PAPER 1

A CAUSAL LAYERED ANALYSIS OF SOUTH AFRICA'S READINESS FOR THE FOURTH INDUSTRIAL REVOLUTION TOWARDS 2035

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ABSTRACT

The term Fourth Industrial Revolution (FIR) has gained ever increasing relevance and importance. The world is on the edge of a technological revolution that will fundamentally alter the way we live, work and relate to one another; and that in the pure scale, scope and complexity, the transformation will be unlike anything humankind has experienced before. What is certain is that the FIR is predicted by many to impact significantly on jobs in the world as robotics, automation and artificial intelligence become more prolific. This shift will have a direct bearing on South Africa in particular. With the challenges facing the country, such as infrastructure constraints, frequent industrial actions, rising costs and shortages of skills, the loss of further jobs should be of concern for government and the private sector alike.

The outcomes of the in-depth analysis of futures studies practice and theory in this article give credence to the argument that the manner in which planning for the future of the FIR in the South African context is taking place requires profound adjustments. The development of fresh insight through the application of futures studies is essential to this planning process, as is progressively evidenced in the tendency for present day business to make collaborative decisions and strategies that are founded on and informed by futures studies.

KEYWORDS:

Futures studies, scenarios, fourth industrial revolution, progress, sustainable development, singularity, artificial intelligence, robotics, disruptive.

INTRODUCTION

Ernst and Young (2015) points out in the report "Megatrends 2015: Making Sense of a World in Motion" that the world we live in is in perpetual motion and that capital, goods and labour are traveling the globe quicker and moving in more innovative patterns than ever before. Technological innovation is altering all industries, as well as the way in which humans manage their lives. In this realm, the ever increasing speed of change is one of the few constants (Ernest &Young, 2015). Technology can be viewed both in terms of possible economic influence and its capacity to disrupt, which means these effects go hand-in-hand and both are of vital importance to leaders (Manyika, Chui, Bughin, Dobbs, Bisson & Marrs, 2013).

There is uncertainty as to just how the Fourth Industrial Revolution (FIR) will develop, however one thing is clear: the critical reaction must be comprehensive and integrated, encompassing all stakeholders of the global society, from the private and public sectors to the academic world and civil society (Schwab, 2016c).

Beck and Schwab (2016) call this phenomenon a revolution of networks, people, platforms and digital technology that is "*blurring the lines between physical, digital and biological spheres*" (Beck & Schwab, 2016).

The overwhelming convergence of evolving and ubiquitous technological innovations overlays an array of comprehensive fields from artificial intelligence (AI), 3D printing, nanotechnology and biotechnology, to the internet of things (IoT), robotics, autonomous vehicles, quantum computing, materials science and energy storage (EnS) (Paine, 2016). The FIR poses risks to the political, economic and social fabric of the country – it will mean significant changes for governments, businesses, civil society organisations and the media. Davis (2015) indicates that one of the most intense impacts of the FIR will be on the jobs people have and the skills that are necessary for success. From a South African perspective, this is of particular concern considering the high level of unemployment in the country.

Any further job losses will have a severe impact on tax revenues; pension funds will be affected, and it is probable that the social damage as a far reaching result of lost taxes, lost employment and lower GDP will increase (Burda, 2015). In order to gain a competitive advantage in this fast changing world, it is imperative that government and business embrace the FIR which, according to Nayyar and Forum (2016), should provide within it some of the solutions to such challenges, in the form of increased effectivity of the value chain via technologies like data analysis, sensors, robotics and 3D printing.

There are other benefits to be derived from the FIR too, including economic growth, foreign direct investment, increased exports and first mover advantage. Kakuru (2016) asserts that the change will bring about an end to wasteful means of production, the transformation of the education system, and also incentivised trade among different communities (with the consequential effective elimination of trade bottlenecks). These and other transformations will be seen in e-commerce, improved transparency and governance, and will also lead to the dawn of innovative industries. The FIR is set to transform the way we work and learn across the entire African community (Kakuru, 2016).

This article endeavours to: (a) identify the key drivers that could impact FIR and public sector adoption by analysing the present state; and (b) using Causal Layered Analysis (CLA) as the preferred method of futures research, to analyse the past, present and future theoretical perspectives of futures studies and the social sciences in an attempt to understand and interpret the readiness of South Africa for the FIR towards 2035.

This article is designed to challenge the thinking of policy and decision makers to look past the perception that the FIR is a non-event.

OUTLINE OF THE PAPER

The paper has been divided into the following sections: The first section looks at the transformation of the Industrial Revolution (IR) and the possible links to futurism. The subsequent section highlights the global trends shaping the FIR, followed by a brief look at Inayatullah's (2008) six pillars of futures studies and deepening the future. Thereafter, the application of causal layered analysis is considered, before going into the detail of CLA in the South African context.

TRANSFORMATION OF THE FOURTH INDUSTRIAL REVOLUTION

The term 'Industrial Revolution' (IR) is used to refer to the transformation of the social and technological economic systems in industry, focusing in particular on changes in living conditions, circumstances of work and economic wealth (Dombrowski & Wagner, 2014).

The first industrial revolution mechanised production, the second one used electric power for mass manufacturing and the third used information technology to automate production; it seems the fourth will distort

the lines between the digital, the physical and the biological realms (Falcioni, 2016).

While the earlier IRs were driven by swift developments in connectivity and automation, beginning with the technologies that launched the first Industrial Revolution in eighteenth-century England, through to the exponential increases in the computing power of modern times, the FIR is similarly driven by the same two forces - automation and connectivity (Baweja, Donovan, Haefele, Siddiqi & Smiles, 2016). Adendorff (2015) suggests that technology is undoubtedly one of the most important drivers of revolution because of its potentially transformative role, with both positive and negative repercussions.

Major advancements in science, technology and society have been witnessed in recent years (European Commission, 2014), frequently accompanying societal paradigmatic changes which alter the fundamental logic, structures and values upon which the systems are based (Wilenius & Kurki, 2010).

GLOBAL TRENDS SHAPING THE FIR

Gaining an understanding of the uncertainty intrinsic in the external and future environments, and testing the strength of any strategic plan against a set of possible futures, are critical components of long-term and strategic planning. Any level of uncertainty must be evaluated carefully before any organisational, whether private or public sector, decisions can be made (Du Plessis, 2016).

The future is unspoilt, promising and rich in potential, while at the same time uncertain and multi-layered. True to its nature, no specifics or evidence of the future exist – although some immediate futures seem probable, others, even if possible, may never materialise – and yet the future matters and not all futures are favoured (European Commission, 2014). Cornish (2004) also suggests that the extraordinary changes taking place in human life and the swiftness of these changes indicate that something amazing is happening in the world, dubbing this spectacle the "Great Transformation" (Cornish, 2004).

It is easy to envisage the intertwining and connectedness of all these changes and, as a result, to appreciate that the environment is having to deal with an all-encompassing transformation. Schwab (2016), on the other hand, foresees that the fundamental and all-inclusive nature of the FIR means it will affect and be impacted by all countries, markets, segments and people, while Du Plessis (2016) also espouses that the extensive effects of these interrelated global trends and the impacts among them will reformat and disrupt the economic and commercial landscape, as has been observed in the past. Table 1, below, summarises some of the recent major global trends that have been identified by leading publications and organisations.

Table 1: Summary of global megatrends

Source	Global megatrend
McKinsey & Company	Mobile internet Automation of knowledge work The Internet of Things Cloud technology Advanced robotics Autonomous and near-autonomous vehicles Next-generation genomics Energy storage 3D printing Advanced materials Advanced oil and gas exploration and recovery Renewable energy
EY	Digital future Entrepreneurship rising Global marketplace Urban world Resourceful planet Health reimagined
PwC	Artificial intelligence Augmented reality Blockchain Drones Internet of Things Robots Virtual reality 3D printing
Organisation for Economic Co-operation and Development (OECD) (Megatrends affecting science, technology and innovation)	Demography Natural resources and energy Climate change and environment Globalisation Role of governments Economy, jobs and productivity Society Health, inequality and well-being

Source: McKinsey & Company, 2013; EY, 2015; PwC, 2016; OECD, 2016

THE SIX PILLARS OF FUTURES STUDIES

Inayatullah (2008) distinguishes six fundamental concepts of futures thinking: the used future, the disowned future, alternative futures, models of social change, alignment and the uses of the future. Furthermore, a number of diverse methodological techniques and approaches to enable the imagination and exploration of probable, possible, plausible and preferable futures have been developed over the years (Roney, 2010). These six pillars of futures studies offer a theory of futures thinking that is linked to their tools and methods, and developed through practice.

These six pillars are listed as follows:

- Mapping;
- Anticipation;
- Timing;
- Deepening;
- Creating alternatives; and
- Transforming (Inayatullah, 2008).

Of these pillars, the critical one to consider is deepening the future. In this pillar, two methods are critical: the first is causal layered analysis (CLA) and the second is four-quadrant mapping. CLA has been selected as the methodology for this article. Derived from theories of poststructuralist discussion, and developed by Inayatullah (1998), CLA provides a basis for evaluating the social hypothesis of the 'real' and proposes a layered approach with which to analyse the results from the key focus areas of the research (Inayatullah, 1998). CLA's capacity to create new ways of knowing by interpreting and re-interpreting issues and their solutions provides a rich method for the analysis of scenarios and case studies (Gould, 2008).

DEEPENING THE FUTURE

Futures studies are uniquely positioned to address the use of techniques like causal layered analysis (CLA), which allows for the systematic and in-depth exploration of problems (Kotze, 2010). Puglisi (2001) explains that the CLA method assumes four levels of analysis:

- The litany is a study of future trends and issues, mainly in terms of

features that are frequently disconnected; here assumptions are rarely questioned.
- The systemic view looking at social causes and analysis that gives understanding to qualitative data, including social, cultural, economic or political factors.
- The discourse or world view is a deeper level of analysis and is linked with discourses and debates surrounding, for example, globalisation procedures, population and consumption discussions.
- The myth or metaphor refers to the deep 'stories', the unconscious dimensions of a problem or dilemma (Puglisi, 2001).

These four levels are used by futurists to find the full array of stories, the conscious, unconscious and emotive view of the issues. CLA's ability to create new ways of knowing by interpreting and reinterpreting issues and their solutions provides a rich method for the analysis of scenarios and case studies (Gould, 2008). CLA opens up space for the delivery of constitutive discussions, which can then be shaped as scenarios. In other words, CLA is a search for integration in methodology, seeking to combine different research traditions (Inayatullah, 2005). Consequently, it is crucial to deepen the exploration into the future of the FIR in the South African environment by probing the underlying stories, assumptions, social causes, metaphors and world views about the South African technology across various industry and sectors (Adendorff, 2015).

APPLICATION OF CAUSAL LAYERED ANALYSIS

The ability of CLA to transcend language and cultural barriers, and bring people from different backgrounds together, positions it well to overcome not only the challenges around open mindedness but also the challenges stemming from information 'stickiness', thus providing a platform for eliciting and capturing the wealth of tacit knowledge held by participants (Kotze, 2010).

This method has been developed in order to explore the world of the alternative futures, investigating both the present and the past with a multidimensional approach (Puglisi, 2001).

In this study, the CLA is completed under three headings, described in tables 2, 3 and 4, below, as follows:

Table 2: CLA – Understanding the readiness of private and public sector for the FIR –'Infrastructure uncertainty'

CLA Level	Societal Approach
Litany	Uncertainty about progress being made in South Africa to embrace the FIR, with the prospect that the country is lagging behind the rest of the world with respect to FIR technology infrastructure and implementation.
Social Causes	Adequacy of the South African technological infrastructure to support the FIR and the subsequent demand as business opportunities emerge, creating the likelihood of an uncertain or unsupportive regulatory environment that could be harmful to the effective growth of the FIR components.
World View	From the South African stakeholder view, the private sector (representing government) and the private sector (being business and individuals) need to collaborate to provide the necessary investment funding to ensure that technological infrastructure is built and in place to support the ideological view that economism is achieved.
Myth and Metaphor	Technological singularity – "singularity is near"; in the South African context, is technology the solution to most of the world's problems?
(Source: Author's own construction)	

Table 3: CLA– Understanding the readiness of private and public sector for the FIR – 'Labour and the economy'

CLA Level	Societal Approach
Litany	Assessing the current impact (or lack thereof) of the FIR on the South African labour and technological environment and further determining South Africa's dependency on the technological sector to drive economic development.
Social Causes	Considerable loss of employment and income due to the introduction of FIR disruptive technology, especially around AI and automation, further creating problems with the ease of doing business in South Africa as a result of the FIR.
World View	From the South African stakeholder view, the private sector (representing government, trade unions and educational institutions) and the private sector (being business and individuals) need to collaborate to increase employment and job security, while at the same time growing the economy, thereby supporting the ideological view that economism is achieved. All participants need to further consider the additional ideological view of the plurality of blockchain as the vehicle to bring AI and IoT to South Africa.
Myth and Metaphor	Technological singularity – "singularity is near"; will the consequence of AI and automation lead to total job losses and replace the need for human interaction and intervention?
(Source: Author's own construction)	

Table 4: CLA – Understanding the readiness of private and public sector for the FIR – 'A sustainable society'

CLA Level	Societal Approach
Litany	Sustainability of the FIR and possible contribution to societal and communal development
Social Causes	The societal appetite for the FIR and related technology by the private and public sector
World View	From the South African stakeholder view, the private sector (representing government and educational institutions), the private sector (being business and individuals) and religious institutions need to collaborate to minimise the impact of the FIR on the 'humanism' of individuals and further need to contribute to the development of communities, thereby supporting the ideological view that sustainability is achieved.
Myth and Metaphor	Technological singularity – "singularity is near"; will robots take over the world? "the Vernor Vinge effect" (researcher's own term)
(Source: Author's own construction)	

LITANY

The 'litany' level of analysis is the sanctioned public narrative of the issues (Inayatullah, 1998) or the day-to-day future, the frequently established headlines of how things either are or ought to be (Inayatullah, 2008) and in which issues, events and trends are not connected but appear discontinuous (Inayatullah, 1998). Nevertheless, this article has recognised that the progress made in technologies in the FIR has strongly highlighted the realities that are evident in the litany layer. Slaughter (2002) corroborates this by indicating that technology is one of the key trends in the litany layer. This layer is known for quantitative developments and difficulties, which are misused by the media and politicians thereby resulting in high public visibility (Kotze, 2010). Owing to their political nature, these developments

or problems are inclined to just as rapidly fall out of vogue, to be replaced by some other new trend. Little to no analysis is completed at this level, as data and trends tend to be considered as fact (Kotze, 2010).

Technology is the central component in the FIR and this phenomenon is considered disruptive, not only to individuals but also to business (Ofir, 2016). Technology may thus be viewed in terms of both its potential economic impact and its capacity to disrupt; these effects go hand-in-hand and both are of critical importance to leaders (Manyika et al. , 2013). The FIR is a global trend that will result in new ways of creating value, novel business models, and increased networking and collaboration between several partners in international networks of value creation (Sendler, 2013).

This article has highlighted the first issue on hand - uncertainty about the progress being made in South Africa to embrace the FIR - revealing that, despite the apparent slow progress in the acceptance and embrace of the FIR, certain pockets or departments in the South African government have acknowledged the importance and potential impact of the FIR on the country. Minister of Trade and Industry, Dr Rob Davies, speaking during the 'Investment Dialogue' session of the 2017 'Investing in African Mining' Indaba programme in Cape Town, acknowledged that the FIR will offer new opportunities to achieve inclusive and sustainable growth by fast-tracking market integration in Africa through industrial corridors and regional integration. Davies further added that the effects of the FIR will not be limited to the manufacturing arena, but should similarly extend to service sectors, including e-commerce and the legal and accounting professions (Medupe, 2017).

From a business perspective, companies understand both the magnitude of embracing the FIR, as well as the catastrophic impact of ignoring it. What is important to consider, especially for South Africa, is the concept of a digital nation; the country should take note of Kenya's investment into its own 'Silicon Savannah' which is taking that country into the most exciting technology advancement on the African continent (Jacobs, 2016). There is good news in that significant headway is already being made in South Africa, as IoT projects are in progress, including the development of smart cities (specifically Cape Town and Johannesburg), which utilise a number of the disruptive components and technologies of the FIR (Sha, 2017). However, the effective 'smart city rollout' is restricted as there has been no coordinating body or even a set of coordinating regulations to facilitate or assist with the rollout. A further stumbling block for co-ordinated urban planning is the country's volatile politics and ever-changing leadership dynamic (Hubbard, 2017).

Further research was conducted here to consider and evaluate the prospect that South Africa is 'behind the curve' in comparison to the rest of the world with respect to FIR technology infrastructure and implementation. In order to complete this evaluation, it is important to understand what infrastructure and plans of action need to be in place for the country and its inhabitants to take maximum advantage of the potential benefits of the FIR. In the view of Schiessl (2016), a large portion of technology and intellectual property (IP) may have originated in developed economies, but it is perhaps in emerging economies where the changes will be most extreme (Schiessl, 2016).

Unfortunately, South Africa's technology readiness had slipped in the Global Competitiveness Index (GCI) report for 2016/2017, issued by the World Economic Forum (WEF, 2016a). The country scored poorly on the availability of latest technologies (WEF, 2016a), which may indicate that it is lagging behind the rest of the world in its preparations to embrace the FIR. On the positive side, the report reflected an increase in the number of internet users and fixed broad band internet subscriptions, which is the backbone of the IoT, linking the multitude of smart devices in use.

An assessment of the current impact of the FIR on the South African labour and technological environment (or lack thereof) was the third issue considered for this article. The technological changes in all of the digital domains, connectivity, robotics and big data will have a far-reaching impact on the labour market into 2035. A major concern from a South African standpoint is the lack of skills needed to take advantage of the FIR. As highlighted earlier, the poor state of the country's education system perpetuates and exacerbates this skills shortage. A key strategic drive identified by Pretorius (2016) is that organisations across all industries need to invest in the reskilling of current employees as part of their transformation and future workforce planning efforts. Companies are great 'universities' for educating the workforce of the future; investing in the training of employees, interns and apprentices, to drive growth and innovation, usually amounts to specialised instruction and hands-on experience that cannot be obtained at even the most prestigious universities (Benioff, 2017). Against South Africa's background of deteriorating employment and decreasing manufacturing growth rate, where antagonistic management-worker labour relations further contribute to current and anticipated job losses, in the researcher's opinion, it appears that the FIR may have continued and sustained resistance from the country's unions.

The next issue to be tackled by the research at the litany level is the sustainability of the FIR and possible contribution to societal and communal development. Sustainability, along with challenges such as climate change, call for society to become more futures-oriented (McGrail, 2011). The longer term outlook is essential in guaranteeing that a concern for inter- and intra-generation equity is built into planning methodologies (Puglisi, 2001). A sustainable society would demonstrate foresight, have a futures-responsive culture and would be determined and prudent in its futures creation (McGrail, 2011). While society cannot completely control the future, it can influence the course of history by making a worthwhile effort to consider the balance between what is desired and what is possible (Glenn, 2004). In order to be sustainable, the FIR would need continuous and collective support from government, business and society, and would need to be woven into the daily fabric of routine for all inhabitants into 2035.

Disruptive technologies have the potential to help solve the real problems of poverty and inequality found in growing African cities and fundamentally driving structural transformation (Mtongana, 2016). While the FIR is decidedly relevant, it does not deal with the unrelenting realities of increasing inequality and growing unemployment in many developing markets, including that of South Africa (City Press, 2016). The potentially higher levels of inequality in the short-run and a need for labour market flexibility to harness the FIR benefits in the long-run, would both need to be taken into account to limit the impact of extreme automation (Baweja et al. , 2016). Pretorius (2016) mentions that organisations can no longer be reactive in their upskilling of the nation's labour force and, as such, a change in mind-set is needed when upskilling talent, which should simultaneously address societal needs (Pretorius, 2016).

From a community perspective, the concept of smart cities is gaining traction in South Africa as a means to encourage environmental sustainability, and to enhance municipal service delivery and efficiency, as urban developers utilise the IoT to better coordinate and manage a city's or community's assets (Hubbard, 2017).

The last issue explored in the litany layer is South Africa's dependency on the technological sector to drive economic development. It may appear challenging for the African continent to be part of the new economic revolution, yet, at the same time, also full of promise since, after years of overreliance on unpredictable commodities cycles, exceptional struggles

of structural change are currently being executed across several African economies (Ondimba, 2016). For South Africa, the elements of energy transitions (which includes rising energy prices and a desire for energy security), food security (such as the rising demand for food and consequently higher food prices globally), climate change and new technologies will continue to drive changes in the way societies work (National Planning Commission, 2011). If computers and machines replace jobs, then the capacity to tax labour income will be reduced in the long run, which is likely to mean that the corresponding social costs of taxes, relative to lost employment and lower GDP, will increase (Borg, 2016).

This is further confirmed by Burda (2015), who suggests that the long term sustainability of fiscal policy would be undermined by an erosion of taxes and the need for increased expenditures, necessitating a significant cut in the spend on social security, a quick solution for employment of young people, and problems in the social framing of the large number of refugees and migrants (Burda, 2015).

There is the realisation by government of the importance of moving to digital platforms and the need for all sectors of society, government and business to be included in the digital future, but unfortunately the South African government's approach to the acceptance of the digital future has resulted in unnecessary and ultimately counterproductive delays (Jacobs, 2016). There are some who are of the opinion that the mentality for digital advancement is almost non-existent in South Africa, especially as evidenced by the troubled telecommunications sector, which would play an integral role in advancing the South African agenda to further the FIR in the country. A robust telecommunications infrastructure is vital to enhance efficiency, effectiveness and transparency in institutional and trade activities which would further result in improvements in trade efficiency (Bankole et al. , 2014).

SYSTEMIC CAUSES

According to Inayatullah (1998), this layer of analysis deals with the systemic causes of the interrelated social, cultural, economic, political, technological, environmental and historical factors of an issue and the causal data. Unlike the litany level, the second level explores the trends and data in an attempt to gain an insight through analysis rather than blind acceptance, and is categorised by the use of technical methods and models constructed on a robust academic foundation (Kotze, 2010). In line with this article, the study at the systemic layer will try to identify drivers and trends that cause the issues accentuated by the litany analysis as they appear to the world and especially to South Africa.

The issues highlighted in Table 2, above, will in all likelihood transcend and merge between the social, cultural, economic, political, technological, environmental and historical factors that characterise this layer. The first issue, surrounding the considerable loss of employment and income due to the introduction of FIR disruptive technology, especially due to AI and automation, will impact the social, economic, technological and historic elements. Borg (2016) cites estimates from Frey and Osborne, that 40% to 50% of all jobs that presently exist will either be changed or cease to be and further asserts that since the global financial crisis of 2008, the number of new jobs have not been traditional, full-time jobs with full social benefits, but instead have arisen from self-employment, seasonal work, short-term contracts and part-time employment, demonstrating that, ultimately, job security was being weakened (Borg, 2016).

In the WEF 2017 report, 'The Future of Jobs', it is suggested that the FIR will cause approximately 7. 1 million jobs to disappear over the period from 2015 to 2020 (WEF, 2016). What should also be noted, as Dmitriev et al. (2016) point out, is that the FIR will create fewer new jobs in new sectors than the previous three IRs.

From an African outlook, Samans and Zahidi (2017), from the WEF, predict that 41% of all work activities in South Africa are vulnerable to automation, 44% in Ethiopia, 52% in Kenya and 46% in Nigeria; and employers are already identifying an inadequately skilled labour force as a key limitation to businesses - in South Africa alone, 39% of core skills considered essential across a number of professions are predicted to be completely different by 2020.

Much of the present skills instability is a result of the number of jobs that are becoming more extreme in their use of digital technologies. According to Samans and Zahidi (2017), some of the professions presently trending on the African mainland include the creative industries, 3D designers, food technologists, data center workers and education, care and health workers. The question of competitive advantage springs to mind at this point in the research, where the quality and skills of the workforce will be a critical feature in capturing this advantage (Lapthorne et al. , 2013). In order to build a pipeline of future talents, South Africa's educators need to design future-ready curricula that encourage creativity, critical thinking and emotional intelligence and, at the same time, fast-track the acquisition of digital, as well as science, technology, engineering and mathematics (STEM) skills to embrace the way individuals will work and cooperate in the FIR (Samans & Zahidi, 2017). According to the GCI, South Africa ranks 123 out of 138 when it comes to health and primary education, and 77 out 138 for higher education and training (WEF, 2016a), implying that there is an uphill battle ahead for the country's education structure if the FIR is to be effectively exploited into 2035.

According to the World Bank (2017), governments wanting to improve a country's economy and its regulatory environment for various industries need to ascertain how they equate to the regulatory environments of other economies. Some of the challenges faced in doing business in South Africa include dealing with construction permits, getting electricity, registering property, securing credit and protecting investors, paying taxes, trading across borders, enforcing contracts and, finally, dealing with the diverse cultures in the country (World Bank, 2017). A stable political environment is one of the key factors for attracting foreign direct investment (FDI), yet, in the view of the researcher, not enough is being done to rectify the fundamental shortcomings of the political malaise that may indeed deter the FDI so necessary to South Africa's progress.

The WEF's 2016 GCI report provides insight into the adequacy of the technological infrastructure to support the FIR and the subsequent demand as business opportunities emerge. As far as mobile-cellular telephone subscriptions are concerned, South Africa ranks a respectable 15 out of 138 (WEF, 2016a). However, the country's internet access in schools ranks a poor 111 out of 138, which could prove to be a stumbling block in the eventual drive to improve the education system and take advantage of the FIR via STEM opportunities. When it comes to technological readiness, South Africa ranks an almost respectable 49 out of 138 (WEF, 2016a). When considering these results, it is vital that government examines the shortcomings in depth, in order to ascertain the processes and changes required to absorb and utilise the FIR into the South African environment.

Business alone cannot determine and manage the effect of the FIR in South Africa; its success or failure will be determined first and foremost by political action, which makes it imperative for leadership to invest in an interconnected, functional infrastructure (Ichikowitz, 2016). Currently, some reasons being cited for Africa's inability to fully participate in the movement include a poor technology infrastructure, the ways in which data is shared and information accessed, insufficient education and an overall deficiency of maths and science skills (City Press, 2016). A robust

telecommunications infrastructure is also important to enhance efficiency, effectiveness and transparency in institutional and trade activities, and would further result in improvements in trade efficiency (Bankole et al. , 2014). Without adequate investment in skills and physical infrastructure, there is the danger that advanced robotics may disadvantage many and be of advantage to just a few (Ichikowitz, 2016). Accenture (2017a) reports that structural inadequacies hamper the capacity of South Africa's citizens to completely integrate fresh technologies into the economy.

Some of these weaknesses include ineffectual innovation systems at a national level, the poor quality of education systems (from primary to university levels), inadequate scientific research bodies, a poor growth-enabling infrastructure, low levels of trust and a deficiency of collaborative approaches, all of which hinder the establishment of an integrated environment (Accenture, 2017).

The next section to be considered in this layer is the uncertain or unsupportive regulatory environment that could be harmful to the effective growth of the FIR components. If the government does not grasp the importance of the FIR, South Africa is in danger of being left 'out in the cold' while other countries, including those from the African continent, embrace the new phenomenon.

The capacity of governmental systems and public authorities to change will determine the country's economic survival; if the government proves capable of embracing a world of disruptive revolution, exposing its structures to the levels of transparency and efficiency that will enable it to maintain a competitive edge, South Africa will endure – if not, it will face growing discontent (Schwab, 2016c). Policymakers must respond to the evolving landscape by assuming roles of leadership and ensuring that education is prioritized as a matter of national importance (especially in preparedness for STEM opportunities). Alternatively, they run the risk of compromising a country's ability to prepare its people for a healthy and sustainable future (Davies, Fidler & Gorbis, 2011).

Grosskurth (2010) cites discussions held with citizens of African countries like Kenya, Rwanda, Uganda, South Africa, Nigeria and Ghana, in which people repeatedly emphasised how much their lives, their cities and their countries had changed recently. Many expressed delight that friends and family living distances away could now be reached with just a phone call or a 'mouse click'. Along with these observations is the belief that extraordinary educational and business opportunities are developing. According to Burda (2015), the five crucial issues influencing the future of labour markets and work circumstances are technology, demographics, economics, sociological developments and government policies. Du Plessis (2014a) stresses that strategies to alleviate the macro-economic and social challenges of information communication technology (ICT) management, as well as its acceptance and proper integration into the FIR, should concentrate on:

- the formation of a predictable and stable regulatory framework;
- improved government structures and organisational capability;
- the establishment of partnerships and formation of agreements between government, local stakeholders and private stakeholders to boost socio-economic and development outcomes; and
- the advancement of local procurement and value added services in the ICT environment.

Balkaran (2017) agreed that South Africa's post-apartheid government's efforts to redress historical economic inequalities with a series of laws and policies have, in the years following their implementation, proved largely trite or sterile. The apparent lack of effectiveness by government to implement regulatory policies and agendas that would fully exploit the benefits of the FIR needs to be fully understood. In many respects, South Africans are worse off today than they were 20 years ago, and the majority are yet to see a tangible positive change in their economic circumstances. Indeed, many see the lack of advancement in their economic livelihoods to be as a direct result of the non-implementation of economic policies and general poor performance of the government of today (Balkaran, 2017). The employment of strategic transformation and implementation of regulatory imperatives by government requires a combination of empowered people with innovative technology and re-engineered business practices, which can best be achieved through effective transformational leadership. This latter is bound to be of great value in the effective change management process that will be required once these policies are designed, approved and implemented (Van Niekerk, 2005).

The last issue to be considered in this section is that of the societal appetite for the FIR and related technology by the private and public sector. The European Commission (2016)suggests that advancements in ICT will drive key social transformations and that the complexity and diversity of societies will make these changes the most challenging to anticipate.

This research has highlighted the conundrum facing society – whether individual or collective, public or private – regarding the extent to which it should embrace the technology that comes with the FIR: Embrace technology too fully and the possibility exists that it could take over people's lives, jobs or humanity; ignore technology and society will lag behind the progress made by the rest of the world, effectively remaining 'in the dark-ages'. The positive expectation is that, in a future further past the digital age, a new type of 'humanism' could arise, in which new technologies profoundly advance the human form, reduce ageing and boost human physical, intellectual and cognitive capabilities; an expectation which, at the same time, creates unique ethical concerns that further necessitate an assessment of mankind's essential values and principles (European Commission, 2016).

Public and private institutions are under pressure to react promptly to serious issues such as globalisation, new communication and information technology, and the intensifying economic role of knowledge (Van Niekerk, 2005). As a societal driver, ICT advances will continually be propelled and encouraged by social challenges. As additional and more ambitious policy objectives are set - those for example, relating to the quality of life or new sustainability challenges- new ICT competences will be required to offer effective responses further up the technology supply chain (European Commission, 2016), thus further generating new technological and societal advances. It is concerning that progress in South Africa's ICT sector has not been complemented by an awareness of the principal policy objectives of reasonable access for all, and by the complete range of communications services that typify modern economies (National Planning Commission, 2011).

It is important to consider the investment being made in the infrastructure of a country. Prosperous countries generally invest extensively and are constantly modernising public infrastructure to suit their settlement, economic and trade patterns; however, in South Africa, a generation of infrastructure upgrading has effectively been squandered as government's investment in new and existing infrastructure falls far short of the capacity necessary to meet the country's economic and social requirements (National Planning Commission, 2011). The FIR brings additional challenges as society moves toward an era of greater responsibility and accountability. Higher levels of trust are being placed in science and scientists, with growing expectations of science and technology to deliver answers to ongoing societal concerns such as education, hunger and the environment (Talwar & Hancock, 2010). To ensure an effective societal impact, the following issues will need to be addressed:

- Trust should be established and preserved between all social participants;

- A communal analysis of the issue should be crafted, along with a shared appreciation that all stakeholders must commit to finding resolutions;
- A clear vision should be outlined of what participants are looking for, with manageable objectives; and
- Leaders should be motivated to assume responsibility for the associated possible risks (National Planning Commission, 2011).

WORLD VIEW

The third layer of futures studies analysis drills even deeper and endeavours to discover the world views fundamental to the trends and problems defined in the previous layer. This presents an opportunity to outline the problem in the 'litany' layer, by not only considering how the various discourses cause and withstand the trends, but also by legitimising and strengthening them (Kotze, 2010). This level is less about the technical inquiry but more about how factors like political views, culture and religion impact people's views about the world (Inayatullah, 2005). Whereas the second layer has a strong technical grounding, this layer uses language to reveal the meanings and diverse ways of knowing (Kotze, 2010). From a foundation of diverse world views, discrete alternate scenarios can be derived by adding a horizontal dimension to the layered analysis (Inayatullah, 2008). Two distinct layers of discourse are recognised at this layer, namely the stakeholder layer and the ideological layer

STAKEHOLDER VIEW

Mankind has learnt significantly from its journey towards globalisation and this knowledge can now be used advantageously, providing it is technology and not political interference that enables this progression. The modern model of international trade demonstrates beyond any doubt that those economies that are open to foreign economic trade, the transfer of technology, capital movements and financial transfers stand a greater chance of ensuring superior and long-term development prospects (Kolodko, 2003). It is therefore a primary obligation of any government to ensure the creation of an investor-friendly environment – an obligation which should be extended to include the adoption and embrace of the technologies within the FIR.

Varying views and interests are held by the many stakeholders included in both the private and public arenas connected with technology and ICT industries. The first stakeholders to be considered in this level of analysis are those within the public domain, which includes government, educational systems and trade unions.

Jeff Radebe (South African Minister in the Presidency for Planning, Monitoring and Evaluation) indicated at the National Development Plan (NDP) Youth Ambassador Masterclass, held in Johannesburg in July 2017 that "the FIR will transform societies and empower individuals, companies and governments in ways that were previously unthinkable. As government, we are well aware that we cannot thrive administratively without incorporating technological innovations. We are constantly on the lookout for new inventions in order to enhance the effectiveness of our operations to improve the lives of the people of South Africa" (Arcangeli, 2017). Mawashe (2017) suggests that technology provides a "transformative power" that can propel South Africa forward if it receives investment from government and business.

There are major benefits to being a first mover in technology and the South African government should be forging clear strategies that involve all the benefits of the FIR (Harvey, 2017). Public-private collaborations are powerful levers for progress, therefore, in order for South African innovators to leverage and improve capabilities, policy-makers need to offer a favourable intellectual property regime which makes it easier to do business in the country and a competitive backdrop (Mawashe, 2017). Radebe emphasises the South African government's regard for ICT as the industry strategic to the country's future growth, with the potential to transform the lives of millions of young people while continuing to create jobs not even considered possible a few years ago – it will be up to local innovators and entrepreneurs, however, to eventually create those millions of jobs required in order to have an all-encompassing economy (Arcangeli, 2017).

Radebe further stresses that the dream of realising a brighter future for South Africa requires training in ICT and business development as crucial elements in the education system (Arcangeli, 2017). As highlighted above, the GCI most recently ranked South Africa's health and primary education system at 123 out of a global 138, and at 77 out 138 for higher education and training (WEF, 2016a). These educational institutions need to play an integral role in achieving this dream and must take their lead from the government's action plan. They will have to align the curricula to take into account those jobs or professions that will only arise or be created as a result of the FIR, and also adjust the curricula for jobs likely to be replaced by AI, robots and similarly advanced technologies. A major concern, from a South African standpoint, is the lack of skills needed to take advantage of the FIR as, while the replacement of humans by machines has been a continuous trend since the first IR, it is anticipated to meaningfully quicken in the coming ten to twenty years (Chen, 2017) because of the substantial advantages of utilising such technology.

Harvey (2017) states that any revolution comes with corresponding risks and, in this instance, it is that of increasing joblessness. Worries of extensive technological job losses are nothing new, yet past experience has shown such fears to be unfounded because, instead, technological breakthroughs actually create more jobs than are replaced (Page, 2017). One of the major problems confronting South Africa is that too many people (especially the leaders) are caught up in a protectionist mode (Venter, 2017).

The future South African workforce will need to align and upgrade its skillset to match the new requirements if it is to keep abreast with all the fresh advances and changes of the FIR. Regrettably, when dialogues about change begin, trade union leaders and other stakeholders tend to move directly into a protectionist mode, expressing opposition to change and disseminating warnings that the FIR is going to "kill jobs" (Venter, 2017). Unions are likely to endeavour to protect and maintain their membership base – the loss of job equals loss of members equals loss of revenue. So how, then, are the unions to assist in embracing the FIR? Firstly, the unions need to recognise and accept that change is inevitable. Secondly, they must plan for this future, preferably with a mission in mind, such as to be a top ten digital economy by 2035. Thirdly, that mission needs to be developed in collaboration with workers, employers and other concerned parties, and, fourthly, unions need to be permitted a fundamental role in the development of skills policies. Lastly, unions need to share in the rewards or spoils of improved productivity within the workforce.

The second group of stakeholders are considered here under the private realm and include businesses and individuals. The impact of globalisation on businesses has been extensive, enabling companies to step into the international arena as technology has 'made the world a smaller place'. That said, while global opportunities have increased for businesses, so too has competition. Businesses rely increasingly on networks and partnerships, and many have had to adopt disruptive business models in order to stay ahead of competitors. The FIR is helping to bring these disruptive business models and technologies to the global market – how they are exploited remains the decision of business leaders.

The FIR will transform not only what people do but also who they are, including intangible effects on their identity and the associated problems

connected with such existential impacts: their sense of privacy, concepts of ownership, consumption patterns, the time dedicated to work and relaxation, and the ways in which they advance their careers, nurture their skills, meet people and foster relationships are all likely to be altered (Schwab, 2016c). Harvey (2017) further highlights that new technologies threaten to worsen existing inequalities (from within and between countries) and that this intensifying inequality and accompanying income torpor will become socially problematic. Numerous analyses of the problems of inequality in economic, gender-related, racial and other aspects (Dmitriev et al. , 2016) have further highlighted that unequal societies are inclined to be more violent, have greater imprisonment rates and inferior levels of life expectancy than their comparative counterparts (Harvey, 2017).

Shortcomings in talent, training and education need to be rethought, with a view to bridging the growing gap, thus ensuring technology can become integral to lower and middle class lifestyles especially and increasing public awareness of the societal expectations of science and technology at all levels of education. Harvey (2017) further warns that the value and benefits of new technologies may become concentrated in the hands of the currently wealthy, and that those who did not profit from previous levels of industrialisation run the risk of being further left behind. Lapthorne et al. (2013), in their report 'The Future of Manufacturing: a new era of opportunity and challenge for the UK', similarly identified that it is crucial that policy makers focus on the supply of skilled workers, apprenticeship schemes, support for researchers and the supply of skilled managers, and that furthermore, firms will need to pay additional attention to building multidisciplinary teams to develop increasingly complex products and possibly innovative business models (Lapthorne et al. , 2013). Therefore, in order for businesses to remain competitive and relevant, it will be critically important that the present workforce is re-skilled to absorb the impact of the FIR.

The final stakeholders reflected upon in this section are the religious communities embedded in the fabric of society. As the world appears increasingly divided, religious literacy is essential to understand and managing the FIR impact on the essence of humanity. Schwab (2016d) makes reference to the Pew Research Centre's data confirming that the world is becoming more religious as it becomes further interconnected.

The WEF (2016b) indicates that the organisation's strategy incorporates values that reflect the general consensus across religions, cultures and philosophies, thus linking three common human objectives:

- the equity and dignity of humans (no matter their gender, race, cultural background or beliefs);
- the significance of recognising a common good that surpasses individual interests; and
- the necessity for stewardship (driven mainly by a sense of concern for the welfare of future generations) (WEF, 2016b).

Debates and deliberations flourish around philosophical questions such as: whether AI and robotics contradict God's creation or are a threat to humans; and whether advances in biotechnology like cloning, genetic modification or in vitro fertilization are ethical. For decades, AI has advanced rapidly to the current point where computers can interpret X-rays, fly planes and scrutinise forensic evidence, while algorithms can paint a work of art and compose a piece of music in the style of Bach. This eruption of AI (frequently stated as 'the singularity') is one of several futures that technologists have anticipated for robots, but the prospect of their risk to humans, no matter how small, is tangible enough to advocate precautionary measures and more than 8 000 people, including Stephen Hawking and Elon Musk, have signed an open letter cautioning against the possible 'pitfalls' of AI advancement (Merritt, 2017). Amongst the questions debated, for instance, is: Can AI have a soul? Although this may seem ridiculous to some, it bears considering in relations to technologies such as genetic cloning and in vitro fertilisation. In such cases, it may be argued that intelligent life is being created by humans, but doubtless countless religious believers would agree that those beings have a soul. The question that arises, then, that if a person has a soul and then creates a physical copy of themselves, is the assumption that the physical copy will then also have a soul? However, if a human brain were to be digitally encoded, then AI would be the digital version of that human; correspondingly, if a digital copy is created, does that digital copy also have a soul?

The 'moral status' of the human embryo is of particularly earnest debate, especially as the in vitro human embryo can be visualised, debated and administered as an autonomous entity (Hurlbut, 2015). The question being asked is: "Is man 'playing God' and entering that realm where the relationship of Creator versus created could confuse and disrupt the basic tenets of faith of the religious populous?"Faith is the greatest controlling force directing economic and societal exchanges, and is the foundation of ethical and moral guidance for many communities and individuals. Schwab (2016d) advocates that spiritual beliefs, religion and faith are capable of discovering new forms of innovativeness, while remaining linked to the nourishing characteristics of man's traditional value structures and, at the same time, taking every opportunity to utilise the power of faith to revitalise new social resurgence that will enable man to be part of something larger - a universal, connected civilisation.

IDEOLOGICAL VIEW

Inayatullah (2004)defines the ideological view as "deeply held positions on how the world is and should be". More broadly speaking, it is a set of conscious or unconscious notions which create goals, expectations and actions or a set of concepts suggested by the main class of a society to all participants of this society (Marope, 2014). Three layers have been identified in this research as comprising the ideological view, namely Economism, Sustainability and Plurality of Blockchain.

ECONOMISM

Haubrich and Wolff (2006) refer to economism as the assertion that theorists and decision makers have miscalculated the potential impact of the economic realm on policy making. This layer rests on the global financial system, which, in turn, rests on the world view of free enterprise, which, itself, finally rests on the myth of greed, the 'invisible hand', and self-centredness (Inayatullah, 2004). Haubrich and Wolff (2006) claim that economism comes in two disguises. The first is a psychological interpretation about the motivation that drives human action, which is assumed to be largely encouraged by economic motives to improve one's own material welfare.

In this research, a closer assessment of the FIR (globally and in South Africa) recognised there to be similar elements existing to those stated by the world views of the FIR and of the broader ICT industry, as discussed previously under the view of the stakeholder. All these factors indicate the need of both the public and private sector to find business solutions to the challenges faced in the acceptance and embrace of the FIR.

The second interpretation refers to the theoretical fundamentals on which public policy is and ought to be built. Economism, in this political model, puts the blame on public policy for establishing economic effectiveness as the primary policy objective, for the application of extravagant economic tools to detect the policy most appropriate to attaining that goal, and for dependency on the market, even possibly as the establishment best equipped to determine the necessary framework. Therefore, the policy adoptions made as a result exceed, or at least reduce, the other

vital values that direct human activities and that the social order might, as a consequence, uphold, such as equality, community, solidarity or friendship (Haubrich & Wolff, 2006).

The emphasis on economic efficiency is an imperative for the South African government who should subject public expenditures to much more stringent economic scrutiny. Since 1994, the expansion of the welfare state has had an adverse effect on economic efficiency and international competitiveness, and has thus become a source of major economic problems, including declining productivity, growth and high levels of unemployment. The government therefore need to resolve to reduce public spending and taxes, and to reassign responsibility for individual well-being from the state to the individual. Investments into public services, such as health, transport and education, may need to be reduced and rather applied in those sectors that will drive economic growth, create jobs and improve competitiveness. This means investing in FIR-related technology industries and professions that can contribute to moving the country out of technological obscurity and into the limelight of global technology.

SUSTAINABILITY

Burda (2015)reports that, in 2015, all UN-affiliated countries adopted a set of 17 sustainable development goals, or global goals, with a view to ending poverty, protecting the planet and ensuring prosperity for all. The specific targets of these goals address poverty, health, energy, education, hunger and food security, water and sanitation, all of which may be assisted by the contributions of technological developments (Burda, 2015). Although the FIR is about technology, Coleman (2016) proposes that these technologies can similarly accelerate access to water, food, energy, healthcare and education (Coleman, 2016). Ethics governs how mankind use technologies. There is a global necessity, for example, to decrease fossil fuel reliancebut still guarantee energy supplies, and Africa has the potential to become a source of renewable energy through the harvesting of solar, wind, water and biomass sources, which are substantial enough for local supply and the export of significant volumes of stored energy. One of the real benefits of the FIR is the strides made in the development of clean, efficient and sustainable energy technologies, which are of particular significance from a South African standpoint because of the increase of fuel prices, together with the increased political and environmental worries, and the current economic slump.

Consequently, in light of the energy challenges, and from the viewpoint of sustainability, all participants of the FIR (public, private and individuals) need, firstly, to recognise that sustainability cannot be attained through a fragmented methodology. Businesses or industries should scrutinise all opportunities in an effort to drive sustainability, which includes sourcing, product development, packaging, manufacturing, distribution, transportation and services. As environmental impact is a strategic undertaking, it needs to be considered as part of overall business strategy.

The second aspect to be considered here is that all FIR participants need to address the ethical element as emphasised in the aforementioned model. One aspect of ethical behaviour is, in broad terms, conducted according to the law.

Many ethical transgressions result when leaders or managers place personal interests over the welfare of an industry or organisation, employees or the public (Marope, 2014). Leaders should look further than self-interest so as to build greater good. Shared leadership can provide a strong system of checks and balances, thereby decreasing the likelihood of unethical and criminal behaviour. The FIR brings its own dilemmas, as new business models are encountered, as well as ethical, safety and social issues, as emerging technologies come to life (Schwab, 2016a). Privacy concerns are crucial, as biotech and AI revolutions will redefine what it means to be human by pushing at the existing thresholds of life span, health, reasoning and capabilities, forcing people to redefine their moral and ethical limitations (Wells, 2016). The increasing significance of BD presents extra challenges for governments and companies, as attackers can abuse massive, distributed BD systems, which in many instances have inadequate security controls and can consequently gain access to incredible amounts of material at once and could be used for unethical purposes (Hewlett-Packard, 2013).

PLURALITY OF BLOCKCHAIN

Blockchain is rapidly becoming a symbol of the FIR. In reiteration of earlier definitions in this work, blockchain is a distributed or shared electronic ledger that utilises software algorithms to record and approve trades or transactions reliably and anonymously, with the recording of those transactions being shared amongst numerous parties. Once the data is entered, it cannot be changed, as the downstream chain underpins upstream trades (Curran, Eckert, & Bhardwaj, 2016). Blockchain works through cryptography, validating parties' identities and generating immutable hashes (digests) of every ledger record, page of records (block) and the binding that connects (chains) each block to the previous ones (Kemp, 2016). The process offers assurances that data is authentic, and that new data is well-defined (Compton, 2017). Blockchain can alleviate security fears, facilitate third party authentication and reduce multiple inputs of identical data across IoT devices (Eastwood, 2017). With blockchain's robust securities against information tampering, the system can assist in the prevention of disruption from a rogue device attempting to transmit misleading information (Compton, 2017). Furthermore, as it is a shared, unalterable ledger of transactions, it offers a sense of accountability and engenders trust across business processes as there is no single entity that has dominion over the records (Eastwood, 2017).

Blockchain is also the system that underpins the cryptocurrency Bitcoin (Baweja et al. , 2016). By shifting the foundations of how money, information and resources are exchanged and tracked, blockchain technology will undoubtedly create enormous opportunities for new flows of value and value-types (Institute for the future, 2017). Given the nature and assumed integrity of blockchain, questions arise as to whether blockchain could become the backbone of the FIR. Blockchain is seen to be the ultimate creation of extreme connectivity, relying for its existence on the interconnection with a great number of computers (Baweja et al. , 2016). Together with the billions of smart devices linked on the IoT, it has the potential to transform homes, cities, businesses and lives (Compton, 2017) and can, furthermore, act as that trusted expert on all types of operations (Montresor, 2016).

MYTH OR METAPHOR

The fourth layer of analysis in futures studies explores what is labelled the myth or metaphor layer. This concerns the discovery of the unarticulated, deeply rooted, highly emotional and unconscious 'stories behind the story' (Inayatullah, 2005). It endeavours to deconstruct the world view into images which can go beyond other structures of interpretation; images are of chief importance to this layer, due to the limitations of language (Kotze, 2010). DuBrin (2011) maintains that a carefully selected metaphor or analogy appeals to the imagination, to the intellect and to values. According to this research, the dominant world view is that technological singularity is an inevitable outcome of the FIR. The first metaphor chosen for this layer is that the 'technological singularity is near', adapted from the title of the book 'The Singularity is Near', by one of the prominent prophets of

the singularity, Google's director of engineering, Ray Kurzweil (Galeon & Reedy, 2017). The singularity, a phrase initially derived from mathematics, expresses the point at which we are incapable of deciphering its precise properties (Tzezana, 2017).

In relation to technology, singularity is that point at which all the progresses in technology, particularly in AI, will result in machines that are smarter than human beings (Galeon & Reedy, 2017). The concept of singularity has escalated to prominence in the last two decades largely because of two thinkers, namely Kurzweil and the scientist and science fiction writer Vernor Vinge who, in 1993, wrote that "within thirty years, we will have the technological means to create superhuman intelligence. Shortly after, the human era will be ended" (Galeon & Reedy, 2017). In reflecting back on this research, the timeframe that Vinge envisioned does not seem unrealistic, considering the exponential growth and the speed at which the FIR has totally outstripped its predecessors.

The possible net result of technological singularity may be that AI and automation will lead to total job losses and replace the need for human interaction and intervention. As Leonhard (2014) suggests, our future may instead lie in "being more human and less like machines". At a recent discussion on AI in South Africa, hosted by Accenture and GIBS Business School, it was suggested that, instead of replacing humans, AI ought to make people more productive and that businesses executing AI solutions should accept the burden of reskilling their workforce; in other words, inclusive economic progress has to be a driver (Accenture, 2017). Talent strategies must take this transition into account (World Economic Forum, 2016). It is clear that FIR and, in particular, AI offer immense potential globally, including in South Africa, but they will not materialise overnight. The first step is for government, business and labour to comprehend their potential and to work together to make the changes that matter (Mzimba, 2017). As the research has highlighted, South Africa's embrace of the FIR has not been as complete and rapid as that of some of its global counterparts, so the inevitability of the 'technological singularity is near' metaphor may be delayed.

The country is facing a myriad cultural, social and structural obstacles, which hamper government and businesses from fully incorporating AI technologies into the economy, ultimately affecting the potential for growth and competitiveness that AI presents.

The alternate scenario is that the singularity is an opportunity for humankind to advance. Kurzweil foresees that the same technology that makes AIs more intelligent will empower humans as well, as these machines will 'power' all humans. Galeon and Reedy (2017) further cite Kurzweil as suggesting that the machines are, in fact, making humans smarter and that, while they may not yet be inside people's bodies, by the 2030sthey are envisaged to have the capacity to connect to an individual's neocortex (the part of the brain where humans do their thinking), which will then connect to the cloud. What this means is that AI will affect everything, thereby meeting the physical needs of all humans and even further expanding people's minds.

The second metaphor chosen in this article is that robots will 'take over' the world; the researcher has called this the 'Vernor Vinge effect', after the scientist and science fiction writer of the same name. This metaphor represents a sinister and darker potential influence of AI. Some of the most popular science fiction movies–including 2001: A Space Odyssey, The Terminator, The Matrix, Transcendence and Ex Machina - have inspired the belief that AI will advance to a point at which humankind will not be able to control their creations, resulting in the demise of the human civilisation. This fear of the swift progress of technology, and mankind's growing dependence on its capabilities, is undoubtedly warranted, given the abilities of modern machines designed, for example, for military purposes (Sainato, 2015). Science fiction, which creates convincing and complex scenarios about the future, offers one possibility in understanding the interactive quality of future evolution (Lombardo, 2008); in many of these scenarios, the technology, like AI and robots, has a nefarious role to play in the scenario outcome.

CONCLUSION

The South African public and private sectors need to determine the acceptable scope of adjustment and to establish the consequences of available choices in influencing the ideal world in which they wish to prosper. The primary objective is to raise the confidence of the various participants to help with the creation of a preferred future, taking into consideration the FIR through the formation of additional effective strategies and innovative thinking, and crafting capabilities that will guarantee long-term progress of businesses and the reduction of perceived job losses.

In order to transform the present and craft the future that embraces the influence and impact of the FIR in South Africa, it is vital to gauge the fundamental issue and associated choices that must be made in creating a preferred future for the stakeholders of the industry, comprising government, business, labour, society, local communities and other interested groups. The recommended future vision of the FIR in South Africa embodies an attainable, realistic and desirable future that could become the basis for the development and advancement of the FIR in the South African context–this is essential for the vision, so as to transform the ICT and relevant industries towards the realisation of a preferred and achievable future.

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