Embracing Industrial Revolutions

"A multi-faceted continuum of change and transformation fuelling ongoing adaptation"

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ABSTRACT

Objective: The objective of this article is to examine the impact of the Fourth Industrial Revolution (4IR) on people, organisations and society more broadly. It considers current knowledge and practice in adapting to the impact of the technological advancements and resulting transformations.

Research Design and Methods: The article is based on available literature, desk research and other relevant internet sources.

Findings: The Fourth Industrial Revolution is an existing and emerging phenomenon, extends the Third Industrial Revolution and share characteristics with all previous industrial revolutions. It has direct implications for people's general well-being and professional advancement, organisations' social license to operate and society's preparedness for change and related opportunities.

Contribution and Value Added: This article raises awareness of how the 4IR affects organisations and people and can be useful to assist workers to gain knowledge about its possible disruptions and opportunities. It has the potential to enrich business leaders understanding of how the 4IR relate to maintaining a social license to operate. It also serves to expose community leaders to potential challenges communities may face as the 4IR unfolds. The study highlights the fact that industrial revolutions appear, not as an event, but rather as a constantly unfolding multi-faceted continuum of change and transformation fuelling adaptation.

Keywords: industrial revolution 4.0; digitisation; automation; socio-techno-economic; industrial revolution 5.0; coping; transformation.

Date: August 2021

INTRODUCTION

SIGNIFICANCE OF STUDY

This research contributes to people's awareness and understanding of the Fourth Industrial Revolution (4IR) and provides details on the potential effects. There is a plethora of research that has examined and explored the changes brought about by the 4IR and their impact in different contexts.

DeLoitte [1], for example, describe the 4IR as being "an era of rapid change, immense challenges, and incredible opportunities for the current and future workforce". Several researchers indicate that the 4IR is drastically influenced by new emerging or rapidly expanding technologies, such as automation, cybernation, nanotechnology, biotechnology, artificial intelligence, new information technology systems and 3D printing, as well as cloud computing [2]. Other scholars such as Zervoudi [3] points out that the integration of computational and physical capabilities in the human-machine-interaction is a core of the 4IR. Other authors already speak of the Fifth Industrial Revolution (5IR) when considering nanotechnologies, expanded global boundary-spanning communication, and advanced human-machine interactions [4]. Although a varied and extensive number of definitions and concepts exist which relate to

the 4IR concepts, this paper focuses on the impact of the different concepts on the workforce, communities and the society as a whole.

This research can be used to raise awareness of how the 4IR affects organisations and people and be useful to assist workers to gain knowledge about its possible disruptions and opportunities. It has the potential to enrich business leaders' understanding of how the 4IR relate to maintaining a social license to operate. It can also serve to expose community leaders to potential challenges communities may face as the 4IR unfolds. The study highlights the fact that industrial revolutions appear, not as an event, but rather as a constantly unfolding multi-faceted continuum of change and transformation fuelling adaptation.

METHODOLOGY

This article is conceptual in nature and derives its propositions from literature review and desk research of current scholarly publications, business press papers, professional reports, company web pages, and blogs.

Searches included secondary literature with the combination of two screening terms: 'industrial revolution' or 'industry 4.0' and 'impact' or 'implications' with 'workforce' and/or 'society'. Many of the sources present similar perspectives, but the current article cites only the most relevant ones.

This article should be considered as a conceptual paper in which literature review and desk research lead to the development of theoretical propositions [5; 6]. As for the scientific approach, it uses a qualitative design of research, the method of indirect observation and description.

LITERATURE REVIEW

The basics and theoretical considerations about the Fourth Industrial Revolution (4IR, Industry 4.0) have been widely discussed in the literature [7-12]. For the purpose of this study, a more in-depth analysis is required according to selected themes. The overall literature review is divided into six sections.

The first section will provide an overview of the characteristics of industrial revolutions with a specific focus on the factors that stimulate and constitute the 4IR. The second section will address the effect of the proliferation of technological advancements of the 4IR and the reoccurring themes and trends of automation and digitisation on people. The third section will focus on factors leading to the establishment and maintenance of an organisation's social license to operate given the changing nature of industries and work due to automation. The fourth section will address education and training for workforces and communities to prepare for the impact of digital technology and transformation of jobs as the 4IR unfolds, while the fifth will show how workforces, communities and societies as a whole can cope with and adapt to the technological advancements and changes to the world. The sixth and last section will indicate how we are already approaching the so-called 5IR and provide an overview of potential advanced collaborative interactions between humans, machines, processes and systems for maximum performance optimisation.

CHARACTERISTICS OF INDUSTRIAL REVOLUTIONS

Researchers, such as Schwab [13] and Wichmann, Eisenbart and Gericke [14], defines the concept of an industrial revolution as the invention of new technology which redefines the levels of industrial performance by radically changing how products are produced and how industries strengthen their supplier networks and improve societal conditions. The two components, the creation of new technology

and the change in production brought about by the new technology, subsequently transform society and how people work and live [15].

Among all collected papers and online sources from this literature review and desk research, industrial revolutions are perceived as evidently disruptive and reshape our economic, social, cultural and human environments. Industrial revolutions have the promise to raise global income levels - economic growth – and improve the quality of life - rise in human prosperity – for populations around the world [8; 14; 16; 17]. As the revolutions become more complicated, multiple new technologies are discovered and the process accelerates causing new developments in industrial and nonindustrial spheres. These include (1) agricultural improvements (the provision of food for a larger non-agricultural population); (2) economic changes (a wider distribution of wealth, the decline of land as a source of wealth in the face of rising industrial production, and increased international trade); (3) political changes (shifts in economic power, as well as new policies corresponding to the needs of an industrialised society); (4) social changes (the growth of cities, the development of working-class movements, and the emergence of new patterns of authority); (5) cultural transformations; and (6) psychological changes (the confidence in the ability to use resources) [15].

In the 19th century, economic historian Arnold Toynbee used the term 'Industrial Revolution' to describe Britain's economic development from 1760 to 1840 [15; 18]. During this time, depicted as the **First Industrial Revolution** (1IR), the hydraulic and steam machine was introduced to mechanise production [7; 17]. This first technological advancement is taken as the shift from our reliance on animals, human effort and renewable organic material as primary sources of energy to the use of fossil fuels and the mechanical power this enabled [19]. It focused primarily on textile manufacturing and steam power and lead to the move from a predominantly agrarian economy with self-sustaining rural communities and wealth creation through the trade of tobacco and resources such as lumber, minerals, fur and fish, to the evolution of urban centres and 'manufactories' (an early word for 'factory') [20]. Although the wages were often low and conditions were harsh, working for businesses paid a better living than farming. People may have felt lost and bewildered and were confronted with challenging working conditions in uncomfortable and unfamiliar environments, but over time, factory and mine workers developed a sense of community among them [21].

The **Second Industrial Revolution** (2IR) occurred between the end of the 19th century and the first two decades of the 20th century (1870-1914) and brought key breakthroughs in the form of power distribution using electric power [17]. It introduced both wireless and wired communication and led people to an era of affordable consumer products of mass production, the separation of components (the synthesis of ammonia) and the assembly of products, whilst the factory system introduced labour division [7; 19]. It led to inventions such as the telephone, the steam engine, the sewing machine, the X-ray, the lightbulb, and the combustible engine.

The 2IR created a great deal of change in society with the shift from small-scale, decentralised manufacturing work being done at home by hand (cottage industries), to work being done in purpose-built factories. In turn, the prevalence of the factories created an increase in employment opportunities for managers and employees to operate them, increasing the job supply and overall wages. However, as the changes encourage employers to increase profits, the working conditions in factories deteriorated. It included harsh and unsafe working conditions, long working hours with inadequate breaks and insufficient remuneration. Owners of the mines and factories could control the lives of labourers and increase child labour to keep the costs of production low and the profits high. Consequently, the working class lived in hardship, while the employers – the middle class at the time – grew wealthy [21]. This eventually fuelled the rise of labour unions that led to improved working conditions and more fair wages. Unfortunately, the rapid progress of the numerous advancements caused other issues such as an increase in urban pollution (people flocked to cities and uprise of factories); sewage and unsanitary living conditions (waste dumped

in streets and rivers); and food shortages (workers left their farms for factories and less food was produced). As a result, regulations, and laws were enacted to protect the population [20].

The **Third Industrial Revolution** (3IR), starting around the 1950s, is not driven by a physical engine, such as previous revolutions, but by technologies relating to a 'digital engine' such as the Internet. It featured a wide application of electronics and information technology (hardware) to automate production and is also known as the digital revolution [7; 17]. It included rapid advances in computing power which have enabled new ways of generating, processing and sharing information [19] and opened the doors to space expeditions, research and biotechnology. It saw the introduction of semiconductors, mainframe computing, personal computing, renewable energy and 3D printing. Major inventions included Programmable Logic Controllers (PLCs) and Robots that led to the start of an era of high-level automation [16].

Due to the positive effects of the first and second industrial revolutions, and with the promise to raise income levels and improve the quality of life, there was indeed an increase in wealth and the production of goods, that improved the standard of living. People had access to healthier diets, better housing, and more affordable goods. In addition, education and health care increased and people began to live longer. However, where the first two industrial revolutions were the driving forces in shaping modern-day society, the 3IR changed almost every aspect of our society and can be seen as a broader and long-term societal transition that affects not only the way we work but how we communicate with friends, shop, listen to music, do our banking, etc.[22; 23].

The most immediate effect was the development of advanced technology and the subsequent explosion of knowledge. The driving force of the 3IR was business in their quest to reduce the production costs of goods and provide services to wider markets. This then spilled over into advances in medical, economic, defence, agriculture, construction, and government services. At the same time, individuals gain access to knowledge and opportunities that were never before possible. Although it affected every sector of national and local economies, at different times and in different ways, the advancement of technology brought about significant changes in the way that goods and services were produced, the management of systems, design and development practices, and life-cycle use of materials [14; 16; 22].

For many developed economies, the major challenge was the decrease in job opportunities for the unskilled and very low skilled workforce. Businesses were scaling down on labour where the capital/labour ratio costs made it more beneficial to mechanise. As such, considerable pressure was put on social support budgets to address the societal risks associated with the large pool of surplus, low-skilled labour [22; 24]. In addition, industries required retraining of workers to stay competitive during the digital revolution, given the workforce of the 3IR needed skills in renewable energy technologies, green construction, information technology and embedded computing, nanotechnology, sustainable chemistry, fuel-cell development, digital power grid management, hybrid electric and hydrogen-powered transport and hundreds of other technical fields. Furthermore, entrepreneurs and managers had to be educated to take advantage of the advanced and new business models, including distributed and collaborative research and development strategies, open-source eCommerce, commerce networking, performance contracting and shared savings agreements, and sustainable low-carbon initiatives of logistics and supply chain management [25].

The **Fourth Industrial Revolution (4IR)**, sometimes described as 'Industry 4.0' (the term first coined in 2011) or the 'data-informed manufacturing revolution' [26] is, for the purpose of this paper, the convergence of the physical, digital and biological worlds enabled by advanced and disruptive technologies such as the Internet of Things, Artificial Intelligence, advanced robots, autonomous vehicles, cloud computing, large data sets, augmented/simulated reality, 3D printing, nanomaterials, distributed databases and twin technology [7; 11; 27].

Based on the desk research and literature review, the concept of the 'fourth industrial revolution' was first proposed by a paper in 1985 referring to resource enhancing activities and then, before 2012, it was more frequently referred to in relation to nanotechnology. Since then, the concept of the 4IR has been diverse in referring to the automation and machine era and the use of Big Data in the field of brain, mind and neurosciences [28].

The 4IR not only builds on the 3IR but extends the impact of digitisation and is characterised by a blend of enabling technologies and the widespread application of integrated computing, networking and physical processes in the manufacturing environment [7]. Although these resources are reliant on the technologies and infrastructure of the 3IR, the 4IR represents entirely new ways in which technology becomes embedded within societies and even our human bodies and mainly originate from the software field [19].

The breakthroughs and transformations in the 4IR evolve exponentially in speed, scope and systems impact compared to previous industrial revolutions. The breadth and depth of these changes are demonstrated in all aspects of society, including technology, production systems, management, utilisation of goods and services, business and governance, education and training, and it is influencing every field of human life [7; 17; 29].

IMPACT OF TECHNOLOGICAL ADVANCEMENTS OF 4IR ON COMMUNITIES, ORGANISATIONS AND SOCIETY AS A WHOLE

As argued by authors [8; 14; 16; 17] previously, the 4IR, like the revolutions that preceded it, is believed to have the potential to raise global income levels and improve the quality of life for all people. Various scholars also argue that the 4IR intends to achieve a higher level of operational efficiency and productivity, as well as a higher level of automation. To date, technological advancements have led to new products and services that increase the efficiency and pleasure of consumers' personal lives (e.g. ordering a cab, booking a flight, buying a product, making a payment, listening to music, watching a film, or playing a game—any of these can now be done remotely), and in time should also lead to suppliers' longer-term profits and increased efficiency and productivity (e.g. decrease in the costs of transportation, communication and trade, and more effective logistics and global supply chains, all of which would create new markets and push economic growth) [13; 19]. It is enabled by many converging technological developments including the widespread Internet connectivity and increasing efficiency, cost-effectiveness, and capability of the hardware and creates opportunities for differentiation and competitive advantage which are enabled by the more intelligent, automated, flexible, and agile production processes organisations can adopt [30-32].

Often, the impact of the 4IR is discussed in the context of specific industries, such as mining and engineering, and technological advancements, however, the 4IR also has a major systemic effect on individuals, societies and the ever-changing world [8; 33]. It includes new lifestyles, new ways of communication, new value chains and changes in human values and emotion [34-36].

In 2017, the World Economic Forum reported major areas that will be impacted by the 4IR including the disruption to job and skills; innovation and productivity; inequality; agile governance; security and conflict; business disruption; fusing technologies; and ethics and identity [37]. For this paper, the focus is on the impact on business and the labour market, governance, security and conflict, and ethics and identity. The authors of this work also include education as an area that is, and will directly be, affected by the 4IR and beyond.

Business and the labour market

As with previous revolutions, there is clear evidence that the innovations that underpin the 4IR are having a major impact on businesses across all industries. The potential positive impact of the new wave of

technologies of the 4IR on business is the increase in the level of productivity and growth and for businesses to respond to global issues such as environmental sustainability. On the other hand, there is concerning risks of the potential increase in social inequalities, the deterioration of work conditions and unemployment due to automation [8; 38; 39].

Newly emerging work conditions, due to the widespread implementation of new technologies in organisations, affects not only the employability of workers but also the survival and growth of organisations [40]. There is no clear agreement on the exact impact the new technologies will have on employment. Some authors describe the impact as a disruptive effect where technologies such as artificial intelligence will increase the number of automated jobs and consequently reduce the demand for work and forcing workers into unemployment. Other authors describe the impact as a capitalistic effect where the increasing demand for new goods and services will lead to the creation of new jobs, new companies and new markets and the efficient functioning of these new businesses will require highly qualified and talented employees with limitless opportunities [40-42].

In most countries, rural communities have been relying on manufacturing as a primary source of income and financial stability for generations. Simultaneously, to ensure growth, manufacturing companies strive for innovative processes to increase their profits. This includes saving money, reducing employees' hourly wages and increasing the company's profit margin and companies can eliminate uneconomical and inefficient efforts by automating repetitive tasks in factories. With the technological advancements of the 4IR, automation poses the greatest threat to these communities and employment [31; 42-45], considering the decrease in demand for workers with less education and lower skills and increase in the demand for highly skilled workers [11; 13].

Unemployment due to automation has in the past mostly impacted sectors that mainly employ men, such as manufacturing and construction. However, with the ability to use artificial intelligence and other technologies to automate tasks in service industries, more job categories are at risk that may increase gender inequality. Jobs include call centre jobs and retail and administrative roles that are the source of livelihood for many young female workers and lower-middle-class women [19; 46]. This cause many workers to be disillusioned and anxious about the longevity of their income in the future and they increasingly experience a sense of discontent and unfairness.

The 4IR impacts businesses in the way they operate and is driven by the expectations of their customers, the enhancement of their products, their collaborative innovation and their organisational structures [47]. Regardless of the nature of the business, the customers are progressively the focal point of the economy and are all about improving how customers are served. New technologies allow for physical products and services to be enhanced with digital capabilities that increase their value and can make assets more durable and resilient, while data and analytics are transforming how they are maintained. Given the speed at which innovation and disruption are taking place, new forms of collaboration are required to assist with the plethora of customer experiences, data-based services, and asset performance through analytics. The emergence of global platforms and new business models also means that talent, culture, and organisational structures need to be revised [13].

Some essential aspects for businesses to be successful, and stay competitive, would be the revision of organisational structures as flexible hierarchies; implementing new ways to attract, retain and manage qualified individuals that are capable of implementing innovative ideas and strategies [48]; and developing innovative ways to evaluate and reward performance [13; 41]. While human capital and technological innovation will play the most important role in the success of companies, it will require ongoing training and upskilling to become a worker's right as part of their new employment contract [40; 48].

Governance

With the technological advancements of the 4IR and the convergence of the physical, digital and biological worlds, citizens are being enabled to engage with governments, voice their opinions, coordinate their efforts, and even circumvent the supervision of public authorities. Governments are also acquiring new technological powers which can be used to increase their control over citizens (and other populations), based on widespread surveillance systems and the ability to control digital infrastructure [19]. They will increasingly face pressure to change their current approach to public engagement and policymaking considering new sources of competition and the redistribution and decentralization of power that new technologies make possible. Only the capacity of government systems and public authorities to adapt to the changing world will define their survival. By embracing a world of disruptive change and subjecting their structures to the levels of transparency and efficiency that will enable them to maintain their competitive edge, they should be able to endure [19; 49].

With the evolution of systems of public policy during the 2IR, decision-makers had time on their side to study specific issues and develop the necessary responses or appropriate regulatory frameworks applying a linear, top-down approach. However, such an approach is no longer practicable, given the 4IR's rapid pace of change and widespread impacts where legislators and regulators are being challenged to an unprecedented degree to cope. To protect the interest of the consumers and the public at large, while continuing to support innovation and technological development, governments and regulatory agencies should embrace agile governance and collaborate closely with business and civil society to adapt to a new, fast-changing environment and to truly understand what they are regulating [19; 37].

Security and conflict

The new technologies of the 4IR are set to strongly impact the national and international security landscape, affecting both the probability and the nature of conflict. The history of warfare and international security is considered as the history of technological innovation - the rapid spread of digital infrastructure during the 3IR means that in the course of the 4IR, cyberspace is seen as strategic a stage of engagement as land, sea and air. As commented by Klaus Schwab, "while any future conflict between reasonably advanced actors may or may not play out in the physical world, it will most likely include a cyber-dimension simply because no modern opponent would resist the temptation to disrupt, confuse or destroy their enemy's sensors, communications and decision-making capability" [13].

The technological advancements of the 4IR present expanded capabilities for waging war which is increasingly accessible, such as autonomous, biological and biochemical weapons, drones, nanomaterials, wearable devices and distributed energy sources [19; 50]. Even technologies such as social media sites have on previous occasions been used to conduct various attacks on government institutions, on global warfare and in the recruitment of global teams from various countries [37]. As this expansion takes place and advanced technologies become more accessible and usable, individuals and small groups could gradually join governments in being capable of causing mass harm. Although the potential to reduce the scale or impact of violence through the development of new modes of protection does exist, it is a matter of concern that causes feelings of uncertainty and fear [19].

Ethics and identity

The innovations of the 4IR are redefining the essence of lifespan, health, and cognition and as new biological breakthroughs are made that challenges social norms, issues of ethics become more critical. Technological advancements also confront the issue of identity, both physical and digital identities as there is the propensity that both are disconnected from one another [8]. It affects our sense of privacy, our beliefs of ownership, our consumption habits, how we distribute our time between work and leisure, and how we grow our careers, cultivate our skills, meet people, and foster relationships [19]. The inevitable

integration of technology in our lives even affects some of our typical human capacities, such as compassion and cooperation, as seen by our relationship with our smartphones where the constant connection may deprive us of the vital benefit of time to pause, reflect, and engage in meaningful conversation [51].

Digital media platforms, sites or spaces of multi-directional instantaneous communication, is becoming the primary driver of our individual and collective framing of society and community. It connects people to individuals and groups in innovative ways, promoting friendships and creating new interest groups and transcend many traditional boundaries of interaction [19]. Our lives are constantly connected to the network and it paradoxically limits our communication and social relations. With more than a third of the global population using social media platforms to connect, learn, and share information, the interactions offer the opportunity for cross-cultural understanding and cohesion. The interactions can, however, also generate and propagate unrealistic expectations as to what signifies success for an individual or a group, as well as offer opportunities for radical ideas and ideologies to spread [19; 40].

The advancements occurring in biotechnology and AI are redefining our perception of being human as it challenges the current thresholds of life span, health, cognition and capabilities. It compels us to reexamine our moral and ethical boundaries [19; 37]. In order to reside in the changing world in which the nature of the dialogist (human or artificial) and the milieus (real or virtual) in which relationships are understood will not always be obvious, we are required to develop skills and consider and redefine some typically social attitudes such as delegation, control, trust, autonomy and responsibility to deal with the society of the future at both individual and collective levels [19; 40].

Education

Business disruptions, due to technological advancements, have also disrupted the current educational system. It is often implied that the education sector has to fit in with economic and political trends, however, a general understanding of the relationship between education and the socio-economic structures, and what the education position involves, aid in projecting the future of higher education associated with the 4IR [37]. Already, a new form of a higher education institution is emerging. It still does teaching, research and service, but is interdisciplinary with virtual classrooms, laboratories, libraries and teachers. The educational experience is not downgraded but augmented by technology [37; 52].

The increase of affordable mobile devices, available internet broadband and accessible rich education content is already transforming how education is delivered. Some 4IR technologies, like cloud computing, afford even more innovative options of educating people and could ultimately disrupt the current higher education systems [37]. With the support of 4IR technologies, government decision-makers and business practitioners have the opportunity to make key strategic decisions on the delivery of education in the quickest, most efficient and affordable form; informing skills development and preparing students for the new job market in the most appropriate way; and share resources across institutions, regionally, nationally and internationally in the smoothest fashion [52; 53].

FACTORS TO MAINTAIN A SOCIAL LICENSE TO OPERATE

Automation is changing the face of many industries and in particular mining. Technologies are progressively being applied to existing mines and replacing employees. Although the immediate implications and primary reasons for the automation, as mentioned in previous sections of this paper, are that mine sites will be more efficient, more sustainable and safer, it will also have a decrease in employees and spending on domestic procurement for items linked to employees and the new technologies [54; 55].

Considering these changes of automation on business organisations, with fewer jobs on-site, how can companies demonstrate their social licence to operate?

To operate a legitimate business, there are many formal legal and regulatory licensing and permit requirements that vary by country, state, local laws and industry CoA, [56]. There are, however, also the informal social license granted to a company by various stakeholders who may be affected by the company's activities. Such a license, known as the 'social license to operate' (SLO), is based on the trust and confidence of the community in which the company operates [57].

The term "social licence to operate" originated in, and has been part of, the mining lexicon for a long time and is based on the principles of the Global Mining Initiative[1], which was developed in 1998 by major mining and metals companies to expand the industry's role in the transition to sustainable development [58; 59]). At the time, it represented the power of communities to impose conditions on, or to completely reject, the advancement of mineral exploration or the operation of an existing mine [60-62]. More recently, the term has spread to other industries and describes the growing and ongoing relationship between industries and their stakeholders and includes the concepts of procedural and distributional fairness, trust and acceptance [55; 57; 58; 60; 62-64].

This corporate social responsibility of any business organisation is made up of three components: (1) *legitimacy*, the extent to which an organisation follow the customs of the community, be they legal, social, cultural, formal or informal; (2) *credibility*, the company's capacity to provide true and clear information to the community and fulfil any commitments made; and (3) *trust*, the willingness to be vulnerable to the actions of another which is a high quality of relationship that takes time and effort to build [55; 57; 60; 62; 63]. When an organisation has an SLO it means that its activities or project has sufficient social approval, which is a prerequisite for its sustainability in the long term [58; 59].

As such, a business organisation is deemed *legitimate* and granted a social licence when its operations (activities and/or projects) and the organisational values and processes underpinning them meet stakeholder expectations and satisfy societal norms [60; 65]. However, the extent to which an organisation's activities are deemed socially acceptable, as well as the community engagement and public participation, should all be considered [55], in particular engaging around the new developments caused by the impact of the technological advancements of the 4IR on organisations.

Having an SLO can be to the advantage of the business and can include an improved corporate reputation, ongoing access to resources, reduced regulation, better market competitiveness, strengthened stakeholder relationships and positive outcomes for employees [63; 66]. A business can face increased pressure from stakeholders if it loses its social licence which can subsequently lead to additional regulation or reduced market access [55].

Various authors [55; 59] highlights that the perceived acceptability of an organisation is not only based on the specific operational practices or planning process that a particular community engagement activity or initiative seeks to address, but also on the overall practices and image of the organisation. Factors that are also considered to potentially influence social perceptions include labour conditions, the corporate contributions the organisation make to the community, its environmental stewardship practices and public commitment to international, environmental and human rights standards and expectations [55; 58]. Social, legal and economic constraints, as well as company history and culture, all affect stakeholder perceptions, resulting in multiple influences which community engagement cannot control, highlighting why social licence cannot be considered in isolation [55; 67].

[1] https://www.icmm.com/en-gb/about-us/our-history

In addition to observing local laws and complying with appropriate international standards, various authors [51; 58; 59; 61; 63] and, in particular, Baumber, Scerri and Schweinsberg [68] and Walton and McCrea [69] highlight factors that organisations need to consider when deciding how to gain (or maintain) an SLO during times of change, such as the 4IR:

Organisations should hire adequate and appropriately qualified and experienced social performance staff who are competent in community relations and are sufficiently resourced. This will in turn ensure the implementation of a meaningful, inclusive and ongoing stakeholder engagement process right from the start of an initiative.

Organisations should be loyal, have regard to the interests of the other parties, be fair and be perceived as being transparent, honest, and authentic. They should treat communities with respect and fully respect their human rights as the effective co-existence of businesses and individuals within a community requires the development of strong and lasting relationships that are based on mutual respect and understanding. To this extend, organisations should understand and respect the local culture and be prepared to provide a valid justification for the automation and any major decisions they make that affect local communities. They should be part of the community, be vested in the community, and be seen as such.

Organisations, together with industry and the representative associations, should provide high-level and coordinated advocacy to the broader community highlighting the significant benefits of new technology and automation and the importance of their industries in the wider society, beyond the immediate jobs in operations on-site. Efforts need to be coordinated between industry bodies and associations and individual companies who are seen as leaders or major players in the sector and take an active role in leading positive change, maximising benefits and eliminating harm.

Organisations should attempt to empower communities through training and capacity building, local content policy, and utilising all opportunities to involve local communities - the most outspoken as well as marginalised voices - in decision making. Organisations should ensure that the broad community support of local people is gained before proceeding with any project or change initiative to help solve certain objectives proactively and to realise the common benefits. This early inclusion and collaboration should be maintained throughout the life of the project to secure constructive relations with community members.

Organisations should act with full transparency and accountability. They should encourage and support community-led monitoring and evaluation of the potential impacts, the related mitigation measures and the adequacy of benefit-sharing programs. They should demonstrate their accountability to the public and transparency by providing communities with real-time performance data (including environmental and employment statistics) and social data with two-way feedback that can be established using online tools and social media. Furthermore, by using the latest digital technologies such as virtual and augmented reality, organisations should show communities both the benefits and impacts of proposed projects early in the planning phase.

According to Vanclay and Hanna [63], companies should have effective community engagement activities, social impact assessment processes, environmental and social impact management procedures, and human rights-compatible grievance redress mechanisms in place to gain an SLO. Having the processes and procedures in place could assist in identifying and addressing any environmental and social impacts before matters escalate and social risk amplifies.

Social risks, as well as engineering and technical issues, are business risks that can threaten an organisation's SLO. Only when all the issues are fully considered, and the local community have good reason to trust the company, will they give an organisation's initiative a social license to operate and allow

it to grow. The social licence to operate is earned by the company, granted by the community and needs to be well maintained and constantly renewed across the life of the organisation.

In the words of Richard Boele, National Leader Human Rights and Social Impact Services, KPMG Australia "social license is maintained by organisations that are responsive to changing community concerns and expectations. Society has a powerful ability to tell companies when they are no longer wanted. After listening, and understanding, organisations must act upon what is heard in a sensitive and timely manner. Most importantly, they must be publicly seen to act upon that information. A social licence is a licence that must be earned every day" [70].

EDUCATION AND TRAINING TO PREPARE FOR THE 4IR AND BEYOND

The impact of automation and digitisation across labour markets and a significant shift towards sustainability make it essential to future-proof workers from technological change and assist organisations by offering new skills for the 4IR. The technology-driven labour market change, accelerated by the COVID-19 pandemic, not only created disruption but also created new opportunities for online learning, redeployment and reemployment [50; 71; 72]. The acceleration in automation places a large percentage of repetitive jobs at risk of redundancy while creating the need for new roles and skills across industries. Those jobs becoming redundant involve repetitive physical or routine tasks [40-42], whereas the new jobs will increasingly require complex problem-solving, social and system skills and therefore require higher levels of education, training and specialised study. This rising predisposition to skill requirements disproportionally affects older and lower-income groups and those working in industries most susceptible to automation by new technologies [19].

As regions adapt to the ongoing impacts of technology on businesses and workforces, organisations need to find new education and training opportunities to address the upskilling needs of their workforce and to ensure they remain relevant, productive and employable amid the 4IR. It necessitates a new mindset of continual development and lifelong learning to reskill the current workforce and requires closer integration, collaboration and training partnerships between organisations and education and training providers, supported by the government and society, to equip people to meet these challenges [72-75]. Through engaging in dialogue with industries, education providers can ensure that the requirements of the digital economy are reflected in training provisions. There should also be improved mobility and pathways between vocational and higher education and between the different training and continuous professional development programmes and systems, as well as improved recognition of skills that are still relevant in the workplace despite not being connected to an employee's specialist area [75].

Given the anticipated increase in the range of knowledge and skills with which workers would need to be equipped to adapt to remain relevant, productive and employable, education and training solutions should allow for the expanded scope of tasks in existing jobs. Besides developing technical skills and knowledge relevant to technological advancements, it is equally important to enhance the development of generic or soft skills which are essential for preparing workers to be flexible and to cope with the rapid changes in the future workplace as a result of disruptive technologies [41; 76].

Mehra et al. [72] explain that during the 20th century, learners in formal education were treated as large amorphous segments, whereas we now need education and training that is more personalised and give people access to the right education and training to suit their individual needs and context. Considering the technological and demographic change and individual learning requirements, new accessible teaching methods and learning assistance systems will form part of the education and training solutions. It calls for the development of standards for the recognition of nonformal and informal education to ensure that individuals' training potential is recognised as well as the development of digital learning techniques and

the use of digital media and innovative educational technologies relevant to knowledge transfer and skills acquisition [40; 75].

The World Economic Forum, in the Future of Jobs Report 2020, predicts "work to be divided equally among humans and machines by 2025, with machines carrying much of the heavy lifting with respect to data processing, administrative tasks and routine manual jobs" [77]. This, together with the public fear of automation-related displacement, enforces the need to upskill and reskill for new jobs. Although it is not clear on the number of jobs automation will eventually create or eliminate, the jobs that are most likely to be automated first certainly are those composed of routine tasks which make up a majority of low-skill occupations. Given those at the highest risk of displacement are working adults, including women and underserved minorities, who balance caregiving, paying their bills and minding their personal and mental health [19; 46], a traditional higher education degree education will not suit them.

The option to more affordable pathways to quality jobs would be the education sector embedding non-degree credentials in traditional degree programmes [41]. Considering the rapid pace of technological changes and the potential impact on jobs, graduates may complete their formal education with skills that are no longer relevant to employers. Furthermore, any changes to accredited educational programs usually require a multi-year national consultation process to ensure that the programs align with industry practice and needs. As such, providers of accredited training may not be able to respond as rapidly to changes in technology and their skill requirements than not nationally accredited training providers who have greater flexibility to change the content of the training. In addition, even if it was possible to respond to the changes more promptly, trainers of accredited providers need to be exposed to current and emerging technologies by undertaking training and development to enable them to be competent technology users as well as educators [41].

Quality, non-degree credential programmes can overcome the hurdles mentioned above and play an important role in supporting workers' transitioning into the new fields of work by allowing people of all ages to access a curriculum that would prepare them for the jobs of tomorrow. These programmes simultaneously foster curiosity and creativity that will inspire workers to remain engaged in lifelong learning, and the interpersonal and global citizenship skills to be ready for a world of collaboration and connection [50; 78].

Jyotishi [78] recommended five criteria for identifying quality non-degree programs. This includes the development of programs that (1) leads directly to an in-demand, high-quality job that provides at least the local living wage; (2) leads to life-long learning by providing the students with credit that can count towards a future advanced credential or degree; (3) is affordable, resulting in a reasonable average student debt load and accompanied with financial aid eligibility; (4) has a respectable completion rate and pass rate for licensure or certification exams where applicable; and (5) attracts students that demographically resemble or include more underrepresented groups compared to the region's population. The programs should address the increased demand in technical skill areas like artificial intelligence, virtual reality, cloud and data analytics, business process analysis and web design. However, equally important, there should also be programs to prepare individuals for the service orientated roles and creative occupations where greater cognitive-adaptability, design-thinking and empathetic reasoning is required if workers are to fulfil their human potential in a machine-augmented future [73; 77].

In their study, "Holistic approach for human resource management in industry 4.0", authors Hecklau, Galeitzke, Flachs and Kohl [79], analysed macro-environmental challenges using the PESTEL-framework considering political, economic, social, technical, environmental and legal factors. They further derived core competencies for the identified challenges and clustered the competencies into predefined groups – technical, methodological, social and personal.

Figure 1 shows a simplistic competence model of the challenges as described by previous authors linked to skills and competencies. The skills are coloured according to the competency cluster in which they are categorised.

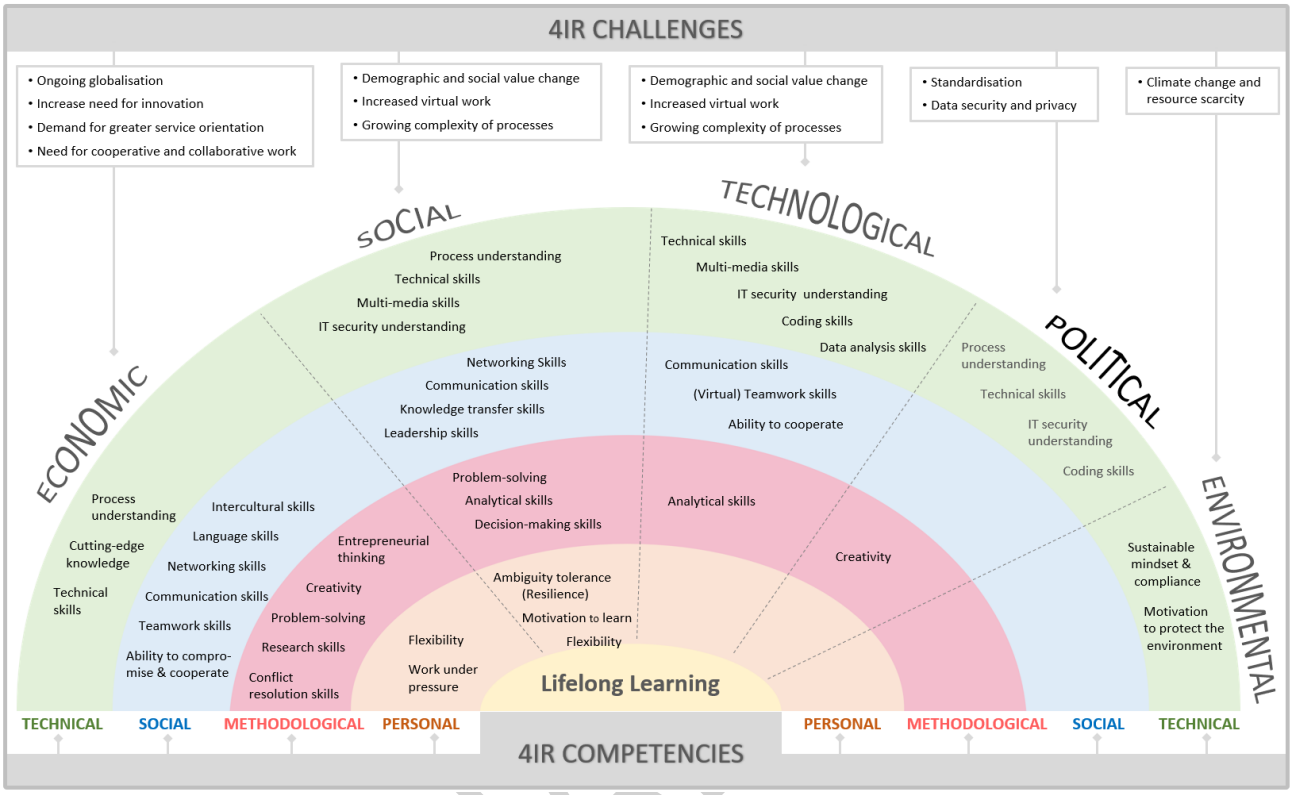

Figure 1. Competence model of the 4IR.

All workers need the skills to interact with digital technology. Accordingly, education systems around the world "need to create workers with the skills and competencies required to thrive in a continuously changing environment. The most important skill is the ability to acquire new skills — life-long learning" [41] (depicted in Figure 1). Core skills, as identified by the Mackay Regional Jobs Committee in the Greater Whitsunday Roadmap [80], are the skills that will be required across broad-reaching workforces and essentially need to form the foundation of education and training programs for both new entrants and transitional workforces. The core skills include those identified as *technical* skills (see Figure 1), while the additional component of enterprise skills, the so-called 'soft skills', identified in Figure 1 as *methodological* and *social* skills should get attention to support long-term job success.

Although there is no question about the extent, urgency and universal nature of the future skills challenge, it also offers an opportunity to establish long-term, sustainable, equitable and inclusive growth for the education sector as well as the global workforce [72]. The workforce of today and the future generations needs to redirect its professional path due to the changes that digitalisation, automation and artificial intelligence progress have on the world of work. With the type of skills required by organisations changing, it profoundly impacts an individual's career path. It requires the need for individuals to develop processes of learning new skills (reskilling) to enable them to do a different job or train people to do a job differently. [40; 50; 71; 72]. It further requires individual workforce transitioning plans "which identify the existing skills gaps against the career goal and the [cross-industry skilling and] development pathways to address these gaps" [80].

COPING MECHANISMS TO ADAPT TO TECHNOLOGICAL ADVANCEMENTS AND A CHANGING WORLD

"All industrial revolutions are ultimately driven by the individual and collective choices of people. And it is not just the choices of the researchers, inventors and designers developing the underlying technologies that matter, but even more importantly those of investors, consumers, regulators and citizens who adopt and employ these technologies in daily life" [19].

Various authors note that automation is an element of social change that impacts society, vested interests, personal values, beliefs and uninformed opinion [45; 81-83]. While it has given rise to an unprecedented pace of innovation that is disrupting every mentionable industry, it is also transforming the 'way' people work. One of the challenges that organisations are facing is to safeguard employees, an organisation's most valuable assets, to cope with the increasing ambiguities arising in the 4IR [4; 45].

Authors, Broad and Luthans [81], argue that attention must be paid not only to performance, but also to wellbeing in life and at work in volatility, uncertainty, complexity, and ambiguity times. If individuals are unsuccessful in their personal transitions, not embracing and learn new ways of working and perceptions of an insecure future, ongoing changes are associated with anxiety and the employee's lack of trust and employee's withdrawal [83; 84]. Distress and anxieties in organisations relating to the negative impacts of the 4IR could interfere with the objective of organisations to transform and grow. The authors emphasise that positive resources are needed in psychiatry surrounding the 4IR. This can be accomplished through the psychological capital approach which integrates hope, efficacy, resilience and optimism [81].

Through the psychological capital approach, positive, rather than negative emotions, can be created which complements the adoption and transitioning into the 4IR. Such an approach can support individuals and organisations to create meaning and a new, transformed, integrated and interconnected outlook to meaning in life and at work. Authors, Mayer and Oosthuizen [84] promote that being positive about the transition could create a higher degree of resilience and happiness and contribute to structural changes on social and political levels [7]. Basic psychology explains that both positive and negative emotions are vital in human interactions and in particular during times of change and when transitions are in progress. Emotions influence thoughts and behaviour as well as organisational and individual life [4; 33] and impact mental health and well-being. Just as negative emotions can lead to ill-health or psychological problems, positive emotions can contribute to increased mental health and well-being that can support individuals coping with disruptive times [4].

Coping behaviour is shown to be logically compatible with rationality and well suited to dealing with the fear of joblessness. Research support and highlights the notion that the disruptions of the 4IR should be managed by individuals and workforces and that the ability of these individuals and groups to cope with transitioning is essential for success [34; 85]. Coping can be described as the extent to which an individual can handle an unpleasant occasion. It is believed to be of basic significance in deciding whether an unsettling occasion, such as being confronted with job changes, results in adaptable or maladaptive outcomes. Emotions train individuals for action in response to stimuli [45], however only if the challenges of the 4IR evoke a significant emotion within an individual, will they find it necessary to cope.

Authors, Oosthuizen [45] and Mayer and Oosthuizen [82] iterates that coping with emotions involves a conscious effort to alter the intensity of an individuals' emotions (for example, by avoiding emotion-eliciting situations or by reconsidering the meaning of a situation) or behaviours provoked by emotion, regardless of whether the behaviours are intended to control the emotional experience. For example, the fear of unemployment due to automation could elicit the emotion to motivate individuals to improve their digital skills, thereby ensuring that they have a competitive edge in knowledge-intensive economies.

Although upskilling might reduce their fear, it could also potentially maintain or even aggravate their fear as people respond differently to emotions [45].

A positive internal resource that employees can use to navigate disruptive change, strong uncertainty and a stressful workplace in the 4IR context, is employee resilience [45]. It is conceptualised –as the attitudes and abilities of employees to cope with the challenges of the changing workplace. A resilient workforce that is well managed and supported will not only survive but thrive and the 4IR workplace [45; 86] as they will be capable of responding positively and competently in the face of uncertainty which will benefit the prosperity of the organisation [87] Resilient employees can learn from adversity and uncertainty and these are becoming increasingly important skills as individuals hold more jobs throughout their work life and have more flexible work schedules [45]. Employee resilience should therefore be seen as a set of skills and abilities that can be developed through appropriate human resources interventions with an emphasis on the behaviour and engagement of managers and leaders that encourage the development of supportive behaviours in employees [86]. It is important to note is that the key resource on which employees and organisations rely for this resilience is their imagination and creativity. This may be displayed at the individual or collective level, whether as a narrow community or a wider society [45].

The wider society, environmental and social systems can also be resilient by adapting to transforming environmental conditions [45]. However, the uncertainty central to this field of the 4IR is high due to not knowing how extensive job losses due to automation will be. Although financing actions could increase the readiness of employees to face that unknown future and empower citizens to shape that future, mindfulness training can also be useful for coping with the automation challenge. Increased social resilience requires a concerned, critically engaged public prepared to push policy-makers to respond to the 4IR challenge [45].

Ivaldi et al. [40] confirmed that coping with the impact of the 4IR and dealing with employees, work and management within the digital realm, requires different mindsets and new approaches in innovative workplaces. This includes a strong revision of the traditional managerial function and required skills to attaining new competencies and tools for changing and aligning strategies and activities to these new labour features; identifying and developing the skills necessary for the workforce of the future; a strong and diffused learning culture that allows constant updating of the skills of the employees; exploring new learning opportunities and tools; and developing the "soft skills" [41; 76] as human abilities, which represent the central qualitative difference between man and machine, as mentioned in the previous section.

THE HUMAN ELEMENT

Though different experts have different explanations about what the 5IR is, most of them agree that it would be based on the 4IR as history shows that each revolution became the foundation for the next revolution [18; 76; 88-92]. The technological advancements of the 4IR (robotics, artificial intelligence, augmented reality, virtual reality, etc.) have created a growing scenario in which the role of humanity seems too often overshadowed by the momentum of technology and commerce.

In the 5IR, in contrast to trends in the 4IR toward dehumanisation, humans and machines will work together [88; 90]. According to Joseph [88], it is foreseen the 5IR to be a revolution of artificial intelligence with the potential of quantum computing which will draw humans and machines together at the workplace as the rate of disruption increases and the problems to be solved become more complex [76; 88]. No matter how sophisticated technologies become, it will need humanism, civility, inclusivity, increased human creativity and purpose to meet these challenges and to thrive alongside profit and progress enabled by digital technologies [76; 91].

Within the context of this paper, the term Fifth Industrial Revolution (5IR), occasionally described as 'Industry 5.0', refers to people working alongside robots and smart machines where robots assist humans to work better and faster by leveraging advanced technologies and adds a personal human touch to the 4IR pillars of automation and efficiency [89]. As smart machines in the workplace evolve and get more connected, the 5IR is set to merge those cognitive computing capabilities with human intelligence and resourcefulness in collaborative operations.

According to industry leaders and authors [88; 89; 91; 92], to be prepared for the 5IR and its potential impacts, there are some key elements to consider given that the 5IR is aimed at strengthening – not replacing – humans. Robots are much more consistent than humans and better at precision work, but they are inflexible and incapable of the adaptability and critical thinking that define humans. Robots can fulfil their designated purpose of assisting humans with mundane tasks when working together with people. The term "cobots" is used for collaborative robots to emphasise the importance of the role of people in robotic technology[2]. With the 4IR and smart factories, mundane and repetitious tasks are being phased out of humans to Cobots can perform mundane and repetitious tasks swiftly, without human supervision, and can work day and night shifts, without requiring breaks. However, tasks are channelled directly to human intelligence or rerouted from cobots to humans when the complexity of a task exceeds certain thresholds or requires tacit knowledge that cannot be codified [91].

The 5IR is about discovering the best possible balance of efficiency and productivity. Where the objective of the 4IR is to interconnect machines, processes and systems for optimal performance, the 5IR is to refine the collaborative interactions between humans and machines. Some of the changes that are already becoming commonplace are more people working remotely, more regularly; menial administration tasks are performed by machines; implantable technologies for health and other proposes are becoming widespread and will lead to a healthier, longer-living population; 3D printing is becoming more prevalent; chatbots are becoming a routine part of the customer experience; and greater importance is placed on human intelligence opening the way to curiosity, creativity, empathy and judgment that ensures a balance between people and technology [89-91].

The progress of the 5IR is unavoidable and when you've used technology to make a task more efficient, there is no reason to revert to the old way of performing that task. However, while the progress of the 5IR cannot be stalled, highly integrated systems are vulnerable to systemic risks such as total network collapse. As noted by various authors [89-91], to be prepared for the many challenges and opportunities the 5IR will invariably bring will require planning and preparation appropriate to each industry's needs and expected outcomes and on how to best leverage new technologies to drive optimal outcomes from human and machine interactions.

ADAPTATIONS IN EMBRACING THE 4IR

Martin Nowak, a professor of mathematics and biology at Harvard University, stated that cooperation is "the only thing that will redeem mankind". If we dare to take collective responsibility for the unfolding changes and nurture our ability to work together to raise awareness and shape new narratives, we can embark on restructuring our economic, social and political systems and take full advantage of emerging technologies [19].

The advancement of the technologies driving the 4IR and the extent of their impact means that all stakeholder groups should work together on innovative governance approaches to ensure that emerging technologies improve lives in as broad-based and meaningful a way possible. It requires learning from,

[2] https://en.wikipedia.org/wiki/Cobot

implementing and extending thoughtful approaches to deal with the junction of technology and society and to support the development, commercialisation and diffusion of current and emerging technologies. To guide the evolution of the 4IR in the decisions we make daily as citizens, consumers, and investors we need to develop a comprehensive and globally shared view of how technology is affecting our lives and reshaping our economic, social, cultural, and human environments.

The stakeholder groups who can play a significant role in assisting with the adaptations required to embrace the 4IR are the government, organisations, employees and educators: [35; 93]

Government

The **role of the government** is not only to support the industrial sector but also to take amendatory steps to encourage the wider adoption of technologies. Where appropriate, governments can, similar to Germany, propose a proper regulatory framework, develop competitiveness and form favourable policy environments for an enabling 4IR country. The government can also act as a key partner to promote employment and upskilling for the successful implementation of the 4IR.

As Enabler, governments can:

- Encourage and support the research of developing technologies in emerging areas;
- Mandate an industry-oriented curriculum in the education sector, relevant to the region, at a graduate level and interdisciplinary curriculum at the undergraduate level;
- Promote problem or project-based learning (PBL) at the education and training institutions;
- Review and restructure the skill sets imparted during the undergraduate levels;
- Strengthen the vocational training infrastructure in partnership with the private sector and include elements of automation and technological advancements in vocational training, whilst involving the industries for building the necessary infrastructure;
- Continue VET at the school levels, thereby creating awareness for the vocations of the future and need-based education systems.

As Facilitator, governments can:

- Create a dedicated portfolio in the Department of Industry, Science, Energy and Resources to oversee and promote 4IR adoption;
- Establish a network of ‘test labs’ or ‘activation hubs’ to collaborate with businesses, industry bodies, government, academia, labour organisations and the wider community to advance the adoption of the 4IR and potentially connect with similar labs and 4IR initiatives worldwide to share best practice.

As Policymaker, governments can:

- Offer financial incentives and support for small to medium businesses (MSMEs) in the form of tax breaks, subsidies or rebates to make the adoption of the emerging technologies of the 4IR affordable to them;
- Improve telecommunications infrastructure to ensure the seamless implementation of the Internet of Things;
- Formulate adequate cyber security policies.

Organisations

Organisations, particularly large and multinational manufacturing companies, will adopt automation if they see returns on investment. To ensure a sustainable competitive advantage and increase in business

performance during the unprecedented times of change brought about by the 4IR, organisations should elevate their people and harness human potential together with innovative technology.

As Adopter (the Manufacturing Sector), organisations can:

- Include MSMEs in their supply chain;
- Accept disruption in business models;
- Invest in Leadership 4.0[3].

As Supplier (the Technology Sector), organisations can:

- Invest in research on emerging technologies and innovation to improve output quality;
- Continue developing verticalised technology solutions for the 4IR.

The preparation of a roadmap for the adoption of technology at various levels, that is of technology appropriate for different scales of operations, especially for MSMEs, is essential. It is proposed that having a long-term strategic vision to lead an organisation's transformation in the 4IR era may ensure the organisation benefit from the 4IR advancements. The vision and relevant policy should cover talent retention and re-skilling; enable timely up-skilling of the workforce, relevant to 4IR trends; foster a culture of innovation and trust in the organisation; provide a conducive environment for humans and robots to work together; and focus on strengthening organisational data privacy and cyber security protocols, as threats may arise due to connected ecosystem.

Employees

Employee resilience is essential under the workforce to cope with the disruptive changes brought about during the 4IR. Armstrong (2020) in Ferreira et al. [86] suggests that resilient employees require an awareness of predictions of the future as many of the predictions will come true, sooner or later than expected, while others will not.

As Resilient Employees, they need to:

- Plan for the future by being aware of predicted technological and social changes, but live in the present;
- Keep learning to be current and upskill their abilities. They need to make the conscious choice, harness the skill to reinvent themselves continuously to stay relevant;
- Central to career success would be core skills such as collaboration, effective communication, initiative, persistence, trustworthiness, creativity and diligence;
- STEM skills, the science, technology, engineering and mathematics skills, will remain critical in many evolving job categories;
- Employees should improve their knowledge of technology and use the tools at their disposal and emerging technologies to enhance their organisational productivity and effectiveness;
- Employees need to be able to diversify their skills with a determination to succeed in their careers - as employees regard their work to be meaningful and purposeful, it becomes a source of motivation;
- Employees should understand the future demand for skills. Careers that are less likely to be performed by a robot in the short to medium term requires social intelligence, creative intelligence and manual agility. Careers that emphasise these skills are less vulnerable to automation and may experience growth in demand in the future;

[3] https://ijol.cikd.ca/article_60332.html

- Given that customers usually base their decisions on how they feel rather than on what they know, employees need to be able to engage the hearts, minds and souls of their customers. In the 4IR and beyond, it is their humanness that defines and distinguishes them;
- With the new frontiers in ethics, politics and governance exposed in the digital world, employees need to use the power of speech and make their voices heard in shaping their future.

Educators

Technology is disrupting education - as it is every other industry – but the difference is that the purpose of the education sector is to uniquely create our future capabilities. As such, educational institutes and governments should plan for the future of work and life. The nature of work is changing, and the education sector must prepare people for a radically different future where tomorrow's jobs may not yet exist. This requires access to lifelong learning for people to upskill throughout their lifetime. The education sector must adapt its education and training programmes to meet the learner's specific needs in real-time and offer accessible flexible experiences. Through partnerships between education and training institutions and industries, there is an opportunity to increase the learners being reached and the value contributed through leveraging educational technologies.

As Leaders of education and training, educators and decision-makers in the education system can:

- Improve the quality of teachers and modernise the learning infrastructure to be current and forward-looking;
- Align course curricula in tandem with requirements of the 4IR;
- Ensure well-regulated and industry-relevant timely and up-to-date content;
- Focus more on practical, result-oriented knowledge over theoretical content;
- Promote a culture of research in emerging technologies and other aspects of the 4IR and act as the test hubs for innovation and new learning;
- Participate actively in the development of modular, credentialled open online courses; and
- Collaborate with industry players.

CONCLUSION

Undertaking this research highlighted the fragmented nature of available literature in providing a comprehensive overview of the interconnected effects of the 4IR on people, organisations and society more broadly. This study found that the 4IR is an existing and emerging phenomenon, extends the 3IR and share characteristics with all previous industrial revolutions. It has direct implications for people's general well-being and professional advancement, organisations' social license to operate and society's preparedness for change and related opportunities.

While this study has uncovered the current observations regarding the 4IR on various sectors of society, it should not be taken as a definitive list of impacts and adaptations. Future research could investigate how a social license to operate relates to the unfolding public discourse on sustainability and other emerging and relevant societal issues. Additionally, future research may delve deeper into societies preparedness for the ongoing evolution of technology and strategies to support the general well-being of people. Finally, further research needs to focus on educational pathways and models to support professional advancement at a time when educational institutions are undergoing disruption in their own right.

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