge about the Fourth Industrial Revolution were those with post-graduate degree qualifications, followed by those with diplomas and degrees respectively.

**Figure 5** Means plots of the education levels group on understanding of the Fourth Industrial Revolution



**Figure 6** Means plots of the employment status on understanding of the Fourth Industrial Revolution



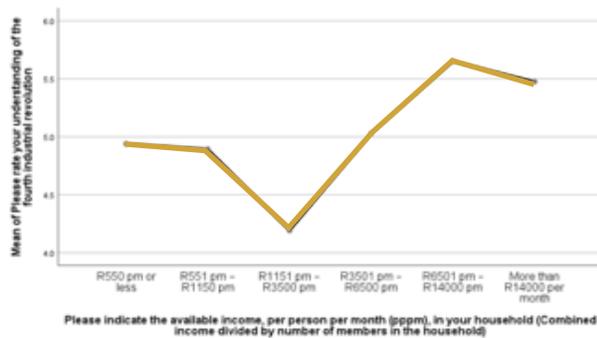
Those with primary education, or no formal education had lower levels of understanding and knowledge.

Employment status showed differences within the level of knowledge. Those who are full-time employed are the most knowledgeable about the Fourth Industrial Revolution than the unemployed. The lack of knowledge among the unemployed is driven higher by the tertiary institutions' students and unemployed graduates.

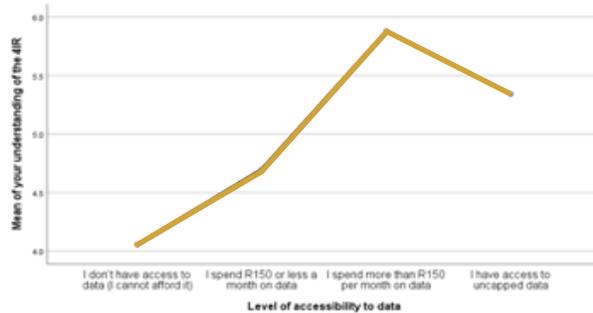
The part-time employed respondents indicated that they do not have a lot of knowledge and the self-employed have the least knowledge and understanding about the Fourth Industrial Revolution (Figure 6).

The income levels and access to internet data, based on affordability, show that higher knowledge about the Fourth Industrial Revolution was biased towards citizens with higher economic status (Figure 7).

**Figure 7** Means plots of the income levels on understanding of the Fourth Industrial Revolution



**Figure 8** Means plots of the income levels on understanding of the Fourth Industrial Revolution



**Revolution was biased towards citizens with higher economic status (Figure 7).**

Respondents with higher knowledge about the Fourth Industrial Revolution were those who spent more than R150 per month on internet data, followed by those who have access to uncapped data. Respondents who had the least knowledge were those with no access to data or who cannot afford it. Meanwhile,

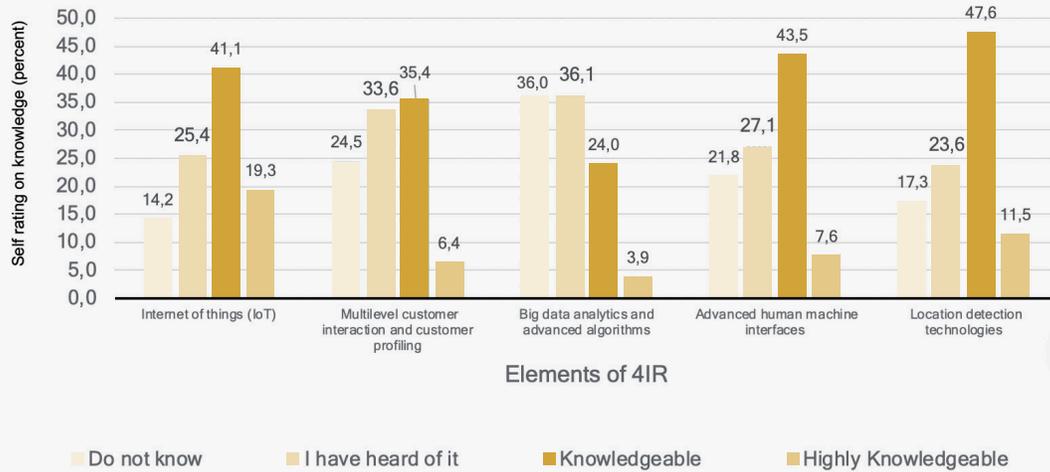
those who spend a maximum of R150 or less on data a month also had lower knowledge about the Fourth Industrial Revolution in comparison to those who spend more than R150 on data or have uncapped internet data.

## KNOWLEDGE OF THE TECHNOLOGIES OF THE FOURTH INDUSTRIAL REVOLUTION

The respondents were also asked about their knowledge of the five core elements of the Fourth Industrial Revolution, which are the Internet of Things, multilevel customer interaction, big data analytics, advanced algorithms, and location detection technologies. 41.1% indicated that they are knowledgeable about the Internet of Things (IoT), while 19.3% indicated that they are highly knowledgeable about the IoT.

A total of 25.4% indicated that they have heard of it, while 14.2% of the respondents indicated that they had no knowledge of the Internet of Things. On multilevel customer interaction and customer profiling (MCICP), 35.4% indicated that they were knowledgeable about the multilevel customer interaction and customer profiling, followed by 33.6% who have only heard about the multilevel customer interaction and customer profiling. There were only 6.4% who were highly knowledgeable while 24.5% did not know about the multilevel customer interaction and customer profiling.

**Figure 9** Self-rating on knowledge on technologies of fourth industrial revolution



On big data analytics and advanced algorithms (BDAAA), of the 1123 responses, there were 1090 who responded to this question. 3.9% indicated that they are highly knowledgeable about big data analytics and advanced algorithms, with 24.0% who indicated that they are knowledgeable about this. A total of 7.1% had either heard of it or had no knowledge about big data analytics and advanced algorithms. A total of 1099 responses were completed of the 1123. Most of the respondents indicated that they are knowledgeable about the advanced human machine interfaces (AHMI) with a total of 43.5%.

This is followed by 27.1% who indicated that they have heard of these. A total of 21.8% indicated that they have no knowledge about the advanced human machine interfaces while only 7.6% are highly knowledgeable about these.

A total of 1083 completed this question. Figure 11 shows that a total of 47.6% of the respondents, which is almost half of the respondents, are knowledgeable about the location detection technologies (LDT), with a further 11.5% indicating that they were highly knowledgeable. There were 23.6% respondents who indicated that they have heard of these and 17.3% did not know about the location detection technologies.

Further analysis on the difference between males and females was evaluated for five technologies of the Fourth Industrial Revolution. The results show that there are significant differences between males and females for all five elements of the Fourth Industrial Revolution.

**Table 4** Mann Whitney U and Kruskal Wallis H tests with effect sizes on the differences between gender on knowledge on technologies of the fourth industrial revolution.

Gender		N	Mean Rank	Sum of Ranks	Mann-Whitney U	Z	Asymp. Sig. (2-tailed)	Effect size (r)
IoT	Male	607	584	354507	133522	-3,62	0,000	0,11
	Female	500	518	258772				
MCICP	Male	603	585	352512	131095	-3,93	0,000	0,12
	Female	500	513	256345				
BDAAA	Male	594	570	338703	132636	-3,00	0,003	0,09
	Female	496	516	255892				
AHMI	Male	600	581	348649	131051	-3,78	0,000	0,11
	Female	499	513	255801				
	Total	1099						
LDT	Male	590	561	330722	134494	-2,29	0,022	0,07
	Female	493	520	256265				

The knowledge score about the IoT was greater for males (mean rank = 584) than females (mean rank = 518),  $U = 133522$ ,  $z = -3.62$ ,  $p < .001$ . The same pattern was found for Multilevel customer interaction and customer profiling ( $U = 131095$ ,  $z = -3.93$ ,  $p < .001$ ), Big data analytics and advanced algorithm ( $U = 132636$ ,  $z = -3.00$ ,  $p = .003$ ), Advanced human machine interfaces ( $U = 131051$ ,  $z = -3.78$ ,  $p < .001$ ) and Location detection technologies ( $U = 134494$ ,  $z = -2.29$ ,  $p = .022$ ) with knowledge of males higher than females. With all the results being significant, the effect size was evaluated to determine the magnitude of the difference, and all the differences were small between males and females ( $r = 0.07 - 0.12$ ). A Kruskal Wallis H test shows that there is a statistical difference in the knowledge level about the elements of the Fourth Industrial Revolution between the different age groups (Table 4).

**Table 5** Kruskal Wallis H tests with effect sizes on the differences between age group on knowledge on technologies of the Fourth Industrial Revolution.

		IoT	MCI	BDA	AHMI	LDT	Post hoc (Bonferroni correction)
	<b>N</b>	1091	1087	1074	1083	1067	
<b>Age</b>	<b>Median</b>	3,00	2,00	2,00	3,00	3,00	IoT: (>55) < (≤25); (46-55) < (≤25)
	<b>Chi-Square</b>	17.3	30.2	9.03	7.77	22.2	MCICP: (>55) < (≤25); (>55) < 36-45; (>55) < 26-35; 46-55 < 36-45; 46-55 < 26-35; (≤25) < 26-35
	<b>df</b>	4	4	4	4	4	
	<b>Asymp. Sig.</b>	0,002	0,000	0,060	0,100	0,000	
	<b>Effect size (r)</b>	0.016	0.029			0.021	LDT: (>55) < 36-45; (>55) < 26-35; 46-55 < 26-35; (≤25) < 26-35

The results show that there was a significant difference between the knowledge about IoT across the different age groups,  $2(4) = 17.3$ ,  $p = 0.002$ ,  $r = 0.016$ . Overall, younger respondents had better knowledge than older respondents. There was also a significant difference on the knowledge of multilevel customer interaction and customer profiling,  $2(4) = 30.2$ ,  $p < 0.001$ ,  $r = 0.029$  and location detection technologies,  $2(4) = 22.2$ ,  $p < 0.001$ ,  $r = 0.021$ . Based on the Bonferroni correction results, the most knowledgeable group were aged 36-45 years and 26-35 years, with the least knowledgeable group being older than 55 years and 46-55 years.

There were no significant differences between the level of knowledge for data analytics and advanced algorithms and advanced human machine interfaces.

On the socio-economic factors, academics which included tertiary students, early childhood development (ECD) educators, basic school educators and tertiary school educators had higher knowledge about IoT. The entrepreneurs had the lowest level of knowledge in big data analytics, advanced algorithms and location detection technologies (Table 5).

## INSIGHTS ON KNOWLEDGE ABOUT THE FOURTH INDUSTRIAL REVOLUTION

The use of self-assessment as a measurement tool has gained popularity and has been found to be an effective approach to assessment (Butler & Lee 2010;

Gholami et al. 2011; Nelms 2015). Findings show that self-assessment compared well with the external instrument assessment for knowledge (Sundstrom 2005). Studies by Shrauger and Osberg (1981) showed that more than three quarter of the studies (total studies 43) were as good as, and sometimes better than the test scores or external rater. Most of those that showed a disconnect between self-rating and grading were those where the respondent had a higher stake, such as promotion or selection. These cases were not applicable in this study. This was supported by the studies of Bowers et al. (2005) and Clauss and Geedey (2010) who found correlation between self-assessment and examination scores with no evidence of variation between these two methods of assessment.

This study worked on the basis that it was possible for the respondents to understand and know their current levels on the knowledge about the Fourth Industrial Revolution (Claus & Geedey 2010).

**Table 6** Kruskal Wallis H test on the differences between socio-economic factors on technologies of the 4IR

Socio-economic factor		IoT	MCI	BDA	AHMI	LDT	Post hoc (Bonferroni correction)
Occupation group	N	1091	1087	1074	1083	1067	IoT: OT < PVT; OT < GVN; OT < ACD
	Median	3,00	2,00	2,00	3,00	3,00	
	Chi-Square	13.406	46.864	27.053	7.378	5.842	MCI: UN < ENT; UN < ACD; UN < GVN; UN < PVT; UN < COC; OT < ENT; OT < ACD; OT < GVN; OT < PVT; OT < COC
	df	6	6	6	6	6	
	Asymp. Sig.	0,037	0,000	0,000	0,287	0,441	BDA: OT < ACD; OT < GVN; UN < PVT; UN < ACD; UN < COC; UN < GVN; ENT < GVN
Effect size (r)	0.012	0.043	0.025	-	-		
Education	N	1091	1087	1074	1083	1067	IoT: NPE < SE; NPE < MT; NPE < DG; NPE < DP; NPE < PD; MT < PD.
	Median	3,00	2,00	2,00	3,00	3,00	
	Chi-Square	21.897	72.877	106.075	15.597	21.254	MCI: SE < MT; SE < DP; SE < DG; SE < PD; NPE < MT; NPE < DP; NPE < DG; NPE < PD; MT < DP; MT < DG; MT < PD.
	df	5	5	5	5	5	
	Asymp. Sig.	0,001	0,000	0,000	0,008	0,001	BDA: NPE < MT; NPE < DG; NPE < DP; NPE < PD; SE < DG; SE < DP; SE < PD; MT < DG; MT < DP; MT < PD.
Effect size (r)	0.020	0.067	0.099	0.014	0.020	AHMI: NPE < MT; NPE < DG; NPE < DP; NPE < PD; SE < DP; SE < PD. LDT: NPE < DG; NPE < DP; NPE < MT; NPE < PD; SE < DG; SE < DP; SE < MT; SE < PD.	
Employment	N	1091	1087	1074	1083	1067	IoT: SET < FTE
	Median	3,00	2,00	2,00	3,00	3,00	
	Chi-Square	10.368	57.867	24.398	10.563	10.562	MCI: UN < SET; UN < FTE; PTE < FTE
	df	3	3	3	3	3	BDA: PTE < FTE; UN < FTE.
	Asymp. Sig.	0,016	0,000	0,000	0,014	0,014	AHMI: UN < FTE; PTE < FTE. LDT: PTE < SET; PTE < UN; PTE < FTE.
Effect size (r)	0.010	0.053	0.023	0.010	0.010		
Household income	N	1090	1086	1073	1082	1066	IoT: (551-1150) < (1.1K-3.5K); (551-1150) < (3.5K-6.5K); (551-1150) < (>14K); (551-1150) < (6.5K-14K).
	Median	3,00	2,00	2,00	3,00	3,00	
	Chi-Square	11.531	88.692	86.137	11.272	12.311	MCI: (551-1150) < (6.5K-14K); (551-1150) < (>14K); (≤550) < (6.5K-14K); (≤550) < (>14K); (1.1K-3.5K) < (6.5K-14K); (1.1K-3.5K) < (>14K); (3.5K-6.5K) < (6.5K-14K); (3.5K-6.5K) < (>14K).
	df	5	5	5	5	5	
	Asymp. Sig.	0,042	0,000	0,000	0,046	0,031	BDA: (1.1K-3.5K) < (3.5K-6.5K); (1.1K-3.5K) < (6.5K-14K); (1.1K-3.5K) < (>14K); (551-1150) < (>14K); (≤550) < (6.5K-14K); (≤550) < (>14K); (3.5K-6.5K) < (>14K).
Effect size (r)	0.011	0.082	0.080	0.010	0.012	AHMI: (551-1150) < (>14K); (551-1150) < (3.5K-6.5K); (551-1150) < (6.5K-14K); (1.1K-3.5K) < (>14K); (1.1K-3.5K) < (3.5K-6.5K); (1.1K-3.5K) < (6.5K-14K); (≤550) < (>14K); (≤550) < (3.5K-6.5K); (≤550) < (6.5K-14K) LDT: (1.1K-3.5K) < (3.5K-6.5K); 1.1K-3.5K < (6.5K-14K); (1.1K-3.5K) < (>14K); (≤550) < (6.5K-14K); (≤550) < (6.5K-14K)	
Level of internet access	N	1091	1087	1074	1083	1067	IoT: CAD < 150D; CAD < (>150D); CAD < UD; 150D < UD; (>150D) < UD;
	Median	3,00	2,00	2,00	3,00	3,00	
	Chi-Square	75.273	126.711	64.719	23.567	33.098	MCI: CAD < 150D; CAD < (>150D); CAD < UD; 150D < (>150D); 150D < UD; CAD < 150D; CAD < (>150D); CAD < UD; 150D < UD;
	df	3	3	3	3	3	
	Asymp. Sig.	0,000	0,000	0,000	0,000	0,000	AHMI: CAD < 150D; CAD < (>150D); CAD < UD; 150D < (>150D). LDT: CAD < (>150D); 150D < (>150D); UD < (>150D)
Effect size (r)	0.069	0.117	0.060	0.022	0.031		

The findings reveal that the average knowledge score is 5 out of 10, with only a quarter of the respondents assessed themselves to have 7 out of 10 knowledge about the Fourth Industrial Revolution. This means that only a quarter of the Respondents had acceptable knowledge as the literature indicates that 70% - 80% is the threshold for acceptable knowledge during evaluation (Sodano, Radici, Rossini & Alessandro 2015; Ogunrin, Daniel & Ansa 2016; Naidoo, Mahomed, Asmal & Taylor 2014).

Within the technologies of the Fourth Industrial Revolution, location detection technologies and Internet of Things were best known while the big data analytics and advance algorithms and multilevel customer interaction and customer profiling were the least known by the Respondents. Knowledge of these elements will assist the citizens to seize their associated opportunities, in order to mitigate the negative effects of large scale job losses anticipated during the Fourth Industrial Revolution (Shank 2016). For example, there is an expectation on the increase in the Internet of Things, of market opportunities, and this is expected to be worth \$7 trillion by 2020 (Bloomberg, 2016). The number of connected devices is expected to double to an estimated 50 billion in 2020 from 2015 where there were 25 billion customers (Hatzakis 2016).

The higher knowledge levels were biased towards the Respondents with higher socio-economic status, which are education, employment, household income and level of access to internet data. The citizens with higher socio-economic status had higher knowledge of the Fourth Industrial Revolution, including the elements of the Fourth Industrial Revolution.

In the end, there is an urgent need for citizens to develop adequate knowledge about the Fourth Industrial Revolution so that this knowledge can then be the catalyst and motivator for engaging with the Fourth Industrial Revolution to prepare citizens, including business, to leverage opportunities. This is possible as Agbedia (2013) explains that knowledge, attitude and practice (KAP) can be assumed as a chain of action, one influencing the other.

## EMBRACING TECHNOLOGY & DIGITISATION

Technology and digitisation are regarded as being critical for sharing economy and future of the countries and competitiveness. Technology-enabled innovation creates new competitive pressures that encourage even more innovation by citizens and institutions. Digitisation provides opportunities for dramatic improvements in performance. This expectation is even greater for first movers, who combine high investment levels with advanced digitisation (Geissbauer, Vedso, & Schrauf, 2016).

## THE DIGITAL CULTURE IN SOUTH AFRICA

It is evident that the digital culture and digital maturity is a must in South Africa as it provides the necessary vehicle for economic participation for those who are effectively leveraging it. Some of the progressive nations, both developed and developing, are using technology and digitisation for competitive advantage purposes and sustainability.

The major disadvantage that South Africa has is that technology is highly used in organisations, particularly private organisations, and less by small business and general citizens as it can be seen in places such as India.

***"So, if we can try by any means to embed it in the culture of the people so the people accept it, then we try and work our way out from there, I'm sure it will bring about positive in our development towards the Fourth Industrial Revolution, just like what these other first world countries are doing." IAP1***

*"If you look at India, for example, and even Kenya, there's been banking and commercial apps developed which have particular relevance to people selling produce from one village to the next, you can advertise, you can pay, you can ... so, they essentially looked at their own needs and then found apps or invented apps to meet those needs."* **IPP13**

## EMBRACING TECHNOLOGY

There was an agreement amongst the Respondents that there is a need for citizens to embrace technology as it is the grounding of the Fourth Industrial Revolution where technologies converge to solve problems, to improve efficiencies and to improve customer service.

*"So, the future is really going to be about embracing what the convergence of technology may bring."* **IGP8**

*"So, that's the relevance in our Africa ... Africa and South Africa, we are global players, we have to move as well with times and technology, it's the way to go. We have to embrace the Fourth Industrial Revolution. We've got to use these technologies to our benefit, but the human always has to be at the centre."* **IGP1**

*"I think, first and foremost, it's a willingness to change and to use and embrace technology."* **IGP3**

"South Africa must build a pipeline of future talent that can embrace the age of emerging tech." **IPP12**

## TECHNOLOGY CATALYST FOR INNOVATION

Within the discussion, there was a strong and clear message that there is an urgent need for South Africa and Africa to focus on innovative solutions that are problem focused, so that the innovation can result in an impact. This can only be done by ensuring relevance rather than a duplication of solutions.

The empirical data shows that the Respondents believed that having knowledge about the Fourth Industrial Revolution and embracing its technologies is an important step, that will allow the citizens to be excited about and look for opportunities to leverage it.

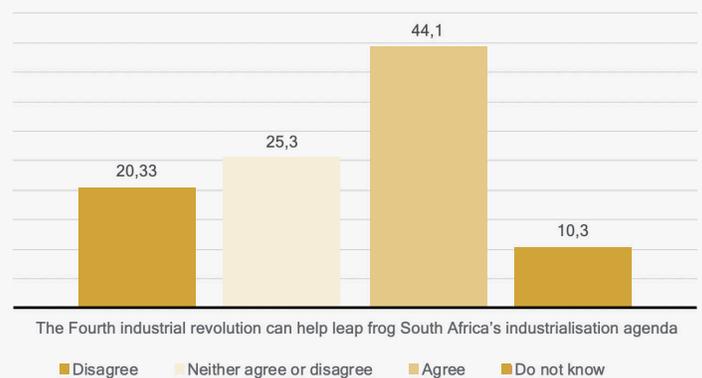
*"Give knowledge about this smart technology to the active citizen, then that is very, very critical and that will actually help."* **IAP1**

## TECHNOLOGY TO LEAPFROG PREVIOUS REVOLUTIONS

A total of 44.1% of the Respondents agree and believe that the Fourth Industrial Revolution can help leapfrog South Africa's industrialisation agenda while 25.3% indicated that they neither agree nor disagree, while 20.33% of the Respondents disagreed. There was only a total of 10.3% of the Respondents who indicated that they do not know if the Fourth Industrial Revolution can help leap frog South Africa's industrialisation agenda (Figure 10).

These problems complicate the adoption and implementation of the Fourth Industrial Revolution in South Africa and in Africa. So, the reality is that there is a need to leverage the opportunities of Fourth Industrial Revolution.

**Figure 10** Ability of the fourth industrial revolution to leapfrog previous revolution



It is critical to find the balance and utilise the Fourth Industrial Revolution to manage and improve certain elements within the second and the third industrial revolution.

*"Fortunately, by its nature the Fourth Industrial Revolution will allow us to leapfrog some of the challenges from the previous industrial revolution."* **GOV1**

Furthermore, there are still high levels of technological illiteracy, poor technological advances and inadequate access to technology. There are still South Africans who have never touched the gadgets (smartphones, laptops), due to illiteracy and affordability issues. This shows that there is still a huge backlog to deal with the left-overs from the previous industrial revolution [3IR].

***“Fortunately, by its nature the Fourth Industrial Revolution will allow us to leapfrog some of the challenges from the previous industrial revolution.”***  
**GOV1**

Respondents from government indicated that the ideal approach that should be taken by South Africa and Africa at large, is such that it must use the tools and equipment of the Fourth Industrial Revolution to make sure that it positions South Africa and Africa, as leaders of society, while also dealing with the remnants of the second and the third industrial revolutions. This is because during the second industrial revolution one of the main drivers was electricity but still today, there are communities in South Africa and on the African Continent without electricity

***“As we talk of the Fourth Industrial Revolution, there are still left-overs from the previous industrial revolution. For example, electricity, if we connect 200 000 households per annum, it will take 20 years for South Africa [2IR] to connect all its citizen households.”*** **GOV1**

## **INSIGHTS ON EMBRACING TECHNOLOGY AND DIGITISATION**

Kane et al. (2017) posits that to fully exploit the opportunities presented by digitisation and ensure the survival in the new digital age, companies need to undertake the immense task of preparing for a digital future by transforming their organisations towards digital maturity. Digital maturity is a state in which the companies achieve digital congruence where the company strategy, structures, culture, processes, people and digital capabilities are aligned towards a set of company goals. South Africa's industries and opportunities are some of the reasons it ranks top amongst African countries.

The country has developed significantly in the area of technology, ranking second in the sub-Saharan Africa region on the Networked Readiness Index (World Economic Forum, 2016).

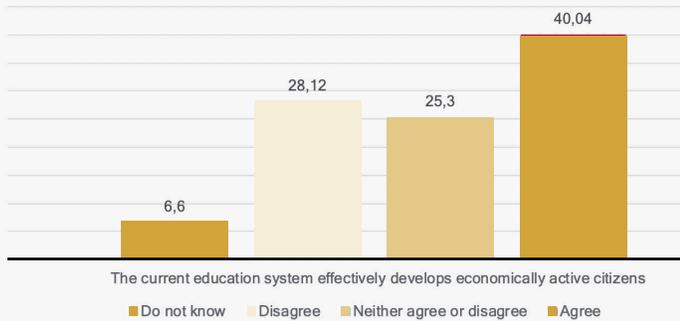
The opportunity for South Africa to align itself as a leading economy lies in the ability of both the private and public sectors partnering with each other in the exploitation of digitisation and technology. Despite this, South Africa, which is the leading African country on the GCI, is amongst the lowest adopters of technology. Thus, the country needs to improve the participation in digital technologies introduced with the Fourth Industrial Revolution which presents great opportunities for increased economic growth and societal progress (Baller, et al., 2016). In South Africa there is an urgent need for all citizens to embrace technology as the future for the digital culture to improve and mature to leverage the opportunities brought by the technologies of the Fourth Industrial Revolution. This is a non-negotiable imperative for the development of an economically active citizen during the time of the Fourth Industrial Revolution.

## **RESPONSIVE EDUCATION SYSTEM**

A responsive education system can be described in terms of its adaptability to the needs of the society it serves at a point in time. Education system was identified as one of the ten critical factors in the development of an economically active citizen during the time of the Fourth Industrial Revolution.

The focus is on understanding the views on the state of the current education system and then proposed relevant improvements that will strengthen the education system to produce citizens who will be able to leverage the opportunities associated with the Fourth Industrial Revolution. Central to the responsive education system is the autonomy of the learner that must be developed through some kind of legislation to enable the learner to take responsibility for their own development.

**Figure 11** Level of agreement on the effectiveness of current education system to develop an economically active citizen



## CURRENT EDUCATION SYSTEM

Of the total 1123 respondents, two in five (40.0%) agreed that the current education system was effective in developing an economically active citizen, while just over a quarter (28.1%) disagreed that the current education system was effective. The rest of the respondents (31.9%) indicated that they neither disagreed nor agreed or they do not know (Figure 11).

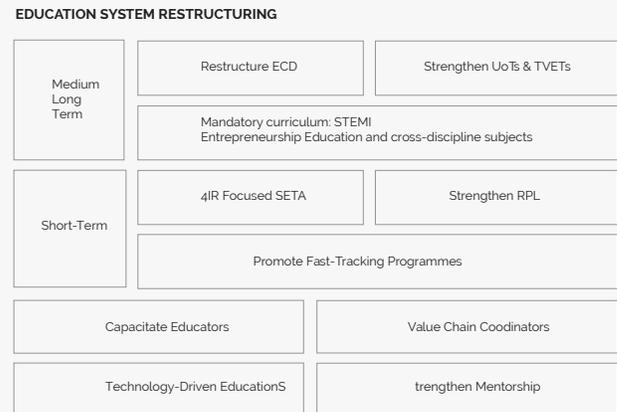
Education system restructuring was identified as one of the critical pillars that need optimisation during the process of developing an economically active citizens during the time of the Fourth Industrial Revolution.

There were ten focus areas that were identified by the stakeholders that require attention as part of the restructuring of the education system in South Africa to better prepare its citizens for the Fourth Industrial Revolution (Figure 12). These were classified as either short-term education and training or long term education and training as well as the enabling factors.

## SHORT-TERM EDUCATION AND TRAINING

The findings of the study confirm that the Fourth Industrial Revolution requires a fusion of several skills and multi-disciplinary knowledge.

**Figure 12** Components of education system restructuring



These are skills that need to be harnessed by South African citizens so that they are able to effectively participate in the Fourth Industrial Revolution. The Fourth Industrial Revolution is synonymous with the high speed of change and this requires urgent intervention for the currently semi-skilled employed who can be negatively affected by its technologies, such as artificial intelligence and robotics.

The same interventions are required for the high level of unemployed youth who seek to be economically active. As such, there is a need for short-term empowerment of the citizens. There were three routes that were identified to acquire the first principles knowledge and skills.

## SETA FOURTH INDUSTRIAL REVOLUTION FOCUSED

Re-alignment of the Sector Education and Training Authorities (SETAs) as they are already well positioned to manage and create learnerships, skills-based programmes, among others, for all the occupations in South Africa.

These SETAs need to be overhauled and be made to focus their offering on the Fourth Industrial Revolution. The government can put certain measures in place whereby they make sure that the employers, in collaboration with all the other stakeholders, produce courses and programmes that focus on the 4IR within the next 24 months and make access available to the general public. This can be the

same approach that government has successfully used to launch and maintain programmes such as SETA programmes and programmes such as the extended public works programme(EPWP) which then can ensure that it creates a situation where there is a focus on developing the skills the country really needs.

## **STRENGTHEN RECOGNITION OF PRIOR LEARNING CERTIFICATION**

Strengthen the recognition of prior learning. Many people have acquired experience through on-the-job training whilst in employment and are thus able to apply their knowledge effectively. However, there is a lack of certification to this effect and this needs to be enhanced so that these people can prove their competency.

## **ACCREDIT SKILLS DEVELOPMENT FAST-TRACKING PROGRAMME**

There is an urgent need to promote fast-tracking programmes; there are certain fast-tracking programmes that are already available and producing good results such as Harambee, WeThinkCode and others. However, they are not well co-ordinated and the backlog of skills within the country requires that these fast-track programmes are recognised, regulated, certified and people can have certification of the skills offered through these programmes. These are some of the elements that can quickly be put in place to make sure that the skills gap and the first principles knowledge are achieved for citizens within a short space of time.

These programmes within the SETAs vary in length from a few days to two years for the WeThink Code course. These programmes can fill the skills gap within a short time. This is critical, as already explained, there is a need for people to be re-skilled as many jobs will be changed or re-invented, especially at the semi-skilled level and many jobs will be lost through automation.

## **SUCCESS STORY: SKILLS FAST-TRACKING**

### **PROGRAMMES**

*A candidate started an internship within one of the Telecommunications company after not having a skill or tertiary education but went through a programme set up by one these fast-tracking skill development companies for a period of just over a year and a half. The candidate was placed for four months in the company. The abilities and the performance of the intern was such that after the internship was complete, the managers ensured that the candidate was retained. He was able to do programming, coding and lot of work which can be done by people with higher degrees of learning. This is one of those success stories which shows that it is possible to focus the skill and re-skill even a less educated individual.*

*Intern, Telecommunications company*

## **MEDIUM AND LONG-TERM EDUCATION AND TRAINING**

For the medium and long term, there is a need to restructure early childhood development (ECD), strengthen the basic education curriculum making Science, Technology, Mathematics and Innovation (STEMI), as well as entrepreneurship education, mandatory and to revise the curriculum to be cross-disciplinary.

## **MAXIMISE THE WINDOW OF OPPORTUNITY AT EARLY CHILDHOOD DEVELOPMENT**

Firstly, there was a view that early childhood development is used for educational purposes so that the window of opportunity for children while they are still young being stimulated can be optimised.

This should include incorporating the ECD into the Department of Basic Education, with the Department of Social Development playing a critical role. This will ensure that the ECD is educational, rather than being an after care facility because parents are not there, which is the case in most places, especially in the rural areas, and townships in South Africa, and this would require some major overhaul.

## CURRICULUM CONTENT REVIEW

There is also an urgent need for the primary and secondary school education curriculum to make STEMI courses compulsory. This will be an improvement from the current standard where mathematics numeracy is compulsory, as this is not adequate for preparing learners for the Fourth Industrial Revolution. STEMI is central to the future. In addition to this, entrepreneurship education must also be compulsory to enhance entrepreneurial intent and provide grounding for an entrepreneurial career.

This will ensure that in South Africa, entrepreneurship is being inculcated at a young age, and children are exposed to the possibilities of self-employment in addition to being employed. This is critical to improve the potential of SMEs.

***“Educational development wise, make technology a compulsory subject, entrepreneurship a compulsory subject, teach our kids about coding and everything about technology.” IPP4***

This is critical to ensure that the learners are ready for the future, instead of pushing through a quantity of learners who might be unemployable in the future.

***“High school curriculum needs to assess future potential opportunities to channel the potential to the career path at a gr9 stage instead of pupils choosing easy subjects just to pass matric.” IAP2***

The main advantages for restructuring the school's curriculum, according to the respondents, will be that more people will be empowered and be able to participate in the

economy actively, they will develop thinking skills, and thus be technologically savvy. The respondents further indicated that schools must focus on STEM (Science, Technology, Engineering and Mathematics) and the focus of education needs to include technology and entrepreneurship as mandatory subjects.

Also critical is to ensure that coding and programming are part of the curriculum at school.

***“What we also aim to do is to introduce coding and robotics as basic or school course, so that citizens have future work available to them. We are also aware of the concept of technotopia such as we see in ‘The Venus Project’ in which robotics obviates the need for work. However, we believe that is a long way away.” IGP14***

For students to be innovative during the Fourth Industrial Revolution, it is critical that they have all the right resources and be exposed to the right technological systems that will develop them as well as educate them. Exposure to technology will give them the basic training and skills and put them in the correct mind-set to actually have a clear understanding of what the 4IR is all about. The respondents indicated that if the students have access to computers and smart phones, they will be on the right track to becoming more innovative and relevant during the time of the Fourth Industrial Revolution, but what is the point of having all those gadgets with the high cost of data?

They further indicated that learners need access to cheap data and Wi-Fi to help them surf the internet and gather all the information necessary.



The respondents strongly believe that if the learning time was extended and the teachers made sure that after every lesson students have a good and clear understanding of the work, that could lead to relevant educated students for the Fourth Industrial Revolution. In addition to giving lessons, the teachers must also be knowledgeable about what they are teaching the students and be able to explain and apply this practically.

Education systems curriculum restructuring must create a module for technology as early as primary school. Children must start learning about technology at a very early stage so that by the time they get to university, they already are knowledgeable and have had enough exposure to technology.

It is important that the way schools educate or teach changes to prepare individuals for the future for them to be able to apply knowledge and understanding and not just memorise information and apply as per the textbook, as is currently the case.

The respondents also suggested that the students should be taught to know and understand their skills at an early age so that by the time they get to tertiary level they know how to apply them in the future.

## **STRENGTHEN AND LEVERAGE UNIVERSITIES OF TECHNOLOGY (UOTS) AND TECHNICAL AND VOCATIONAL EDUCATION AND TRAINING (TVET'S)**

The Universities of Technology and Technical and Vocational Education and Training (TVET's) are practically based institutions and they are already set up with a focus on skills, engineering and all the other related subjects, that is what they were traditionally intended for in the first place: artisan and technician education. Everywhere around the world people use this leverage, especially universities of technology.

Countries, such as Japan and Singapore, have those institutions driving the outcome for practices, both entrepreneurial and for ensuring that science and technology-related employment is created, and as such, this is an opportunity for South Africa to ensure that the universities of technology are strengthened so that they can effectively play a fundamental role within society within the economy to really drive the Fourth Industrial Revolution.

The Fourth Industrial Revolution is about the automation of things in which technology plays a major and pivotal role. The respondents see it as critical that the education in UoT's and TVET colleges is strengthened and developed. More technical schools and tertiary institutions must be implemented to train and educate the students.

## **ENABLERS OF EFFECTIVE EDUCATION SYSTEM**

The enablers for this education system to work effectively include ensuring that the education is technology-based, educators are relevantly capacitated, there is a value chain co-ordinator and lastly that mentorship is strengthened.

## **TECHNOLOGY-BASED EDUCATION**

It is evident that there is an urgent need for technology-driven education in this day and age where students are central to the education, where the teaching takes place within and outside of the classroom, where interaction is both within the classroom and outside the classroom, where in other cases there is information and data that might assist to leapfrog some of the vulnerabilities within the education system. For example, certain schools in the rural areas do not have all the amenities, equipment, laboratories, instruments and even though they might not have them physically all the time, the information is available on the internet and they can see what should happen in experiments so that they have an appreciation of scientific practices.



*“that technology will actually help to bridge that gap and actually help people earning more, and it will then maybe make that income gap smaller between the rich and the poor.” IPP4*

This also applies to tertiary education where it is clear that there is a huge infrastructural backlog within the education system and if you look within the country the number of universities that have been built, as opposed to the population the disconnect is apparent. Secondly, with the introduction of free education thereby allowing greater access to tertiary education, together with open and easy access to information, it makes it possible for everyone who wants, to obtain a good and useful education.

This can be achieved using technology such as E-learning and M-learning. However, this needs to be monitored to ensure that standards are maintained.

*“Provision of ICT education in schools, development of teachers in ICT, implementation of E-learning.” CQ36*

*“students should have smart phones and device for internet and provide more practical work.” CQ2*

## RELEVANTLY CAPACITATED EDUCATORS

Educators play a critical role as facilitators, where they guide the learners and students at the higher level through the system; this is important because most of them studied in an era of lecturing and spoon-feeding the learners, but the information that is now available opens them to not knowing everything and to be challenged by the very students they are teaching in a student centric learning process and as such, they need to be provided with all the tools necessary and relevant to do their jobs and more importantly, to run their jobs more effectively and efficiently.

*“Our teachers also need to be continuously trained and built up so that they are able to keep up with the times of the children they are educating.” IPP8*

*“Get experts to educate and train our school teachers. CQ38*

*“There needs to be a course on automation for educators. CQ27*

The government should also play a role in keeping the educators encouraged and emphasise the importance of skills development and ensure that the educators are trained on how to implement skills development of the students; this can be done through training in workshops.

## **EDUCATION VALUE CHAIN CO-ORDINATOR**

There is a need for a value chain co-ordinator. What is important and came out strongly within the results is that there are significant disconnections within the education value chain. When you look at the South African education system, the value chain starts at an EDC level and goes to basic education which comprises primary and high school education, then goes to tertiary education; the tertiary education branch has several aspects which will have different types of universities, which is the traditional comprehensive and vocational institutions.

On the other hand, there are also colleges that are commonly known as TVETs, there is then a need to make sure that there is a value co-ordinator across all of these so that all programmes within the education systems are rolled out to all types of institutions so that learners/ students have transferable options across all institutions.

Strengthen mentorship

Strengthen mentorship; like any other situation having a mentor who has managed to succeed is critical and it is important that within South Africa, with high levels of inequality and with low levels of exposure to on-going learning that there should be a programme of mentorship that can assist in order to review and see a vision beyond finishing and staying within that rural area for the learners. With the strengthening of mentorship, there are possibilities that can be linked to other programmes of the government, for example, within the requirements of the SETA, within an employee requirement and government can then look at possible beneficiation for those who have

participated in mentorship, for example, a discretionary grant to be part of the skills development levy.

*“Make sure learners choose the right stream when they reach FET level at high schools”. CQ88*

As much as all was said about developing relevant students, enhancing mentorship is seen to be also important so that the students are encouraged and mentored to perform well at school and to have a full understanding of why they need to do well in their school work and why it is critical for them to stay in school and have a qualification, stay encouraged and recognise their strengths and weaknesses at an early age so that by the time they get to university they know which course they should go for. The respondents believe that the learners must be encouraged to be creative and to develop relevant skills while they are still in school.

These are all the supporting structures that are needed to ensure that they are able to assist within the education system.

## **INSIGHTS ABOUT A RESPONSIVE EDUCATION SYSTEM**

The education system is central to the effective development of an economically active citizen, who is either an employed citizen or a capable entrepreneur. The focus on education must be both short term and long term and must also include critical enabling structures.

The advent of the Fourth Industrial Revolution marks a new, important journey for the world, especially the developing countries in Africa and South Africa. This study explores the understanding and knowledge of the South African citizens about the Fourth Industrial Revolution. This was important as there is a general agreement that the Fourth Industrial Revolution is a reality and is influencing the way we work, live and interact with one another. These findings revealed that the education system needs enhancement.

## RE-DEFINED WORK STRUCTURE

The Fourth Industrial Revolution is expected to see changes in job structure. In the Global Challenge Insight Report: The future of Jobs – Employment, Skills and Workforce Strategy for the Fourth Industrial Revolution, the WEF (2016) argues that 44% of the job structure is changing with an increase in flexible working arrangements and this effect is already being felt because technologies are enabling workplace innovations. These changes are a double-edged sword, some being positive, while others are negative.

On a positive note, new jobs will be created, the job can be performed with better accuracy and precision and ease of access and will result in citizens having multiple jobs that will result in multiple sources of income. The anticipated increase in work mobility is also a positive, as it allows the citizens to work on jobs thousands of kilometres away from their homes without being physically present at those sites. Societies who are well prepared and equipped with relevant skills can seize the opportunities that are associated with the problem of skills shortages in countries and avail themselves for those jobs. This high level of connectivity and high mobility is central to the ability of citizens to have multiple sources of income.

On the negative side, there is an expected large loss of jobs. This finding of new jobs being created by the advent of the Fourth Industrial Revolution, due to the rapid advances in new technology is unlikely to happen (Prisecaru, 2016). In explaining the expected job losses due to the Fourth Industrial Revolution, (Xu, David and Kim ,2018) assert that a new revolution affects and destroys jobs of preceding revolutions. As such, the jobs that are being destroyed are manual jobs due to the advent of knowledge workers and advanced automation and machine learning, rather than due to the changes in government policies or free trade agreements. This supports the assertions of (Prisecaru, 2016) who posits that automation is replacing the 'blue collar jobs' Cann, the Director at the World Economic Forum, predicts that the labour market will substantially change in the next five years with as many as five million net loss of jobs from developed and emerging economies lost through redundancy, automation or disintermediation (Cann, 2016).

## OPTIONS TO BE ECONOMICALLY ACTIVE

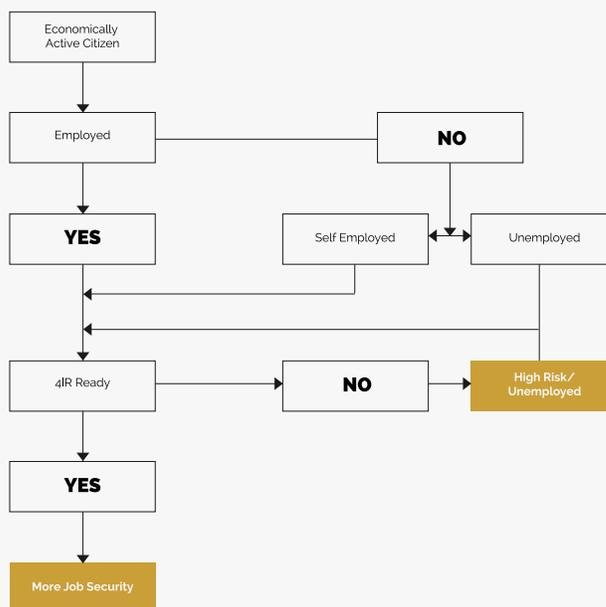
Citizens are currently being able to be economically active by either seeking employment or through self-employment as an entrepreneur (Figure 13). However in South Africa there is a huge number of citizens that are unemployed, especially the youth.

The advent of the Fourth Industrial Revolution has brought possibilities of job restructuring which can be either positive or negative depending on the level of preparedness.

*Acknowledge that the nature of work and job market is changing in an increasing pace. Secondly, as it no longer makes sense to ask children what they would like to 'do' when they grow up. By the time they enter the world of work, a large portion of current job types will have disappeared, and as many (if not more) jobs, presently not defined, will have become both every day and essential. IPP12*

The job structure is changing, with some of the semi-skilled jobs being taken over by the machines and the growth of the artificial intelligence. Drones are used for surveillance and looking after livestock instead of groups of employees.

**Figure 11** Level of agreement on the effectiveness of current education system to develop an economically active citizen



Some of the other examples that were advanced by the panel included the use of robots in call centres to assist the customers. This, together with some companies in telecommunications, resulted in a decrease of staff and an increase in efficiency, with time to solve problems decreasing substantially from the original time frames.

There are also challenges of unemployment and poverty in South Africa. This is because the embedded formal dynamics of the economy were left untouched, resulting in the incumbents deepening their grip on the economy.

*“The problem is that 30% of population does not have skills, knowledge or sophistication to fit into the modern economy.”* **EGP2**

It is also critical that as the economically active citizen is developed, the current trends are considered. There is an increasing need for people to be influencers, and they need to get involved in multiple activities rather than just one.

*“Trends are for independent youth with multiple source of income. Corporates and society are looking for influencers.”* **EEP2**

*“It’s inevitable that jobs are going to be impacted as artificial intelligence automates a variety of tasks. However, just as the Internet did 20 years ago, the artificial intelligence revolution is going to transform many jobs—and spawn new kinds of jobs that drive economic growth.”* **IPP12**



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## ENHANCE ENTREPRENEURSHIP

The data analysis of both the qualitative and quantitative research that was conducted, themes and consolidated codes were developed based on the views of the respondents. The respondents were required to give innovative solutions to develop successful entrepreneurs within the economy.

## TRAIN AND UP-SKILL ENTREPRENEURS

South Africans need to train and up-skill themselves as this comes with good rewards. Up-skilling brings about progress in the workplace, with either salary increases or an advancement in rank due to acquiring new skills. More training and up-skilling may also help an individual make extra money. Even though South Africans have the confidence in acquiring more knowledge and skills in ways of studying more courses and doing additional training to increase earnings, the importance of more training and up-skilling does not end there. South Africans believe that the more we learn and actively use new skills, the better is the output. Therefore, it is important to conduct workshops on the Fourth Industrial Revolution as this will enlighten, educate and inform individuals on how they may benefit from it as well as advance their skills and knowledge

*“Take them to workshops to teach them about the 4th industrial revolution and how they will benefit from.”*  
**CQ62**

*“Education system must start introducing business studies from primary throughout the syllabus.”*  
**CQ20**

*“Get highly skilled automation users to teach the country.”*  
**CQ26**

*“Those entrepreneur education programs should start in high school to develop and build the required tenacity and competencies required to manage own business and personal finance.”*  
**CQ58**

*“Entrepreneurial skills development through learnerships.”*  
**CQ36**

*“I think, the physical psychologies for practical and training people and educating people”*  
**IPP7**

The entrepreneurs must be trained so that they have the skills to identify threats and to quickly have solutions to those threats.

*“So, the people who would be successful and economically active, are people who are able to see the complexity of the problem from different angles and are able to appreciate the principles of systemic – where you realise there are multiple complex systems that are interacting with each other to give rise to some of the issues and solutions that we are trying to build.”*  
**IPP8**

## OPTIMISE FUNDING STRUCTURE FOR ENTREPRENEURSHIP

The respondents stressed that government must finance start-ups and show entrepreneurs the right way of utilising funds to achieve going concerns in business. The financial institutions are urged to assist those who can establish small businesses, grow them and thereby creating employment. If government would collaborate with the private sector and work on the same goal of empowering small growing entities and educate them on financial management, as well as business management, that would result in strong successful entrepreneurs, not only to educate them but to assist the SMME's with funds and the resources they need to start the business so that they can become sustainable.

*“Government should provide with start-up money for business.”*  
**CQ5**

*“Government and private sector must teach us how to use funds the right way in order for the business to be successful.”*  
**CQ21**

*“Banks should open doors to help people get money to start their own businesses”*  
**CQ31**

*“Help those who are able to establish small businesses to grow them bigger so they can employ others.”*  
**CQ54**

*“Necessary funding facilities must be put in place.”*  
**CQ46**

## DEVELOP AN ENTREPRENEURIAL INTENT

The reason people commence business is to seize and utilise an opportunity to make a profit. Entrepreneurial intent provides direction and the manner of a start-up enterprise from the beginning. Intentions may arise when entrepreneurial characteristics are generated and are related to entrepreneurship development. This means that a person must display entrepreneurship intent first before carrying out any action related to it. The respondents believe that for entrepreneurial intent to be developed everyone must be seen to be equals.

## SUSTAINABLE OPPORTUNITIES IN GOVERNMENT AND THE PRIVATE SECTOR

Government should consult with business minded people and learn about their ideas and plans, then assist them in every way possible in achieving their goals.

*“Government should consult with business minded people and hear their plans and ideas, then help them in every way possible.” GOV1*

Respondents indicated the importance in partnering with the private sector for the benefits that include training and gaining of experience.

In partnering with the private sector, entrepreneurial skills development may be gained and enhanced.

*“Partnering with private companies for training and experience.” CQ30*

*“I think by enhancing the opportunities and invest more in the Education system development in sectors” IPP13*  
*“the opportunity is about uplifting people from their current situations and the opportunity, if you do that, it’s about sharing and developing caring citizens” IPP10*

## DEVELOP ENTREPRENEUR NETWORK CAPACITY

For small upcoming entrepreneurs to become successful in the business industry, they must build network capacity through mentors and peer support groups which will add value to their careers and assist in business development. This networking can be in a form of a constant blend of educational programmes, dialogues and workshops.

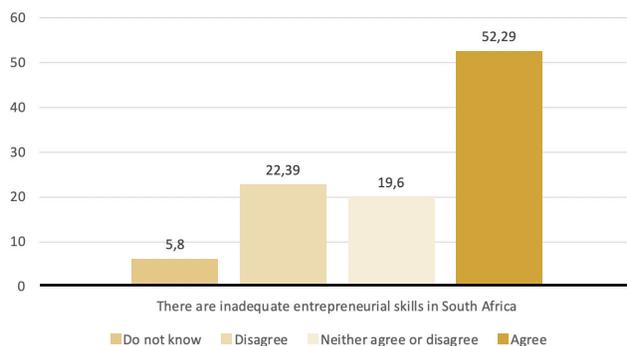
“So, the ability to be collaborative and work with people, but also to be able to understand and apply yourself to another person’s experience and not come with a ready-made solution.” IPP8

## DEVELOP BENCHMARKS AND EXCHANGE PROGRAMMES

There were also views from the respondents that part of developing the entrepreneurs is to benchmark and conduct exchange programmes with counterparts from other countries who have had better success in the entrepreneurial space.

“International exchange programs for entrepreneurs it’s about sharing and developing caring citizens.” IPP10  
 Figure 14 shows the results of the level of agreement of the respondents to the statement “there are inadequate entrepreneurial skills in South Africa” - over a half of the respondents with a total of 52.29% agree and strongly believe that South Africa lacks entrepreneurial skills,

**Figure 14** Level of agreement on the adequacy of the entrepreneurial skills in South Africa



while 22.39% disagree and are optimistic that there is the skill within the country. Only 5.8% of the respondents indicated that they do not know

and 19.6% were neutral. However, the overall summary to the results indicate that there is still a need for implementation of entrepreneurial skills in South Africa.

## INSIGHTS ABOUT RE-DEFINED WORK STRUCTURE

The availability of both employment and entrepreneurship was fully advanced with the citizens, as there is still large majorities who study with the aim of being employed. For South Africa to effectively fight the high unemployment rate within its economy, there is a need to encourage entrepreneurship. Citizens must be encouraged to start their own businesses no matter the size ththeyey can be a vendor selling vegetables next to the road or open a small shop in the township as long as you are doing something as the South African's famous saying "Vuka uzenzele".

Entreprership by the small business is where South Africa pins its hope, as envisaged that 90% of the new jobs by 2030 (NDP vision 2030) must come from the small business (Presidency, 2011). The individuals start their businesses intentionally not by reflexes, they pursue and exploit business opportunities because of intentional processes. These intentions can be stimulated by the development of some entrepreneurial characteristics such as skills and knowledge that are closely related to the entrepreneurship development (Sanchez, 2013).

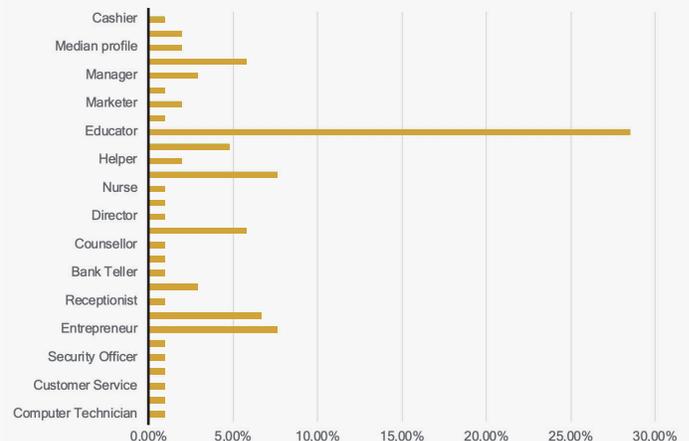
Therefore, the South African government must implement an effective entrepreneurship education system that will increase the desire and skills for successful entrepreneurs.

## SKILLS DEVELOPMENT FOR EMERGING JOBS

Besides technology and entrepreneurship as mandatory subjects at school, there is also a need to balance content taught in class and the imparting of skills at the same time, to strike a balance. Of importance is to prioritise

the skills the country requires. Citizens need to be prepared for the emerging jobs and thus require relevant skills so that they do not find themselves marginalised during the time of the Fourth Industrial Revolution.

Figure 15 Current job profile of the respondents



"So, some of the things that I feel do need to change is in the future and the current reality, content is not the focus, the focus is skills. I'm not sure how useful and how successful a child will be purely because they are able to recite content and remember dates when we literally can access that information on our cell phones." ICP1

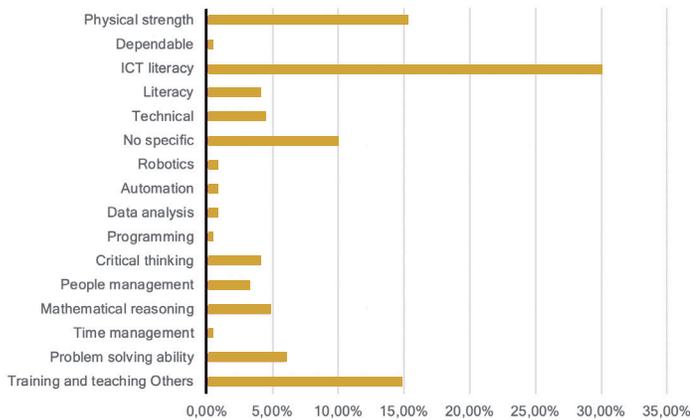
"So, all the education system must be reformed, restructured, so that at the end...at the exit of every phase, there must be a skill wherein the very same learners are able to...when they go home for example, if they have done plumbing, for example, they must be able to use that skill to earn a living." IAP2

## RELEVANCE OF SKILLS AND COMPETENCIES

The emergence of new technologies and growing business pressure requires employees to continually audit the relevance of the skills and competencies they possess in order to survive in the business world, because the skills and competencies required for them to succeed today are not the same as the skills and competencies they may need in the future. In the same vein, for businesses to survive the turbulent and competitive environment, it needs to employ a skilled and competent workforce

The misalignment of employee skills and competencies with available jobs is becoming a major issue for businesses the world over. It becomes mandatory that government as the policy maker, together with academia, labour unions, NGO's and the private sector collaborate their efforts in developing an economically active citizen in the climate of change, a citizen who will be able to meet the needs of the country's workforce, thus minimising the impact of disruptive changes in different industries.

**Figure 16** Required skills and competencies during the time of the fourth industrial revolution



## CURRENT SKILLS AND COMPETENCIES

The skills and competencies are captured in Figure 15. Each respondent was asked to mention at least three current skills and competencies they had. There was an overlap of skill/competencies hence these are combined in one table. Because of the words being used interchangeably, no further analysis was carried out on the data set save to summarise it in the table for better visualisation.

### Required Skills and Competencies

Respondents mentioned training and teaching others, ICT literacy, problem solving, critical thinking, mathematical reasoning, physical strength, and technical skills as required skills and competencies for the Fourth Industrial Revolution, according to the respondents.

Interestingly, a sizeable number of respondents said they did not think there are any specific skills set and competencies that were required

Respondents identified required job profiles in ICT, entrepreneurship, teaching and engineering as important (Figure 16).

There were some respondents who did not know what job profiles were required while others believed there are no specific job profiles required for the Fourth Industrial Revolution.

"I don't know because there are many improvements already." CQ22

"None specific because training will be provided." CQ26

"If training will be given no job profile." CQ2844

How to develop the required Skills and Competencies and Job Profiles for the Fourth Industrial Revolution?

In their preface to the report at: The Future of Jobs: Employment, Skills and Workforce Strategy for the Fourth Industrial Revolution, Schwab and Samans (2016) remarked:

"While some jobs are threatened by redundancy and others grow rapidly, existing jobs are also going through a change in the skill sets required to do them. The debate on these transformations is often polarised between those who foresee limitless new opportunities and those that foresee massive dislocation of jobs. In fact, the reality is highly specific to the industry, region and occupation in question as well as the ability of various stakeholders to manage change."

During the interviews, some respondents were complacent that they will still retain their jobs even when the Fourth Industrial Revolution is fully implemented, others conceded that they will lose their jobs.

In order to develop the required skills, competencies and the job profiles for the Fourth Industrial Revolution, respondents shared the following insights:

*"Improve access to computers and internet at local libraries for free."* **CQ17**

*"Innovative approaches to education should be introduced at all levels"* **CQ30**

*"Access to free education for all."* **CQ51**

*"Easier access to the internet (fibre connections even in rural areas)".* **CQ49**

*"Access to information."* **CQ33**

*"Companies should empower their employees."* **CQ22**  
*"Government must increase the relevant institution."* **CQ47**

It is clear from the foregoing discussion that respondents identified academia, business and government as pivotal role players in preparing the country for the Fourth Industrial Revolution, whilst at the same time, the individual's own motivation was identified as important.

This assertion is supported by findings from the research by Reilly (2004) which indicated that co-operation is mutually advantageous to universities as well as to corporations. RAND therefore recommended that corporations and educational institutions work together to assume joint responsibility for co-producing a globally competent workforce.

This table shows changes in jobs in various industries. Some industries are showing the increase in the number of job such is the health care because the life expectancy of individuals has increased. Future job profiles exist within these industries.

## **INSIGHTS INTO THE SKILLS, COMPETENCIES AND JOB PROFILES (CURRENT VS REQUIRED)**

This analysis gives an insight into the discrepancy between the available skills and competencies as espoused by the respondents in the study versus the required skills and competencies as per the World Economic Forum. Whereas the Future of Jobs Survey reported that the overall scale of demand for various skills in 2020, more than one third (36%) of all jobs across all industries are expected to require complex problem-solving as one of their core skills, compared to less than 1 in 20 jobs (4%) that will have a core requirement for physical abilities, such as

physical strength or dexterity (Schwab & Samans, 2016). Although these changes will differ from industry to industry, for example, industries in the technology arena.

## **INSIGHTS ABOUT THE PEOPLE'S KNOWLEDGE OF WHAT SKILLS AND COMPETENCIES ARE REQUIRED**

Most respondents were well aware of what skills and competencies were required including job profiles for the Fourth Industrial Revolution.

*"programming skills."* **CQ31**

*"They must have degrees so that they could get jobs."* **CQ3**

*"Honours degree in technology"* **CQ20**

## **INSIGHTS ABOUT THE COUNTRY'S READINESS FOR THE FOURTH INDUSTRIAL REVOLUTION - THE VIEW OF INDUSTRY**

In a survey by Deloitte, South African executives expressed greater doubt about their organisations' readiness to fully harness the changes associated with Industry 4.0 than the survey population at large. Only 4 percent of executives in South Africa feel highly confident, compared with 14 percent of executives globally (Adão, et al., 2017). These executives are most focused on the changing regulatory environment.

The results of the research by Kolibáčová (2014) suggest that when the competency rate of one employee is a unit higher than the competency rate of another employee, it can be assumed that his performance rate is 7 to 12.5% higher. It stands to reason, therefore, that there is a correlation between competence and performance as both are required for the success of the organisation.

## **REDUCE DRIVING SOCIO-ECONOMIC BARRIERS**

There are challenges where it is difficult to access the information and to use it effectively for advancement.

This problem exists, especially in South Africa and other African countries, where data is very expensive. This inhibits the citizen from accessing information, to effectively communicate and build networks. This is a barrier that has seen protests such as #DataMustFall, but to date nothing tangible has come out of these efforts. Despite this, there are efforts to develop localised telecommunication networks that will increase the reach of connectivity and improve the cost structure of communication and data.

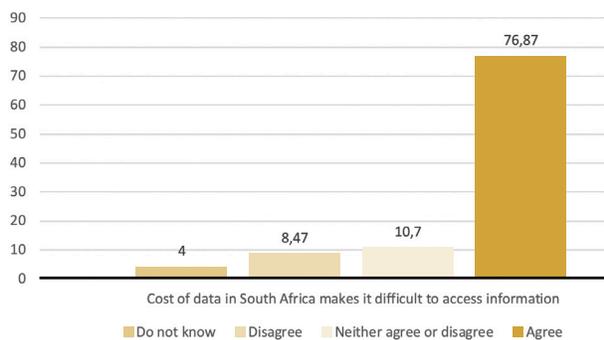
***“Localised telecoms network is critical for reach of connectivity into communities and to improve the cost of data” GOV1***

The respondents were asked to indicate their level of agreement on the statement “cost of data in South Africa makes it difficult to access information”; a total of 76.87% of the respondents agree and believe that the cost of data is a hindrance to information access while only 8.47% disagreed.

A further 10.7% were neutral and only 4% indicated that they do not know. This summarises that the cost of data in the country plays a huge role and is a source of prevention to information access (Figure 17).

The socio-economic barriers include a lack of general acknowledgment of technology’s growing importance, a lack of acceptance of technology, and a lack of resources maintenance, use, and effectiveness-for poorer schools and families.

**Figure 17** Level of agreement on the cost of data in South Africa



Access to the internet and technology is identified as a socio-economic barrier; this is viewed as a hindrance because in this day and age everything revolves around technology and the internet, if you do not have a cell phone or access to a computer it because a challenge for an individual to have access to information, a student to do his school work because they need that handset or computer to surf the internet for information and do research. The digital culture is critical and has taken over in the sense that if you do not have

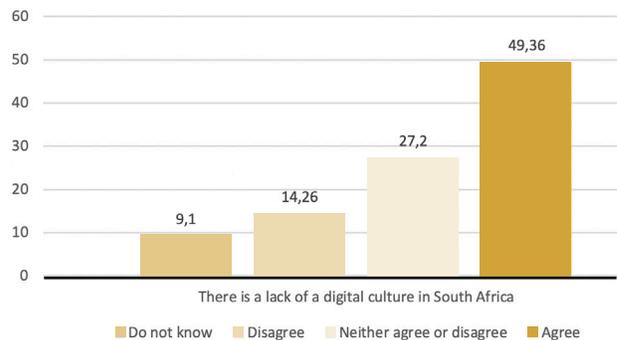
***“Students should have smart phones and device for internet” CQ34***

***“There must be cheap computers to help ease the access to computers,” CQ31***

A total of 49.36% of the respondents who took part in this question indicated that they agree and believe that there is a lack of a digital culture in South Africa, meanwhile only 14.2% of these respondents disagree to this statement, a further 27.2% were neutral and indicated that they neither agree nor disagree and only 9.1% indicated that they do not know (Figure 18).

One of the drivers or one of the profiles that seems to be rife within the Fourth Industrial Revolution is further development of entrepreneurs, so that they become economically active citizens.

**Figure 18** Level of agreement about the digital culture in South Africa



Other factors that have perpetuated the lack of economic inclusion are the lack of mutually beneficial partnerships. Corporates increase their footprint and dominance into the township economy within a partnership that does not grow the township partner. Funding is another major issue and this means that there must be an ability to create a vision and innovative business where there is proper engagement, a vision of what needs to be done so that it is easier to fund those businesses.

Hence, one of the issues that was raised by the panelists is to say, because of the global issue where more than 70-80 percent of the starts-ups failed, there is now a point to develop those mainstay ones, those that have already been there and have done at least the ground work.

So, this means the resilience, the perseverance and the knowledge of the basics when you are running a business is important for an entrepreneur so that they can have better access to funding because they have done some of the ground work.

These are all the societal problems that the technologies of the Fourth Industrial Revolution can assist to overcome. "The Fourth Industrial Revolution is applicable to South Africa and Africa for the following reasons: in order for South Africa to continue attracting investment into the country it is important to embrace the opportunities that are presented by the Fourth Industrial Revolution as a way of broadening participation for inclusive economic growth"IGPg

## INSIGHTS ABOUT DRIVING SOCIO-ECONOMIC BARRIERS

Of concern to these findings, there is inequality of knowledge with higher knowledge found in the Respondents with higher socio-economic status. This is particularly concerning considering that South Africa is currently regarded as one of the most unequal nations in the world (Statistics South Africa 2017), with a Gini coefficient of inequality at 0.63 as at 2015 (South African Institute of Race Relations 2017). The Fourth Industrial Revolution is critical and should be on all nations' national agenda. Central to this agenda should be how all the citizens can participate in it without allowing for the perpetuation of inequality within the society.

The implication is that there is a need for all stakeholders to work in collaboration to develop the knowledge of the citizens about the Fourth Industrial Revolution and to assist them to identify the opportunities that are being offered by it, and prepare them in order to mitigate the challenges associated with it.

## CONCLUSION

*The six core factors and two complementary factors are important in the development of an economically active citizen during the time of the Fourth Industrial Revolution. This means that there is an urgent need for a quest to develop the entrepreneur.*

*This is especially true when considering that even big government projects which are aimed at empowering the community, end up with the community and its entrepreneurs not adequately benefiting, as most of the finances end up back in the big corporates.*

*This can be done through the development of an entrepreneur who has a vision and has the necessary skills to succeed. This revolution is also associated with products-as-services, the sharing economy and digital services and exports.*

*Thus, this creates opportunities for markets that are currently underdeveloped in Africa, but have substantial potential, given Africa's geography, demography and on-going urbanisation (Naude 2017). A further opportunity is on re-industrialisation in Africa, thus making the continent more competitive.*

## POLICY DILEMMA

Most of the respondents acknowledged that both in South Africa and other African countries, there are two huge policy dilemmas.



# 03

## STRENGTHENING INSTITUTIONAL CAPACITY EFFECTIVENESS

Institutions as the humanly devised constraints that structure the political, economic and social interaction and that they comprise both informal constraints (customs, traditions, ethics and codes of conduct), and formal rules (legislations, regulated processes and rights) (Kingston & Caballero, 2006). The major role of institutions in a society is to lessen uncertainty by establishing a structure to human interaction (Buitelaar, Legendijk & Jacobs, 2007).

In this research, institutional capacity effectiveness was regarded as an important factor during the development of economically active citizens during the time of the Fourth Industrial Revolution. This was critical as it will allow for consistency, repeatability and scalability of the initiative required to achieve this objective.

of balancing the need for jobs using the manual labour and efficiency from digitisation and automation, and demand for decolonisation vs the colonialist nature of the 4IR and globalisation.

### NEED FOR JOBS VS. NEED FOR EFFICIENCY

It was evident from the respondents' views that there was a policy dilemma for a need for jobs vs. need for efficiency, which is central to the adoption and leveraging of the Fourth Industrial Revolution.

*“Primarily the clash between the need to provide jobs – which often translates into low-quality manual labour jobs – versus the need to upskill people to cope with the digital skills to meet the requirement of the 4IR.”*  
**IGP14**

*“Technology has moved such that the graders we use for road construction are fitted with land surveyor capabilities, which are programmed from the office, you punch the levels of survey, and the grader adjust itself. But the local government does not accept that, they would want you to have two men running in front of grader with a rope checking levels, balancing the road [to create employment].”* **IGP4**

This issues was also highlighted in some of the African countries.

*“In a nutshell, the challenges are that, the embed structure in some of the Africa countries such as Mali, Guenea and Burkina Faso forces the companies especially in mining, to show that they will create an employment and cannot improve efficiencies at the expense of employing manual labour”* **IPP7**

Demand to decolonise vs. Colonialist nature of Fourth Industrial Revolution and Globalisation

Another dilemma highlighted is the challenges of trying to balance the demand to decolonise vs. the nature of the economic structures and globalisations. This means that the agenda of the world is dictators for South Africa and Africans.

*“The demand to decolonise seems to contradict the colonialist agenda of the fourth industrial revolution and globalisation.”* **IGP14**

The same applies to the structure of the business and economy, which is dominated by a few companies. This is critical as the threats are such that more and more people do not want to be employed, but would rather be the employer and an entrepreneur. There is however, a big challenge with the sustainability of the entrepreneur, especially within the townships. They are operating no growth businesses; one of the big challenges is embedded structures that are difficult to break to allow for some of these businesses to prosper.

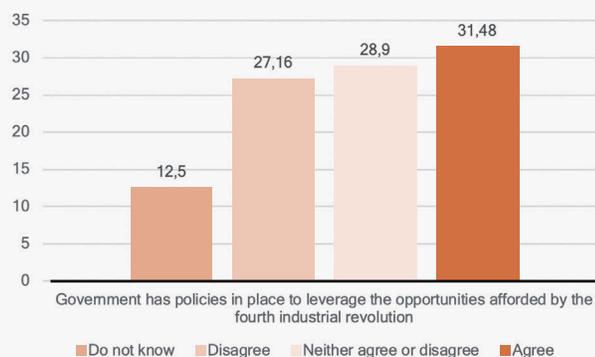
***“A lot of businesses within especially the townships and the rural areas are non-growing business with a revenue a “majority of them having a revenue of R70 000 per annum with only about 10- 15 percent of those businesses managed to get a revenue of a million rand a year” EGP2***

This is despite the fact that townships have huge purchasing power. The unfortunate part is that these citizens are not spending within the township, but rather in the towns and cities, resulting in high leakage in the township economy and the consequence is poor development in the township.

***“People in township like Soweto have huge spending power, but spend very little in township business, there is a very high leakage, money leaving Soweto to the city, and the city develops” EGP2***

During data collection, there were two encounters worth reporting as supplementary data as they directly contextualise some of the aspects of the study. These were encounters that were reported to the data collectors by the respondents and realities that have taken place in the Industrial Zone (Coega) in Nelson Mandela Bay and another in a Car Manufacturing Company.

**Figure 19** State of government policies to leverage the fourth industrial revolution



## ATTEMPT TO USE OF ROBOTS TO IMPROVE EFFICIENCIES: COEGA

*Last year, in Port Elizabeth, company from China came to our community promising our people that they are here to ease the youth unemployment as they are going to build a factory that will hire almost a thousand people from our area. It was just few months after our people were addressed about this project, we started seeing big plants (machinery) being dropped by that space of development. But one thing that didn't go well with the community members was that they were told those machines need people with operational papers and that the thousands of people that were promised are no more going to be need because one of those big plants that they saw being dropped it can build it just needs people to load bricks on it and that there are going to be shifts others working during the day others during the night but to their surprise were told that they want a good relationship with the community members. Community threatened protest and social unrest directed at the company and plants were withdrawn by the company and community members worked manually instead to build the factory.*

*Citizen, Nelson Mandela Bay*

## ATTEMPT TO AUTOMATE THE PROCESS IN CAR MANUFACTURING COMPANY

*A young man who works for one of the big South African car manufacturing companies advised that last year they had an issue on their factory as they were told by their employer that they are going to bring about 50 robots that are going to be installed on their factory, but the bad news are that there is going to be a huge retrenchment that was going to happen because each robot requires one person so meaning they going to need the number of people that are the same with the number of robot that they are bringing, plus few support staff, meaning few hundred people were going to lose jobs so . That did not sit well with employees and their Unions, so they fought this issue. Management end up backtracking and the robots were set back to America, so he says.*

*Data collector: So after the whole story I asked him personally how he feels about the Fourth Industrial Revolution, he said that ‘this is here to kill black people as they are already swimming in a pool of poverty so with this being introduced or implemented it will definitely send them to an early grave so he wish that our government would stop copying such thing from this other countries well developed countries and work on challenges that South Africa is facing’.*

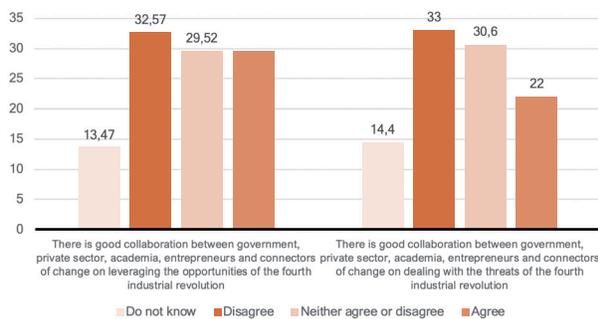
*Employee, car manufacturing company*

These were some of the stories that were encountered during the data collection, and they are an eye opener on the urgent need to deal with the realities of a society with a high unemployment rate and progress brought by the technologies of the Fourth Industrial Revolution to improve the performance and efficiencies in the organisations.

## FACTORS TO IMPROVE INSTITUTIONAL CAPACITY EFFECTIVENESS

There were seven factors that were identified that the respondents believed needed to be improved to strengthen the current institutional capacity effectiveness in South Africa. This, in particular the public institutions. These were Political Will and Leadership, enabling and responsive policies, capacitating the officials, multistakeholder collaboration, curbing corruption and promoting good governance and resource mobilisations and prioritisation and national co-ordinator.

Figure 20 Collaboration for the fourth industrial revolution



## POLITICAL WILL AND LEADERSHIP

There is a need for political will and leadership within the institutions as time and time again it has been proven that where there is a will, there is a way.

Practical example includes the development and maturing of the EPWP from the government. This was implemented and people all rallied behind it. This became a flagship programme for the government to allow citizens, especially youth, to participate in the economy.

***“EPWP is compulsory to all the project now, the government is interested on the number of people that will be employed, trained and also on local insourcing of the material. Proposal without these aspects are at a disadvantage.”***  
**IPP12**

***“As government officials we were sometimes complaining about the cost increase associated with the required aspects of EPWP, but government stood firm and insist it must be incorporated, now we are seeing the results and we have buy-in on it. The same must be done about the Fourth Industrial Revolution”***  
**IGP4**

## ENABLING AND RESPONSIVE POLICIES

A total of 31.48% of the respondents believed and agreed that the government has policies in place to leverage the opportunities afforded by the Fourth Industrial Revolution, followed by 28.9% of those who neither agree nor disagree to this statement. Those in disagreement to this statement were 27.16% meanwhile, 12.5% indicated that they do not know. Conversations with the respondents was clear that attempts must be made to avoid malicious compliance with the policy as this will not be useful or helpful to the stakeholders in the long run, and this tends to be to the disadvantage of the learner and citizens in general. “Well from an educational perspective, there’s a process..we need to look at our processes of implementing..of implementation because currently, it’s about compliance and in many cases it’s malicious compliance. And for me, you cannot go in and assess people if you haven’t supported them and developed them”**IPP10**

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This included strengthening the policies, so both can enable and protect the citizens.

***“The legal, security, privacy, regulatory dimensions of business dealing will need to be looked at.” IAP4***

In addition, there is a need to revise the labour and IT laws so they can enable participation and competitiveness.

***“There will be more globalisation and reduced geographical barriers, but that access also has some regulatory implications, thus need to refine such. Our labour laws and ICT policies would need to be revised” IAP4***

## MULTISTAKEHOLDER COLLABORATION

A total of 1035 respondents took part in answering questions in this study, in this section the respondents were asked if there is good collaboration between the government, private sector, academia, entrepreneurs and connectors of change on leveraging the opportunities of the Fourth Industrial Revolution. 32.6% of the respondents indicated that they disagree. Followed by respondents who neither agree nor disagree at 29.5%. A total of 24.5% of the respondents indicated that they agree, whereas 13.5% of the respondents indicated that they do not know.

A total of 1096 respondents took part in answering questions in this study, in this section the respondents were asked if there is good collaboration between the government, private sector, academia, entrepreneurs and connectors of change on dealing with the threats of the Fourth Industrial Revolution. 33% of the respondents indicated that they disagree.

This was followed by respondents who neither agree nor disagree at 30.6%. A total of 22% of the respondents indicated that they agree, whereas 14.4% of the respondents indicated that they do not know. The complex structure of developing an economically active citizen during the time of the Fourth Industrial Revolution means that it will just not be easy for a stakeholder, be it government or private sector, to work alone. This is because there is a lot of work that needs to be done for the change to occur.

This is because the policies seem not to be ready at this point in time, meaning that the workforce is not prepared. This is also because there is a culture of change that is required. With all those factors at play, it is impossible for an entity to drive it alone. Despite that, we must start somewhere and must ensure that the Fourth Industrial Revolution is in swing.

There are several areas of collaboration which the entities ought to look upon. Findings from the study confirm that there is a sharing of the same view that collaboration is the way to go, and it should be done between the different stakeholders. With the entity collaboration, there is then a huge potential to address the risks collectively and seize the opportunities collectively.

## THIS CAN BE DONE, OF COURSE WITH THE ASSISTANCE OF POLICY FORMULATION.

***“So, government, adhoc, so this is a nice NGO we’re going to work with you, that’s a nice NGO we’re going to work with you. Instead of saying to themselves; “we need these NGO’s”, like... a simple example; we need these five NGO’s to assist us and so you formalise a long term working together partnership. You don’t just work with them when you feel like working with them or when there’s a problem and the results are bad, then you work with them.” IPP10***

***“It needs to be a focused, structured partnership where there is in-depth, deep diving collaboration.” IPP10***

***“So, I’m thinking that, maybe as those programmes are in... are introduced, we need to ensure that there’s policy positions that will assist the people that are in that space to still be relevant in terms of delivering” IGP6***

## CAPACITATE THE OFFICIALS

The officials need to be capacitated with the know-how and become technologically savvy so that they can assist with the necessary policy development and ensure that they perform their jobs efficiently.

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*"All institutions should educate staff in the imperatives of 4C's – creativity, collaboration, communication, critical thinking as well as the ability to use digital tools, language, competence.."*  
**IGP13**

## **CURB CORRUPTION AND PROMOTE GOOD GOVERNANCE**

There is a need for good governance in the institutions so that there is an increase in confidence and there is fairness in dealings. This is critical, especially for the small business that need fair opportunities to survive.

Corruption damages the social and institutional fabric of a country; therefore, a sensible combination of reward and punishment must be utilised as the driving force of reforms. Because of corruption going on, the small developing businesses are deprived of opportunities. There must be transparency in government to stop bribes and corruption that happens behind closed doors.

*"Transparency"* **CQ42**

*"Stop corruption"* **CQ51**

"Given the opportunity, given a tender, properly and without any kind of back door and brown envelopes, you could probably tomorrow employ twenty people." IPP10  
"So, it's difficult for people to come through here and invert and bring those technologies or even themselves to do things like that because of the level of corruption." IPP7

## **RESOURCE MOBILISATION AND PRIORITISATION**

The findings have also revealed that there is an urgent need for resource mobilisation and prioritisation to prepare the different sectors, especially the education system, for the Fourth Industrial Revolution

*"Innovations follows money"* **IAP5**

*"And I think that we also need to have a lot of policy discussions around the reallocation of resources, and that is where, for example, in the country, the discussion around the .. the land becomes important. To what extent does that play a role in enabling people to become active economic respondents?"* **IAP3**

## **NATIONAL CO-ORDINATION VALUE CHAIN**

As already explained in the section, there is a need for a national co-ordinator to make sure that the different value chains, the different directorates and all the initiatives related to the Fourth Industrial Revolution are not a duplication or replication of one area to the next and the resources end up doing the same thing repeatedly.

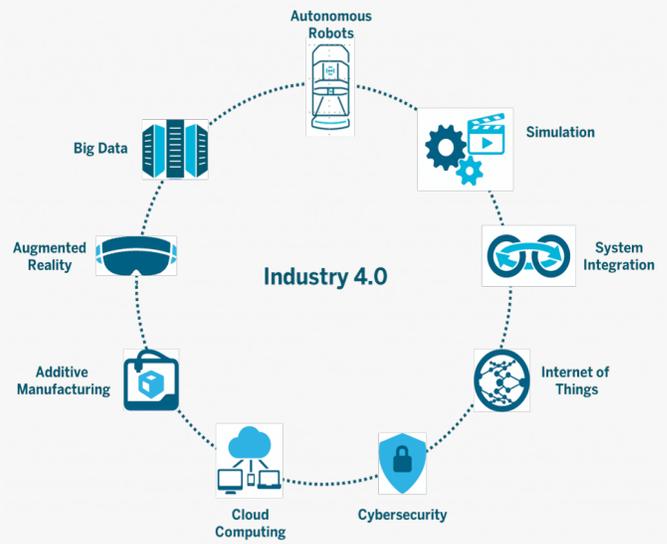
The national co-ordinator will make sure that there is optimal usage of resources, which will be critical to make sure that at the end of the day, objectives are achieved. Those resources, no matter how limited they could be, they can go very far in making sure that the digital culture and the Fourth Industrial Revolution is being leveraged by the citizens.

## **INSIGHTS ON INSTITUTIONAL CAPACITY EFFECTIVENESS**

Changes in institutions are commonly characterised with the introduction of new arrangements and organising and at work, it has a probable substantial effect on individuals employed in organisations (El-Farra & Badawi, 2012:161). There are two critical features that create an additional complex and interactive picture of organisational or institutional change, the motor of structural change that is concurrently

structured by the process it is driving. In addition, the architects of such reorganisation and change have to craft their appropriate and precise combination of the old and new so that they can construct an innovative dynamic; this implies that change does not just occur, it is naturally interactive.

This is the approach that should be in mind when improving the institutions to be effective during this time of the Fourth Industrial Revolution. The key imperatives such as the Fourth Industrial Revolution national value chain co-ordination and resource mobilisation and prioritisation are critical. Even more importantly there is a need to build institutional capacity through collaborative approaches with the private sector, academia, entrepreneurs and connectors of change.



## CONCLUSION

*There was a strong view that government and other public institutions need to be strengthened so that the adoption of the Fourth Industrial Revolution is successful, and an enabling environment is created for the citizen to thrive during this time.*

*Resolving policy dilemma and improving the identified areas will improve preparedness to leverage the Fourth Industrial Revolution.*



04

## CHANGED MINDSET TO LEVERAGE OPPORTUNITIES

Changing the thinking and mindset is crucial for the citizens to be able to effectively leverage the opportunities that are associated with the Fourth Industrial Revolution. Equally important is the citizen who is a "go-getter, a hassler" who will take the "bull by the horns" to advance themselves to becoming economically active during the era of the Fourth Industrial Revolution. This is even more critical in order to understand and mitigate the threats, such as those of potential job losses, so that the citizens can strive despite those potential negatives. A paradigm shift removes the sense of entitlement and allows the people to bring new perspectives and to unearth hidden potential. With a changed mindset, people are focused, patient, courageous and have a learning mindset.

### EXISTENCE AND PARTICIPATION IN THE FOURTH INDUSTRIAL REVOLUTION

The study took place across nine provinces in the country and the respondents were asked if the Fourth Industrial Revolution exists or does not exist. A total of 80.9% of the respondents believe that the Fourth Industrial Revolution does exist and only 19.15% of the respondents believe that the Fourth Industrial Revolution does not exist. There was a total of 1123 of respondents who took part in answering the questions in this study. The respondents were asked to share their level of agreement, 56.51% of these respondents agree that the South African citizens should take part in the Fourth Industrial Revolution, while 25.02% disagree to this statement.

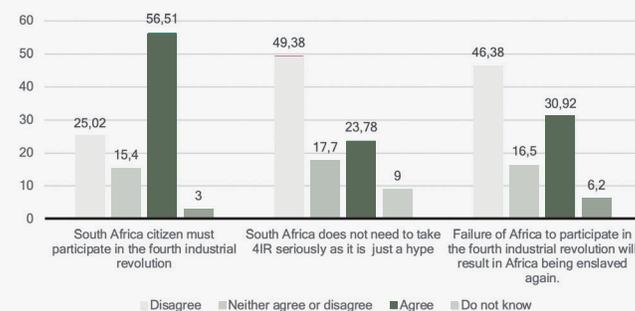
The study also found from people within the country, 29.9% of the respondents indicated that they disagree with the statement that South Africa does not need to take the Fourth Industrial Revolution seriously as it is just a hype, with a further 19.5% respondents strongly disagreeing to this matter.

This means that about a half (49.4%) of the respondents believe that South Africa should take the Fourth Industrial Revolution seriously. 17.7% of the respondents indicated that they neither agreed nor disagreed on this matter, and 9.0% indicated that they do not know. There was a total of 46.38% of the respondents who indicated that they disagree that failure of Africa to participate in the Fourth Industrial Revolution will result in it being enslaved, a further 30.92% of these respondents believe that Africa will result in being enslaved again if it fails to participate in the Fourth Industrial Revolution (Figure 21).

The respondents were asked to indicate their level of agreement with the statement, "failure of Africa to participate in the Fourth Industrial Revolution will result in Africa being enslaved again". 27.3% of the respondents disagreed with the matter and a further 19.1% strongly disagreed.

This means that a total of 46.4% of the respondents do not believe that Africa will be enslaved again if it does not participate in the Fourth Industrial Revolution. A total of 30.9% of the respondents believe that if Africa does not take part in the Fourth Industrial Revolution, it will be enslaved again (Figure 22).

**Figure 21** Participation in the fourth industrial revolution

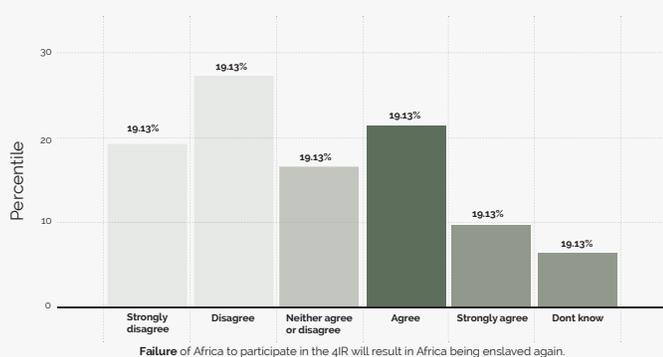


## OPPORTUNITIES IN THE FOURTH INDUSTRIAL REVOLUTION

Of the completed responses, 25.5% disagree that the Fourth Industrial Revolution will impact society by creating job opportunities, with a further 14% strongly disagreeing that there will be job opportunities created.

This means that almost 40% of the respondents believed that there will be no job creation opportunities during the time of the Fourth Industrial Revolution. However, 34.6% of the respondents believed that the Fourth Industrial Revolution will have a good impact on society and create job opportunities. 40.1% of the respondents agree that the Fourth Industrial Revolution will have a major societal impact which will result in large scale job losses, furthermore, 11.6% strongly agree that there will be a result of job loss within society. This means that over half (51.7%) of the respondents believe that there will be large scale job losses within the country. 13.9% of the respondents indicated that they strongly agree that the Fourth Industrial Revolution will not result in large scale job losses, and only 12.2% disagree that there will be job losses within society during the Fourth Industrial Revolution.

**Figure 22** Consequence of non-participation in fourth industrial revolution



A total of 17.3% respondents disagree that there will be an impact of social unrest with the advent of the Fourth Industrial Revolution, with a further 6.2% strongly disagreeing that the Fourth Industrial Revolution will result in social unrest. Meanwhile, 43.0% agree that there will be a result of social unrest due to the societal impact of the Fourth Industrial Revolution.

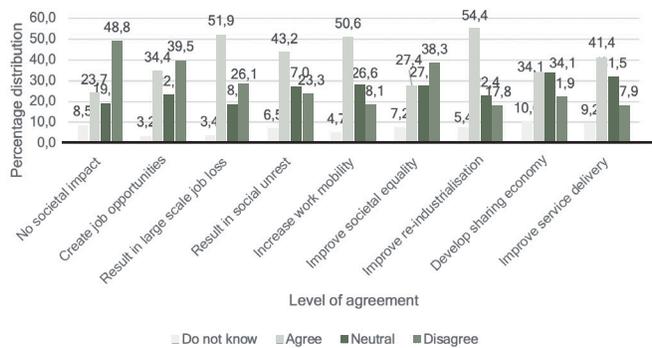
Work mobility refers to the ease with which labourers are able to move around within an economy and between different economies, which is one of the factors of production. 39.9% of the respondents think that the Fourth Industrial Revolution will increase work mobility, with a further 11% strongly agreeing that there will be fast production within the economy. This means that half (50.9%) of the respondents think that there will be an increase in work mobility which will result in fast growth and productivity. A total of 26.4% of the respondents were neutral, and neither agreed nor disagreed to this, however 4.7% indicated that they do not know if the Fourth Industrial Revolution will result in a work mobility increase. A total of 18.1% disagree that the Fourth Industrial Revolution will result in work mobility increases.

Almost 40% of the respondents disagree that there will be an improvement in societal equality with the advent of the Fourth Industrial Revolution, while 27.4% of these respondents are of the idea that the Fourth Industrial Revolution will improve societal equality. Across all the people surveyed, none were confident that the Fourth Industrial Revolution will improve societal equality. 54.1% of the respondents believe that there will be an improvement in re-industrialisation because of the Fourth Industrial Revolution. Only 17.8% of the respondents do not believe that there will be an impact of improved re-industrialisation by the Fourth Industrial Revolution. However, a total of 22.6% respondents were neutral and neither agreed nor disagreed with the matter and 5.3% indicated that they did not know. Government and private sector respondents were optimistic that the Fourth Industrial Revolution will improve re-industrialisation. 562 respondents took part in answering this question and the other 651 respondents did not answer. This was indicative of the respondents' poor understanding of the statement 'Developing sharing economy'. Of those who answered, 34.3% of the respondents were neutral on the matter, they neither agreed nor disagreed and only 9.8% of the respondents indicated that they did not know. Of the respondents who answered, 28.5% believe that the Fourth Industrial Revolution will develop a sharing economy and an additional 5.5% of the respondents strongly agree that a sharing economy will be developed and create an impact during the time of the Fourth Industrial Revolution. 558 respondents responded to this question.

A total of 34.8% believe that during the Fourth Industrial Revolution, there will be an improvement in service delivery and an additional 7.3% of respondents strongly believe that the Fourth Industrial Revolution will affect service delivery.

17.9% of the respondents do not believe that there will be an impact in improved service delivery during the Fourth Industrial Revolution (Figure 23).

**Figure 23** Opportunities during the time of the fourth industrial revolution



## RELIABILITY AND ONE SAMPLE T-TEST

The nine variables of societal impact were evaluated for reliability, and a Cronbach alpha ( $\alpha$ ) of 0.830 indicated the reliability of this construct (George & Mallery, 2003).

Table 4.1 present the reliability of societal problem solving ( $\alpha = 0.723$ ), job restructuring ( $\alpha = 0.711$ ) and development and growth ( $\alpha = 0.800$ ). The reliability for societal instability only had one variable, hence no reliability analysis.

A one sample t-test was conducted to understand which of these three constructs of societal impact were significantly different from the overall societal impact, using its mean as the hypothesised value ( $\mu = 2.82$ ). Findings show that Job restructuring ( $t(548) = 10.2, p < 0.001$ ) and Development and growth ( $t(548) = 2.04, p = 0.042$ ) were significantly higher than the hypothesised mean of the societal impact.

## SHAPING OF THE FOURTH INDUSTRIAL REVOLUTION

68.67% of the respondents believe that South Africa is influenced by globalisation while 18.1% neither agree or disagree; only 8.71% respondents are sceptical and disagree with this statement and 4.5% indicated that they do not know.

Over a half (55.78%) of the respondents agree and believe that South Africa has developed the cultural identity of an individual which can be assigned to a local, national or religious value while 11.25% disagree to this.

The respondents indicated their level of agreement to the statement "African culture must be incorporated within the Fourth Industrial Revolution" and of these respondents, 35.4% agreed and 30.3% of these respondents are neutral to this statement with a further 20.52% of the respondents who indicated that they disagree with this.

The Fourth Industrial Revolution in South Africa must reflect the national identity of South Africa, only 5.6% of the respondents indicated that they do not know and 23.3% were neutral while 18.9% respondents disagreed with this. However, over half (52.17%) of the respondents indicated that they are of the idea that the Fourth Industrial Revolution should reflect the national identity of South Africa (Figure 24).

	Test Value = 2.82					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Societal problem solving	-1.002	550	.317	-.04958	-.1468	.0476
Development and growth	2.043	548	.042	.10532	.0041	.2066
Job restructuring	10.252	1076	.000	.24685	.1996	.2941

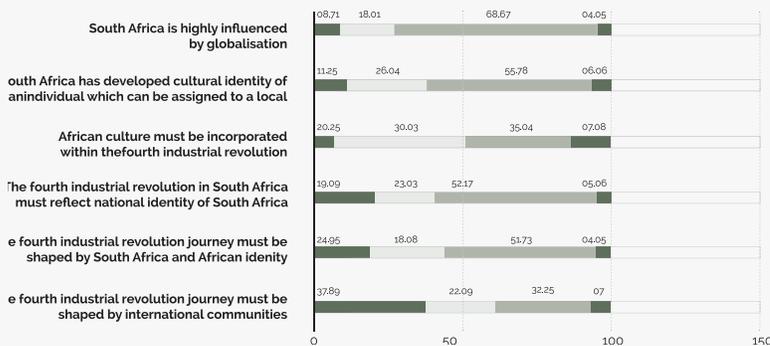
Revolution should reflect the national identity of South Africa (Figure 24).

The respondents were asked to indicate their level of agreement to the statement “the Fourth Industrial Revolution journey must be shaped by international communities”, however, the majority, 37.89%, of the respondents were against this and disagree to the statement while 32.25% indicated they believe and agree to this statement, a further 22.9% were neutral and indicated that they neither agree nor disagree to this.

## LEAPFROG PREVIOUS REVOLUTIONS

A total of 44.1% of the respondents agree and believe that the Fourth Industrial Revolution can help leapfrog South Africa’s industrialisation agenda while 25.3% indicated that they neither agree or disagree, a further 20.33% of these respondents disagree with this. There was only a total of 10.3% of these respondents who indicated that they do not know if the Fourth Industrial Revolution can help leapfrog South Africa’s industrialisation agenda (Figure 25).

**Figure 25** Ability of fourth industrial revolution to leapfrog previous revolution



## INSIGHTS ON THE OPPORTUNITIES

The availability and the enhanced use of technologies of the Fourth Industrial Revolution are threatening stability within the community in a country which already has elevated levels of service delivery protests and threats of job losses in an already high unemployment society with 27.2% of potential workers officially unemployed (Statistics South Africa, 2018).

The stories encountered during data collection show the brewing problem, because even though the employers had backed down from using the automation (robots) due to threats, this is not sustainable. This is in line with the prediction of Lye (2017) who suggested that the effects of the disruptive technology that is being brought by the Fourth Industrial Revolution is disastrous and if the government is unable to mitigate this, it will result in employment and social inequality issues, and societal unrest can result in the society.

Within the midst of high competition for goods and services and increased demands from the customer (Evans, 2016), the Fourth Industrial Revolution technologies offer opportunities to develop customisation and individualisation of customers by profiling their needs. This is commonly done with artificial intelligence, machine learning and the Internet of Things. From the round table discussion, it was evident that there is an increase in the gathering of customer data, mostly through loyalty programmes which have seen an increase in South Africa. The highlighted downside is the diminishing privacy, a view which is confirmed by the literature (Jin, 2018).

The findings show that there were mixed views on whether the Fourth Industrial Revolution will positively impact society and assist with growth and development in South Africa. The round table discussion revealed that the Fourth Industrial Revolution will improve re-industrialisation and assist in developing a sharing economy. This was not as certain from the quantitative data from the citizens. 54.1% of the respondents believe that there will be an improvement in re-industrialisation from the Fourth Industrial Revolution, although only a third of the citizens believed it will help develop a sharing economy. This will create improvements in small scale manufacturing in Africa that may become more competitive and efficient as a result of the mentioned technologies (Naude 2017). This is particularly important as African markets are currently underdeveloped but have substantial potential.

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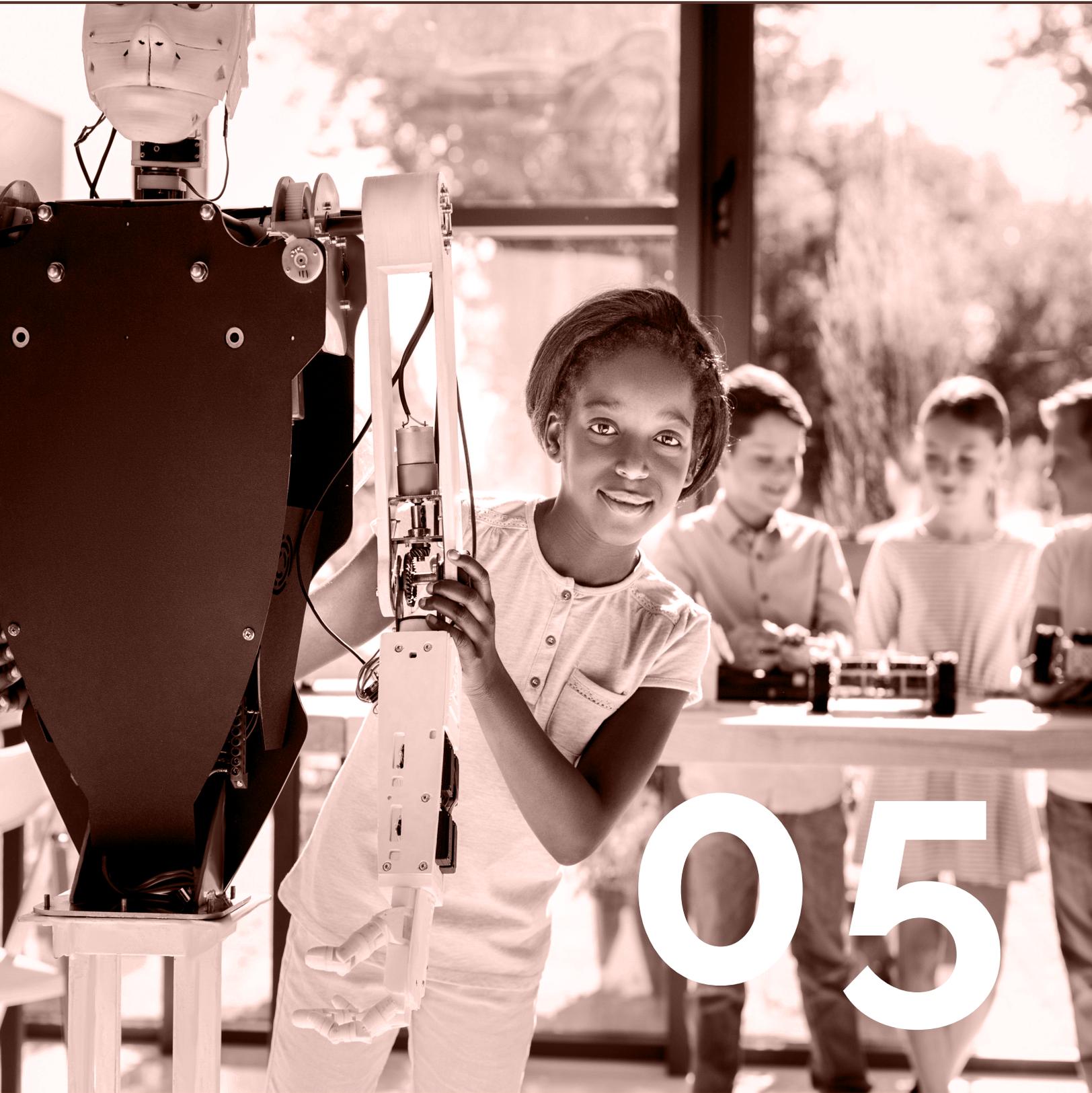
## CONCLUSION

The findings from this study clearly demonstrate that new technologies associated with the Fourth Industrial Revolution have a tremendous societal impact and opportunity for South Africa, Africa, and the rest of the world. Within South Africa, which is regarded as the most unequal country in the world, it creates a challenge, as there is a sizeable section of the population who are not fully aware of its implications, are not sure how it will influence them, let alone being aware of how these advances can be used to their advantage because the access to technologies remain uneven.

The World Economic Forum conducted a study in 100 countries which represent 96% of the global gross domestic product (GDP) and manufacturing value added (MVA) and rated them on their state of readiness for future production assessment (World Economic Forum, 2017). Of the 25 countries classified as leading in structure and drivers of production with the highest readiness for future production, there was not a single African country.

These countries are concentrated in Europe, North America and East Asia. South Africa, together with Argentine and Brazil, were regarded as the least ready countries within the G20 nations (World Economic Forum, 2017). This underpins the work ahead for South Africa and the other African countries to effectively leverage the opportunities associated with the Fourth Industrial Revolution, while working against time to ensure that the negative effects are kept under control.

According to PwC (2016), South Africa has the opportunity to leapfrog ahead of those in the developed economies, given their greenfield starting position in implementing the advances of the Fourth Industrial Revolution. As such, South Africa needs to develop a policy and implementation plan that will ensure that the Fourth Industrial Revolution is advanced for the good of her citizens and society.



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# CONCLUSIONS AND IMPLICATIONS

## PROPOSED CONCEPTUAL MODEL

Due to the multiplicity and complexity of developing an economically active citizen during the time of the Fourth Industrial Revolution, our approach was to develop a conceptual framework which shows the determinants for this development.

The use of a model presents the theoretically-based proposition that emerged from the data and it relates directly to the original objective of this research; to help stakeholders better understand what needs to be done successfully to develop an economically active citizen. The proposed model shows the major contributors and enablers (Figure 26).

This study proposed that the six critical factors and the two complementary factors have interlinkages, and this will result in developing an economically active citizen during the time of the Fourth Industrial Revolution. Some of the noticeable linkages were as follows:

- Knowledge about the Fourth Industrial Revolution was biased in favour of citizens with a better socio-economic status.
- Responsive education system that is focused on STEMI as this will be required during the time of the Fourth Industrial Revolution
- Entrepreneurship education has the potential to improve the entrepreneurial intent, which is a pre-requisite for entrepreneurship.
- Promotion of skills-based programmes which will fast-track the individuals' skills since re-skilling is needed for those educated as well and to push people into the mainstream economy.

## IMPLICATIONS FOR STAKEHOLDERS

Literature is generally in agreement that the industrial revolutions put pressure on education systems, on the workforce, and on societal equality (Bloom, Crasper & Drunkelger, 1958). Mesnard (2016) explains that all revolutionary technologies change industrial production drastically and can put jobs at risk. This is not different in this revolution. The pertinent question, is how much pressure the Fourth Industrial Revolution will put on our education system, workforce and society. With the Fourth Industrial Revolution characterised by the fusion of these technologies which ends up blurring the lines between digital, physical and biological spheres, the overall impact is huge and difficult to forecast (Schwab, 2015).

Despite this, what is known about the impact of the Fourth Industrial Revolution is that it is disruptive in nature and requires stakeholders to collaborately increase their focus and respond to it for the good of society and the country. Some of the identified areas of focus include knowledge and awareness campaigns about the Fourth Industrial Revolution, Thought Leadership, Problem-solving model, Public-Private Partnerships, and Collaborative Governance.

## KNOWLEDGE AND AWARENESS CAMPAIGN

Knowledge and awareness campaigns are one of the first fundamental areas of collaboration between the stakeholders, because it has become clear that the general citizens have low knowledge of the Fourth Industrial Revolution. In particular, those with low socio-economic status with higher knowledge, even though not adequate, being more biased towards citizens with higher socio-economic status.

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Therefore, there is a need for a knowledge and awareness campaign to become part of the national agenda. This can be rolled out to all different platforms, a mass media campaign when, for example, the government is hosting the national science week. The national science week is about the Fourth Industrial Revolution, when there is a conversation about all the different emerging topics of importance and discussions by the politician, civil servants, church leaders and all stakeholders advising people about the Fourth Industrial Revolution and what it is about. So, the knowledge and awareness campaign can be a very good starting area of collaboration.

## **THOUGHT LEADERSHIP**

Thought leadership is another area of importance as there is a need for full understanding and dissemination of the Fourth Industrial Revolution and its societal impacts. There needs to be a certain level of national identity and a need for a certain level of culture that is incorporated within how the Fourth Industrial Revolution is shaped. This can only happen if there are thought leaders who are growing and developing within the same context, who understand the culture and society. The fact that there are very few to no thought leaders within the Fourth Industrial Revolution, one being prominent, being the World Economic Forum. It means that most of the work is done largely within certain areas, like Europe, and this is coming through to the fact that this study is one of the first where it went to the grass root level in order to understand what is happening, the knowledge of and preparedness for the Fourth Industrial Revolution.

The focus in some of the studies is on big business, economics structures and on manufacturing. The skill becomes part thereof and is not the main focus, being that of an economic citizen. Developing thought leaders will be able to assist with advocacy of knowing people that if one is left behind in this revolution, one will be highly disadvantaged.

## **INNOVATION FOR SOCIETAL PROBLEM SOLVING**

It becomes quite clear that the Fourth Industrial Revolution offers all the opportunity to leapfrog some of the previous industrial revolutions. It also becomes clear that some of the challenges that exist, such as high levels of inequality, agitation of the citizens due to poor service delivery, offers an opportunity whereby areas of problem solving can be collaborated. An example of some of those programmes include the HACKATHON 2030 that is aligned to the National Development Plan, where private citizens, private sectors and all the different stakeholders are coming together to make sure problems can be solved that are part of fundamental imperatives to assist the society. This can also be done in a collaborative manner where the government works with the private sector and the entrepreneurs who are regarded as the future of employment.

## **PUBLIC PRIVATE PARTNERSHIPS AND MULTISTAKEHOLDER COLLABORATION**

Public private partnerships are also a big areas of collaboration. This is particularly so, because there is a huge backlog of infrastructure, be it on network data, some digital and on all other different types of infrastructure. It might be of interest to make sure that the public private partnership within the education space, within the economic space, procurement and otherwise that are on-going can have a focus on the Fourth Industrial Revolution and that they can create all those infrastructures and all those requirements that will assist to reduce the societal barriers, socio-economic barriers that were found as quite central if South Africa was to create an economically active citizen during the Fourth Industrial Revolution. These partnerships are then critical to make sure that the government works together with all its entities to achieve the goals associated with the Fourth Industrial Revolution.

That this can be achieved by the development of digital skills is pre-eminent using public-private partnerships as they are powerful levers for development and industries are being disrupted digitally and require an effective response (Mawasha, 2017).

## COLLABORATIVE GOVERNANCE

Governance is an area that is tricky, where there is a need to balance how the processes are being underpinned, how the regulations take place and some of those factors are because we have borderless or very porous borders, due to the Fourth Industrial Revolution. We have diminishing privacy and other factors, so it becomes important that there is collaboration between all those different stakeholders who can make sure that there is a proper outcome.

## DESIGN OF EXPERIMENT

In line with some the suggestions that came from respondents, it was clear that there is a need to start with early adopters and innovators. It will not be useful for everyone to be mobilised before the start, we must possibly work on innovator and first movers' approach which can create lessons and then this can assist others to engage further. It is ideal that the design of experiment can be done by the stakeholders and piloted to see some of the lessons that can be learnt. This ought to use new and existing data as it is already available in some instances, such as in agriculture, and within health, and so on. The design of experiment can improve chances of success as it has a futuristic view of what needs to be done in order for the implementation. to be successful.

The practical implication of this study is that it offers a good baseline for policy makers and other stakeholders to ensure that positive societal impacts are enhanced while negative societal impacts are mitigated. Wolf (2015) explains the need for a 'science-society-economy-policy' interface so that practical outcomes are driven by policy and actions. This study argues well for the engagement that has started in South Africa to get the country ready for the Fourth Industrial Revolution as the Speaker of the National Assembly alluded in May 2018 that there is currently no legislation and policy in South Africa

that is focusing on the Fourth Industrial Revolution, and the President of South Africa, in the BRICS summit in July 2018, confirmed that the BRICS nations are planning to up-skill, provide opportunities and develop policies to deal with both the opportunities, and the challenges of the Fourth Industrial Revolution.

## LIMITATIONS

**THIS STUDY, LIKE MOST STUDIES, WAS NOT WITHOUT LIMITATION, AND IT WILL BE WORTHWHILE TO MENTION THEM.**

- The knowledge of the respondents was conducted through self-assessment, but this was adequate for this study.
- Although it was a multi-stage design where the sampling was done, using proportionality and stratified at a Provincial level, it was still convenient sampling at a district level. So, there is no total generalisability of the study.
- This was not surprising as the Fourth Industrial Revolution is a new terrain for the majority of the citizens in South Africa and indeed, there was a sizeable portion of the respondents in some questions within the survey phase of the research who said they did not know.

## CONCLUSIONS

*The Fourth Industrial Revolution is a reality and the countries around the world have started to put actions in place so that they can effectively participate and leverage the opportunities associated with this revolution.*

*South Africa and Africa is still in their infancy stage, but despite this, there are glimpses of success of the leveraging of the technologies that are associated with this revolution.*

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**BASED ON THE FINDINGS OF THE STUDY THE FOLLOWING CONCLUSIONS CAN BE MADE ABOUT THIS RESEARCH:**

- The Fourth Industrial Revolution is already in progress, unfortunately currently there is a low level of knowledge about it and the lack of preparedness of the South African citizens. This knowledge scale is tilted towards citizens with higher socio-economic status and if this remains unchecked, will further perpetuate inequality in an already highly unequal society.
- The economic factors, structures of the employment and other political considerations and labour laws within the country offer a window of opportunity for the citizens who are in employment to be ready for the transition, as it is still very costly to automate, especially with inadequate infrastructure, and the labour availability makes it very easy to transition.
- However, the majority of the citizens, especially the youth, is unemployed and thus the technologies within the Fourth Industrial Revolution offer opportunities to developed entrepreneurs with low barriers of business set-up.
- The opportunities offered by the Fourth Industrial Revolution can assist in solving problems of national interest in the country.
- There are lots of opportunities that are available to develop an economically active citizen if the education is focused and options for fast-tracking and the long term are considered to upskill and re-skill the citizens.

# REFERENCES

---

Adão, V., Vincent, M. & Davies Dr. M., 2017. [Online] Available at: <https://www2.deloitte.com> [Accessed 21 August 2018].

Agbedia, C. (2013). Knowledge, attitude and practice (KAP) of sandwich under graduate students of Delta State University, Abraka, Nigeria on condom use in the prevention of sexually transmitted infections (STIs) and unwanted pregnancy.

IOSR Journal of Humanities and Social Science (IOSR-JHSS) Volume 7, Issue 4 (Jan. -Feb. 2013), PP 73-78 e-ISSN: 2279-0837, p-ISSN: 2279-0845. Baldassari, P. & Roux, J.D (2017). Industry 4.0: preparing for the future of work.

The 4 industrial revolutions.40. ISS3 Baller, S; Di Battista, A; Browne, C; Hanouz, Margareta D; Crotti, R; Gaviria, Daniel G; Sala-i-Martin, X; Geiger, T; Verin, S; Marti, G. 2016. The Global Competativeness Report 2016-2017. World Economic Forum. Geneva Baller, S., Di Battista, A., Dutta, S., Garrity, J., Lanvin, B., Pepper, R., & LaSalle, C. (2016).

Global Information Technology Report 2016 - Innovation in the Digital Economy. Geneva: World Economic Forum. Blinder, A. S. 2006. Offshoring: The Next Industrial Revolution? Foreign Affairs, March/April: 113-128. Bloem B., Poorthuis R. B., Mansvelder H. D. 2014.

Cholinergic modulation of the medial prefrontal cortex: the role of nicotinic receptors in attention and regulation of neuronal activity. Front. Neural Circuits 8:17. 10.3389/fncir.2014.00017 Bloom R.L, Crasper B.L & Dunkelberger, 1958. "5.

Some Social Effects of the Industrial Revolution. Pt XIV: The Industrial Revolution, Classical Economics, and Economic Liberalism." Ideas and Institutions of Western Man (Gettysburg College, 1958), 15-16. [http://cupola.gettysburg.edu/contemporary\\_sec14/5](http://cupola.gettysburg.edu/contemporary_sec14/5) Bloomberg, (2016). Benchmark. These Are the World's Most Innovative Economies South Korea dominates the index, with Germany and Sweden taking silver and bronze. By Michelle Jamrisko and Wei Lu January 19, 2016

Bowers, N., Brandon, M., & Hill, C. D. 2005. The use of a knowledge survey as an indicator of student learning in an introductory biology course. *Cell Biology Education*, 4, 311-322.

Braun, V & Clarke, V. 2006. Using thematic analysis in psychology.

*Qualitative Research in Psychology*, 3(2), 77 – 101

Buitelaar, E. Lagendijk, A. & Jacobs, W. 2007. A theory of institutional change: illustrated by Dutch city-provinces and Dutch land policy. *Environment and Planning [Online]*, 39(1). Available from: [www.0eds.a.ebscohost.com.tkplib01.tut.ac.za/ehost/pdfviewer/vid=7&sid=ad-4627-533%40sessionmgr4002&hid](http://www.0eds.a.ebscohost.com.tkplib01.tut.ac.za/ehost/pdfviewer/vid=7&sid=ad-4627-533%40sessionmgr4002&hid) Butler, Y. G., & Lee, J. (2010).

The effect of self-assessment among young learners. *Language Testing*, 17(1), 1-27.

Cann, O. 2016. Five Million Jobs by 2020: The Real Challenge of the Fourth Industrial Revolution. *World Economic Forum*. [Online] <http://www.weforum.org/> Cebrian, J. 2018.

Prediction, anticipation and influence: The importance of AI and machine learning in loyalty programs. [Online] <http://www.martechtoday.com/prediction-anticipation-and-influence-the-importance-of-ai-and-machine-learning-in-loyalty-programs-215283> Clauss, J. & Geedey, K. 2010. Knowledge surveys: Students ability to self-assess. *Journal of the Scholarship of Teaching and Learning*, 10(2): 14 – 24. Creswell, John W. (2013).

Qualitative inquiry and research design: Choosing among five approaches (3rd ed.). Thousand Oaks, CA: Sage.

Department of Trade and Industry, 2018. The Future Industrial Production & Technologies [Online] [http://www.dti.gov.za/industrial\\_development/fipt.jsp](http://www.dti.gov.za/industrial_development/fipt.jsp) Dosi, G. 2012.

'A Note on Information, Knowledge and Economic Theory.' In *Handbook of Knowledge and Economics*, edited by R. Arena, A. Festré and N. Lazaric, 167–82. Cheltenham: Elgar.

El-Farra, M. M. & Badawi, M. B. 2012. Employee attitudes toward organizational change in the Coastal Municipalities Water Utility in the Gaza Strip. *EuroMed Journal of Business [Online]*, 7(2). Available from: <https://www.emeraldinsight.com.tkplib01.tut.ac.za/action>.

Éva Kuruczleki, Anita Pelle, Renáta Laczi, and Boglárka Fekete. 2016. The Readiness of the European Union to Embrace the Fourth Industrial Revolution. *management* 11 (4): 327–347

Fisher, B.S. and Schnittger, S. 2012.

Autonomous and Remote Operation Technologies in the Mining Industry. Benefits and Costs. BAE Research Report 12.1. Canberra, February

Galvin, P. (2003). The Industrial Revolution and its Educational Impacts. <https://www.oswego.edu>

Fetters, M. D., Curry, L. A., & Creswell, J. W. 2013.

Achieving integration in mixed methods design—Principles and practices. *Health Services Research*, 48, 2134– 2156. doi: 10.1111/1475-6773.12117

Geissbauer, R; Vedso, J; Schrauf, S. 2016 *Global Industry 4.0 Survey: Building the digital enterprise*. PwC

George, D. & Mallery P, 2003. *SPSS for windows step by step*:

A sample Guide & Reference, 11.0 update. 4th Edition ed. Boston: Allyn & Bacon.

Gholami, A. Nori, AA. Khojastehpour, M. & Askari, M. 2011. Quality gap in primary health care in Neyshabour health care centers. *Daneshvar pezeeshki*. 18(9): 1-11 (Persian).

Guetterman, T. C. (2015).

Descriptions of Sampling Practices Within Five Approaches to Qualitative Research in Education and the Health Sciences. *Forum: Qualitative social research*.

Gutierrez, A. 2017. Fourth Industrial Revolution & Its Dramatic Impact on Society [Online] <http://www.ipsnews.net/2017/11/fourth-industrial-revolution-dramatic-impact-society/> Hatzakis, E.D. 2016.

The Fourth Industrial Revolution. Chief Investment Officer. McKinsey Global Institute, "Disruptive technologies: Advances that will transform life, business, and the global economy,"

Hotz, R. L. 2017. Drones deliver medical supplies to remote areas in Rwanda – *WSJ [Online]* <https://www.wsj.com/articles/in-rwanda-drones-deliver-medical-supplies-to-remote-areas-1512124200> Jin G. Z, 2018.

Artificial Intelligence and Consumer Privacy, 1050 Massachusetts Avenue Cambridge. <http://www.nber.org/papers/w24253>

Johannesburg (miningweekly.com) –JSE-listed ELB pulls South Africa into Fourth Industrial Revolution with IoT.nxt. <http://www.miningweekly.com/article/elb-2018-03-13>  
Jones, C., & Pimdee, P. 2017. Innovative ideas: Thailand 4.0 and the Fourth Industrial Revolution.

Asian International Journal of Social Sciences, 17(1), 4 –32. <https://doi.org/10.29139/aijss.20170101>All works licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives

4.0 International License. Jensen, Michael C. (1993). The Modern Industrial Revolution, Exit, and the Failure of Internal Control Systems. *The Journal of Finance*, Vol. 48,

No. 3, Papers and Proceedings of the Fifty-Third Annual Meeting of the American Finance Association: Anaheim, California January 5-7 Kagermann H, Wahlster W, Helbig J. 2013. Securing the future of German manufacturing industry: recommendations for implementing the strategic initiative INDUSTRIE 4.0.

Final report of the Industrie 4.0 working group. Berlin: Forschungsunion im Stifterverband für die Deutsche Wirtschafte Kingston, C. & Caballero, G. 2009. Comparing theories of institutional change. *Journal of institutional economics*. [Online], Available from: <https://doi.org/10.1017/S1744137409001283>. Kane, G. C., Palmer, D., & Phillips, A. N. (2017).

Achieving digital maturity - Adapting your company to a digital world. Massachusetts: MIT Sloan Management Review. *The History of Education Under Apartheid, 1948-1994: The Doors of Learning and Culture Shall be Opened*. Cape Town, SA: Pearson Education Kolibáčová, G., 2014.

The Relationship Between Competence and Performance. *Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis*, 62(6), pp. 1315-1327. Leedy, P.D and Omrod, J.E. 2015. *Practical Research: Planning and Design*, 11th ed. Colorado: Pearson. Lele, U, & Goswami, S. 2017.

The fourth industrial revolution, agricultural and rural innovation, and implications for public policy and investments: a case of India. [online] Available from <https://www.researchgate.net/publication/319957420>  
Liao G, Wang Y, Liu TB, Kohli G, Qian W, & Shor E, Subbian S, Xue C. (2018). Role of the inositol pyrophosphate multikinase Kcs1 in *Cryptococcus* inositol metabolism. *Fungal Genet Biol* 113:42-51. Liao, Y., Loures, E. R., Deschamps, F., Brezinski, G., & Venâncio, A. 2017. The impact of the Fourth Industrial Revolution: a cross-country/region comparison. *Production*, 28, e20180061. DOI: 10.1590/0103-6513.20180061 Lye, D. 2017.

The Fourth Industrial Revolution and Challenges for the Government. <https://www.brinknews.com/> Maglitta, J. 1996. *Know-How, Inc. Computerworld*, 30(1), January 15. Mawasha, M. 2017. The Fourth Industrial Revolution - An African perspective. <https://www.fin24.com/Opinion/the-fourth-industrial-revolution-an-african-perspective-20170921> McQueen, R. 1998.

Four views of knowledge and knowledge management. *Proceedings of the Americas conference of AIS*, August 1998, pp. 609-611

Mesnard, Louis De. (2016). "Price consistency in the Leontief model [La cohérence des prix dans le modèle de Leontief]," *Post-Print halshs-01338092*, HAL. Meads, 2018 Vision 2030 Summit, 4IR – Its implications for South Africa Morrar, T., Arman, H. & Mousa, S. 2017.

The Fourth Industrial Revolution (Industry 4.0): A Social Innovation Perspective. *Technology Innovation Management Review* (Volume 7, Issue 11) Naidoo, S., Mahomed, O.H., Asmall, S., & Taylor, M. (2014). 'Nurses' knowledge of chronic disease management'. *Health SA Gesondheid* 19(1), 8 pages. <http://dx.doi.org/10.4102/hsag.v19i1.809>. Naude, W. (2017).

Entrepreneurship, Education and The Fourth Industrial Revolution in Africa. Discussion Paper Series. IZA DP No. 10855 Ogunrin, O. A.; Daniel, F. & Ansa, V. Knowledge of J Empir Res Hum Res Ethics, [Internet] Parliament Monitoring Group, 2018.

---

Three-Stream Model; Fourth Industrial Revolution: Department progress report Basic Education, [Online] <https://pmg.org.za/committee-meeting/26296/> Priscearu, P. 2016. Challenges of the Fourth Industrial Revolution. *Knowledge Horizons – Economics*, 8(1): 57–62. PwC. 2016. *Industry 4.0: Building the digital enterprise*.

Global Industry 4.0 Survey South Africa highlights. [www.pwc.com/industry40](http://www.pwc.com/industry40) Race Relations in South Africa – Reasons for Hope. (2017). *The power of ideas. SOUND SEQUEL but Fraying at the Edges*. Reilly, E. M., 2004. *Competencies and skills in the globalized workforce*. [Online] Available at: <http://scholarcommons.usf.edu/etd/1218> [Accessed 17 August 2018]. Salisbury, T. (2016).

Education and inequality in South Africa: Returns to schooling in the post-apartheid era. *International Journal of Educational Development*, 43-52. Sannino, A., Engeström, Y., & Lemos, M. (2016). Formative interventions for expansive learning and transformative agency. *Journal of the Learning Sciences*, 25(4), 599-633. Scaratti, G. Galuppo, L. Gorli, M. Gozzoli, C. & Ripamonti, S. (2017).

The social relevance and social impact of knowledge and knowing. *Management Learning*, 48(1) 57–64 Schwab, C. 2015. *Market Outlook*. All rights reserved. Member SIPC. Compliance number for this project is 1214-8150 Schwab, K. & Samans, R., 2016. *The Future of Jobs*, s.l.: World Economic Forum. Schwab, K. 2016. *The Fourth Industrial Revolution*. Davos: World Economic Forum. Shanks, G. & Parr, A. (2016). *Positivist*,

*Single Case Study Research in Information Systems: a Critical Analysis*. Positivist, *Single Case Study Research*. Shenton, Andrew K. 2004. Strategies for ensuring trustworthiness in qualitative research projects. *Education for Information* 22 (2004) 63–75 63 IOS Press Shrauger, Sidney J. & Osberg, Timothy M. (1981).

*Self-Prediction: Exploring the Parameters of Accuracy*. *Journal of Personality and Social Psychology* Copyright by the American psychological association. 1986, Vol. 51, No. 5, 1044-1057 Sodano, L., Radici, F., Rossini, A., & Alessandro, D.D. 2015. Cross-sectional study on knowledge of health care workers about Ebola Virus Disease and its prevention: a pilot study in two hospitals in Rome (Italy), 27. 814-823 *Statistics South Africa, STATS SA*. (2017). *Annual Report 2016/17 The South Africa I Know*,

*The Home I Understand [Book 1]* Sundstrom, A. (2005). *Self-assessment of knowledge and abilities. A literature study*. Issn 1103-2685. *The Truth Loyalty Whitepaper 3rd Edition* October 2017, [www.truth.co.za](http://www.truth.co.za) van Baalen, S.M., Schutte, C.S.L., Leipzig, K von. 2015. *Journal of the South African Institution of Civil Engineering* Volume 57 No 1. ISSN 1021-2019 Wits, 2018 *Young digital entrepreneurs showcase cool innovations* [Online] <http://www.wits.ac.za/news/latest-news/general-news/2018/2018-05/young-digital-entrepreneurs-showcase-cool-innovations.html>

Wolf, M. (2015, Jul./Aug.). Same as It Ever Was: Why the Techno-optimists Are Wrong. In *The Fourth Industrial Revolution*. Foreign Affairs. World Economic Forum. (2016). *Global information technology report 2016*. Geneva: World Economic Forum. World Economic Forum 2016. *Report: The Future of Jobs. Employment, Skills and Workforce Strategy for the Fourth Industrial Revolution*, January. Davos: WEF.

World Economic Forum. 2017. *Realizing Human Potential in the Fourth Industrial Revolution: An Agenda for Leaders to Shape the Future of Education, Gender and Work*. World Economic Forum. 2017.

*The Future of Jobs and Skills in Africa Preparing the Region for the Fourth Industrial Revolution*. Xu, M. David, J.M & Kim, S.H. 2018. *The Fourth Industrial Revolution: Opportunities and Challenges*. *International Journal of Financial Research*. 9(2)



# ACKNOWLEDGEMENTS

We would like to thank the following for collecting the data throughout the targeted districts of South Africa.

- **Gugu Gumbi**  
(Amajuba, KwaZulu-Natal)
- **Thobelani Mhinana**  
(Amathole, Eastern Cape)
- **Trust Tivane**  
(Bohlabelo, Mpumalanga)
- **Sinazo Manyisane**  
(City of Cape Town, Western Cape)
- **Lwazi Mahali**  
(City of Cape Town, Western Cape)
- **Nolufefe Mgozolwelwa**  
(Eden, Western Cape)
- **Nhlakanipho Ncube**  
(eThekweni, KwaZulu-Natal)
- **Nkosinathi Manqele**  
(Ekurhweni, Gauteng and Nkangala, Mpumalanga)
- **Lorato Tshetlho**  
(John Taolo Gaetsewe, Northern Cape)
- **Nomcebo Nxumalo**  
(King Cetshwayo, KwaZulu-Natal)

- **Vuyiswa Chondo**  
(Mangaung, Free-State)
- **Sibusisiwe Mtotywa**  
(Nelson Mandela Bay, Eastern Cape)
- **Larona Tekana**  
(Ngaka Modiri Molema, North West)
- **Noxolo Manentsa**  
(Sedibeng and City of Johannesburg, Gauteng)
- **Kano Mashinini**  
(Thabo Mafutsanyana, Free-State)
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(Capricorn, Limpopo)

We would also like to thank the research support staff of Alchetech especially, Dimpo Sipuka and Smilo Manqele for management of data collection.



Notes



# END NOTES

## 1. NAUDE, W. (2017).

Entrepreneurship, Education and The Fourth Industrial Revolution in Africa. Discussion Paper Series. IZA DP No. 10855.

## 2. SCHWAB, K. (2016). T

The fourth industrial revolution.  
Geneva: World Economic Forum.

## 3. BRITS, M BERNSTEIN, J., KETLEY, R., MELA, M., MOGADIME, K., NAIDOO, B., QABAZI, N., SCHOEMAN, M. & WAPENAAR, K. (2017).

The impact of the 4th industrial revolution on the South African financial services market.

## 4. DELOITTE.

(2018) The Fourth Industrial Revolution is here - are you ready. Deloitte Insights. UK: Deloitte.

## 5. PWC. (2016). INDUSTRY 4.0:

Building the digital enterprise. Global Industry 4.0 Survey South Africa highlights.

[www.pwc.com/industry40](http://www.pwc.com/industry40)

## 6. BALDASSARI, P. & ROUX, J.D (2017).

Industry 4.0: preparing for the future of work. The 4 industrial revolutions.40. ISS3

## 7. LIAO G, WANG Y, LIU TB, KOHLI G, QIAN W, & SHOR E, SUBBIAN S, XUE C. (2018).

Role of the inositol pyrophosphate multikinase Kcs1 in Cryptococcus inositol metabolism. Fungal Genet Biol 113:42-51.

## 9. SANNINO, A., ENGESTRÖM, Y., & LEMOS, M. (2016).

Formative interventions for expansive learning and transformative agency. Journal of the Learning Sciences, 25(4), 599-633.

## 10. ISRAEL, G. D. (1992).

Determining sample size. University of Florida Cooperative Extension Service, Institute of Food and Agriculture Sciences, EDIS.

## 11. TEJADA, JEFFRY J., AND JOYCE RAYMOND B. PUNZALAN.

"On the Misuse of Slovincs Formula."

The Philippine Statistician 61(1), 129-136.

## 12. SODANO, L., RADICI, F., ROSSINI, A., & ALESSANDRO, D.D. (2015).

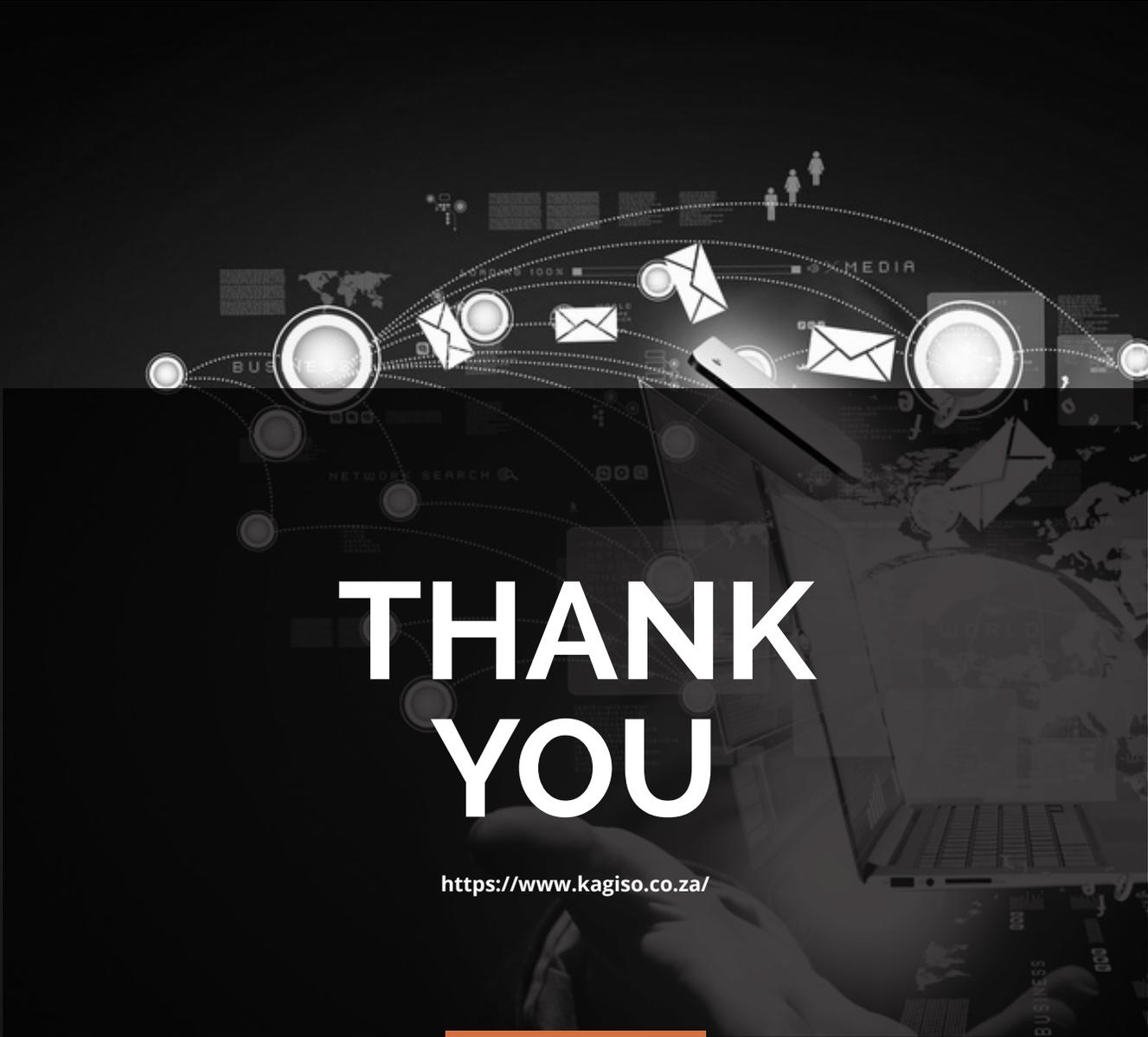
Cross-sectional study on knowledge of health care workers about Ebola Virus Disease and its prevention: a pilot study in two hospitals in Rome (Italy), 27. 814-823.

## 13. OGUNRIN, O. A.; DANIEL, F. & ANSA, V. KNOWLEDGE

Of the Nigerian Code of Health Research Ethics Among Biomedical Researchers in Southern Nigeria. J Empir Res Hum Res Ethics, [Internet] Accessed May 31 2016. ISSN 1556-<http://jre.sagepub.com/content/early/2016/05/27/1556264616650072>. abstract

## 14. NAIDOO, S., MAHOMED, O.H., ASMALL, S., & TAYLOR, M. (2014).

'Nurses' knowledge of chronic disease management'. Health SA Gesondheid 19(1), 8 pages. <http://dx.doi.org/10.4102/hsag.v19i1.809>.



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